RO-260

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April 5, 2005

Robert W. Schultz, P.G.
Hazardous Materials Specialist
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502

APR 07 2005

Subject: Site Conceptual Model
400 San Pablo Avenue, Albany, CA

Dear Mr. Bob:

Please find enclosed a copy of the February 17, 2005 Site Conceptual Model Report prepared by Enviro Soil Tech Consultants on the subject property.
I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

Sincerely,

Murray T Stevens, President
Kamur Industries Inc.

P.S. Per our telephone conversation earlier today, the lateness of this report is completely my fault. Enviro Soil Tech sent me all the all copies of the report including yours that I was to send on to you. I never opened the package until yesterday. Sorry!

As I mentioned, I have a large amount of money held in escrow awaiting an approval of some sort of plan that will hopefully result in environmental closure on this property. As early a reply to this report as possible would greatly be appreciated.

File No. 8-90-421-SI

SITE CONCEPTUAL MODEL
FOR THE PROPERTIES
LOCATED AT 398 & 400 SAN PABLO AVENUE
ALBANY, CALIFORNIA
FEBRUARY 17, 2005

PREPARED FOR:
MR. MURRAY STEVENS
KAMUR INDUSTRIES, INC.
2351 SHORELINE DRIVE
ALAMEDA, CALIFORNIA 94501

BY:
ENVIRO SOIL TECH CONSULTANTS
131 TULLY ROAD
SAN JOSE, CALIFORNIA 95111

File No. 8-90-421-SI

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ENVIRO SOIL TECH CONSULTANTS

Environmental & Geotechnical Consultants

131 TULLY ROAD, SAN JOSE, CALIFORNIA 95111

Tel: (408) 297-1500 Fax: (408) 292-2116

February 17, 2005

File No. 8-90-421-SI

Mr. Murray Stevens
Kamur Industries, Inc.
2351 Shoreline Drive
Alameda, California 94501

SUBJECT: SITE CONCEPTUAL MODEL FOR THE PROPERTIES
Located at 398 and 400 San Pablo Avenue, in
Albany, California

Dear Mr. Stevens:

Per your request and authorization and in conjunction with the request from the Alameda County Health Care Services Agency (ACHCSA), enclosed is the site conceptual model report that was prepared by Enviro Soil Tech Consultants (ESTC) for the properties located at 398 and 400 San Pablo Avenue, in Albany, California.

Please forward a copy of this report to ACHCSA and Regional Water Quality Control Board (RWQCB) for their review and comments.

The conclusions contained in this report represent a professional interpretation, and are based on a limited amount of data, some of which has been supplied by an independent laboratory. The work has been performed in accordance with currently accepted hydrogeologic and engineering practices, and recommendations have been provided in accordance with regulatory requirements. No other warranty is implied.

If you have any questions or require additional information, please feel free to contact our office at (408) 297-1500.

Sincerely,

ENVIRO SOIL TECH CONSULTANTS

REGISTERED GEOLOGIST VICTOR B. CHERVEN No. 3475 STATE OF CALIFORNIA

VICTOR B. CHERVEN, Ph.D.
REGISTERED GEOLOGIST #3475

LAWRENCE KOO, P. E.
C. E. #34928

FRANK HAMEDI-FARD
GENERAL MANAGER

EXECUTIVE SUMMARY:

This report presents a generalized interpretation (conceptual model) of the hydrogeology of two parcels of property located at 398 and 400 San Pablo Avenue in El Cerrito, California. The report also includes a relatively detailed history of groundwater flow and migration of the plume of hydrocarbon-impacted groundwater that underlies the site. A car wash operates on the southern portion of the property, and also dispensed unleaded gasoline from 1970 to 1989. A dry cleaners occupies the northern part of the site. The investigation began in 1989, when free-phase hydrocarbons were observed floating in El Cerrito Creek just north of the dry cleaners, and a leak was detected in the dispenser area of the car wash facility.

The site is underlain primarily by fine-grained sediment (clay) at shallow depths, and groundwater appears to be partially confined beneath this relatively impermeable layer. When borings are drilled through the clay layer, groundwater normally rises from more than 15 to less than 10 feet below grade. The clay bed was impacted by gasoline leaks from the underground storage tanks and fuel lines, and underlying sediment was probably also affected. The exact nature of this underlying sediment is not well known, but it is somewhat coarser grained and is probably the first water-bearing unit below surface grade. Most borings were drilled to a depth of 15 or 25 feet, but few soil samples below 7 feet have been analyzed for the presence of hydrocarbons, so the full extent of contamination in this saturated hydrogeologic unit is ambiguous.

Subsequent development and evolution of the plume of gasoline-impacted groundwater has been traced using a series of 1) groundwater elevation maps and 2) Total Petroleum Hydrocarbon concentration maps. These were the primary data sources available for this report, and the maps were compared to the conceptual model for validation of its basic tenets. This time-variant analysis demonstrates that the history of groundwater flow and plume development has been more complex than predicted by the model, but analysis of the variations in groundwater flow and depth to groundwater is capable of resolving most of the details and aberrations of plume growth and contraction.

The spread of hydrocarbons in groundwater led to contamination of all of the property in the 1990's, but some of this contamination has attenuated naturally since 2000 and the southwestern portion of the site may no longer be contaminated. A narrow strip along the northern site margin is also largely contaminant free at this time. Interim remediation, involving excavation of several hundred yards of contaminated soil from the former underground tank cavity and adjacent dispenser area, aided in the reduction of contaminant mass and no doubt has been partly responsible for the reduction in the magnitude of contamination. Residual soil contamination is present north and west of the excavated area, and is probably contributing additional hydrocarbons to the groundwater there, where TPH concentrations still exceed 100,000 parts per billion.

TPH concentration data reveal that a groundwater plume formed north of the dry cleaners building during the 1980's, and by 1989 concentrations were approximately 100,000 parts per billion in this plume. The full extent of the plume was largely delineated by 1995, and this Northern Plume remained centered near the dry cleaners until about that time. Starting in the mid-1990's, concentrations began to rise in the center of the site area near the car wash fuel tanks. Concentrations in that area peaked at 300,000 parts per billion in 1995. At the same time, concentrations in the Northern Plume began to wane, although the reasons are not fully understood. Located just north of the car wash fueling facility, the southern locus of contamination is herein referred to as the Southern Plume. It has persisted for more than 9 years, and concentrations remain above 100,000 ppb in one monitoring well located there.

Several unanswered questions remain regarding the extent of the problem. The relative importance of gasoline contamination from the car wash facility and solvent contamination from the dry cleaners has not been clearly resolved. In comparison to the number of samples analyzed for gasoline, almost no samples have been analyzed for chlorinated (solvent) hydrocarbons. No data have yet been collected on aquifer characteristics, so groundwater flow rates, transport paths, and the fate of contaminants in soil are unknown. Lastly, the investigation has focused on very near-surface contamination. Few soil samples below a depth of 7 feet have been analyzed, and the vertical extent of contamination is uncertain. These gaps in the existing database should be plugged before a decision is made regarding site remediation or case closure.

1.0 INTRODUCTION:

1.1 BACKGROUND

Plaza Car Wash is located at 400 San Pablo Avenue in Albany, California and is one of two businesses operating at that location. Norge Dry Cleaners occupies a separate building on the northwest side of the property at 398 San Pablo. These buildings were constructed in the late 1950's, when the site was first developed. Figure 1 shows the location of the site, and Figure 2 is a generalized map of the site and surrounding area.

In 1970, Mr. Murray Stevens of Kamur Industries, Inc. leased the car wash from the property owner, Mr. George Ososke and installed three underground fuel tanks on the car wash portion of the property and began dispensing gasoline. Each tank had a capacity of 10,000 gallons. . Mr. Stevens operated the business until October 1, 2003.

Evidence of an unauthorized release of gasoline first surfaced in July 1989, when a film of free product was observed floating on the water of El Cerrito Creek north of the Dry Cleaners building. During remedial work by the Albany Fire Department to contain the spill, free-phase hydrocarbons were observed at the outlet of a storm drain to the creek, located northwest of the Dry Cleaners building (Figure 2). This observation led investigators to suspect that the storm drain was the source of the free product in the creek. Water samples were collected approximately two weeks later from the outlet and the adjacent creek, and high concentrations of gasoline-range hydrocarbons were detected. The following month (September), a video pipeline inspection confirmed that the storm drain was cracked and bent, creating a pathway for subsurface contaminants to enter the drain and eventually discharge into the creek.

Meanwhile, a product-line test had confirmed a leak in the product line to the unleaded fuel dispenser at the car wash. The leaking line was exposed and repaired, 5 to 10 cubic yards of soil were removed from around the leak, and a sample of the excavated soil was analyzed for the presence of petroleum hydrocarbons. Total Petroleum Hydrocarbons in the gasoline range (TPH-g) were detected at a concentration of 7,500 mg/kg (parts per million).

Investigation of the source(s) of the hydrocarbons was initiated in late 1989, and has been ongoing since then. The details of the investigation are presented in the following sections.

1.2 PURPOSE

In August 2003, the Alameda County Environmental Health Services Agency (ACEH) requested Mr. Stevens to provide a summary of the investigation to be used in evaluating the status of the case and determining whether additional studies are needed to move the site toward case closure. Enviro Soil Tech Consultants (ESTC) submitted a report titled *Historical Events Report for...* on behalf of Mr. Stevens. In that report, ESTC chronicled the history of the investigation and gave a brief interpretation of the site geology. The ACEH found that report to be inadequate in several respects, and requested that a new report, prepared in the style of a Site Conceptual Model, be submitted. This report was prepared to meet that purpose.

1.3 DATA ANALYSIS

This report is based on data gathered by ETSC and other consultants during the time period from August 1989 through August 2004. The data were collected by a number of different contractors and for different specific purposes, samples were analyzed by several different laboratories, and the work was performed under the supervision of more than one regulator. Hence, the data are of uneven quality. However, we believe that the data are adequate to develop a reasonable geologic model, identify holes or weak spots in the model, and generate a list of additional tasks that can be used to test and improve the model.

Water depth measurements and groundwater analytical results form the primary database for the site. The first four monitoring wells were installed in 1989, and since then six additional wells have been drilled. In recent years, seven wells have been monitored quarterly, providing a fairly consistent record for the site. In this report we present several new groundwater elevation maps and hydrocarbon isocontour maps derived from this database, and use these maps to interpret various aspects of the site's hydrogeology.

The groundwater database is supplemented by analytical results from soil samples that were collected during drilling and excavation activities. Most of the analyzed soil samples were collected at shallow depths (3-15 feet), so the depth interval for which interpretations can be provided is relatively limited. Using these data, we have constructed new maps and cross sections that illustrate the three-dimensional distribution of petroleum hydrocarbons in the soil.

1.4 ORGANIZATION OF THIS REPORT

The data have been used to generate a conceptual model of the site, which is presented in schematic form in section 2.0 of this report. In support of the model, section 2.0 also includes:

- Two geological cross sections through the site
- A plot of water depth over time at the site
- A map showing the early (1989) distribution of hydrocarbon vapors in the soil
- A map showing the extent of the hydrocarbon release, as revealed by the distribution of petroleum hydrocarbons in the soil prior to interim remediation
- Graphs showing the time-variant concentrations of gasoline in groundwater samples from selected wells.

After presenting the conceptual model, section 3.0 of the report examines the hydrogeology of the site through a series of site-specific groundwater elevation maps for the years 1989-2004. These maps depict the hydraulic gradient and groundwater flow direction during that time, and lay a basis for examining the distribution and migration of gasoline compounds in the groundwater in section 4.0. Implicit in this analysis is that the petroleum hydrocarbons migrate in the direction(s) of groundwater flow, although at a slower rate than the groundwater due to various retardation factors. Maps depicting the distribution of Total Petroleum Hydrocarbons (reported as gasoline by the laboratory) are presented for the same dates as those depicted in the groundwater elevation maps. The discussion of these maps focuses on the extent to which the groundwater plume has evolved as predicted by the site conceptual model, given the changes in groundwater flow direction and gradient depicted by the maps in section 3.0.

1.5 SITE LOCATION AND DESCRIPTION

The site is located in an industrial area, and the local topography is flat. The original car wash was located in the southern part of the site, but was removed in 2001 and replaced by a newer car wash tunnel along the southern property boundary and an office building to the west. The dry cleaning facility is located in the northwestern portion of the site, and the remainder of the site is mostly a paved parking area. The underground storage tanks were located in the eastern portion of the site, but were removed in November 1990.

2.0 SITE CONCEPTUAL MODEL:

This section compiles a variety of geological and chemical data that have been collected to develop a conceptual model of the origin and subsequent evolution of the plume of gasoline-contaminated groundwater that underlies the site. Lithologic data collected from borings indicate that fine-grained deposits underlie most of the site to a depth of at least 20 feet. The strata are poorly sorted and some contain a mixture of clay, silt, sand, and gravel, and it is somewhat uncertain which unit is the principal water-bearing deposit beneath the site. Because these shallow deposits have characteristics that are more typical of aquitards than aquifers, it is possible that the principal aquifer lies below the depth of most borings and that groundwater is partially confined beneath the surficial layers. In some wells, water levels have stabilized at shallower depths than those at which groundwater was first encountered during drilling, supporting the suggestion of partial confinement.

Groundwater-elevation data indicate that the depth to groundwater has been rather stable over time. In MW-2, one of the oldest wells, the depth has been between 4.3 and 5.8 feet below surface grade (BSG) in most years, which is remarkably stable. Changes in groundwater flow direction have taken place, but southeast or northwest flow directions have been most common. Laboratory analyses of soil samples demonstrate that soil in the vicinity of the UST excavation was impacted by a gasoline release, but also that soil near the dry cleaners building has also been impacted by hydrocarbons. Some evidence suggests that the latter is not due to the release from the UST product lines, but to some other (perhaps surficial) source. As will be shown in the following sections, the data lead to the conclusion that there may have been multiple releases and more than one source of soil and groundwater contamination.

2.1 HYDROGEOLOGIC UNITS

2.1.1 LITHOLOGY

It is somewhat difficult with the existing borehole data to distinguish discrete, correlative stratigraphic or hydrologic units at this site. In most borings, clay or silty clay is apparently the predominant lithology in the upper 15 feet. However, this clay varies in color from black to light brown, and the color differences create a degree of uncertainty in correlations of this clayey interval from boring to boring (Figure 3).

Below a depth of 15 feet, the sediment appears to be slightly coarser grained. In various borings it has been described as clayey silt, sandy clay, or sandy to gravely clay. Neither the thickness nor lateral extent of this interval can be determined with confidence, because of the lack of deeper borings and the apparent lateral changes in lithology (Figure 3).

2.1.2 HYDRAULIC CONDUCTIVITY

No samples have been tested to determine hydraulic conductivity or distinguish between water-bearing and non-water-bearing lithologic zones, and no aquifer tests have been conducted. This represents a gap in the database for generating the Site Conceptual Model, because groundwater flow rates cannot be determined without this information.

2.2 GROUNDWATER FLOW DIRECTION

The prevailing direction in which groundwater flows and the hydraulic gradient are important aspects of the conceptual model, because these factors exert a strong influence on the mobility and migration patterns of dissolved petroleum hydrocarbons. Before examining the local groundwater flow pattern in detail, however, it is instructive to consider the flow pattern on a larger or more general scale, because this helps to reveal trends and overall patterns. At this scale, the schematic model for the site involves generally westward groundwater flow from the Berkeley Hills recharge area to the San Francisco Bay discharge area.

On a more local scale, groundwater flow is undoubtedly influenced by inflow and outflow from El Cerrito Creek. During times of high creek flow, outward flow through porous levees or riverbanks is likely, causing groundwater to flow southward from the creek toward Plaza Car Wash. During times of strongly reduced flow and low water levels, groundwater is more likely to flow northward and discharge by underflow into the creek. Hence, the regional westward flow direction is likely to be altered in some years or quarters by the influence of El Cerrito Creek, causing flow vectors to bend to the northwest during creek inflow and to the southwest during outflow.

2.3 DEPTH TO GROUNDWATER

Another aspect of the site hydrogeology to consider in the conceptual model is the variation in the depth to groundwater, both seasonally and long-term. At most sites, the depth to groundwater increases during the dry season (summer and autumn in California) and decreases in the wet season. Groundwater at this site illustrates this type of behavior beginning about the middle of 1994 (Figure 4). At that time, the water depth in MW-2 reached its recorded maximum (7.47 feet in August). Late in the year the water level rose rapidly to only 4.69 feet in November. Through most of 1995 the water level declined, but then began to rise again late in the year and reached its annual minimum depth in February 1996. It then began declining before rising again in early 1997.The depth then declined through August, but rose again in early 1998 to 4.76 feet in March of that year. This cyclic behavior is typical and related to seasonal precipitation changes.

Prior to mid-1994, however, the water level went through a relatively persistent decline, beginning in the middle of 1992. This is not a typical pattern, particularly in that the water depth between May and August of that year was higher than at any other time since this investigation began except for the month of March 1991. At this time, we have no explanation for the high water table in 1992 or its subsequent decline into 1994.

A monitoring gap of four years occurred between 1999 and 2003, and when monitoring resumed in August 2003, the water level had dropped to 7 feet. Since then, it has remained near this depth. We currently have no explanation for this period of low water.

2.4 FUEL RELEASE

The final aspect of the site conceptual model to be considered is the source(s) of the unauthorized release. Laboratory data from samples collected during the tank removals, as well as from borings drilled before and after the tank removals, are useful in this regard.

2.4.1 SOIL VAPOR SAMPLES

Subsurface Consultants, Inc. (SCI) conducted a soil vapor survey, mostly near the perimeter of the site, shortly after the floating product was discovered in El Cerrito Creek. The purpose of the study was to aid in locating potential borehole locations for collecting soil and water samples. Twenty-six shallow probes were emplaced, and soil vapor readings were collected from each probe. SCI concluded that virtually the entire site was impacted by hydrocarbon vapors, at concentrations ranging from 500 parts per million up to 5000 parts per million. These data are contoured in Figure 5, and three "hotspots" are suggested by closed contours along the west side of the property.

