Seattle City
Seattle Center
VCP NW1493

Site Remediation and Current Conditions Report Former Metro Bus Barn Site Seattle Center Seattle, Washington

September 21, 2004

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SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

At Shannon & Wilson, our mission is to be a progressive, well-managed professional consulting firm in the fields of engineering and applied earth sciences. Our goal is to perform our services with the highest degree of professionalism with due consideration to the best interests of the public, our clients, and our employees.

Submitted To:
Seattle Center
305 Harrison Street
Seattle, Washington 98109-4645

By:
Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, Washington 98103

21-1-12151-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

50 Years 1954 - 2004

September 21, 2004

Seattle Center
305 Harrison Street
Seattle WA 98109-4645

Attn: Ms. Shelly Yapp

RE: SITE REMEDIATION AND CURRENT CONDITIONS REPORT FORMER METRO BUS BARN SITE, SEATTLE CENTER, SEATTLE, WASHINGTON

The attached report provides the results of our review and documentation of the remedial actions that have been accomplished at the former Metro Bus Barn site. It also includes the results of the installation and sampling of three new groundwater monitoring wells at the site. The objectives of this assessment were to evaluate the adequacy of the remedial actions that have been accomplished at the site and identify the extent to which contamination remains on site, and to provide a consolidated document that summarizes the environmental investigations and remedial actions that have been accomplished since 1989.

Please call me at 206 695-6886 if you have any questions or would like further explanation of the materials or conclusions presented in this report.

Sincerely,

SHANNON & WILSON, INC.

Daniel N. Clayton
Senior Vice President

DNC/eet

Enclosure: Site Remediation and Current Conditions Report, Former Metro Bus Barn Site, Seattle Center, Seattle, Washington

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400 NORTH 34TH STREET · SUITE 100
P.O. BOX 300303
SEATTLE, WASHINGTON 98103
206·632·8020 FAX 206·695·6777
TDD: 1·800·833·6388

21-1-12151-002

SITE REMEDIATION AND CURRENT CONDITIONS REPORT
FORMER METRO BUS BARN SITE
SEATTLE CENTER
SEATTLE, WASHINGTON

1.0 INTRODUCTION

This report presents the results of an evaluation of the environmental conditions at the former Metro Bus Barn site, located at the intersection of Taylor Avenue North and Mercer Street in Seattle, Washington (Figure 1). The objectives of this evaluation were: (a) to provide a synthesis of investigative and remedial work that has been performed over the course of about a decade, (b) to evaluate groundwater quality below the site, and (c) to summarize the current status of the site with respect to residual soil and groundwater contamination.

This report was prepared by Shannon & Wilson, Inc. on behalf of the Seattle Center. This work was authorized by Mr. Neal Erickson of Seattle Center on July 26, 2004, and was accomplished in accordance with our proposal dated July 22, 2004.

2.0 SITE DESCRIPTION AND LAND USE HISTORY

2.1 Location and Description

The former Metro Bus Barn site occupies a two-block area directly east of the Seattle Center in downtown Seattle, Washington. The tax identification number for the property is 198820-0836, and the address listed for the site is 520 Fifth Avenue North. The site is identified in the tax assessor records as D.T. Denny's Home Addition blocks 63 and 64. It is bounded on the north by Mercer Street and on the west by 5th Avenue North. Parking lots bound the site to the south and east across vacated Republican Street and 6th Avenue North, respectively.

The property is owned by Seattle Center and is developed as an asphalt-paved surface parking lot that is used primarily for Seattle Center event parking. The paved surface of the parking lot is undulatory with an overall slope toward the northeast. The current topography is shown in the site plan (Figure 2). Currently, the south-central part of the parking lot is occupied by a temporary building and parking area that are used by Tower Records for a retail store. The only

other facilities on the property are a basketball court in the southwest corner of the site, light standards spaced throughout the parking area, and a small structure that is used as a pay station for collection of parking fees.

2.2 History of Site Use

The 1893 and 1908 topographic surveys of Seattle show a swampy depression in the central part of the site. This depression apparently was filled in the early 1900s along with regrading of a much more extensive area around the southern shore of nearby Lake Union. The earliest known use of the site was in 1903, when it was occupied by a baseball stadium. By 1907, the site ownership was transferred to the Seattle Electric Company and then in 1917 to Puget Sound Traction Light & Power Company for maintenance and parking of streetcars. The southern Bus Barn building was constructed about that time in the southwestern part of the property (see Figure 2), and a network of rails and ties occupied the remainder of the property. Ramps were constructed to provide streetcar access to the site, which was about 20 feet below the grade of the adjoining streets.

When Seattle's street cars were converted to buses in the mid- to late-1920s, the rails and most of the ties were removed, several underground storage tanks (USTs) were installed, and much of the site was paved with concrete. A fueling station for bus fueling was constructed in the 1930's. The City of Seattle (City) acquired the property in the late 1930's and took occupancy in 1939 for use as part of the City transit system. By 1946, records indicate that the City had constructed additions to the Bus Barn, and was using the building for repair and maintenance of buses. The locations of the former USTs and fueling station are shown in Figure 2.

By 1967, a portion of the original Bus Barn roof was removed, dividing the building into two separate structures. City of Seattle Department of Construction and Land Use (DCLU) records indicate that in 1972, two USTs were installed at the site and a "bus cleaner facility" was relocated. A 1972 site plan shows two new 5,000-gallon tanks, one for gasoline and the other for diesel (T-1 and T-3 respectively, Figure 2); two existing 5,000-gallon diesel USTs (T-5 and T-6, noted as abandoned); and an existing 10,000-gallon gasoline UST (T-2). DCLU records from 1974 indicate that another 10,000-gallon UST was installed (T-4), and 1981 DCLU records indicate that a 2,000-gallon lube oil UST (T-11) was installed northeast of the Bus Barn. At that

time, the two existing waste oil tanks (T-12 and T-13) at the northeast corner of the north Bus Barn building were abandoned.

In 1974, ownership of the site was transferred to the Municipality of Metropolitan Seattle (Metro), then to the City of Seattle in 1986, at which time the bus maintenance at the site was apparently discontinued. In 1989, the City retained SCS Engineers (SCS) to investigate the site for environmental concerns. Based on their findings, SCS was subsequently retained to remove the USTs and fueling station, and to remediate associated petroleum contamination in the adjoining soils. Numerous USTs were removed in 1989, at which time widespread petroleum contamination was identified in the area of the USTs and fueling station area, as well as in the vicinity of the Bus Barn buildings.

The site remediation was interrupted in 1990 for commercial use of the site by Turner Broadcasting during the Seattle Goodwill Games. In 1990-1991, the top floor of the north Bus Barn building was used as an emergency shelter for the homeless. In 1993, SCS constructed a land treatment unit (LTU) and associated facilities on the central and eastern part of the site to perform on-site remediation of contaminated soil using landfarming and bioremediation. Approximately 3,000 cubic yards of petroleum-contaminated soil (PCS) were excavated by the City of Seattle, primarily from the vicinity of the USTs and fueling station, and placed in the lined LTU for remediation.

On-site treatment of contaminated soils began in November 1993. In early 1994, construction of the Sonics training facility on the adjacent property to the east began. Reportedly, clean soils from the Sonics building excavation were used to backfill the tank excavation on the Bus Barn site (Berry, 1996), and approximately 2,500 cubic yards of PCS from the site were stockpiled on the Bus Barn site for on-site treatment.

In September 1994, operational management of the site was transferred to Seattle Center. The on-site soil treatment operation was discontinued in November 1994, although site investigations were continued to evaluate the remaining contamination in the soils beneath the site. In 1997, the Bus Barn buildings and the surrounding concrete-and asphalt-paved parking lot were demolished to develop a parking lot for Seattle Center. During the demolition, three additional USTs were found and removed, as were hydraulic hoists, inspection pits, and an oil-water separator within one of the buildings. Following demolition and additional excavation and off-

site disposal of contaminated soil, 130,000 cubic yards of fill soil were imported from a downtown construction site to raise the grade of the site to that of the surrounding streets Approximately 15 to 20 feet of fill were placed, and by 1998, the property was paved for use as a parking lot.

3.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

Several environmental and geotechnical investigations, summarized in Section 4.0, have included subsurface explorations beneath the former Bus Barn site. The following geologic conditions are summarized from the results of those investigations.

3.1 Site Geology

The geology of the site is depicted on two subsurface profiles (Figure 3), based on borings for this and previous investigations. As shown on the profiles, the site is underlain by a relatively thick sequence of fill soils. The fill was placed during three distinct events. The oldest of these fills apparently was placed before the site was developed, about the beginning of the 1900s. This fill consists primarily of gravel, sand, and clay, and varies from 0 to about 15 feet thick, with the thickest areas in an area that had been a swampy depression at the beginning of the last century. Locally overlying this oldest fill are fill materials that were apparently placed during the early years of site use. These fill soils contain debris including scattered wood, bricks, and railroad ties left over from use of the site for streetcar parking and maintenance.

The most recent fill, which ranges from about 15 to 20 feet thick, was placed in 1997 when Seattle Center imported 130,000 cubic yards of fill soil from the Systems Garage site in downtown Seattle to raise the grade from an elevation of 60 feet (City of Seattle datum) to the elevation of the surrounding streets (approximately 15 to 20 feet higher) for construction of the parking lot. Based on borings for this study and fill characterization by PacRim Geotechnical, Inc. (1996), the recent fill consists of various mixtures of sand, silt, clay with some gravel, and local wood, brick, and asphalt debris. Available records suggest that the 3,000 cubic yards of PCS that was treated on site was also used as site fill after contaminant levels had been reduced to below current cleanup levels.

The fill is underlain under much of the site by a layer of peat/silt that ranges from 0 to 6 feet thick. This organic soil formed the floor of a closed, swampy depression that occupied much of

the site before it was developed. Borings indicate that the peat/silt is underlain by 5 to 11 feet of soft gray clay that grades with depth into a medium stiff to stiff, sandy to clayey silt that, in turn, ranges from 5 to 17 feet thick. These fine-grained soils are underlain by a dense to very dense, gravelly, silty sand and sandy silt that ranges from 15 to over 47 feet thick.

3.2 Groundwater Conditions

The water table underlying the site occurs within the sandy soil beneath the clayey silt layer. Based on groundwater measurements from five monitoring wells installed in this zone in 1994, before the placement of the most recent fill, the depth to groundwater ranged from approximately 20 to 50 feet across the site, with a relatively steep flow gradient toward the south-southeast. Fluctuations in the depth to the water table over two years of monitoring (1994/1995 and 1996) were generally less than a foot, with no clear seasonal variations. The direction of groundwater flow and gradient varied only slightly over the two-year period. Figure 3 provides two groundwater contour maps: one portraying the groundwater surface as estimated from the original five site monitoring wells in 1996, and a second showing the estimated groundwater surface as estimated from three new monitoring wells in August 2004.

Measurements from the 2004 monitoring wells show a somewhat different depth and gradient to the water table, after corrections have been made to account for the thickness of fill that was placed on the site in 1997. The original monitoring wells were abandoned in 1997, so a direct comparison of water levels in the two sets of wells cannot be made. However, a comparison of 1996 water level elevations in monitoring well MW-2 with 2004 water level elevations in the nearby monitoring well SW-1 suggests that the water table may be a few feet higher now than in the two-year period from late 1994 to late 1996. Similarly, the water levels in new wells indicate a slightly different groundwater gradient in 2004 from that estimated from the previous wells. As shown in Figure 4, the flow direction in 2004 appears to be a few degrees farther to the southeast than was estimated from the 1996 water level readings. These differences may reflect an error in surveying, or possibly a change in the water table as a result of fill placement and modifications to site drainage.

Based on observations of saturated conditions in soil borings and probes, perched water is locally present at the top of the peat or silty clay. The fine-grained soil layer appears to be a local aquitard, separating shallow water from the deeper water table. This perched zone was detected

primarily in the areas where the original fill was thickest, which corresponds to the area where the depression was deepest before the initial fill placement. Based on subsurface data and observations during site excavation, the perched zone does not contain much water nor is it continuous across the site.

4.0 ENVIRONMENTAL INVESTIGATIONS AND SITE REMEDIATION

Previous investigations of the Bus Barn site have included geotechnical investigations that date back as far as 1968, and environmental investigations and remedial actions that were accomplished between 1989 and 1998. Pertinent information from these investigations is discussed throughout this report, and subsurface data and analytical results obtained from the previous studies are provided in the appendices. References to the full reports are provided at the end of this document. The following provides a summary of the investigations and remediation activities that have been accomplished.

4.1 1968 – 1970 Geotechnical Investigations (Shannon & Wilson, 1968 and 1970)

Geotechnical studies of the Bus Barn site were accomplished to evaluate soil conditions for proposed site development as a multipurpose stadium. Twenty-one geotechnical soil borings were drilled on and adjacent to the site to evaluate the geotechnical properties of the subsurface soils. The locations of these borings are shown in Figure 2, and the boring logs are provided in Appendix A.4. Although these studies were not designed to evaluate contamination, gasoline-saturated soil was noted in the near-surface soils in Boring B-113, in the vicinity of the fueling station.

4.2 1989 Preliminary Site Assessment (SCS, 1989)

Environmental investigation of the Bus Barn site was initiated in response to the enactment of UST regulations in 1987/1988. SCS performed a preliminary site assessment beginning in June 1989, which included a geophysical survey to explore for USTs, and a soil vapor survey to test for the presence of volatile organic vapors in the near-surface soil. Up to 13 USTs were identified based on a records review, although not all 13 could be identified by the geophysical survey. The soil gas survey indicated the presence of volatile organics in the vicinity of the fueling station, but as this was used as only a screening tool, it was not definitive as to the type or concentrations or of contaminant present in the site soils.

4.3 1989 Phase II Environmental Investigation (SCS, 1990a)

Based on the results of the preliminary site assessment, SCS conducted a Phase II investigation including drilling, sampling, and chemical analyses to determine whether PCS was present in subsurface soils. In September 1989, SCS drilled eight boreholes on site to collect samples for chemical analyses: one north and three southeast of the fueling station, two near the northeast corner of the north Bus Barn, and two farther east (Figure 2). In January 1990, they collected soil samples from two shallow utility trenches that were excavated near the fueling station; the locations of these trenches were not shown in their report. Soil samples from the trenches were analyzed for total petroleum hydrocarbons (TPH), with results ranging from 1,200 to 19,000 milligrams per kilogram (mg/kg).

Analytical results from the 1989-1990 borings and trenches (summarized in Appendix B2.1) indicated that TPH was present in the soils at concentrations ranging from less than 1 mg/kg to 14,000 mg/kg, with numerous samples exceeding the Washington State Department of Ecology (Ecology) soil cleanup level of 200 mg/kg. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were also detected in borings adjacent to the fueling station, but at concentrations that were below the Ecology cleanup levels set at that time. Based on these results, SCS concluded that the upper 5 to 15 feet of soil near the fueling station, east of the Bus Barn buildings, and in the far northeast corner of the site (at BH-7) was contaminated with TPH above the MTCA Method A soil cleanup level. SCS indicated that the contaminated soil appeared to be from diesel fuel or degraded gasoline, and that there appeared to be no contaminant migration off site. They estimated that in the area of the fueling station, there may be in excess of 2,800 cubic yards of soil that would require remediation, and that an undetermined amount of soil on the south end of the site, adjacent to the Bus Barn buildings, may require remediation. SCS also indicated that the soil contamination at the south end of the site was probably unrelated to the former fueling station on the north end of the site.

4.4 1989 Underground Tank Investigation (SCS, 1990a)

Nine USTs and one aboveground soap tank were removed from the site in December 1989. Although 13 USTs were expected to be present based on site records and an earlier site reconnaissance, only nine tanks were located and removed. The four other suspected tanks were believed to be located in the fueling station area, but no evidence of these tanks was noted during tank removal activities. Approximate locations of the nine USTs are shown in Figure 2. The

tanks ranged in size from 500 to 10,000 gallons, and had been used to store diesel, gasoline, lube oil, and waste oil. Two 500-gallon, one 2,000-gallon, four 5,000-gallon, and two 10,000-gallon tanks were removed. The tanks appeared to be in good condition.

Soil samples were collected from each tank excavation and analyzed for TPH, BTEX, and total lead. TPH concentrations ranging from 7,800 to 46,000 mg/kg were detected in all the tank excavations, well above the MTCA cleanup level of 200 mg/kg in place at the time. BTEX was detected in all of the tank excavations except for tanks T-11, T-12, and T-13, but at concentrations that were below cleanup levels set at that time. The MTCA soil cleanup levels at the time this work was accomplished were 0.66 mg/kg for benzene, 143 mg/kg for toluene, and 14 mg/kg for ethylbenzene; xylenes did not have an established cleanup level. Lead concentrations detected in the excavations ranged from less than 0.015 mg/kg to 7.01 mg/kg, well below the cleanup level of 250 mg/kg. The analytical results from the soil samples from the UST excavations are summarized in Appendix B, Tables B2.1 and B2.2.

Approximately 400 cubic yards of soil from the waste oil tank excavations was stockpiled at the south end of the site. An additional 20 cubic yards of PCS from the UST excavations was transported to Cedar Hills Landfill for disposal, as permitted by the King County Health Department.

4.5 1990 – 1991 Evaluation of Potential Remedial Alternatives (SCS, 1990b)

SCS evaluated several remedial alternatives for the site, including landfarming-biotreatment, landfill disposal, incineration, and low-temperature thermal desorption. In April 1991, an eight-week treatability study was initiated to determine if full-scale bioremediation was feasible. Based on the results of that study, the City of Seattle Department of Administrative Services (DAS) elected to proceed with excavation of the contaminated soil and on-site remediation using on-site landfarming-biotreatment.

4.6 1991 City of Seattle (DAS) Soil Report (SCS, 1991)

In September 1991, SCS presented the City of Seattle DAS with a soils report of the Bus Barn site. Subsurface conditions encountered during drilling in September 1989 and tank removal activities in December 1989 were summarized for the purpose of fulfilling DCLU grading requirements.

4.7 1991 – 1993 On-site Treatment System Design and Construction

In 1991-1992, SCS prepared plans and design specifications for an on-site land treatment unit (LTU) for treating PCS. A 47,500-square-foot temporary LTU was constructed over the concrete pavement in the central and eastern parts of the site. It had an asphalt-lined base and asphalt perimeter berms to contain the contaminated soils, and an adjacent stormwater retention basin. In April 1992, Hong West and Associates drilled two exploratory borings on site for the design of a soldier pile and timber lagging shoring system to support soils along Mercer Street during excavation of contaminated soil. Although the soils were not sampled for chemical analysis, gasoline odors were noted in near-surface soils in one of the borings. The locations of these borings are shown on Figure 2 and the logs are provided in Appendix A4.