2.4.2 SOIL SAMPLES

After completing the soil vapor survey, SCI drilled five borings (A/B and MW-1 through MW-4, see Figure 6) and collected the first soil samples in August 1989, but for unknown reasons none of the borings were located within the hot spots identified in the soil vapor survey. SCI submitted 10 soil samples for analysis, but did not identify the analyzing laboratory. All ten contained gasoline-range hydrocarbons, including BTEX. The highest concentrations were detected in A/B (15,000 and 27,000 parts per million at depths of 2-4 feet below grade) and in MW-1 (1,100-1,300 parts per million TPHg). Neither of these was close to a soil vapor probe, so it is uncertain why these locations were selected for drilling. Concentrations declined to the northwest (740 ppm in MW-2 and 24 ppm in MW-3), which, in hindsight, is probably predictable from the soil vapor contours in Figure 5.

The underground storage tanks were removed from the property in November 1990, and 19 samples were collected from the sidewalls of the excavation over a period of four days as the excavation was enlarged and extended. Some samples were analyzed by Erickson Analytical, and others were analyzed by Superior Analytical or Mobile Chem Labs. Gasoline-range hydrocarbons were detected in all 19 samples, and at least two potential leak sites are suggested by the occurrence of relatively higher concentrations in the vicinity of the northeast dispenser and the eastern sidewall of the UST excavation (Figure 2). Contouring these data illustrates this suggestion (Figure 6).

2.4.3 GROUNDWATER SAMPLES

Groundwater samples from the site are also illustrative of the history of the fuel release. Figure 7 plots the TPH-g concentration in groundwater samples from MW-1 and its later replacement (STMW-1). By the time this first well was drilled in 1989, groundwater at MW-1 was already impacted at a concentration of 16,000 parts per billion, but groundwater at MW-2 and MW-3 was even more contaminated, with concentrations of 80,000 and 71,000 ppb respectively. The latter concentrations are difficult to reconcile with the concept of a Plaza Car wash UST source, because the concentration at MW-1 was so much lower. This suggests a different source, closer to MW-2 and MW-3. A potential candidate is the "hotspsot" at the Norge Cleaners. This hotspot was never adequately tested for the presence of either soil or groundwater contamination. On the other hand, soil samples from MW-2 and MW-3 were much less contaminated than those in MW-1, as would be expected if they are located farther from the source (see section 2.4.2. This issue will be addressed further in section 4.0.

Returning to the historical groundwater evidence for a release from the Plaza Car Wash fueling facility, concentrations in MW-1 (and later, STMW-1) rose steadily from 1989 through the middle part of 1995, reaching a maximum of 300,000 ppb in August of that year. The tanks had been removed by then, so increasing concentrations likely represent continued downward leaching of hydrocarbons through the unsaturated zone and then dissolution in the saturated zone. In late 1995, concentrations in MW-1 began a steady decline, reaching a concentration of 3700 ppb in December 1997. This suggests that the plume may have begun to attenuate, and the graph in Figure 7 gives the impression that attenuation accelerated after 1997. However, this is incorrect; ESTC switched to Priority Analytical Laboratories in 1996. Due to poor work in 1996-97, Priority Labs was de-certified in early 1998. The results for 1998 and 1999 are therefore invalid, and the results for 1996-97 are suspect. This makes it impossible to say definitively whether concentrations declined after 1995.

After ETSC was informed that Priority Labs had lost its state-certification, sampling was suspended until 2003. Sampling resumed in March of that year, and has continued quarterly since then. These results confirm that concentrations have remained very elevated in the vicinity of the former UST facility, and prove that the plume did not attenuate significantly after 1995.

2.4.4 SUMMARY

In summary, there is evidence of two releases of liquid hydrocarbons from different sources and at different times since the site was developed in the 1950's. Soil-vapor data and groundwater data suggest that the first release of hydrocarbons occurred in the early 1980's or earlier in the vicinity of Norge Cleaners. In 1989, gasoline-range hydrocarbons were detected in monitoring wells near the dry cleaners at the same time that floating product was observed nearby in El Cerrito Creek. Concentrations in these wells were several times greater than those in wells near the UST facility at Plaza Car Wash, which is difficult to explain if the UST's were the source of this contamination. Furthermore, waste-handling procedures at dry cleaning establishments were poor at best prior to the 1970's, and the presence of floating product in the storm drain northwest of Norge Cleaners, as well as the two hotspots near the Cleaners, could readily be interpreted to indicate that the Cleaners was a source of subsurface contamination. On one occasion in 1996, a water sample from the well nearest the Cleaners was analyzed for cleaning solvents, and trichloroethane and perchloroethane (TCE and PCE) were detected by the laboratory. These solvents are in customary use at all dry cleaning facilities.

The underground storage tanks and dispenser islands at Plaza Car Wash were also a source of soil and groundwater contamination. At least as early as mid-1989, gasoline began leaking from one or more of the tanks or product lines and migrated laterally and downward through the soil. Assuming that the groundwater level was not significantly lower in the 1970's than it has been since 1989, the gasoline may have ceased migrating downward at about 10 feet and migrated laterally as a dissolved phase in groundwater. After reaching the underground storm drain, which was emplaced at a depth of approximately 5 feet below grade, the dissolved hydrocarbons could then migrate more rapidly to the northwest in the drain and/or backfill material, and then eventually discharge into El Cerrito Creek.

Much of the gasoline was removed during interim remediation in 1990, when contaminated soil was excavated and disposed of, but some residual gasoline remained adsorbed in the soil beyond the lateral margins of the excavation. From the available data, it is not possible to calculate the mass of this in-place gasoline, but it is no doubt a fairly small fraction of the original amount.

2.5 SCHEMATIC MODEL

The foregoing discussions are summarized into a schematic block diagram of the site in Figure 8. The model predicts that under regional westward groundwater flow, petroleum and other hydrocarbons dissolved in shallow groundwater will migrate to the west, and that over time gasoline compounds will be detected in wells that are located west (downgradient) of the leak points. This situation will be modified by periodic shifts in the groundwater flow direction, which will vary depending on whether flow is toward or away from El Cerrito Creek. The small arrows in Figure 8 illustrate the variations in local groundwater flow that are documented in section 3.0 below.

In this scenario, any gasoline leaked from the dispensers will first impact monitoring well MW-1, which is located immediately west, and will subsequently migrate to STMW-1 and then along favorable flow paths to the southwest, west, or northwest. Fuel leaked from the UST's will follow a similar path, but may begin migrating more to the north because of the close proximity of El Cerrito Creek. In that case, STMW-2 would be impacted relatively early by a UST-derived plume of contaminated groundwater. The last wells to be impacted would be MW-2, MW-3, and

STMW-5, which are not only far from this source but also close to El Cerrito Creek, which might discharge groundwater during high flow periods and inhibit migration of hydrocarbons to the north from the UST's or dispensers. On the contrary, if non-fuel hydrocarbons have been discharged from Norge Cleaners or other facilities, wells in the northwestern portion of the property could be impacted early by these sources and perhaps later by Plaza Car Wash sources. Such merging (co-mingling) of Plaza Car Wash and Norge Cleaners plumes is illustrated in the front panel of Figure 8, where the storm drain might act as one zone where plumes could coalesce.

3.0 HISTORICAL ANALYSIS OF GROUNDWATER FLOW DIRECTIONS:

Groundwater monitoring data dating back to 1990 were used to construct nine groundwater elevation maps for this report. Only one map was prepared for some years, two maps were prepared for others, and none were prepared for 2000-2002, when no monitoring was performed.

The analysis demonstrates that groundwater flow since 2003 has been consistent with the schematic model based on regional groundwater flow patterns, but prior to that the flow has been strongly influenced, in fact largely controlled, by flow into and out of El Cerrito Creek. From 1989 through at least 1999, regional groundwater flow played a rather insignificant role in controlling the migration of hydrocarbon contaminants at the site.

3.1 YEAR 1: 1991

The first year for which a groundwater elevation (potentiometric) map can be constructed is 1991. Figure 9 is a newly constructed map for March of that year. The static water level was nearly 1 foot higher in well OTMW-5 at the south end of the site than in MW-2 at the north end, and the level was intermediate in wells between these two. It is thus clear that the general slope of the water table was northward toward El Cerrito Creek, but in detail the contours arc around MW-2 and reveal a linear trough in the water table that trends northwestward, nearly parallel to the creek. The trough aligns with the underground storage tank facility. The trough probably reflects a linear low-permeability zone, where groundwater flow is somewhat reduced. In situations of homogeneous permeability, groundwater can equilibrate over a relatively large area and the piezometric surface assumes a relatively planar slope toward topographic depressions. Where the permeability is heterogeneous, groundwater flow rates are variable and the water table does not readily equilibrate with the piezometric surface, and mounds and troughs are evident in groundwater elevation maps.

3.2 YEAR 2: 1992

Figure 10 illustrates the groundwater flow pattern 21 months later in December 1992. Conditions had completely reversed, and the water table was 1 to 2 feet higher in the two wells in the northern part of the site than in OTMW-5. As a result of this, there was a 180° reversal in groundwater flow direction, and water was now flowing southeastward out of El Cerrito Creek toward Norge Cleaners. The flow diverged beneath the Cleaners and some of the water began flowing eastward.

Such changes in flow direction often occur due to off-site factors such as an increase in groundwater pumping from a nearby well, or to raised water levels in a nearby stream. These local conditions lower the water table in one portion of the site or raise it in another. In this case, the depth declined by more than 2 feet in OTMW-5, but by less than 5 inches in MW-3. This could indicate that there was a general fall in the water table in the area in late 1992, but that water flows in El Cerrito Creek remained high and outflow was taking place, replenishing the groundwater near the stream. Judging from the contour spacing in Figure 10, the hydraulic gradient was steeper in the northwestern part of the site. Southeastward from MW-3, the gradient was 0.0124 ft/ft, but between Norge Cleaners and OTMW-5 the gradient was only 0.010 ft/ft. Both of these are relatively steep gradients.

3.3 YEAR 3: 1993

Figure 11 shows the groundwater elevation seven months later in July 1993, when the static water level had fallen by 1.5 feet in MW-3 and 1.1 feet in STMW-2 but only 0.4 feet (4.8 inches) in MW-2 and 0.15 feet (1.8 inches) in OTMW-5. As a result of these changes, the east-trending prong in the elevation contours had disappeared, flow was strongly from the northwest across the entire site, and the hydraulic gradient declined to a more uniform slope of 0.008 ft/ft. At this lower gradient, the rate of groundwater outflow from El Cerrito Creek would have been slower than in the previous year.

Figure 12 illustrates the situation a few months later in October 1993. The strong southeast-trending "nose" beneath Norge Cleaners was still present, but the water table had begun to flatten in the eastern portion of the site and the contours there trend sub-parallel to El Cerrito Creek rather than at a high angle to it. This change is due to a greater rise in the static water level in STMW-2 than in STMW-1. In the previous quarter (Figure 11), the level was lower in STMW-2 than in STMW-1, but the situation reversed in October.

These changes reveal that the water table was in a transition mode in October. Previously, groundwater flow was strongly to the southeast and the gradient was 0.008 ft/ft (Figure 11). By October, the flow direction in the eastern portion of the site had rotated to the south and the gradient had declined to 0.004 ft/ft. As shown below, these changes are transitional to the situation in August 1994.

3.4 YEAR 4: 1994

Compared to prior years, the map for August 1994 shows a major change in groundwater flow (Figure 13). The change is so significant that it is clearly evident even though well OTMW-5 had been destroyed by this time and STMW-3, 4, and 5 had not yet been drilled. The water level in MW-2 dropped by nearly 2 feet, remained unchanged in STMW-2, and rose by 1.5 feet in STMW-1. This eliminated the southeast-trending nose in the water table and forced a complete reversal in the groundwater flow direction. The contours trend east-west and slope to the north, implying that groundwater flow was northward, nearly orthogonal to El Cerrito Creek. Whereas the gradient was previously southward or southeastward at 0.004 to 0.008 ft/ft, the gradient became northward and much steeper (0.033 ft/ft).

3.5 YEAR 5: 1995

Figure 14 illustrates groundwater elevations a year later, in August 1995. Further changes in groundwater flow direction are evident. Free product (gasoline) was present in STMW-1, which complicates the interpretation because the thickness of the product layer was not recorded. Therefore it is not possible to correct for the thickness of the product layer. In addition, data were still not available from wells STMW-3 through 5. Nonetheless, it is clear that the static water elevation was higher in STMW-1 and STMW-2 than in MW-2 and MW-3. However, the difference in elevation between STMW-2 and MW-2 had decreased from 1.61 feet to 0.13 feet. As a result, the contours trend generally eastward from STMW-1 toward STMW-2, wrap around STMW-2, and then trend parallel to El Cerrito Creek (Figure 14). This reestablished the trough in the water table that had been present in 1991. As in that year, groundwater flowed to the northwest, parallel to El Cerrito Creek.

Comparison of the numbers in Figure 14 to those in maps from previous years gives the initial impression that the depth to groundwater dropped by several feet over the entire area. This is a false impression. The apparent drop in the water table is actually due to a change in surveyed well casing elevations in 1995, which reduced the elevation of all wells. For example, in the previous survey, the elevation of STMW-1 was measured at 100.62 feet. After being resurveyed in 1995, the elevation of STMW-1 was changed to 96.81 feet.

3.6 YEAR 7: 1997

By 1997, three new wells were available for monitoring and sampling, providing more conclusive evidence of a northwest-trending trough in the water table between MW-2 and MW-3 (Figure 15). Wells STMW-1 and STMW-5 were located along the axis of this trough, and groundwater flowed both southwestward out of El Cerrito Creek and northeastward from the Norge Cleaners area toward this trough. Along the axis of the trough, the water table was very flat, and the gradient was only 0.0012 ft/ft between STMW-1 and STMW-5. Perpendicular to the trough, the gradient was steeper (0.0133 ft/ft between MW-3 and STMW-5).

3.7 YEAR 9: 1999

The groundwater elevation map for April 1999 is nearly identical to that for August 1997 (Figure 16). Again, the small difference in elevation between MW-2 and MW-3 contrasts sharply with the difference between these two wells and STMW-5, which requires the presence of a trough. The nearly identical elevation in STMW-1 is a further indication that a linear depression in the water table existed. Four out of eight groundwater elevation maps between 1991 and 1999 include this trough.

3.8 YEAR 13: 2003

The site was not monitored in 2000, 2001, or 2002, and no maps have been prepared for those years. Monitoring was reestablished in 2003, the 13th year since monitoring began, and Figure 17 shows the situation in August of that year. Groundwater flow had completely changed by this time, and was now southwestward toward San Francisco Bay. This is the first map that shows a flow pattern in close accord with the regional flow direction.

The linear trough that previously characterized the potentiometric surface had disappeared by 2003, and the surface was more uniformly planar than at any previous time during this investigation. The hydraulic gradient between STMW-4 and MW-2 was somewhat more gradual than between MW-2 and MW-3. Near the creek, it was approximately 0.0066 ft/ft, but nearer to MW-3 the gradient exceeded 0.013 ft/ft. This is the same gradient, but in exactly the opposite direction, as existed in August 1997 (Figure 15). Lacking information from the previous three years, neither the timing nor the cause of these changes is clear.

3.9 YEAR 14: 2004

The groundwater flow pattern established in 2003 carried into 2004, and the map for August 2004 is very similar to that for August 2003 (Figure 18). The gradient remained low, at 0.005 ft/ft, as the difference in water levels was less than 1 foot in all wells.

4.0 MOVEMENT OF THE GROUNDWATER PLUME:

The movement of contaminated groundwater, as recorded by changes in TPHg concentrations over time, is depicted in a series of maps for the same quarters as those discussed in section 3.0. The maps were constructed *after* the groundwater elevation maps were completed, and therefore had no influence on the groundwater elevation mapping. Arrows depicting the groundwater flow direction were then transferred to the plume maps to reveal any relationship between flow direction and plume orientation. This allows the extent of groundwater contamination to be compared directly to the direction of groundwater flow at that particular moment in time. These maps thus provide a series of snapshots of the plume over time.

The distribution of contaminated groundwater has changed over time. When the leak from the underground storage tanks was first detected in 1989, groundwater in that area was far less contaminated than groundwater to the northwest, near the dry cleaners. After 1994, groundwater contamination was centered near the tank cavity, and concentrations were much lower in the northern part of the site. Contour maps based on the analytical data reveal this variability quite clearly, and lead to the recognition of a Northern Plume that formed prior to 1989 and a Southern Plume that did not become well developed until after 1994.

4.1 FIRST MONITORING YEAR (1989): NORTHERN PLUME

SCI, Inc. collected the first groundwater samples in August of 1989, and Figure 19 is an isoconcentration map of TPH based on those samples. Contouring the values yields a half-ellipse whose center was between MW-2 and MW-3 in the northern part of the site. Unfortunately, SCI did not provide measured water depths or casing elevations from which a groundwater elevation map could be generated for comparison to the plume map, so the groundwater flow direction at that time is unknown.

The most contaminated well was MW-2, with a TPH concentration of 80,000 ppb. This is the only time during this investigation that this was the most contaminated well. Concentrations in the area of MW-1 and MW-4 were roughly 19% of those around MW-2. No wells were located south of MW-1, but the southeastward trend of decreasing concentrations in Figure 19 suggests that the UST's were not the principal source of groundwater contamination. Presumably, concentrations also decreased to zero where the plume intersected El Cerrito Creek just north of the site.