4.8 1993 – 1994 On-site Treatment of Contaminated Soils (SCS, 1995)

From August 1993 until November 1994, contaminated soil excavated from the northern part of the site was treated in the LTU (by periodic tilling and nutrient adjustments) and tested in accordance with Washington State UST regulations (Washington Administrative Code [WAC] 173-360), the Model Toxics Control Act (MTCA, WAC 173-340), and guidance for treating PCS from UST sites. Approximately 3,000 cubic yards were excavated from beneath the former fueling station area and placed about two to three feet deep within the LTU. Approximately 400 cubic yards of contaminated soil from around the two former waste oil tanks that was originally stockpiled on the south end of the site was moved to the LTU for treatment.

In March 1994, excavation for the Sonics training facility began adjacent to the Bus Barn site. Landau Associates, Inc. (1994) provided oversight for the excavations, and based on hydrocarbon odors, collected soil samples for chemical analysis from test pits and the basement excavation. Although TPH, BTEX, and total lead were detected in soil samples from the test pits and basement excavation, they were generally determined to be below the MTCA cleanup levels. Landau Associates reported that only one soil sample, from the east sidewall of the basement, had contaminant concentrations exceeding MTCA Method A cleanup levels for gasoline, diesel, and heavy oils.

In May 1994, approximately 2,500 cubic yards of the excavated soils were moved from the Sonics training facility site to the adjoining former Bus Barn site. As reported by SCS (1994a and 1995), the soil was segregated into two piles, with the "non-contaminated" soil being

stockpiled on the north end of the site and the TPH-contaminated soils placed on the south end of the site. The TPH-contaminated soil stockpile was subsequently separated into five smaller piles, each about 300 cubic feet, in an attempt to segregate contaminated and non-contaminated soil, to separate large debris, and to provide minimal treatment by aeration. SCS (1995) reported that 25 soil samples were then collected from the piles for analytical testing, and the results indicated that the average concentrations of diesel and heavy oil in each pile exceeded the MTCA Method A cleanup levels of 200 mg/kg. Diesel concentrations ranged from below the detection limit to 410 mg/kg, and heavy oil fraction results ranged from 140 to 490 mg/kg. (These levels are all below the current MTCA cleanup levels for diesel- and heavy oil-range hydrocarbons). SCS recommended a soil pile/screening methodology for treating the soil, based on the relatively low cost compared with other alternatives and a relatively short treatment period.

In September 1994, operational management of the site was transferred to the Seattle Center, and soil treatment operations were modified to expedite cleanup. From September 1994 to November 1994, this included changing from tilling individual lifts in the LTU to active biopile treatment to accelerate soil remediation. In November 1994, after a year of treatment, SCS (1995) concluded that the Ecology Class 3 cleanup criteria goals were achieved for the excavated soils, and recommended moving the biopiles for on-site or fill use. Based on Ecology-accepted uses for Class 3 soils, the treated soils were considered acceptable for use as on-site fill or as subgrade for parking lot construction. While the Class 3 criteria goals for PCS were above the MTCA cleanup levels in 1994, they are below the current MTCA cleanup levels, as revised in 2001. Consequently, the contaminant concentrations reported by SCS upon completion of the on-site remediation are now well within the current MTCA Method A cleanup levels.

4.9 Additional Site Investigations (SCS, 1994a, b, c, d and 1995)

In September 1994, SCS prepared a work plan to better characterize the extent of in-place soil contamination and groundwater at the site. The characterization work consisted of excavation and soil sampling of 14 test pits and 24 Geoprobe borings, primarily around the Bus Barn buildings, and installation and sampling of five monitoring wells (four around the area of the former fueling station and one located at the Sonics training facility to the east of the site).

Soil samples from 6 of the 14 test pits exceeded the 200 mg/kg MTCA cleanup level for TPH that was applicable for soil at the time. TPH concentrations ranged from 58 to 7,100 mg/kg, and diesel concentrations ranged from less than 25 to 610 mg/kg. Soil samples from 7 of the 21 Geoprobe borings had gasoline concentrations that exceeded the MTCA Method A cleanup level of 100 mg/kg (results ranged from not detected to 1,900 mg/kg). BTEX was not detected above cleanup levels at any of the probe locations. Because it was difficult to quantify the diesel concentrations, SCS stated that as many as six samples appeared to have diesel concentrations that exceeded the cleanup level of 200 mg/kg. Heavy-fraction hydrocarbons were present in 3 of the 20 samples analyzed, at concentrations ranging from 530 to 36,000 mg/kg). The analytical results from these samples are summarized in Appendix B.3 Table B3.1, B3.2 and B3.3.

Based on these explorations, SCS (1995) concluded that the area adjacent to the old Skateboard Park in the East Parking Lot and the area north and east of the Bus Barn buildings contained high levels of heavy-fraction petroleum hydrocarbon contamination. They estimated that at least 2,850 cubic yards of PCS was present at the two sites (150 cubic yards near the old Skateboard Park, 2,000 cubic yards north and east of the Bus Barn buildings, and 700 cubic yards below the surface on the west side of the soil treatment unit), and an additional 5,000 cubic yards north of and below the two Bus Barn buildings, and below the soil treatment unit.

4.10 1994/1995 and 1996 Groundwater Monitoring (SCS, 1996)

Quarterly groundwater monitoring was conducted for two years from the four on-site monitoring wells that were installed around the former fueling station (MW-1 through MW-4, as shown in Figure 2) and from one well located to the east on the Sonics training facility site (MW-5). Water levels were recorded and water samples were analyzed quarterly for diesel, gasoline, and BTEX. Based on measured water levels, the groundwater gradient was toward the south-southeast (as shown in Figure 4), and was consistent in direction and gradient throughout the two-year monitoring period. Two of the wells (MW-1 and MW-4) were located in the general downgradient direction from the former fueling area, one (MW-2) was located near the fueling area but cross gradient and slightly upgradient, and the other two (MW-3 and MW-5) were clearly situated in cross gradient locations. The logs of these monitoring well installations are provided in Appendix A1, and the quarterly groundwater sampling results are summarized in Appendix B1, Table B1.1.

Although benzene was repeatedly detected in MW-2 (from 0 to 4.6 parts per billion [ppb]), and xylenes were detected once each in MW-3 and MW-4 (4.4 ppb and 3.5 ppb respectively), all of these detections were below the MTCA cleanup levels. However, the benzene concentration in MW-2 appeared to be increasing slightly over time. Based on the two years of monitoring data, SCS recommended discontinuing the monitoring program, in compliance with MTCA regulations.

4.11 1995 – 1996 UST Decommissioning and Site Assessment

In August 1995, three previously unknown USTs were identified on the southern part of the site. A diesel tank (labeled "heating oil tank") was located between the Bus Barn building and Republican Street; the other two (labeled "gas tank no. 1" and "gas tank no. 2") were located in the Bus Barn site parking lot (see Figure 2). In August 1996, the decommissioning work on the 2,000-gallon diesel (heating oil) tank was completed. Soil samples collected from the tank excavation and from the soil stockpile were analyzed for diesel, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). No PCBs or PAHs were detected in any of the samples. Diesel was detected in the stockpiled soils above the MTCA Method A cleanup level of 200 mg/kg (580 and 410 mg/kg), but was not detected in the tank excavation samples.

In August 1996, the two gas tanks were removed. One tank had a capacity of 550 gallons, and the other had a 2,000-gallon capacity. Soil samples were collected from each tank excavation and stockpile in accordance with Ecology UST tank removal requirements. Samples were analyzed for gasoline, BTEX, diesel, and PCBs. Sidewall samples collected from the two gas tank excavations had gasoline concentrations exceeding the action level (730 and 1,100 mg/kg). Sample results from the stockpiled soils indicated that gasoline and diesel concentrations both and exceeded the applicable cleanup levels. Sampling locations and analytical results from these tank removals are provided in Appendix B5.

4.12 Phase I Environmental Site Assessment (Shannon & Wilson, 1996a)

In October 1996, Seattle Center retained Shannon & Wilson to conduct a Phase I Environmental Site Assessment (ESA) of the former Bus Barn site, in anticipation of demolishing the Bus Barn buildings, regrading the site to street level, and developing the site as a surface parking lot. The purpose of the ESA was to evaluate the potential presence of contamination sources on the Bus

Barn site and the potential for petroleum sources upgradient of the site. Based on a review of historical records and previous remedial activities, Shannon & Wilson recommended additional investigations to: (a) look for and remove any other USTs on site; (b) assess the potential for an upgradient source for the groundwater contamination beneath the site; (c) resolve disposition of contaminated in-place soil beneath the site, including any contaminated soil detected upon demolition of the buildings; (d) resolve disposition of contaminated soil stockpiles on site; and (e) sample the perched groundwater on top of the silty clay layer.

4.13 1996 Additional Investigation (Shannon & Wilson, 1996b)

As a follow-up to the Phase I ESA, Shannon & Wilson performed soil and groundwater sampling to obtain additional information regarding existing conditions. These activities included: (a) a geophysical survey to look for additional USTs; (b) stratoprobe explorations and groundwater sampling to evaluate the potential for upgradient contaminant sources and on-site perched water; (c) subsurface soil sampling to evaluate the soils adjacent to the former gasoline USTs (No. 1 and No. 2); and (d) soil sampling from three soil stockpiles of soils that were treated on site to reduce PCS concentrations. The locations of the probe explorations and the three stockpiles are shown in a site plan provided in Appendix B4. The analytical results from this sampling are summarized in Appendix B4, Tables B4.1, B4.2, and B4-3.