It is standard hydrogeological practice to conclude that concentrations of soluble hydrocarbons dissolved in groundwater decrease laterally away from their source due to dispersion and dissolution. High concentrations, or "hotspots", denote the probable locations of contaminant sources, and isoconcentration contours are usually rather tightly spaced around these sources. As contaminants disperse away from the source, contours generally become more widely spaced, particularly in the downgradient direction if one direction is predominant. With only three widely spaced data points, contour broadening cannot be demonstrated in Figure 19, but the high concentrations between MW-2 and MW-3 suggest that a hydrocarbon source was located in the northern part of the site area. This yields support for the maps of vapor and soil samples (Figures 5 and 6), which also show a "hotspot" in the northern part of the site and suggests the presence of a contaminant source between MW-2 and MW-3.

Due to its location, the hydrocarbon plume shown in Figure 19 is referred to here as the Northern Plume. Clearly, this plume was well developed by 1989, probably with core concentrations approaching 100,000 ppb somewhere between MW-2 and MW-3. Concentrations of this magnitude would require 2 or more years to develop, implying that the Northern Plume originated sometime in the middle 1980's or earlier, 2 or more years before any leaks were detected at the UST facility. Furthermore, if this plume *had* originated at the UST facility, it would likely have taken several years for the core of the plume to migrate to the northwestern portion of the site in the relatively low-permeability sediment that is present. In that case, the Northern Plume would need to have originated prior to 1980, at least 10 years before any leaks were detected at the dispenser/UST facility. It seems highly unlikely that a dispenser leak could go undetected for 10 years.

4.2 STABILIZATION OF THE NORTHERN PLUME 1991

The underground storage tanks were removed in 1990 and contaminated groundwater was encountered in the excavation. Monitoring wells MW-1 and MW-2 were sampled in January and March of that year. The laboratory detected no TPH in MW-1, but TPHg was reported in MW-2 at a concentration of 5,500 ppb in January and 4,100 ppb in March.

The wells were sampled again in March 1991. Concentrations had declined by at least 40% in all wells since August 1989 (Figure 20). By this time, STMW-1, STMW-2, and OTMW-5 had been installed, and the latter well provided a data point at the southern end of the site. Hydrocarbons were detected in this well at 120 ppb and concentrations increased steadily northward to MW-3. The plume was still centered in the northwestern portion of the site, and the shape and extent of the plume appear to have remained relatively unchanged since 1989, although the concentrations were lower.

The low concentrations at STMW-1 and STMW-2 demonstrate more clearly that the underground storage tanks were not a significant source of groundwater contamination at that time. They also prove that the plume did not expand to the southeast (if it had, the concentration in STMW-1 would have been greater, not less, than the concentration in MW-1 was in 1989). The lack of southeastward expansion is most likely due to northwestward groundwater flow (see arrow in Figure 20), which would have inhibited southeasterly diffusion of dissolved hydrocarbons. This also suggests that prior to 1991, groundwater flow may have been to the southeast, causing the Northern Plume to expand in that direction.

4.3 SOUTHEASTWARD WARD EXPANSION RESUMES: 1992

Whether or not the Northern Plume migrated to the southeast prior to 1991, there is no question that it had expanded in that direction by December 1992. Concentrations in all wells were significantly higher than in March 1991, reaching 35,000 ppb in STMW-1 and 44,000 ppb in STMW-2 and likely exceeding 100,000 ppb beneath Norge Cleaners (Figure 21). The eastern limit of the plume had reached San Pablo Avenue, and the contours indicate that groundwater beneath the entire site was contaminated. Moreover, the plume had begun to differentiate and split into an eastern prong and a southeastern prong. The contour pattern closely matches the groundwater elevation contour pattern (Figure 10), leaving little doubt that the southeastward expansion of the plume was in direct response to groundwater flow in that direction and that the two-pronged groundwater flow pattern was responsible for the partial splitting of the plume. Furthermore, it is possible that the sharp jump in concentrations, particularly in MW-3, is due to the high water table, causing more desorption of hydrocarbons from the soil in that area into the groundwater. Comparing Figures 21 and 10 with Figure 5 reveals that the high water table near MW-3 was coincident with both the soil-vapor "hotspot" and the highest groundwater concentrations. Taken together, these maps give strong support to the hypothesis of a hydrocarbon source near or beneath the dry cleaner building, leading to formation of the Northern Plume.

4.4 CONTINUED EXPANSION: 1993

Groundwater flow continued to be to the southeast in the first half of 1993, and the Northern Plume continued to expand in that direction. The TPH concentration in OTMW-5 reached its historical maximum of 3,500 ppb (Figure 22). Concurrently, concentrations decreased somewhat in other wells, which is likely due to diffusion away from the source. Interestingly, the groundwater elevation contours (Figure 11) show only one strong southeast-trending nose, and the eastern nose had disappeared. The eastern prong of the contaminant plume had also disappeared, due to the drop in concentration in STMW-2 (Figure 22). Hence, the shape of the contaminant plume again matches the groundwater flow pattern extremely well.

It is noteworthy that no groundwater "hotspot" or plume core can be detected in the data in the vicinity of the underground storage tanks, even though the dispenser leak had been detected there more than four years earlier. The Northern Plume is still the only body of contaminated groundwater that is evident in the data.

By late 1993, the eastern prong of the groundwater plume had reappeared, and the TPH concentration in STMW-2 reached an all-time high of 62,000 ppb (Figure 23). The concentration in MW-3 also exceeded that in all previous monitoring events. At 180,000 ppb, it was 3 times greater than the concentration in STMW-2 and more than 3 times greater than in STMW-1. This would be very difficult to explain using a Site Conceptual Model involving only one source at the underground tank facility, and is much more compatible with a model involving a second source at Norge Cleaners.

4.5 PEAK CONCENTRATION IN THE NORTHERN PLUME: 1994

Except in STMW-2, the TPH concentrations in August 1994 were quite similar to those in October 1993, so the plume's shape appears to have changed only slightly between those monitoring events (Figure 24). The concentration rose by 20,000 ppb to an all-time high of 200,000 ppb in MW-3, and this was the last time the concentration exceeded 100,000 ppb in that well. The concentration rose by 100 ppb in MW-2, but declined by 8,000 ppb in STMW-1. The decline was more drastic in STMW-2 (58,000 ppb), but this may have been due to some slight change in monitoring procedure (perhaps a change in the purged volume, for instance). Well OTMW-5 had been destroyed before the August monitoring event, but a concentration of 570 ppb was detected in that well in April, so it is likely that the southern limit of contamination was still beyond the southern site boundary.

As discussed in section 3.4, groundwater ceased flowing to the southeast sometime after October 1993 and had begun to flow to the north by August of 1994. This major change in flow direction may be responsible for at least some of the decline in concentrations in STMW-1 and -2, causing the contour lines to recede to the northwest from their position in October 1993 (compare Figures 23 and 24). This would also help to explain the slight increase in the concentration in MW-2.

4.6 DEVELOPMENT OF THE SOUTHERN PLUME: 1995

Figure 25 shows that between August 1994 and August 1995 there was a major change in the distribution of contaminated groundwater beneath the site. For the first time, TPH concentrations in STMW-1 and STMW-2 exceeded those in MW-3. No longer was the plume centered in the vicinity of Norge Cleaners; instead, it was located much closer to the former UST facilities at Plaza Car Wash.

Although it could be argued that the Northern Plume had simply migrated en masse toward the southeast, the groundwater flow data suggest otherwise. As shown in Figure 14, the reversal in groundwater flow direction that had begun in 1994 continued to evolve in 1995, and flow gradually rotated from north to northwest, becoming parallel to El Cerrito Creek by August. This represents the second return to northwestward flow (the first being the change that apparently took place prior to the March 1991 monitoring event). As shown in Figure 25, the plume contours are exactly parallel to the groundwater flow direction, and it is therefore highly probable that dissolved contaminants were diffusing to the northwest (downgradient) at that time, rather than to the southeast. Under conditions of northwestward groundwater flow, the Northern Plume could not migrate to the southeast. Therefore, we interpret the plume depicted in Figure 25 as a body of contaminated groundwater that originated at the Plaza Car Wash UST facility. We refer to this plume as the Southern Plume to distinguish it from the plume that originated at Norge Cleaners. The absence of a detectable Northern Plume in Figure 25 suggests that the two plumes had begun to co-mingle and that the high concentrations in the Southern Plume may have overwhelmed and masked the concentrations in the Northern Plume. However, the overall shape of the Northern Plume is still recognizable when Figure 25 is compared to the previous maps of this plume.

The sudden influx of dissolved hydrocarbons at STMW-1 and STMW-2 is striking. Concentrations in these two wells began rising in the fourth quarter of 1994, and the August 1995 concentrations represent the peak in both wells. A thin layer of free product began to appear in STMW-1 in mid-1993, and by 1995 the layer had become thicker and brown in color. This trend suggests that the Southern Plume may have originated sometime earlier but did not become well developed until 1995.

4.7 RESULTS FOR 1996-1999: FAULTY DATA

As explained in section 2.4.3, the laboratory data after 1995 were ruled invalid by Alameda County EHD because the analytical laboratory had lost its certification. Hence, the data from 1996-1999 do not provide an accurate record of the plume's evolution during those years. This becomes apparent when one compares Figure 24 (August 1995) to Figures 25 and 26 (August 1997 and April 1999). In August 1997, the reported concentration in STMW-1 was less than half of its value in August 1995, and the core of the plume appeared to attenuate from greater than 400,000 ppb to less than 150,000 ppb in a single year. Such a phenomenal reduction could not even be achieved under conditions of active remediation, let alone passive remediation. The decline in the magnitude of the plume from August 1997 to April 1999 is even less credible (Figure 27). Hence, Figures 26 and 27 are included only for the purpose of demonstrating that the data are not valid.

4.8 STABILIZATION OF SOUTHERN PLUME: 2003-2004

Figures 28 and 29 illustrate the Southern Plume in August of 2003 and 2004. The plume has remained centered near the Plaza Car Wash UST facility since it was first recognized in 1995 (this stability supports the earlier conclusion that the Northern Plume could not have migrated from Norge Cleaners to the UST facility in just one year [1994-95]). Although much of the site remains contaminated, there has clearly been some reduction in the size of the plume, because MW-2 is no longer contaminated and the 50-ppb contour line appears to be close to the eastern and southern site boundaries as well. In earlier years, groundwater contamination clearly extended off site in both directions. No groundwater hotspot is identifiable in the northern portion of the site area, and the Northern Plume has apparently been absorbed into the Southern Plume.

5.0 CONCLUSIONS:

Based on this extensive review of data, we draw the following conclusions:

The site is underlain by relatively low-permeability clay deposits from the surface to a depth of at least 15 feet. The main water-bearing unit is somewhat uncertain, but it appears that the sediment below 15 feet may be slightly coarser grained and more permeable.

The groundwater flow direction has varied over time. When the investigation first began, flow may have been to the southeast, but in 1991 it was to the northwest. The direction reversed by 1993, and southeastward flow was dominant until the end of 1994. The flow reversed again, rotating counterclockwise and eventually becoming northwest in 1995. This lasted until sometime after 1999. By 2003, flow had rotated still further in a counterclockwise direction and was westward toward San Francisco Bay.

The depth to groundwater has changed little over time. This is due to the site's location near the San Francisco Bay discharge basin. However, the water depth in El Cerrito Creek has probably varied by several feet in the past 15 years, which likely would have been sufficient to cause reversals in groundwater flow direction.

There is ample evidence of an unauthorized fuel release at the Plaza Car Wash site. Soil contamination was fairly extensive prior to interim remediation in1990, but excavation at that time removed the majority of the contaminated soil. Groundwater near the former UST facility remains contaminated at high concentrations.

Soil vapor data and limited drilling nearer to Norge Cleaners suggest that there was also an unauthorized release of liquid hydrocarbons (probably dry cleaning solvents) at that facility. However, that release has received much less investigation. No soil samples and very few groundwater samples from that property have been analyzed for chlorinated hydrocarbons (solvents), but both PCE and TCE were detected in 1996 in the well near that facility. Those chemicals, being relatively heavy and insoluble, tend to leach downward within the saturated zone and impact deeper aquifers. The vertical extent of contamination near the dry cleaners building has not been determined, and the possibility of contamination in deeper water-bearing zones has not been examined. Water samples from El Cerrito Creek were apparently not analyzed for solvents when free product was observed in 1989, so it is not known with certainty whether the product was gasoline or some other hydrocarbon.

Groundwater contamination was well developed near Norge Cleaners prior to 1989. This contaminant plume remained relatively stationary between monitoring wells MW-2 and MW-3 for several years, but diffusion of hydrocarbons away from this source caused the plume to gradually enlarge and encompass the entire site. In 1995, an even more concentrated plume appeared near STMW-1, and the plume near MW-3 diminished and became difficult to distinguish. The new plume appears to have originated at the Plaza Car Wash UST facility, and has remained in that area since 1995, although concentrations have not regained the peak that was reached at that time.

MTBE and other fuel oxygenates are not a component of the groundwater plume. At the present time, benzene appears to be the principal contaminant of concern (COC), although insufficient sampling has been conducted to rule out the possibility that chlorinated hydrocarbons might be of equal or greater concern. Benzene is present in groundwater in the central portion of the site at concentrations exceeding 10,000 parts per billion, and at the northern margin of the site (adjacent to El Cerrito Creek) at 1 ppb. Benzene is a known carcinogen.

With a few exceptions, the site has been adequately assessed to meet State regulations regarding site characterization. The regulations require that the site be sufficiently assessed to determine what, if any, corrective action is appropriate. The lateral extent of gasoline contamination from the Plaza Car Wash facility has been sufficiently investigated to demonstrate that groundwater over most of the site remains contaminated with benzene and other petroleum-derived hydrocarbons. Earlier in the investigation, monitor well OTMW-5 provided a sampling point for determining the southwestern extent of groundwater contamination as well, but this well was destroyed several years ago. The predominant groundwater flow direction since 2003 has been to the southwest, but currently no monitoring points are available to monitor the movement of contaminants in this direction. Hence, the first exception is that the present limit of groundwater contamination west of the Plaza Car Wash office is unknown.

A second exception is the extent of residual soil contamination. TPHg concentrations exceeding 100 parts per million were detected in soil samples from borings B-4 and B-6 (west of the remediated area) in 2002. Concentrations exceeding 1,000 ppm were detected in two borings north of the excavation. The isocontour map of soil contamination constructed for this report suggests that less than 50% of the impacted area was remediated by excavation methods in 1990, but the map is poorly controlled by subsurface data east of Norge Cleaners and may overestimate the area of remaining soil contamination. In addition, few samples below 7 feet were submitted for laboratory analysis, and elevated concentrations of gasoline hydrocarbons were detected at the 7-foot depth in several borings. Questions regarding the mass of remaining gasoline in the soil or the risk of further groundwater contamination cannot be answered with confidence using the available soil information.

A third exception is the nature of contaminant transport paths and the rate of groundwater flow. No soil samples have been tested to determine the hydraulic conductivity of the native sediment, aquifers(s) and aquitards have not been clearly distinguished, and no aquifer tests have been performed. Detailed soil descriptions are not available for correlating subsurface strata and from which the thickness and orientation of permeable hydrogeologic units can be determined, and no isopach or other aquifer maps have been constructed. Further, groundwater elevation contouring has identified a persistent northwest-trending trough in the water table, and we have interpreted this trough to be some sort of low-permeability zone. The water table has tended to be slightly higher to the northeast and southwest of the trough, and both the Northern and Southern hydrocarbon plumes have tended to follow this trough. However, although the effect of this trough is partially understood, its nature and origin are not. Without an understanding of the nature of the major transport paths, as well as an accurate measurement of the remaining hydrocarbon mass, we cannot address questions regarding the fate and transport of the remaining contaminants.

A last exception involves the possibility of solvent contamination. The magnitude and vertical extent of chlorinated hydrocarbons in groundwater has not been adequately assessed to determine whether remediation of chlorinated hydrocarbons is warranted. Solvents were stored and used at Norge Cleaners, but not at Plaza Car Wash, and are therefore not the responsibility of Kamur Industries. Investigation and remediation of non-fuel hydrocarbons does not qualify for reimbursement under the State Underground Storage Tank Cleanup Fund Program, but the Program may allow limited sampling to establish whether TCE and/or PCE are COC's at this site before any remediation program for fuel hydrocarbons is undertaken.

6.0 RECOMMENDATIONS:

Based on the conclusions outlined in section 5.0, we have identified a few shortcomings in the assessment database. These shortcomings constitute "data gaps" that hamper the full and complete understanding of the contaminant problem, which is necessary in order to determine what, if any, site remediation is required. Further, the lack of such data could limit the cost-effectiveness of any remediation program that is attempted. Therefore, we make the following recommendations to complete the site characterization:

Identify and characterize the principal aquifer at the site. This will involve drilling a few additional borings, mainly along and transverse to the groundwater trough, including two that are continuously sampled through the first water-bearing unit below the low-permeability clay that is present near the ground surface. Figure 30 shows the locations of three proposed borings in the vicinity of this trough.

The lithologic data collected from these borings will improve the correlation of stratigraphic units through the existing borings and provide a clearer understanding of the geometry of the main hydrogeologic units. A few samples should also be collected to determine the hydraulic conductivity of the surficial clay and the (underlying?) aquifer. Depending on the test results, it may also be appropriate to perform slug tests on selected wells. Based on present information, it appears that soil permeability is probably too low for an effective aquifer pumping test.

Assess the extent of remaining soil contamination. This could be performed in conjunction with characterizing the principal aquifer, because the groundwater trough is located in the area where additional soil concentration data are needed. The boring near the northeast corner of Norge Cleaners (Figure 30) should be drilled to the second water-bearing zone to investigate the possibility that a deeper aquifer might be impacted. This boring would be located in the area where high concentrations are predicted (Figure 6) and where deeper migration would most likely occur. Samples should be analyzed for both fuel hydrocarbons (using EPA methods 8015 and 8020) and solvent hydrocarbons (using EPA method 8010) to determine the relative impact of each.