The geophysical survey did not identify any additional USTs, although areas beneath the buildings could not be checked because of access restrictions due to hazardous building materials. The probe sampling did not detect any soil or groundwater contamination, either upgradient of the site or in the perched groundwater on site. Shannon & Wilson concluded, based on very limited perched groundwater encountered beneath the site, that the perched zone is not widespread and would not be expected to provide a migration pathway for contaminants.

Soil sampling from two stratoprobes near the former gasoline tanks detected only very low concentrations of gasoline and/or BTEX. Only benzene, which was detected at 0.62 mg/kg in one sample and 0.31 mg/kg in another, was found to exceed the MTCA Method A cleanup levels. Soil sampling from the three existing stockpiles detected diesel- and oil-range hydrocarbons in every sample. Multiple samples from each of the stockpiles exceeded the MTCA cleanup criteria, but all results were below the Class 3 criteria levels that allowed for on-

site use. All of the diesel and oil concentrations detected in these stockpiles are below the current MTCA Method A cleanup levels.

4.14 1996 Regulatory Review and Alternatives Analysis (Shannon & Wilson, 1996c).

Following completion of the Phase I ESA and additional sampling (Shannon & Wilson, 1996a and 1996b), Shannon & Wilson conducted a review of site conditions as they apply to regulatory requirements and remediation alternatives for the site. The report recommended using a combination of MTCA Method A and Method B for additional excavation and treatment of stockpiles on the site, and developed site-specific Method B cleanup levels using Ecology's Petroleum-Contaminated Soils Rating Matrix. Application of Method B was recommended where the bottom of the soil contamination is no more than 10 feet below the surface, in order to provide at least 10 feet of vertical distance between soil contamination and groundwater. Where contamination is deeper, application of Method A was recommended to be protective of groundwater and to comply with the requirements for calculation of Method B cleanup levels.

The samples collected in 1996 from the stockpiled treated soils (Shannon & Wilson, 1996b) were evaluated statistically to assess the adequacy of the on-site treatment. Based on the Upper Confidence Levels derived from analysis of 18 soil samples collected from the three stockpiles, all three stockpiles were below the MTCA Method B cleanup level for diesel, and Stockpile No. 1 was below the MTCA Method A cleanup level for diesel. Stockpile No. 1 was also below the Method B cleanup level for oil, whereas Stockpiles No. 2 and No. 3 were above the Method B cleanup level for oil. Under the current MTCA regulations, all of the analytical results from the stockpiled soils would be below the MTCA Method A cleanup levels.

Shannon & Wilson provided recommendations for remediation of the remaining in-place soil contamination, and handling of the stockpiled soils. Because all the recommended remediation scenarios involved leaving contaminated soil on site, Shannon & Wilson also recommended re-instituting the groundwater monitoring after the site development activities had been completed to provide for compliance monitoring in accordance with MTCA regulations.

4.15 1997 Soil Excavation (Shannon & Wilson, 1997b)

In April 1997, after the Bus Barn buildings had been removed from the site, Shannon & Wilson initiated an extensive excavation of PCS in the surface and near-surface soils in the central and

north parts of the site, from around an oil-water separator and associated waste tank and a hydraulic hoist pit discovered during demolition of the north Bus Barn, and in the vicinity of the two gasoline USTs that were removed in August 1996.

PCS was initially removed to achieve a combination of MTCA Method A and Method B cleanup levels. MTCA Method A was used as the target cleanup levels for the PCS in the area of the former gasoline tanks. All other areas initially had MTCA Method B target cleanup levels as determined using Ecology's Petroleum Contaminated Soil Rating Matrix. However, the target cleanup levels for the oil-water separator area were changed to MTCA Method A during excavation because of concerns about groundwater contamination. A summary of Method A and Method B cleanup criteria at the time this work was accomplished is provided in the following table, along with the current criteria, and Method A cleanup levels for the contaminants of concern at the site.

1996 and 2001 MTCA Soil Cleanup Criteria

MTCA Method	Gasoline WTPH-G (mg/kg)	Diesel WTPH-D (mg/kg)	Oil WTPH-D Extended (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)
Method A (1996)	100	200	200	0.5	40	20	20
Method B	400	600	600	1.5	130	250	150
Method A (2001)	100*	2,000	2,000	0.03	7	6	9

For gasoline without benzene. The current criterion for gasoline with benzene is 30 mg/kg.

mg/kg milligrams per kilogram
MTCA Washington State Model Toxics Control Act
WTPH-D Washington Total Petroleum Hydrocarbons-Diesel Range
WTPH-G Washington Total Petroleum Hydrocarbons-Gasoline Range

Neither the oil-water separator excavation nor the excavation near the former gasoline USTs was completed to the target cleanup levels. All of the contaminated soil in the oil-water separator excavation could not be excavated because groundwater was encountered in the excavation, and the depth of contamination (greater than 22 feet) exceeded the capability of the excavator. PCS near the former gasoline excavation extended laterally at shallow depths, and the Seattle Center decided to discontinue removal efforts because of budget concerns. Summaries of the excavation activities and sample results for each of the three excavation areas are provided below.

Approximately 6,100 tons (4,100 cubic yards) of PCS were excavated from the site and hauled to Holnam, Inc. in Seattle, Washington, for thermal treatment and recycling. The three existing treated soil stockpiles were left on site, although soil in Stockpile No. 2 was moved and placed on top of Stockpile No. 3. Approximately 200 cubic yards of the soil that was hauled off site was removed from the hydraulic hoist pit area, 700 cubic yards from the oil-water separator area, 1,400 cubic yards from the gasoline tank excavation, and 1,800 cubic yards from the shallow subsurface excavation. Details of these excavations are described in the following subsections, and the site plans and analytical results from the excavations are provided in Appendix B6.

4.15.1 Surface and Shallow Subsurface PCS

Based on information from prior reports (Lawson, 1996; SCS, 1989; SCS, 1990; SCS, 1995; and Shannon & Wilson, 1996b), surface and shallow subsurface PCS in the central and northern parts of the site exceeded MTCA Method B target cleanup levels and required removal. At the start of soil removal, a series of trenches were used to locate contaminated areas. Soil samples taken during initial characterization and PCS removal were designated progress samples, whereas soil samples collected after excavation was completed in any given area were designated confirmation samples. Excavation in these areas proceeded until clean boundaries were established based on MTCA Method B criteria. The locations of these samples, along with analytical results, are shown on site plans provided in Appendix B6. The analytical results are also tabulated in Appendix B6, Table B6.1.

Much of the contamination in the shallow soils was spatially associated with old product pipes that had leaked, drain pipes, and vehicle inspection pits. The remainder was primarily confined to the near surface and appeared to have resulted from surface spills. Soil in the shallow subsurface generally consisted of gravely sands and silty peat, and included a large quantity of organic and industrial debris. In general, between 2 and 6 feet of PCS were removed from the area of the shallow subsurface excavation. Because no contamination was noted deeper than 6 feet below ground surface (bgs), calculated MTCA Method B cleanup values were used to determine the excavation limits. After the PCS was removed, the excavation was backfilled with clean fill as part of the ongoing site filling activities.

4.15.2 Oil-water Separator and Hydraulic Hoist Pit

During demolition of the north Bus Barn building, an oil-water separator with a waste oil tank and hydraulic hoist pit was discovered at the approximate locations shown on Figure 5. The waste oil tank was approximately 500 gallons in size and was located between two bays of an inspection pit. Initial soil samples collected from around the tank indicated elevated levels of oil-range petroleum hydrocarbons (14,000 to 24,000 mg/kg.). Because of these elevated concentrations, MTCA Method A was used as the cleanup criteria for this area. Analytical soil sample results for the oil-water separator and the hydraulic hoist pit are summarized in Appendix B, Table B6.2 and B6.3, respectively.

The concrete inspection pits had a bottom depth of 5.5 feet bgs. Below the inspection pits, a silty clay layer extended to 9 feet bgs. Beneath the clay was gravelly sand. PCS was initially excavated to a depth of 18 feet bgs. Water with a heavy sheen was noted in the excavation at approximately 16 feet bgs. The initial size of the excavation was 32 feet east-west and 18 feet north-south. Soil samples were collected 4 feet below the bottom depth of the initial excavation at a depth of 22 feet bgs. The samples indicated that PCS above MTCA Method A levels remained in the soils both above and below the groundwater level. Samples from the bottom of the excavation contained diesel-range TPH concentrations ranging from 4,700 to 5,600 parts per million (ppm), and oil-range TPH concentrations ranging from 6,500 to 14,000 ppm. No further excavation was performed because it was not technically feasible to continue the excavation below the water. The final dimensions of the excavation were 37 feet east-west, 26 feet north-south, and 22 feet deep. The excavation was backfilled as part of the general site filling activities.

Two hydraulic hoists were removed from a separate area immediately north of the north Bus Barn building. Petroleum contamination was visually noted around the hoists. The stained soil was excavated, and confirmation samples demonstrated that MTCA Method A cleanup levels had been achieved. The excavation was then backfilled as part of the general site filling activities.

4.15.3 Gasoline Tank Excavation

Two gasoline USTs were decommissioned and removed from the southwestern portion of the site in August 1996. Approximately 250 cubic yards of gasoline-contaminated soil were

removed from the site at that time, but closure samples indicated that PCS remained in the center of the tank excavation (Lawson, 1996). In November 1996, Shannon & Wilson collected soil samples at two locations near the tank bed and confirmed the presence of residual gasoline contamination (Shannon & Wilson, 1996c).

During the 1997 excavation efforts, soil was excavated from the edge of the tank bed outward. The maximum depth of the excavation at this location was 5.5 feet bgs. Gasoline contamination extended about 1.5 feet into the silty clay layer near the initial tank excavation. Confirmation samples collected from the south wall of the excavation were determined to meet MTCA Method A cleanup levels. However, as the excavation proceeded northward, levels of gasoline contamination diminished, and diesel and oil concentrations increased in the shallow subsurface soils. At the direction of Seattle Center personnel, the excavation to the north and east was halted before achieving the target cleanup levels because of budget constraints. The final size of the excavation was 112 feet north-south by 120 feet east-west. The excavation was backfilled as part of the general site filling activities.

4.15.4 Monitoring Well Abandonment

In February 1997, Shannon & Wilson (1997a) abandoned the five monitoring wells (MW-1 through MW-5) that were installed by SCS in 1994. The wells were abandoned in accordance with WAC 173-160-560.

4.15.5 1997 Additional Soil Cleanup

During demolition of old sidewalks in October 1997, PCS was discovered under the concrete surface of Sixth Avenue, along the east side of the site. Most of the contaminated soil was excavated, and 136 cubic yards of soil was hauled to Holnam, a licensed disposal facility. However, Lawson (1998) reported that a small amount soil contaminated with gasoline and heavy-oil fraction petroleum hydrocarbons above the MTCA Method A cleanup levels was left in an area where high voltage lines and a stormwater catch basin blocked access for excavation. The location of this excavation and the analytical results are provided in Appendix B7.

5.0 2004 GROUNDWATER MONITORING RESULTS

Three monitoring wells were installed on the site in August 2004, to determine whether contaminants that remain on site have adversely affected groundwater quality. One well, SW-1, was installed in the vicinity of the former fueling area, essentially upgradient of most of the site and near where low levels of benzene were detected in monitoring well MW-2 in 1995 and 1996. The other two wells (SW-2 and SW-3), were installed a short distance downgradient from the two main areas where soil cleanup levels were not achieved during site remediation. Specifically, SW-2 was installed directly downgradient from the oil-water separator excavation where diesel and oil were left in place below the water table, and SW-3 was installed directly downgradient from the area in the southern part of the site where gasoline and diesel contamination in relatively shallow soils was not completely removed.

Each of the monitoring wells was installed with a 10-foot-long screen set across the water table. Soil samples were screened with a photoionization detector (PID), and soils with PID detections were analyzed for petroleum hydrocarbons. Only low levels of TPH were detected in soil, from depths that were well above the water table. The wells were developed shortly after drilling, and were sampled at least 24 hours later using bailers to purge and collect the water samples. Each water sample was analyzed for lead, BTEX, and gasoline-, diesel-, and oil-range petroleum hydrocarbons, and a duplicate sample was collected from SW-3. After elevated benzene concentrations were detected in two of the wells, these wells were then resampled in September to confirm the earlier findings. The analytical laboratory reports and summary tables of the analytical results are presented in Appendix B1.

Benzene was detected in SW-1 and SW-3 at concentrations of as high as 46 ppb and 230 ppb, respectively (see Figure 6). These concentrations are well above the MTCA cleanup level of 5 ppb for groundwater and the levels of less than 5 ppb that were detected in MW-2 in 1995 and 1996. Gasoline contamination (WTPH-G) was also detected at 1,600 ppb in SW-3, which is above the MTCA cleanup level of 800 ppb for groundwater containing benzene; the laboratory indicated that the chromatogram indicated that the sample appeared to contain weathered gasoline. Relatively low concentrations of toluene, ethylbenzene, and xylenes also were detected in these wells, but all were well below regulatory cleanup criteria. Essentially no contamination was detected in well SW-2, downgradient from the oil-water separator.

6.0 CURRENT SITE CONDITIONS

6.1 Residual Soil Contamination

Extensive soil excavation, on-site treatment, and off-site disposal over nearly 10 years has eliminated the vast majority of the petroleum contamination that was once present on the former Bus Barn site. Further, while some PCS was left on site at concentrations that exceeded one or more cleanup criteria in place at the time, the regulations for PCS cleanup have been refined to better address risks posed by the contaminants, and the cleanup levels for both diesel- and heavy oil-range petroleum hydrocarbons have been raised considerably. Accordingly, many of the site soils that once met the Class 3 soil use criteria or MTCA Method B cleanup levels for diesel and oil have concentrations that now are well below MTCA Method A cleanup levels.

Based on a comparison of the current MTCA cleanup levels with contaminant levels achieved during excavation and on-site treatment, there is relatively little soil contamination left on site that is in exceedance of MTCA Method A cleanup levels. The areas where soil concentrations appear to exceed these levels are shown in Figure 5, and are discussed below.

1997 Gasoline Tank Excavation. The largest area where petroleum contamination is suspected to exceed MTCA cleanup levels is in the south-central part of the site along the northern and eastern sides of a shallow excavation that was accomplished in 1997 around two former gasoline USTs. The total area impacted by this contamination is not fully defined, although based on several confirmation samples, it appears that at least a few hundred cubic yards of soil, extending from about 20 to 26 feet in depth, could be impacted with gasoline and diesel-range petroleum hydrocarbons at concentrations somewhat above MTCA Method A cleanup levels.

1997 Oil-Water Separator Excavation. Elevated concentrations of diesel- and heavy oil-range petroleum contamination remains on site in the former location of an oil-water separator and waste oil tank in the north Bus Barn building. Contaminated soil in this location could not be fully excavated because of its depth and its position below the water table. The extent of contamination is not known, although the excavation had a footprint of about 800 square feet, and contamination extended at least 4 feet below the bottom of the excavation. This contamination is situated 18 to 22 feet below the former site grade, or about 38 to 42 feet below the present-day parking lot surface.

Contamination Under Mercer Street. A very limited zone of soil contamination was observed during the 1993 excavation of the fueling station area. According to Mr. Paul Berry (1996), minor soil contamination was left in place beneath the Mercer Street sidewalk because further excavation could have damaged Mercer Street. It is not known whether contaminant levels in this area exceed MTCA cleanup levels because analytical results were not available for review.

Contamination Along Sixth Street. A small area of PCS was left in place along Sixth Street in order to avoid removal of a stormwater catch drain and high voltage power lines. The volume of this contamination probably does not exceed a few cubic yards.

Isolated Contamination Near Southern Shallow Soil Excavation. A single confirmation sample from a soil excavation in this area contained gasoline at a concentration that exceeded the current MTCA Method A cleanup level. When the area was excavated, the soil was cleaned up to MTCA Method B levels. A second area where gasoline contamination may still be present above the MTCA Method A Cleanup level is in shallow soils immediately northwest of MW-1. The basis for identifying this contamination is a Geoprobe sample that was collected in 1994. Both of these areas of suspected contamination are likely very limited in extent and situated about 20 to 25 feet below the present-day parking lot surface.

6.2 Groundwater Contamination

The recent groundwater sampling results from three new monitoring wells have identified elevated concentrations of benzene and weathered gasoline in site groundwater, and determined that elevated oil and diesel contamination below the water table at the former oil-water separator has not had a widespread affect on site water quality. Based on the available information, neither the source nor the full extent of the benzene contaminant plume is known. Possible sources for the benzene contamination include releases from spills, or leaking tanks, or pipes in the fueling station area; a possible additional source in the vicinity of SW-3 where gasoline was detected in near-surface soils; or an unknown, off-site source from which benzene contamination migrated southward beneath the site. Each of these scenarios is discussed below.

If the former fueling station was the source of the groundwater contamination, it is reasonable to expect that much higher concentrations of both gasoline and benzene would have been detected in soils in this area, and that the soil contamination would have extended to the water table instead of terminating at the top of the relatively shallow, low-permeability soil below the area.

Also, because the source was removed nearly 15 years ago, we would expect the benzene concentrations in the 2004 groundwater samples to be significantly less than were detected. Based on these factors, if the fueling station area was the source of the benzene, then it is likely that benzene contamination actually was present in groundwater at high concentrations in 1996 but was not present at elevated levels at the previous monitoring well locations. Based on a review of the subsurface soil conditions, the distribution of the low-permeability peat and silt/clay that underlies most of the fueling station area may have restricted downward contaminant migration in most of the area, but allowed infiltration to the water table where it was absent, as is the case in the vicinity of SW-1. Under this scenario, gasoline could have migrated along the top of the low-permeability soil and downward to the aquifer once it reached the area of SW-1 where the fine-grained soil is absent. From there, the contamination would have migrated south-southeastward with groundwater flow.

A second possibility is that the plume from the fueling station is considerably smaller, and a second source of benzene is present just upgradient of SW-3. Based on soil sampling results, this scenario seems unlikely because relatively little benzene was detected in this area, and the contamination appears to be generally limited to the upper 6 feet of soil (below the former grade), whereas the water table in this area is about 25 feet below the deepest known soil contamination.

The third possibility is that the benzene contamination is from an upgradient source. Evidence in support of this scenario includes the anomalously high benzene contamination in groundwater in contrast to very low levels of benzene in site soils; the low-permeability soil below the fueling station area that appears to have limited downward migration of site contaminants; the detection of low levels of benzene in MW-2, which appears to be cross gradient and slightly upgradient from any likely on-site sources of contamination, and soil contamination beneath Mercer Street, immediately to the north of the site. This possibility was evaluated previously and found to be lacking in any more than circumstantial evidence. Based on records research and probe explorations upgradient from the site (Shannon & Wilson, 1996a and 1996b), no evidence of groundwater contaminant migration from an upgradient source was identified. Although potential petroleum contamination sources (two gas stations) were located upgradient of the site, both were remediated and neither reported any groundwater contamination.