Perform one additional groundwater monitoring event for chlorinated hydrocarbons to determine whether any proposed groundwater remediation program would be impeded by the presence of these compounds. All wells should be tested using EPA method 8010.

Install an additional monitoring well west of the car wash building to monitor the movement of dissolved hydrocarbons in that direction (Figure 30). This location is presently downgradient of the dissolved-phase plume.

Complete a mass balance analysis and develop a fate and transport model for residual contamination. This information should then be used to prepare a Corrective Action Plan.

File No. 8-90-421-SI

A P P E N D I X "A"

FIGURES

ENVIRO SOIL TECH CONSULTANTS

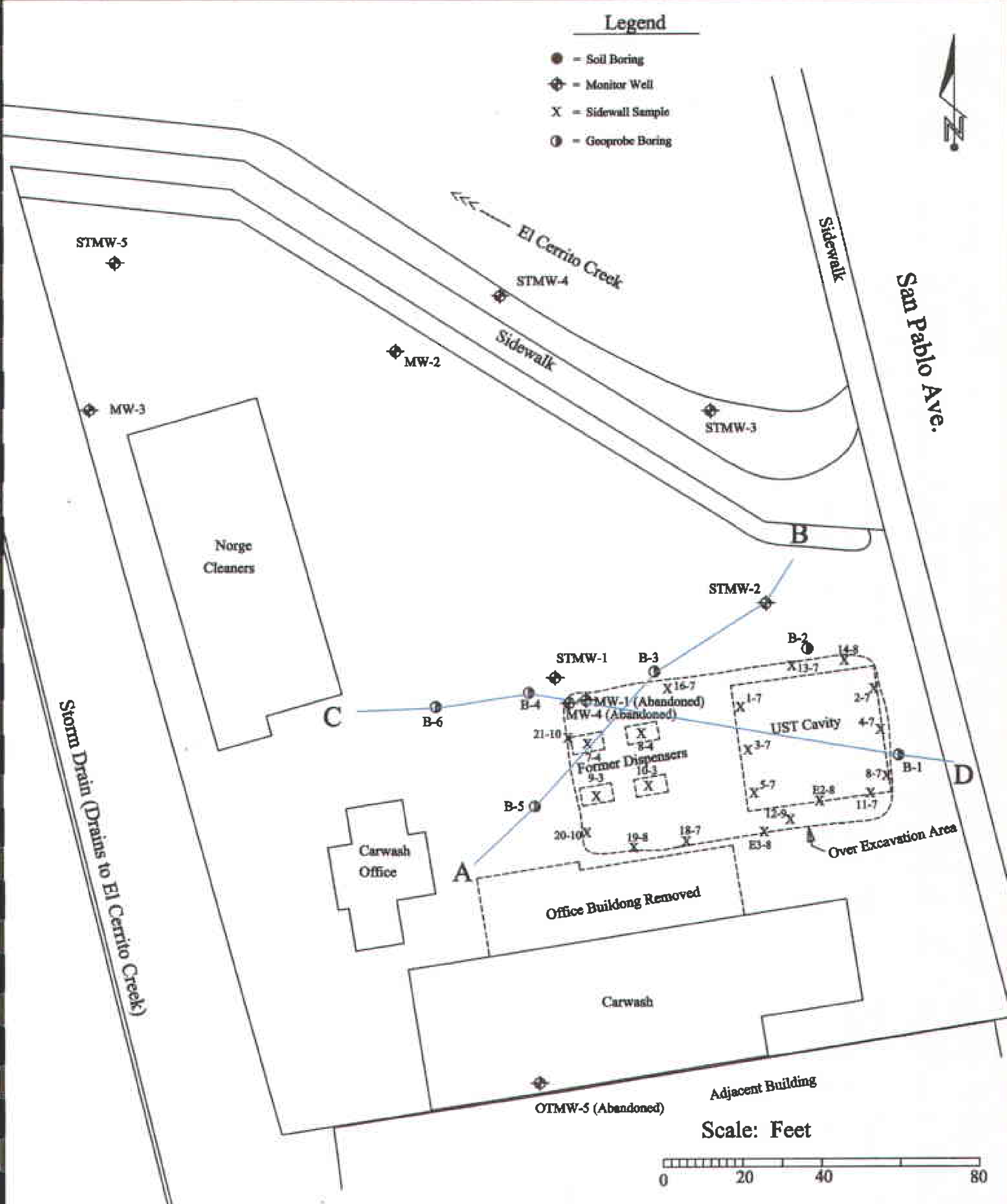
File No. 8-90-421-SI

ENVIRO SOIL TECH CONSULTANTS

Figure 1

M1

Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 N. San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/10/2004	Figure 2 Site Map



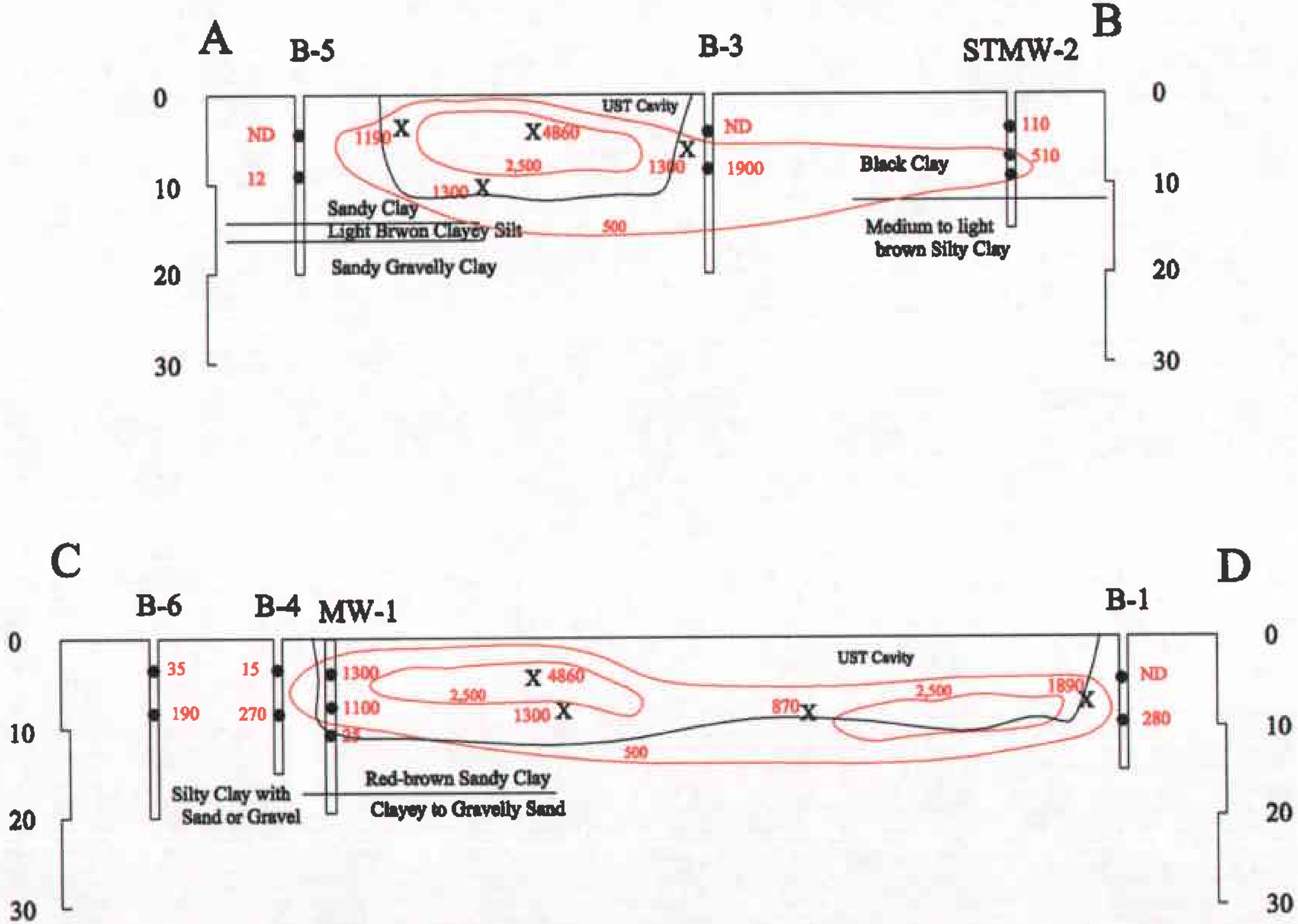


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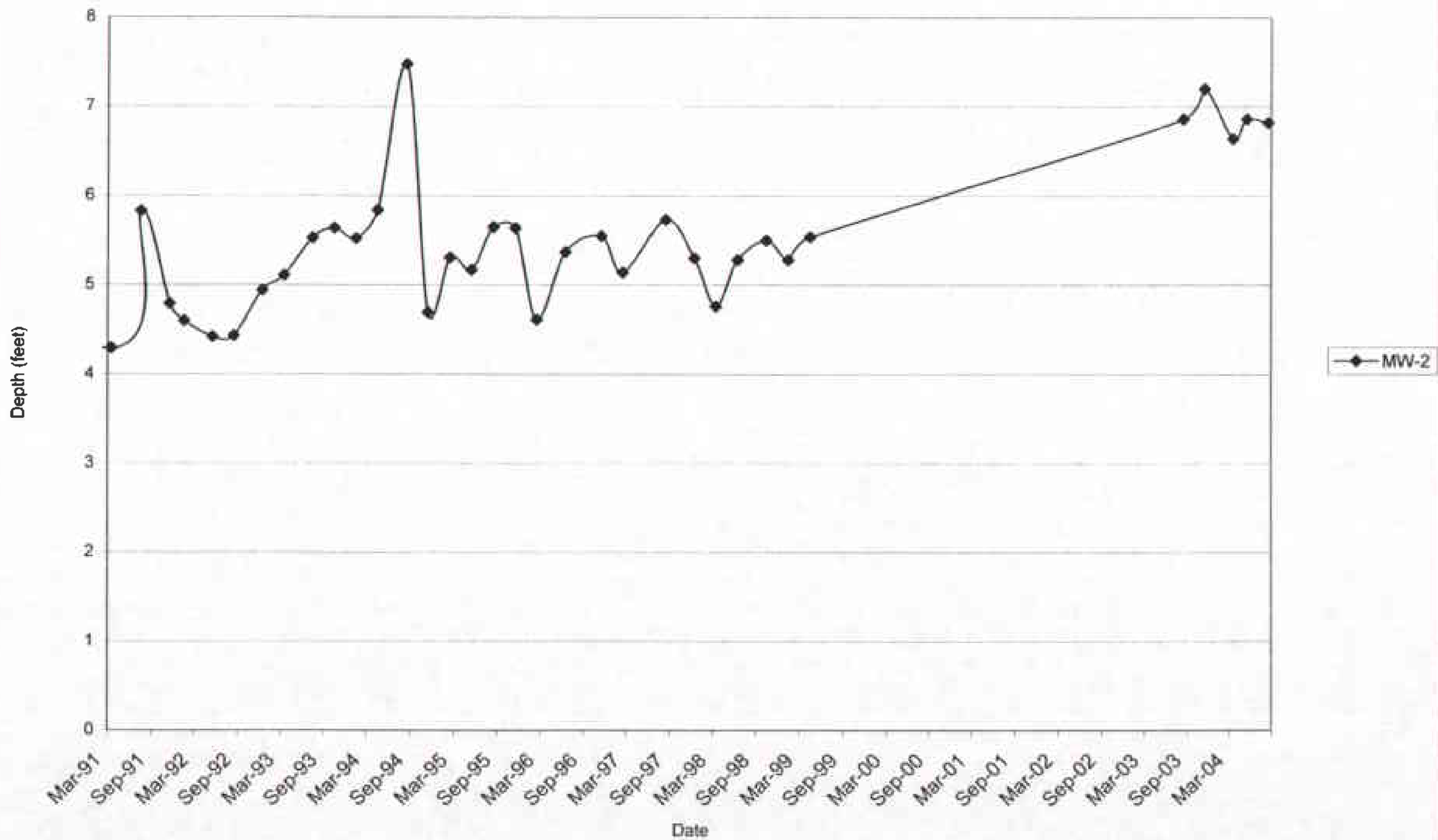
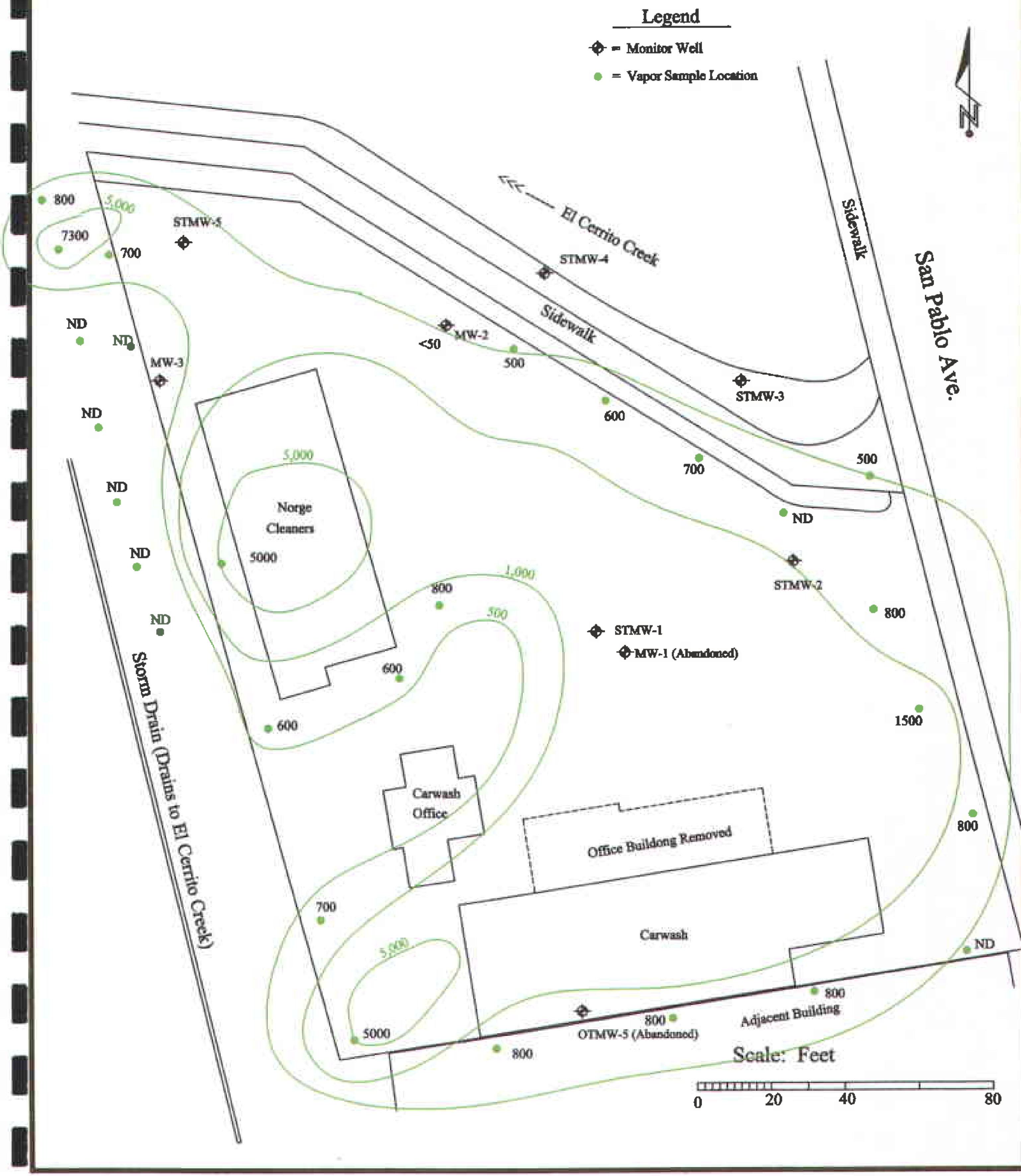
Figure 3