Based on the available evidence, the fueling station is considered the most likely source of the benzene contamination in site groundwater. If this is the case, the benzene plume has migrated at least 350 feet downgradient to SW-3. Benzene concentrations at SW-3 are substantially higher than at SW-1, suggesting that the plume is capable of migrating a substantial distance without appreciable attenuation.

6.3 Regulatory Status

The former Bus Barn site has had a series of owners, including King County Metro (and its predecessor transit agencies), the City of Seattle Department of General Administration, and the Seattle Center. Each agency has reported various activities to the regulatory agencies. Currently, the site (identified as 520 5th Avenue North, Seattle, Washington) is listed on the following agency databases:

- Resource Conservation and Recovery Act (RCRA) Notifier (WAD 981762206)
- Underground Storage Tank (UST) (7884)
- Contaminated and Suspected Contaminated Sites (C&SCS)
- Leaking Underground Storage Tank (LUST) (1201)

The most recent releases reported to Ecology were apparently on August 7, 1996, although Seattle Center has records of reporting the contamination found in 1997 along Sixth Avenue during demolition.

The Seattle Center has performed Independent Remedial Action (action without formal Ecology oversight) at the site, as allowed under the MTCA. Cleanup activities have been carried out in accordance with MTCA requirements; however, formal oversight by Ecology has not been obtained. After completion of site cleanup cleanup, Ecology review may be sought via their Independent Remedial Action Program (IRAP). Such a review would be required in order to obtain a No Further Action determination for the site.

7.0 RECOMMENDATIONS

Based on the current understanding of the environmental conditions at the former Bus Barn site, the residual soil contamination does not appear to pose a risk to human health or the environment

under the current site use. However, if deep excavation is required as part of future site development, petroleum-contaminated soils could be encountered. Accordingly, protective measure for site workers would be required, as would sampling of excavated soil to determine proper disposal.

The extent of benzene and gasoline contamination in site groundwater is not known. Because the detected concentrations of these contaminants are in exceedance of regulatory standards, we recommend that additional monitoring wells be installed and sampled to evaluate whether contaminants are migrating off site in groundwater, and to confirm that the contamination is not from an upgradient source. Depending on the results of this sampling, either long-term groundwater monitoring or remediation may be required. Additional site explorations and well installations would be required to delineate the extent of site contamination, design an effective remediation system, and establish a compliance monitoring program.

Based on current site use, the groundwater contamination does not appear to pose an on-site risk to human health or the environment. However, for any future site use, it would be necessary to impose institutional controls to prevent installation of wells on site until contaminant concentrations no longer exceed the regulatory criteria. Also, for any future development that would require deep excavations or dewatering for foundations, it would be necessary to establish provisions that provide for the safety of site workers and for proper disposition of any groundwater that is extracted from the site.

8.0 LIMITATIONS

This report is based on limited research at the site and should be considered representative at the time of our observations. Changes in the conditions of the property can occur with time from both natural processes and human activities. In addition, changes in governmental codes, regulations, or law may occur. Because of such changes beyond our control, our observations and recommendations applicable to this facility may need to be revised, either wholly or in part.

This report was prepared for the exclusive use of the Seattle Center and in no way guarantees that an agency or its staff will reach the same conclusions as Shannon & Wilson, Inc. We have

prepared Appendix C, "Important Information About Your Environmental Report" to assist you and others in understanding the use and limitations of our reports.

If you have any questions, please call me direct at (206) 695-6886.

Sincerely,

SHANNON & WILSON, INC.

Daniel N. Clayton
Senior Vice President

DNC/eet

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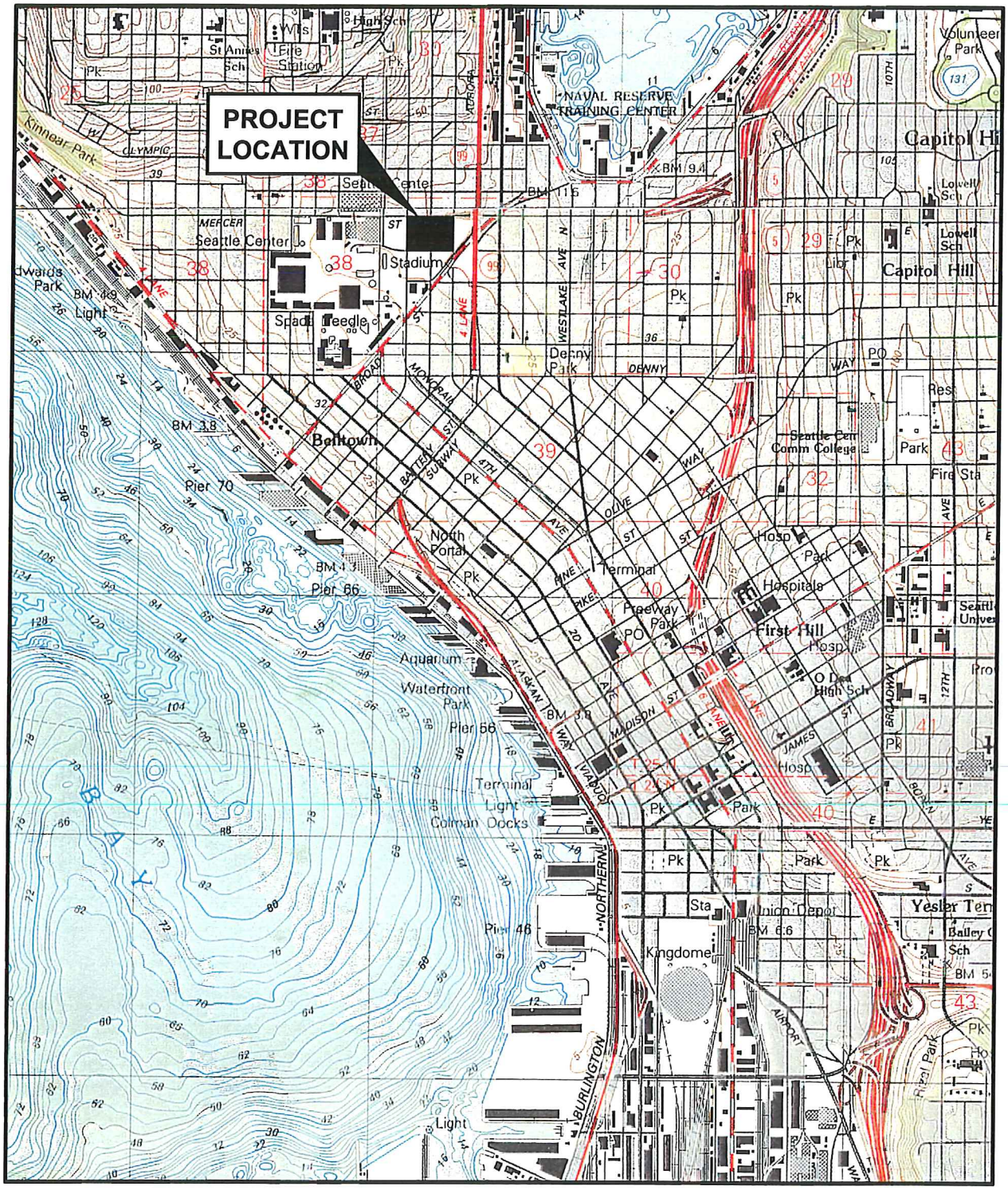
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0 1/2 1

Scale in Miles

NOTE

Map adapted from 1:25,000 USGS topographic maps of Seattle North and Seattle South, WA quadrangles, dated 1983.

Former Metro Bus Barn Site
Seattle Center
Seattle, Washington

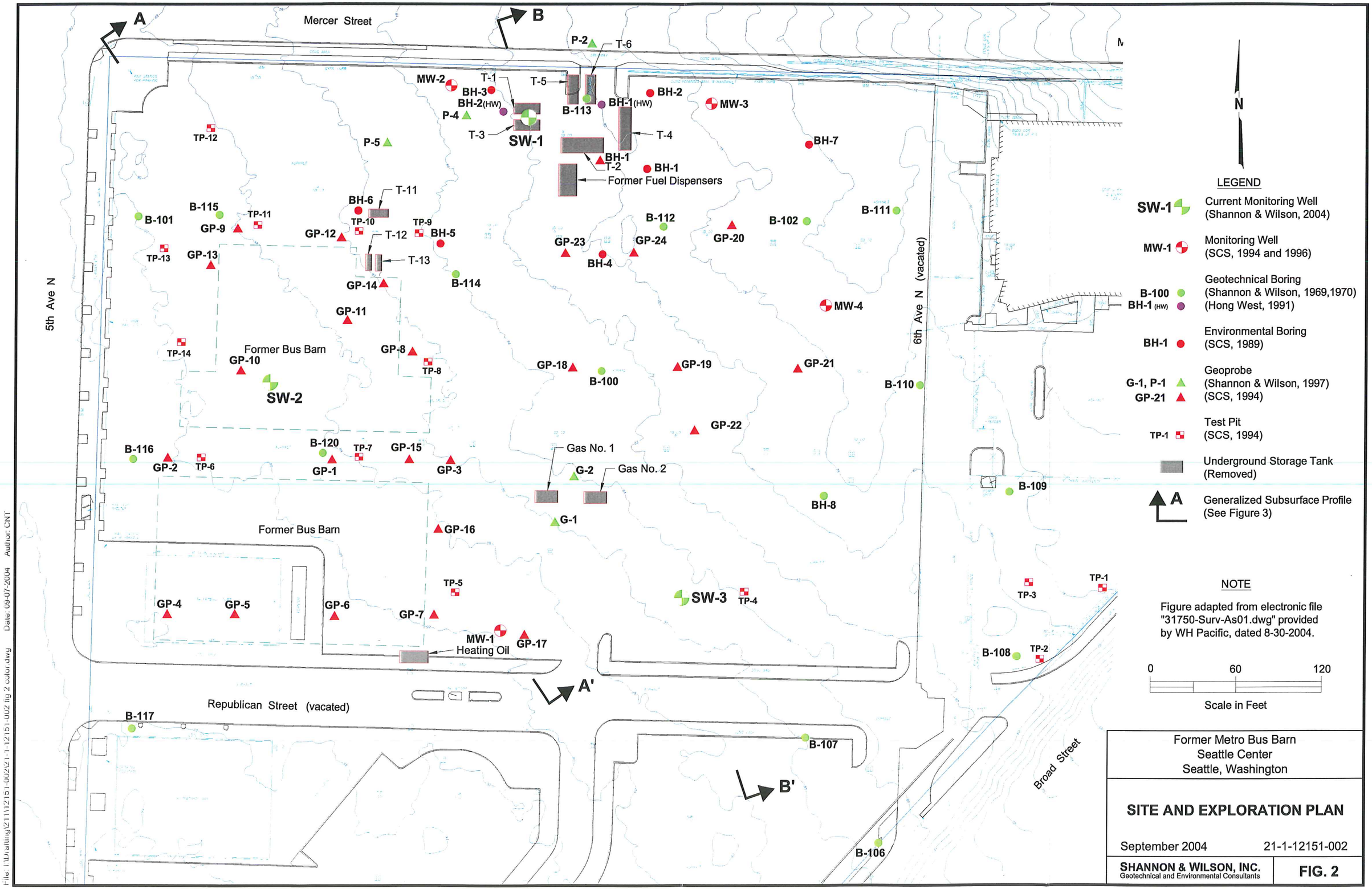
VICINITY MAP

September 2004 21-1-12151-002

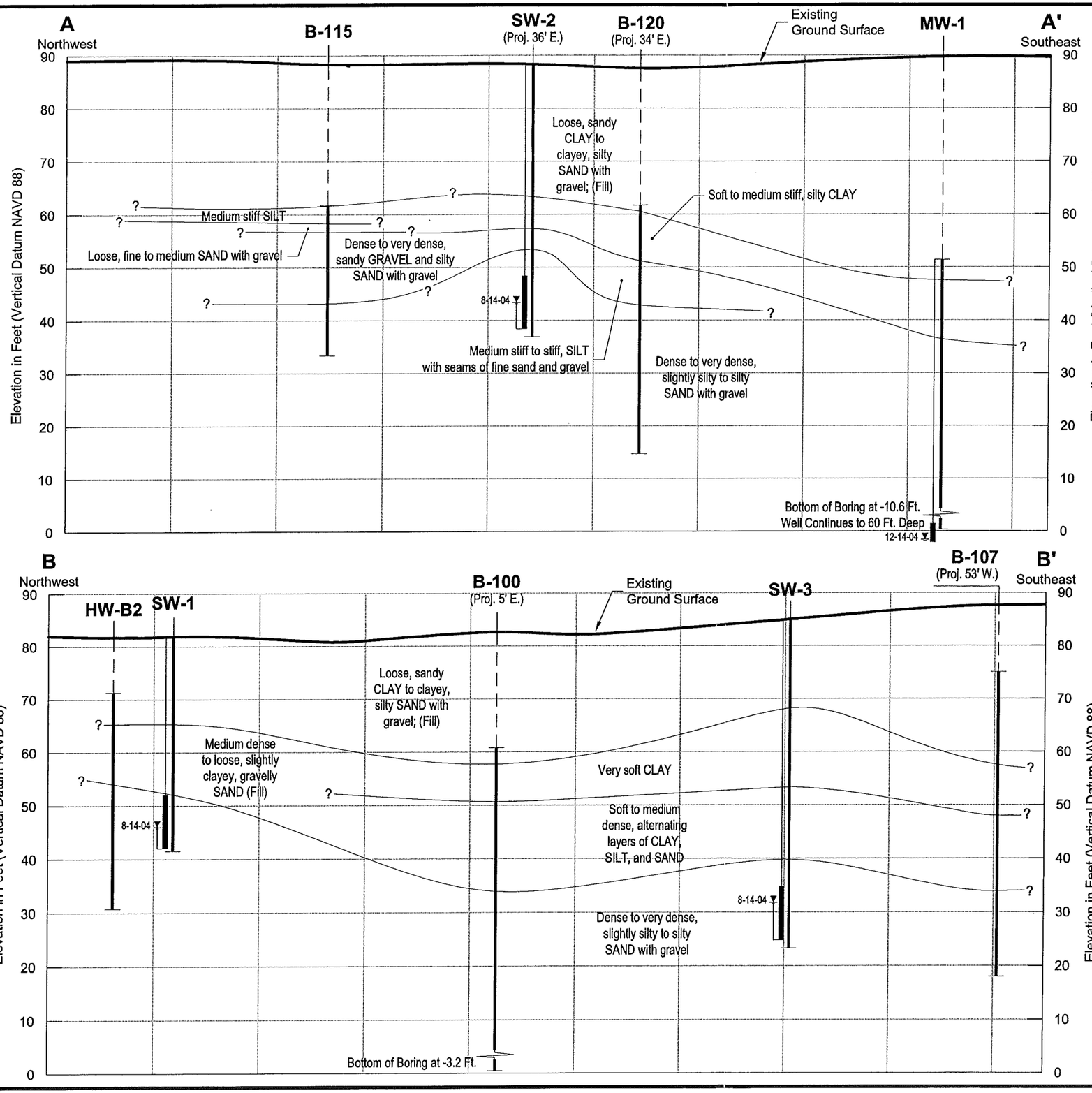
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1

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File I:\Drafting\21\12151-002\21-1-12151-002 fig 2 color.dwg Date: 09-07-2004 Author: CNT



LEGEND

SW-2 (Proj. 36' E.) — Boring Designation / Projected Distance

Well Screen

Water Level and Date Observed — 8-14-04

Approximate Geologic Contact

Bottom of Boring

0 20 40

Vertical Scale in Feet

0 60 120

Horizontal Scale in Feet

Vertical Exaggeration = 3X

NOTE

This subsurface profile is generalized from materials observed in soil borings. Variations may exist between profile and actual conditions.

Former Metro Bus Barn Site
Seattle Center
Seattle, Washington

GENERALIZED SUBSURFACE PROFILES A-A' AND B-B'

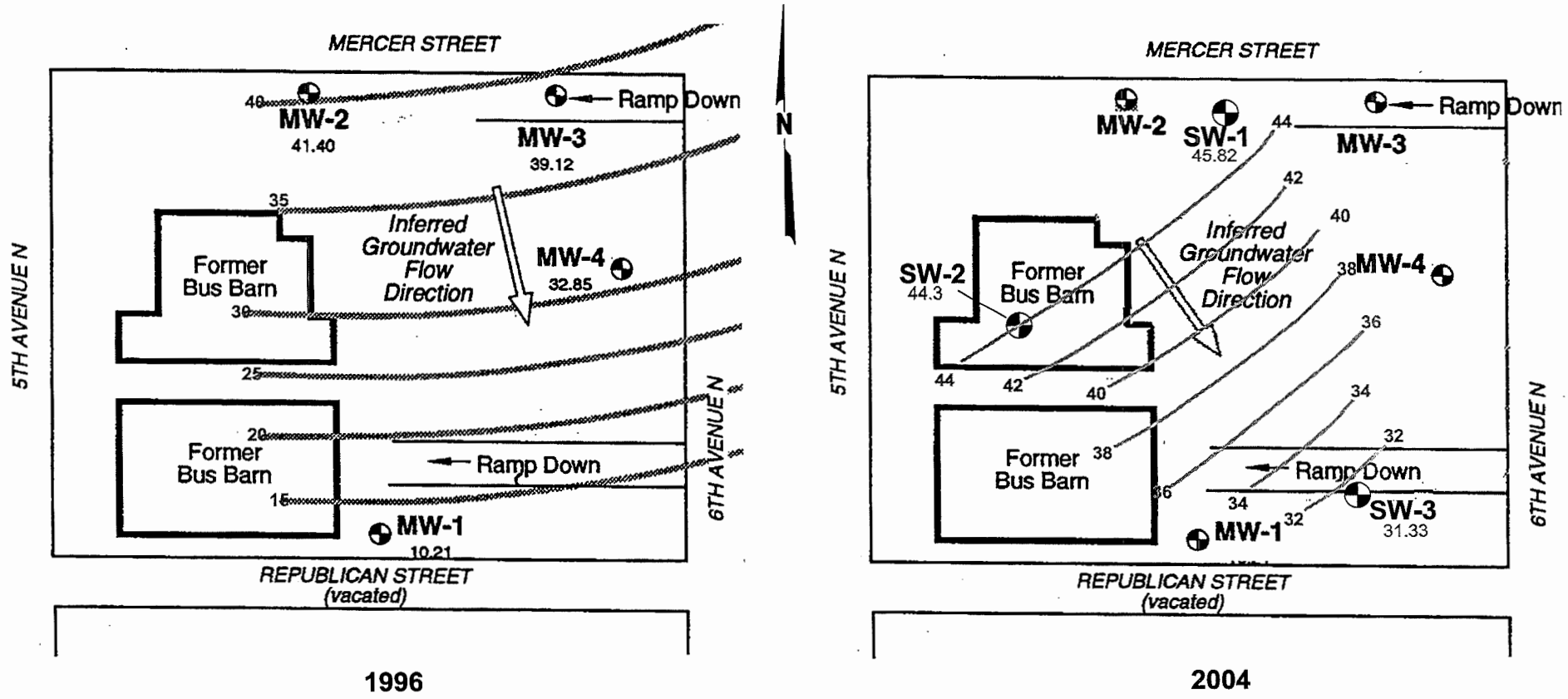
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FIG. 3