Cross Sections
A - B & C -D

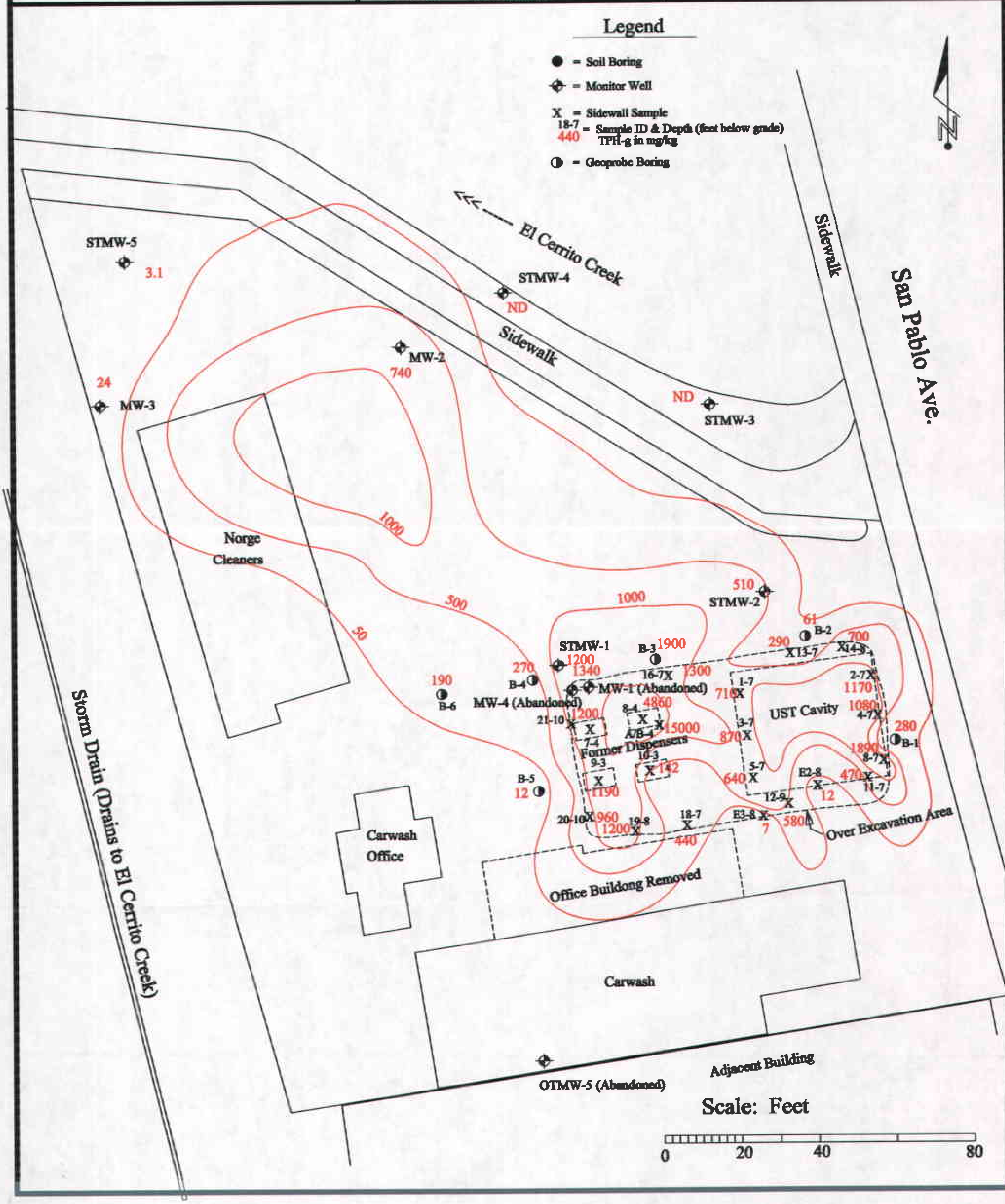
Figure 4. Depth to Groundwater in MW-2 vs Time



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/30/2004	**Figure 5** **Isocontours of Soil Vapor Samples**



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/10/2004	Figure 6 Isocontours of TPH in Soil at 5-10 feet, 1990



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File No. 8-90-421-SI

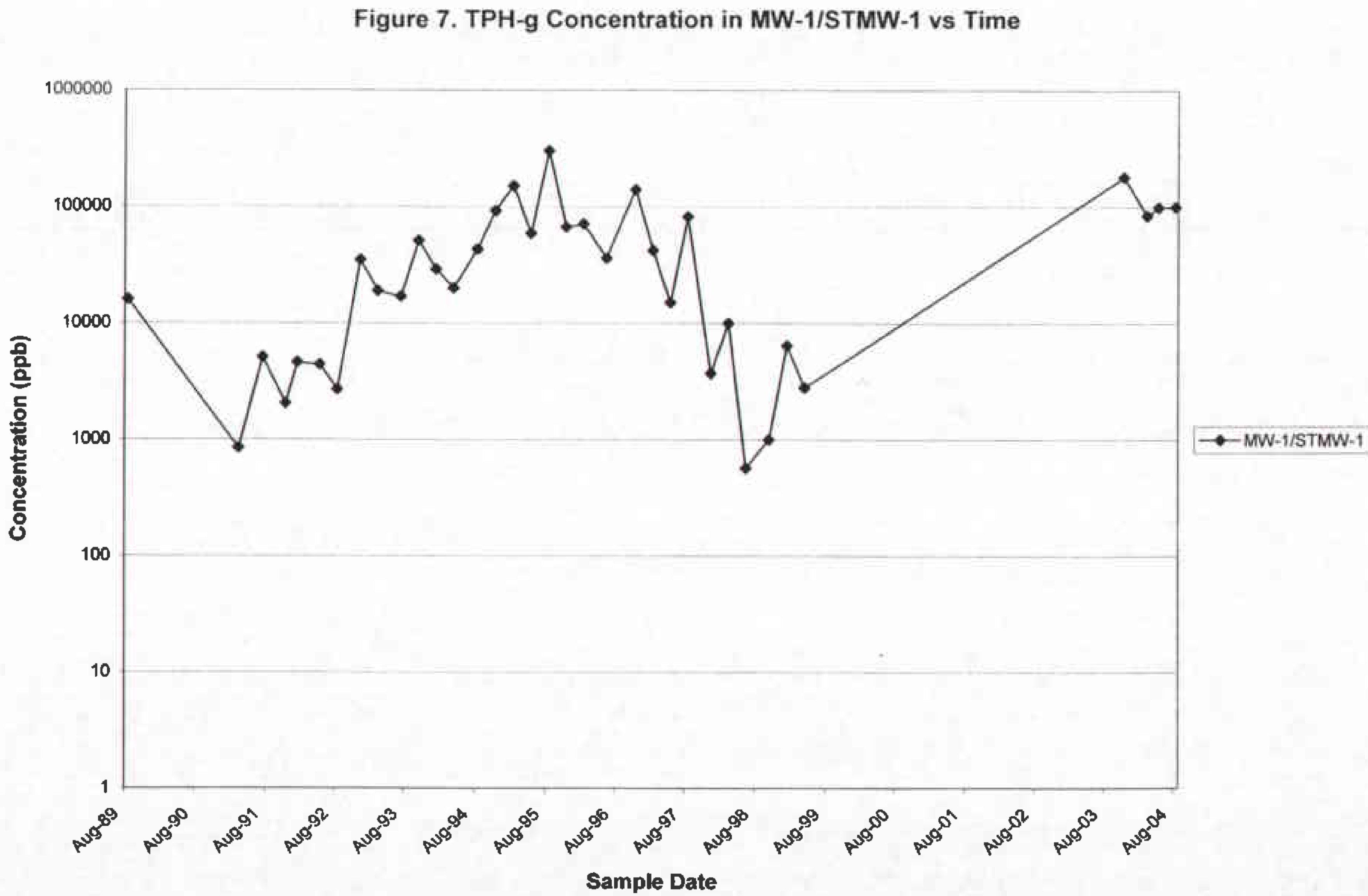

Figure 8

File No. 8-90-421-SI

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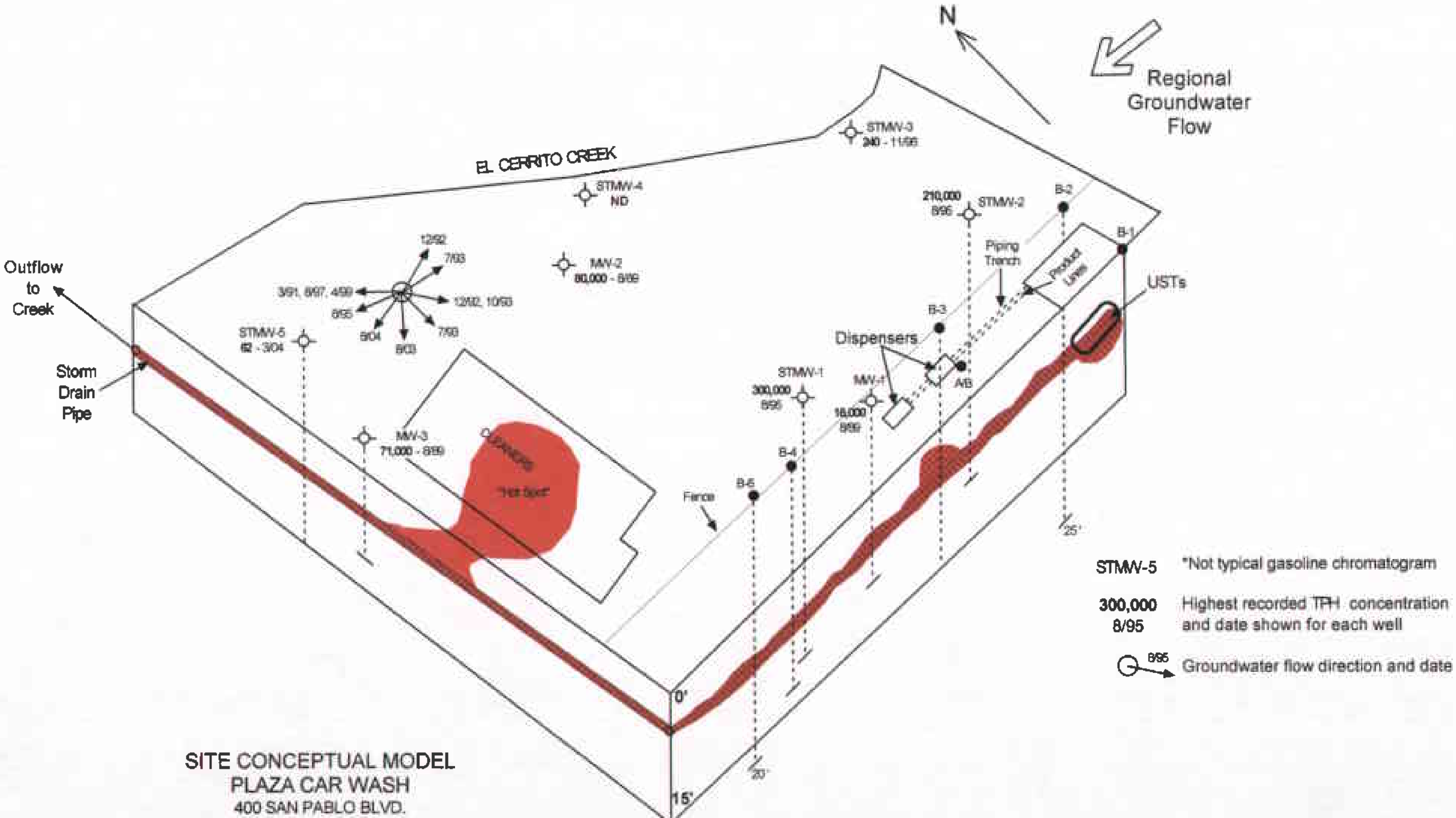

SITE CONCEPTUAL MODEL
PLAZA CAR WASH
400 SAN PABLO BLVD.
ALBANY, CA

Project No. 8-90-421-SI

Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/10/2004	Figure 9 Groundwater Elevation Map March 1991

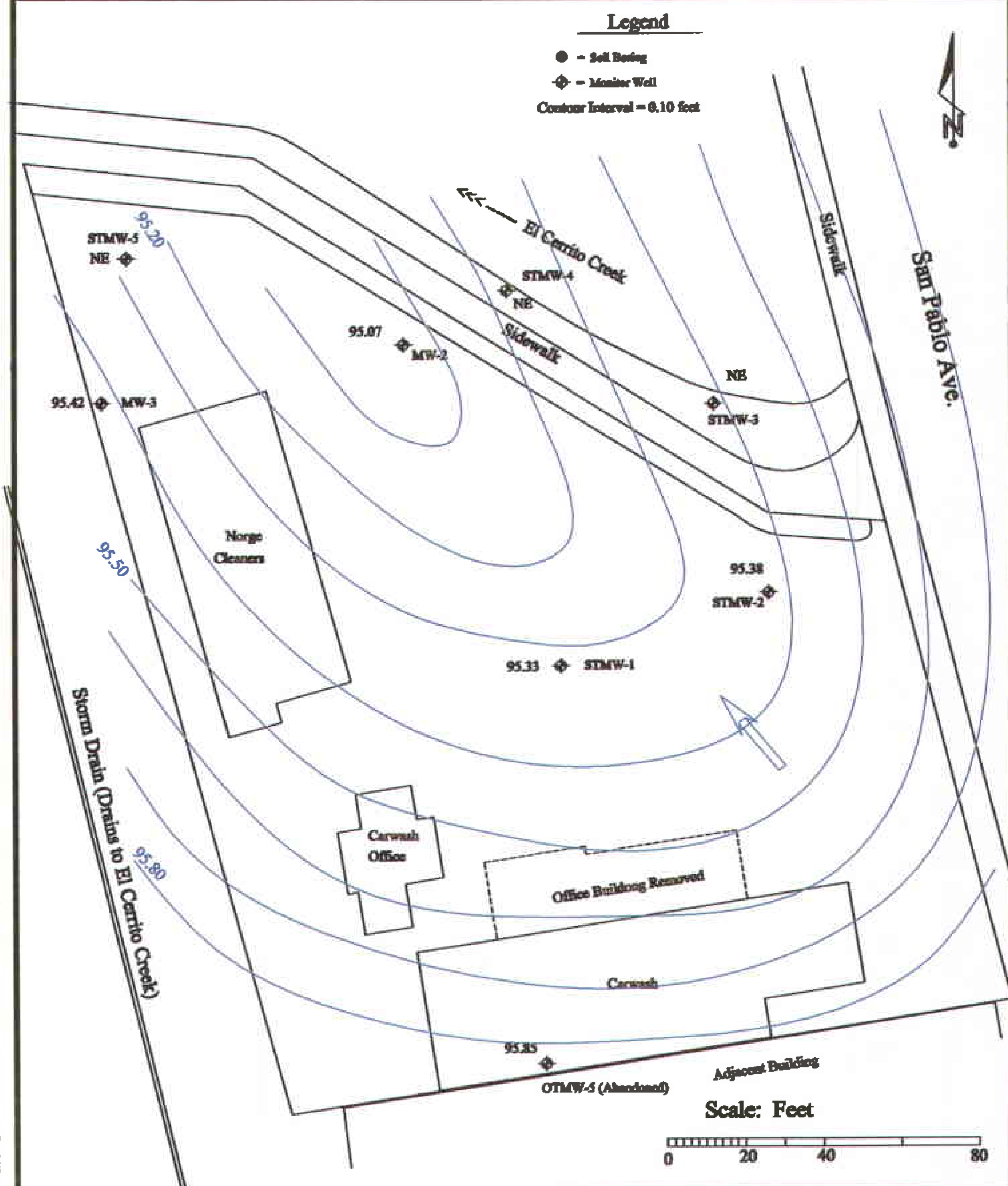

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Figure 10

Groundwater Elevation Map December 1992

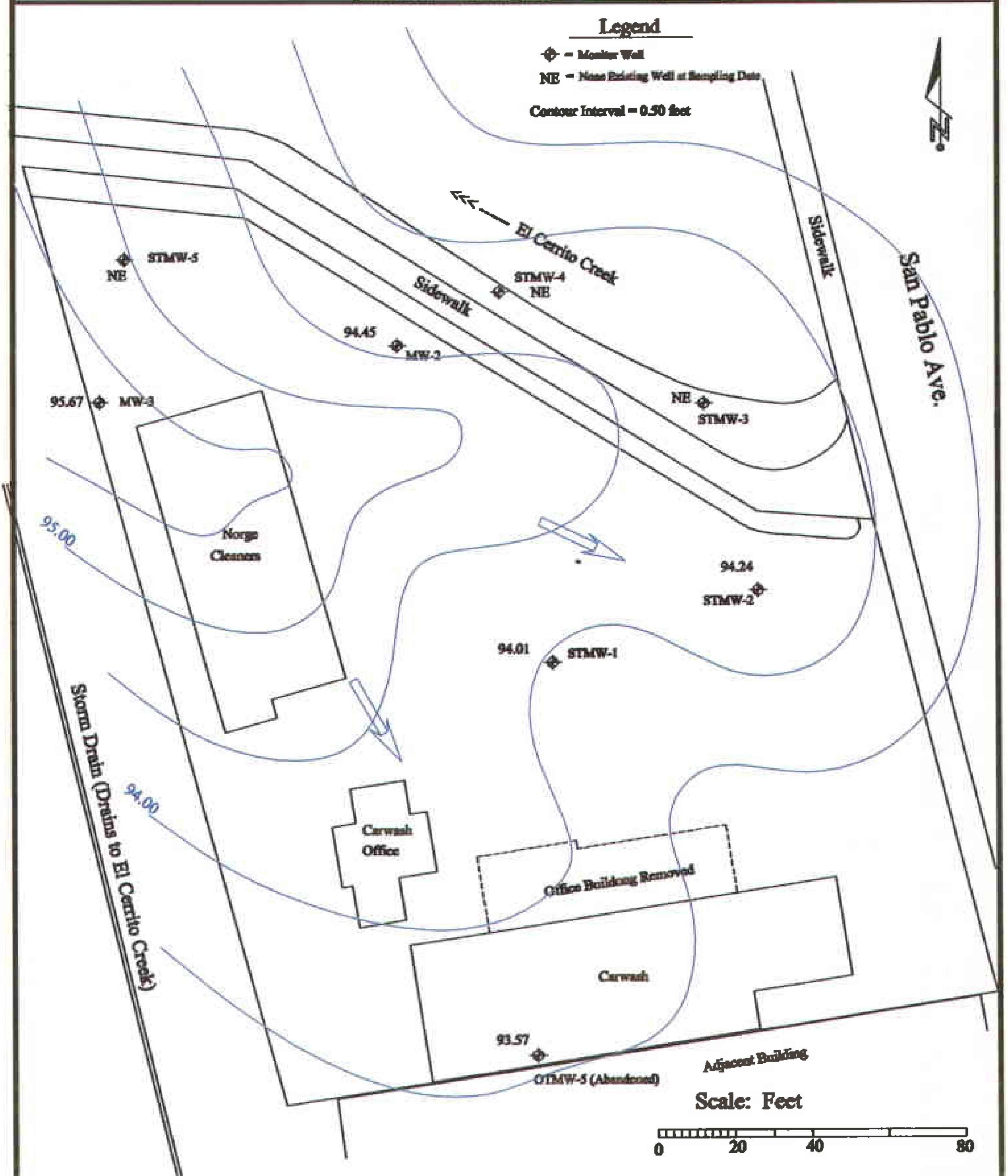

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Figure 11

Groundwater Elevation Map July 1993

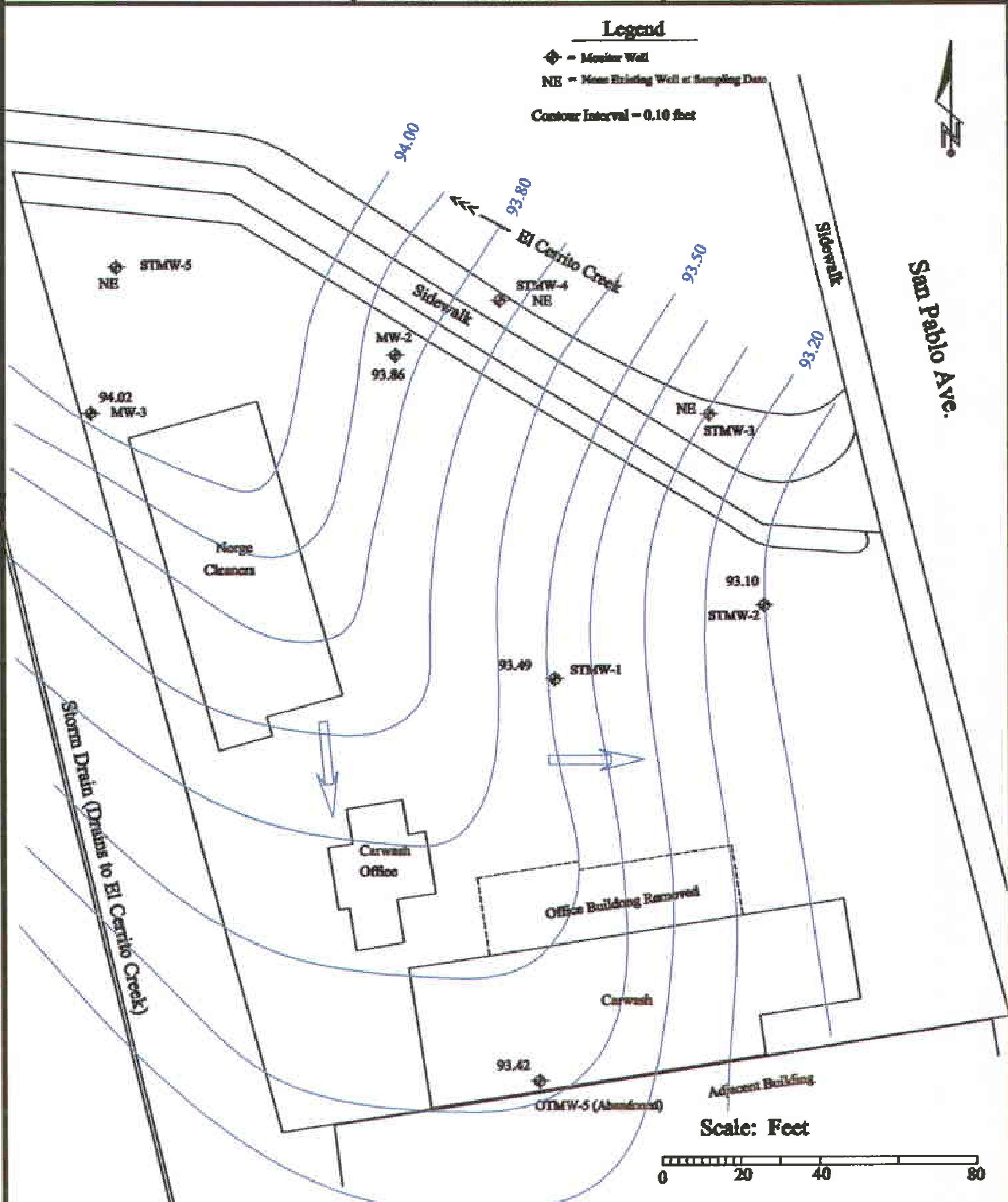

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Figure 12
Groundwater Elevation Map October 1993

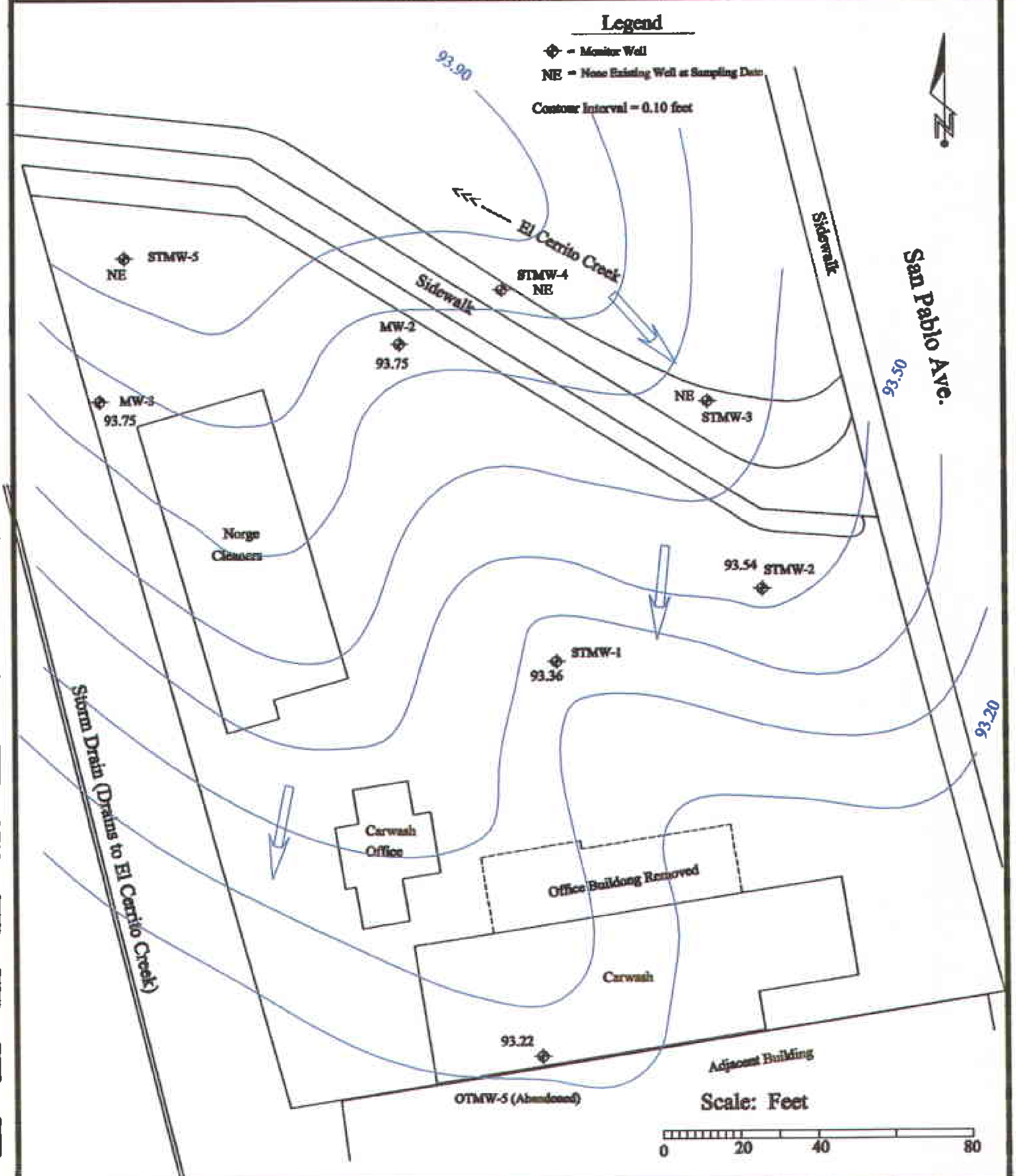

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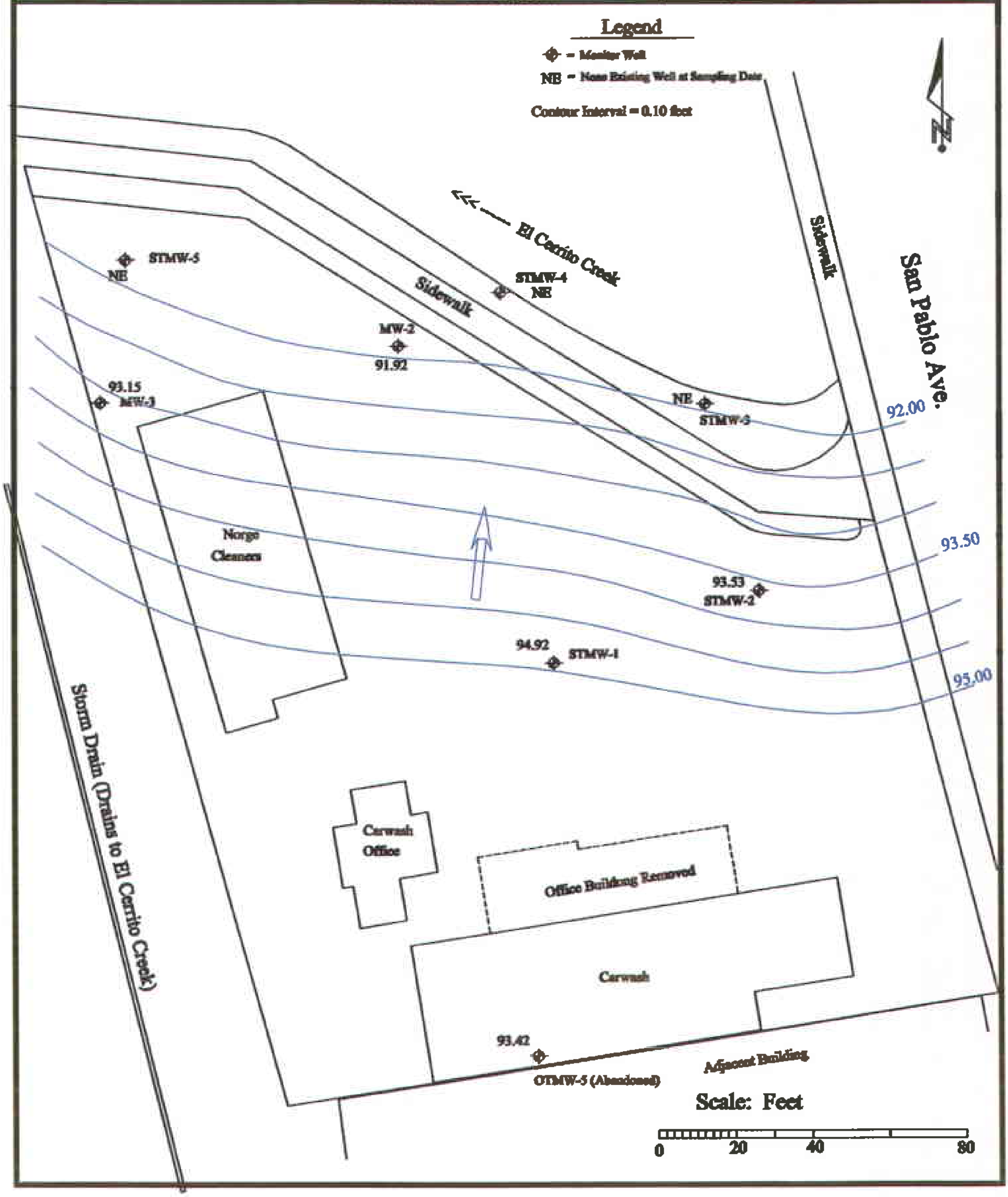
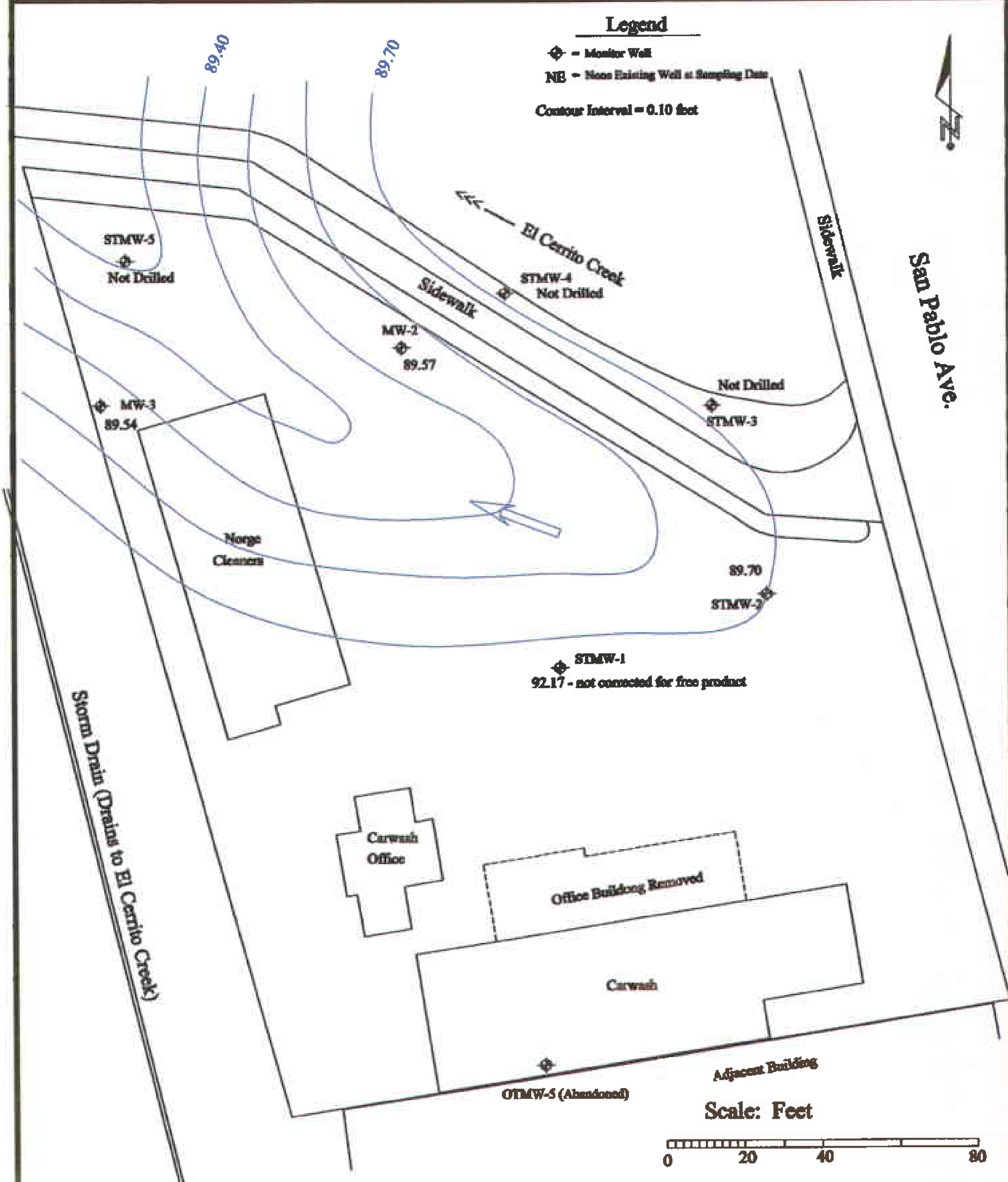
Figure 13

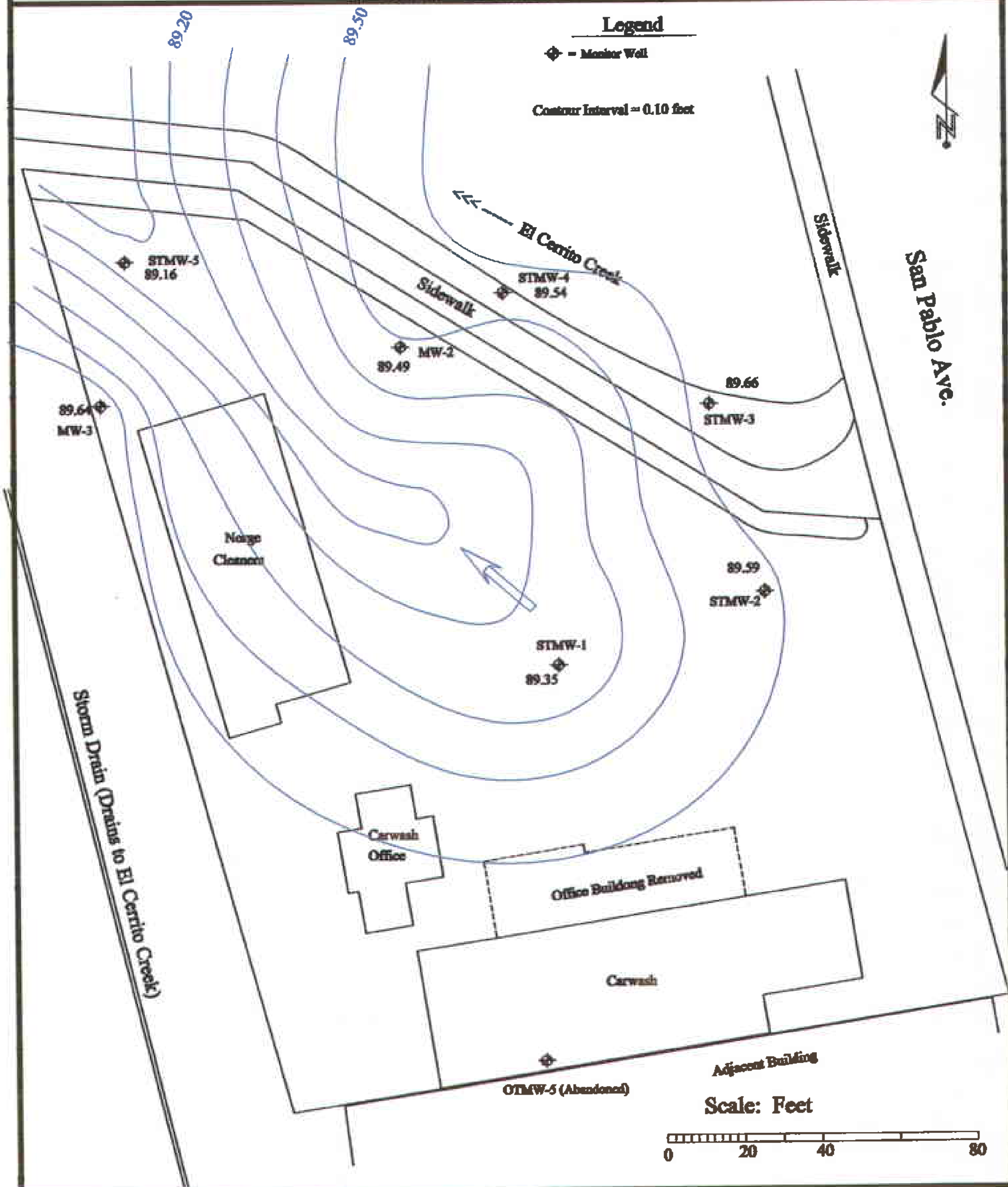
Groundwater Elevation Map August 1994



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 14 Groundwater Elevation Map August 1995