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File: I:\Drafting\211\12151-002\21-1-12151-002 fig 4.dwg Date: 09-07-2004 Author: CNT



Not to Scale

LEGEND

MW-1 / SW-1 ⊕	Monitoring Well Designation and Approximate Location
34.05	Groundwater Elevation in Feet
—— 15 ——	Groundwater Contour, Elevation in Feet

Former Metro Bus Barn Site
Seattle Center
Seattle, Washington

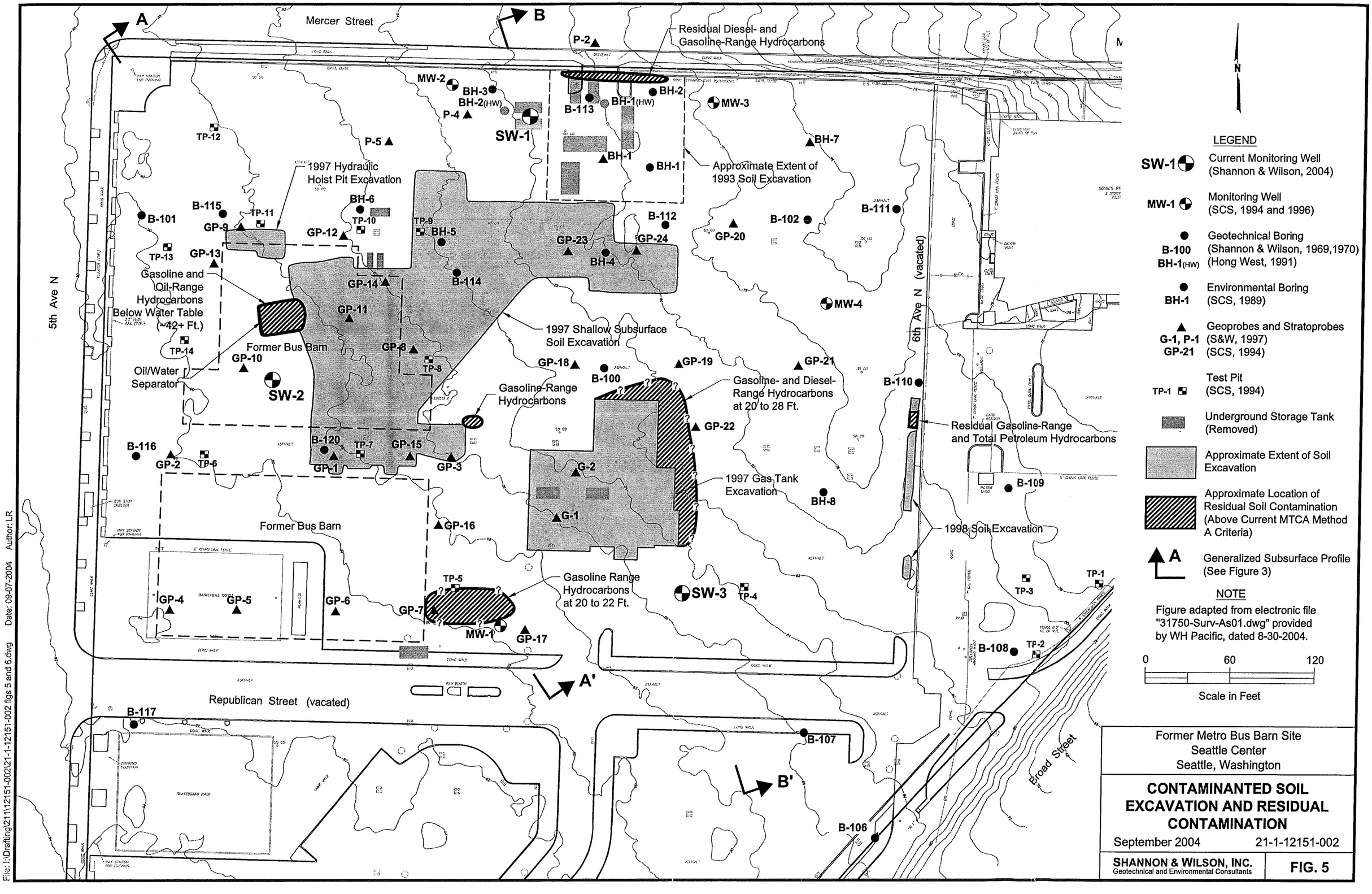
GROUNDWATER CONTOUR MAPS 1996 AND 2004

September 2004 21-1-12151-002

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FIG. 4

FIG. 4



Former Metro Bus Barn Site
Seattle Center
Seattle, Washington

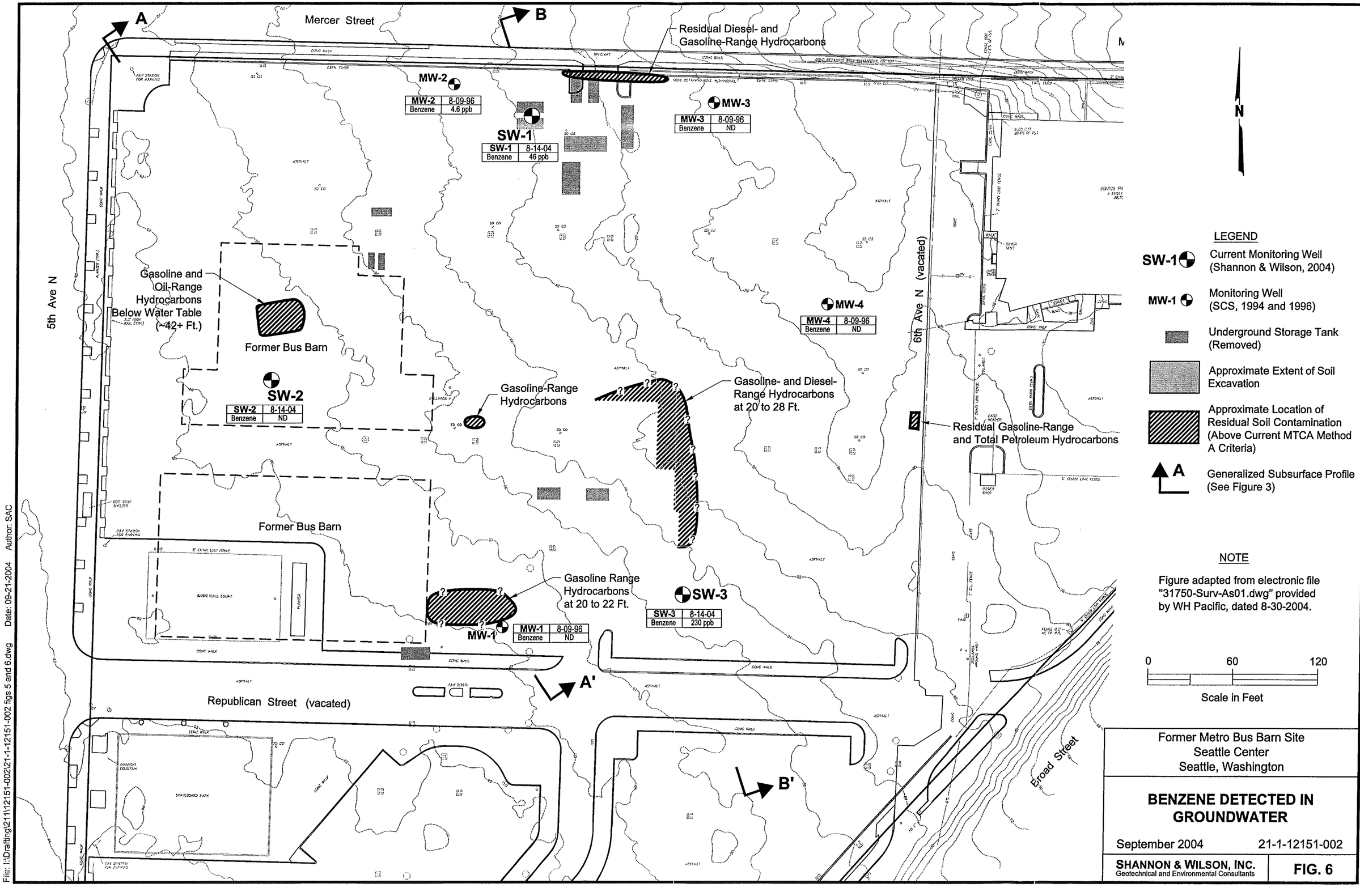
CONTAMINANTED SOIL EXCAVATION AND RESIDUAL CONTAMINATION

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FIG. 5

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Former Metro Bus Barn Site
Seattle Center
Seattle, Washington

BENZENE DETECTED IN GROUNDWATER

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FIG. 6

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