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 15 Groundwater Elevation Map August 1997



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 16 Groundwater Elevation Map April 1999

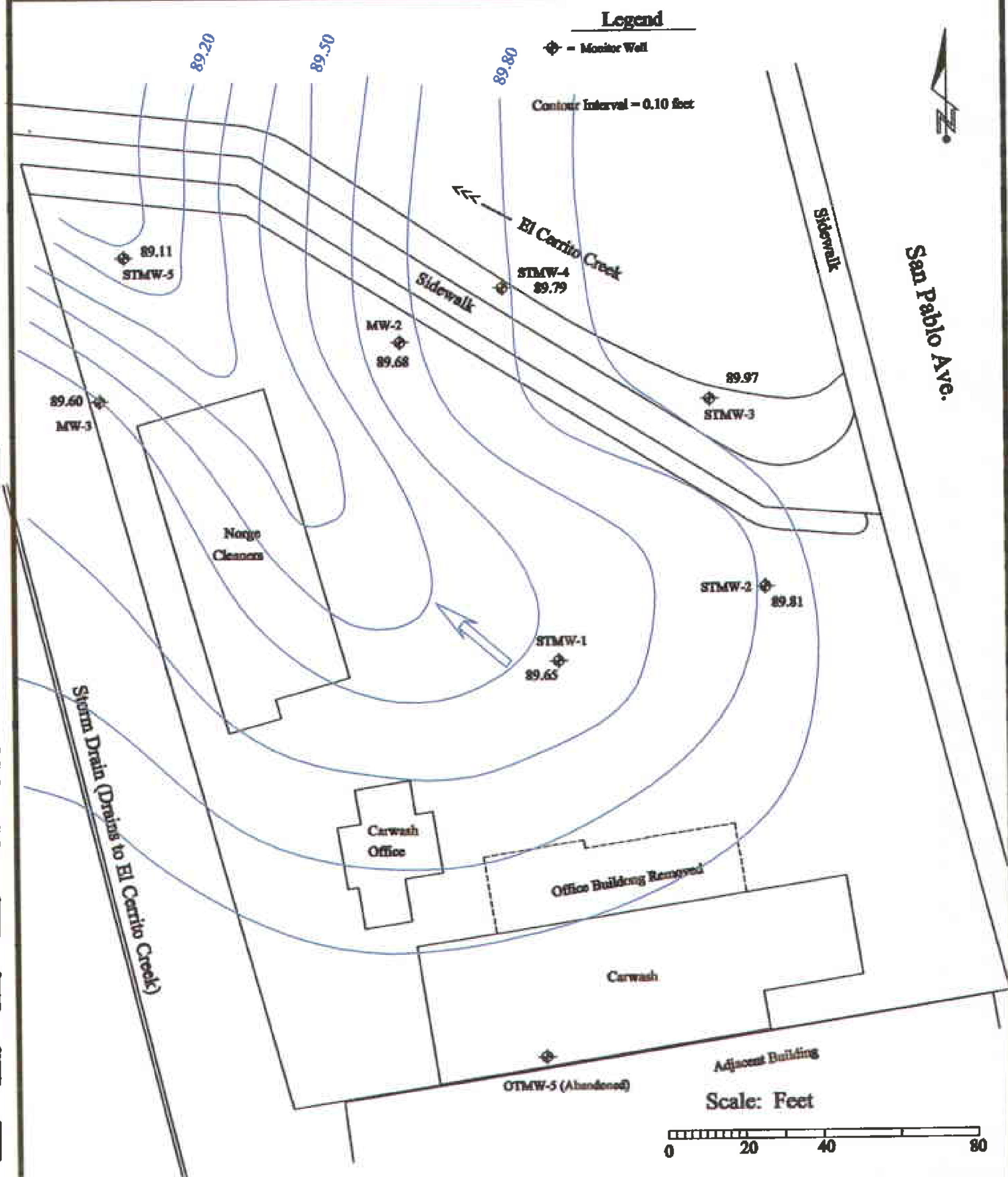


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Figure 17

Groundwater Elevation Map August 2003

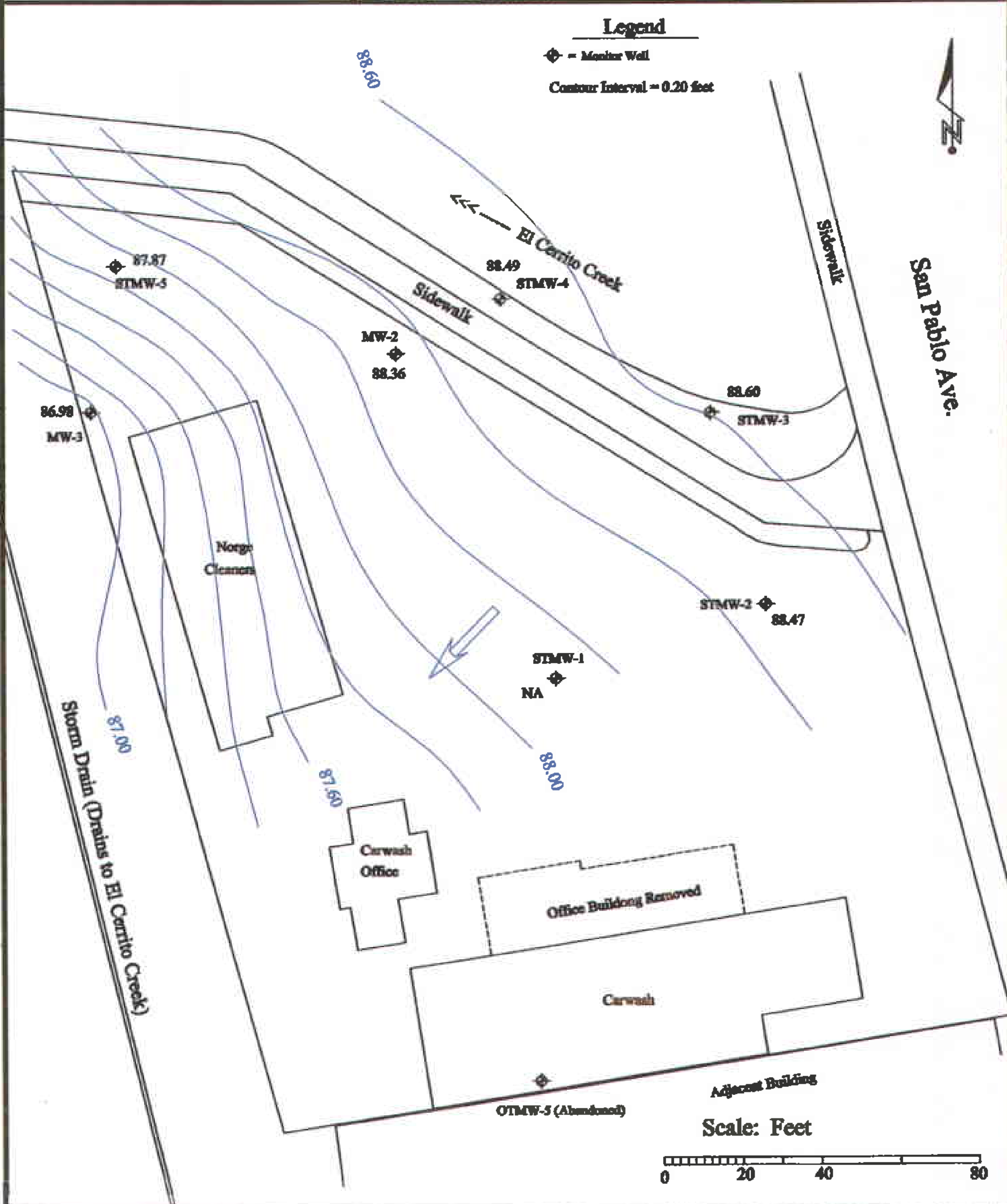

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Figure 18

Groundwater Elevation Map August 2004

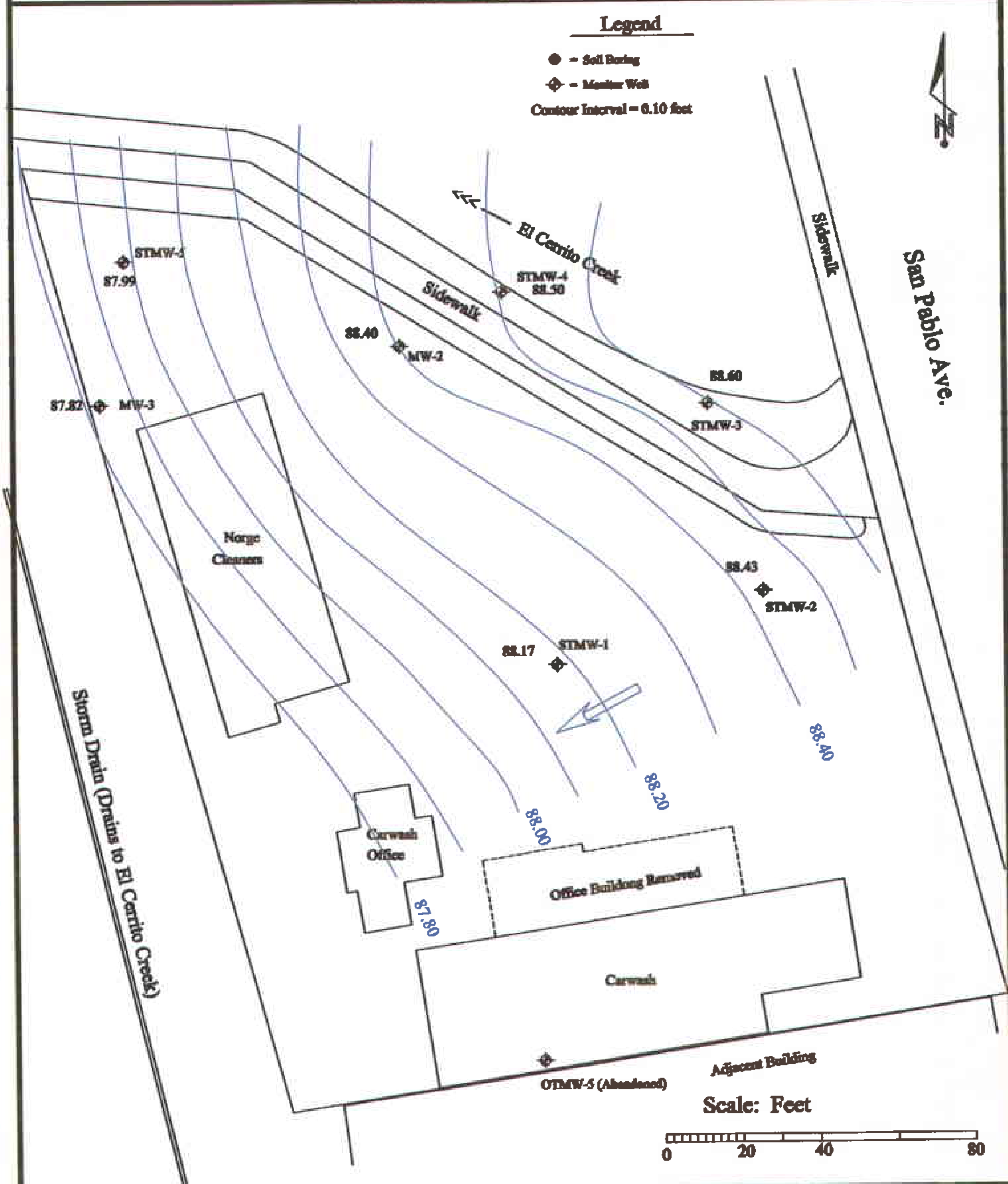

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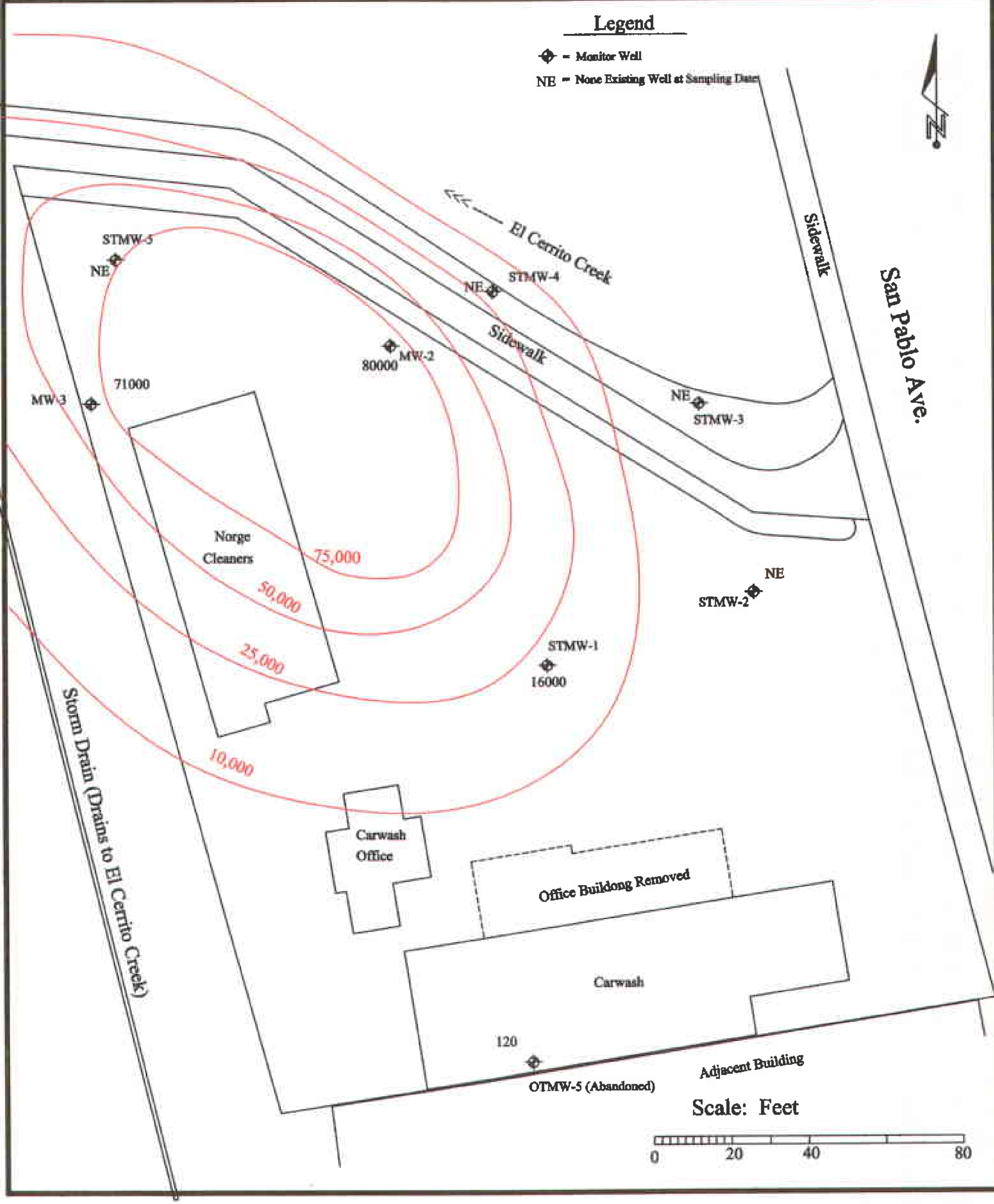
Figure 19

Isocontours of TPH-g in Groundwater, August 1989



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/10/2004	Figure 20 Isocontours of TPH-g in Groundwater, March 1991

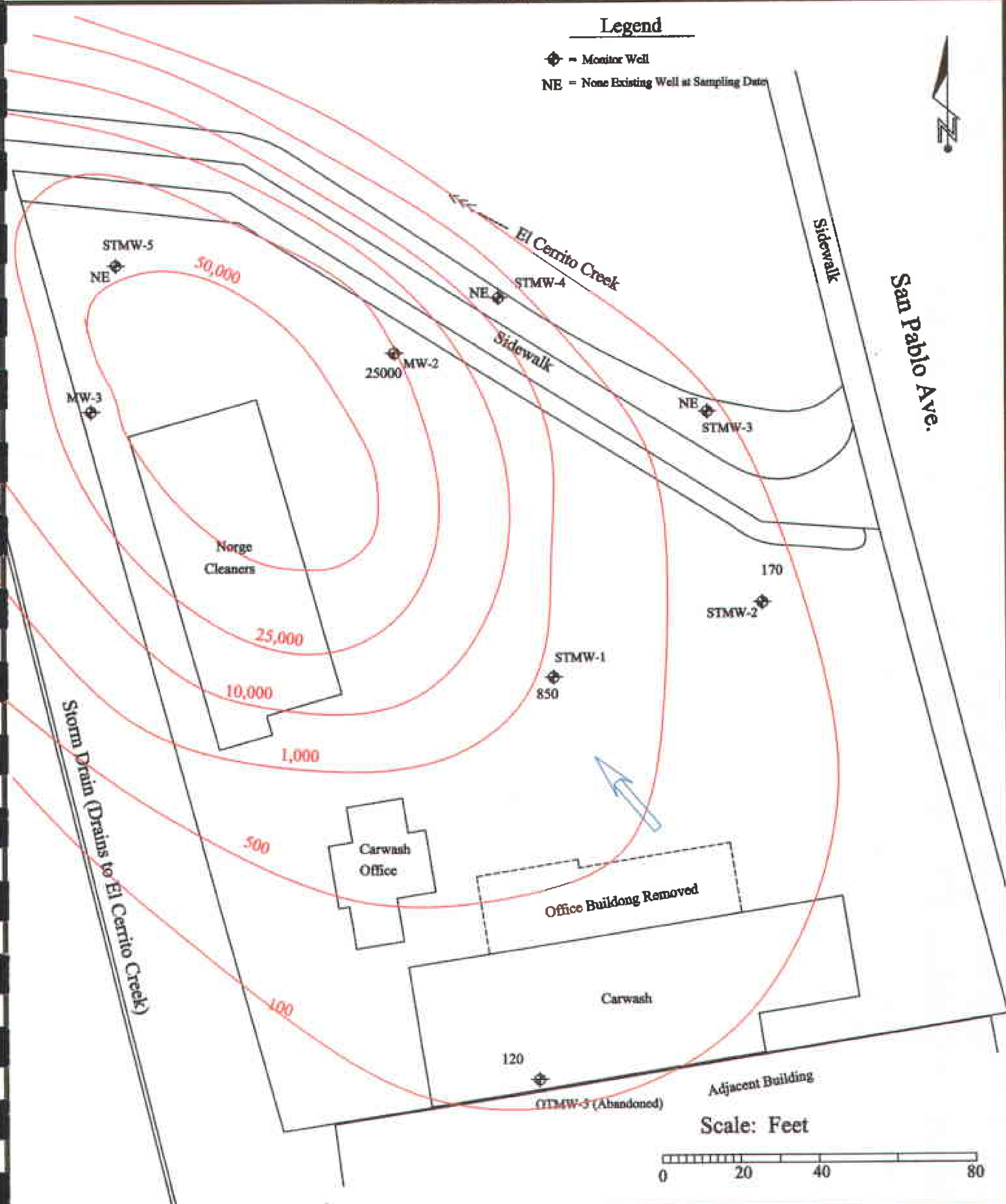


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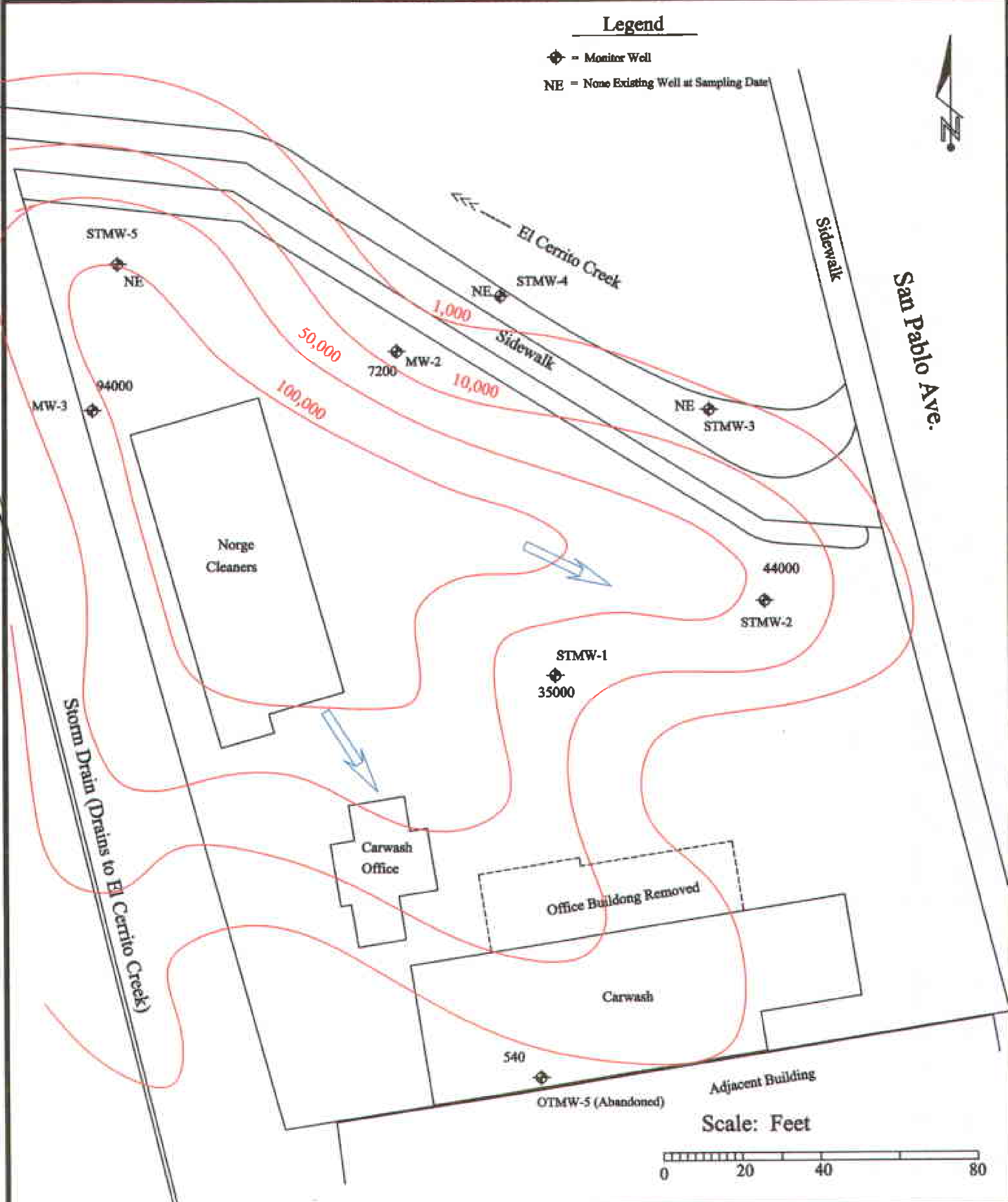
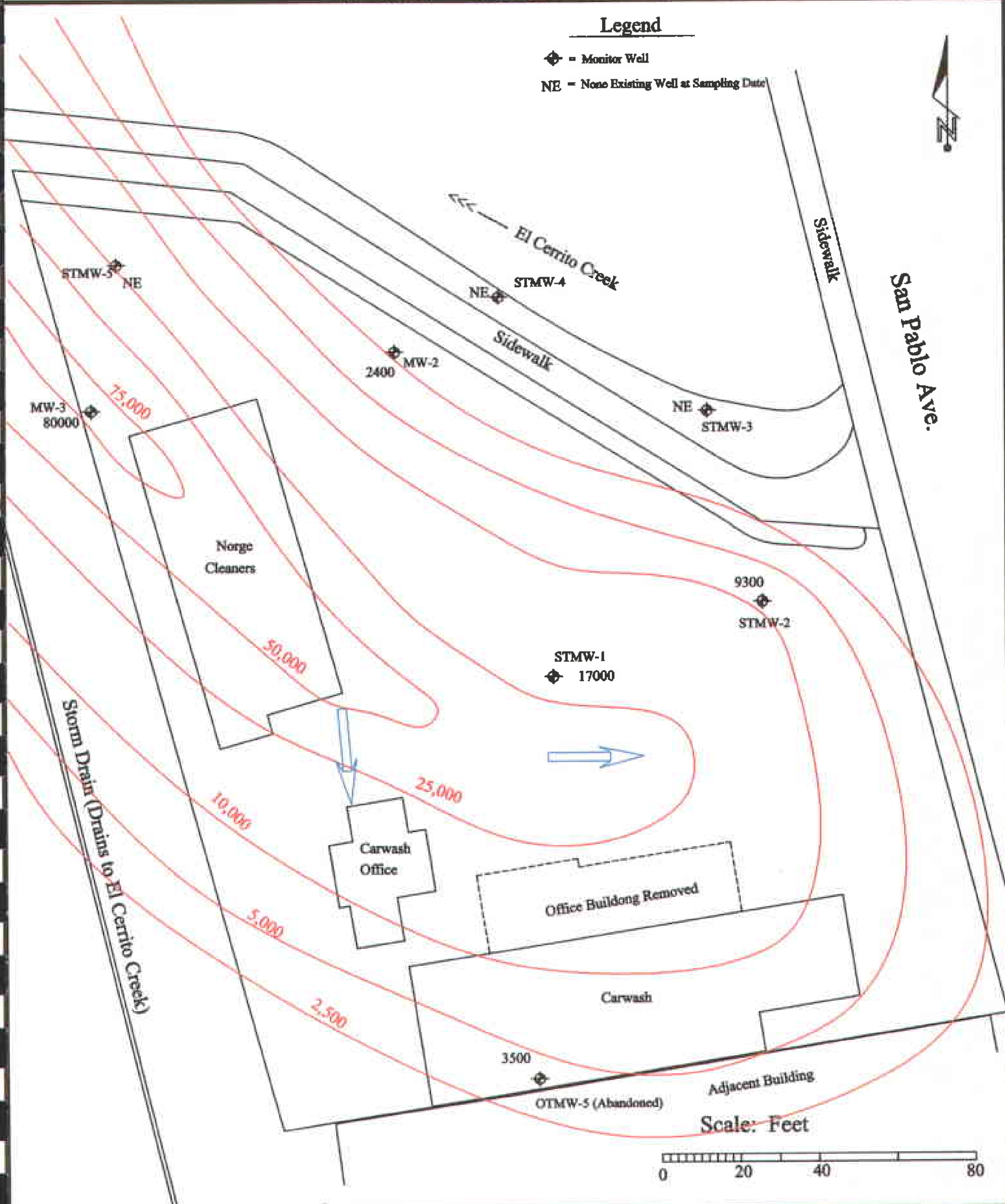
Figure 21

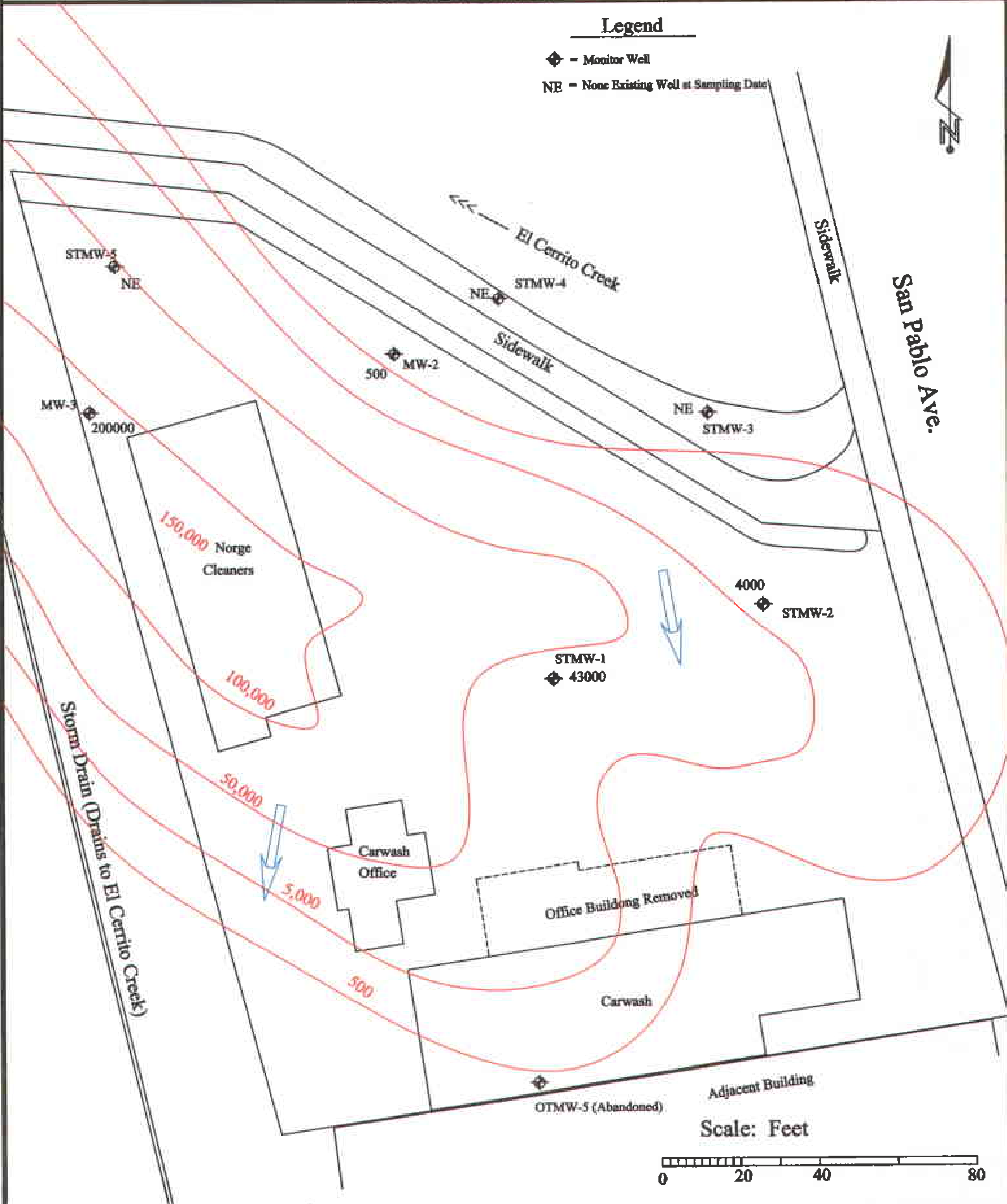
Isocontours of TPH-g in Groundwater, Dec. 1992



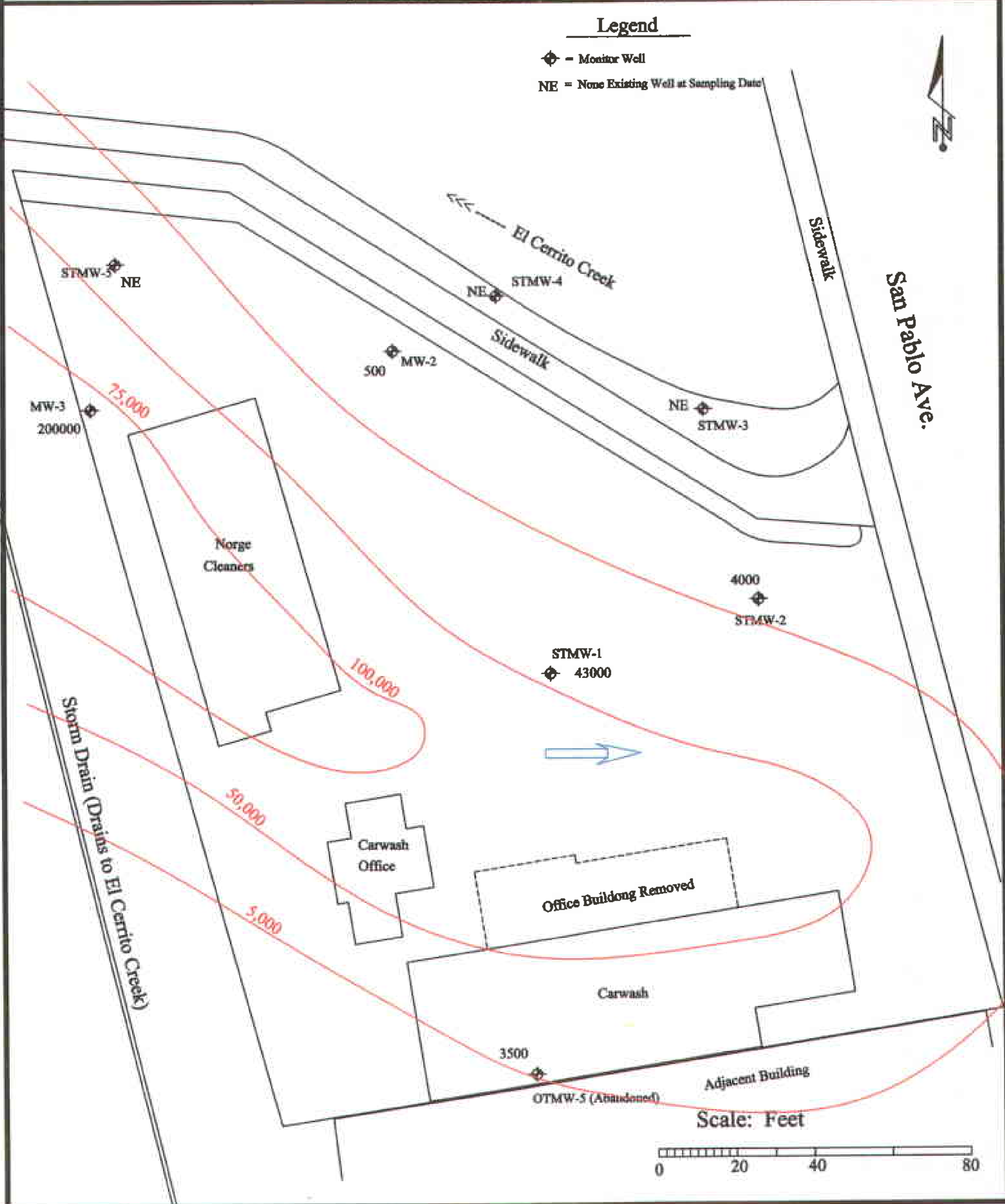
Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 22 Isocontours of TPH-g in Groundwater, July 1993



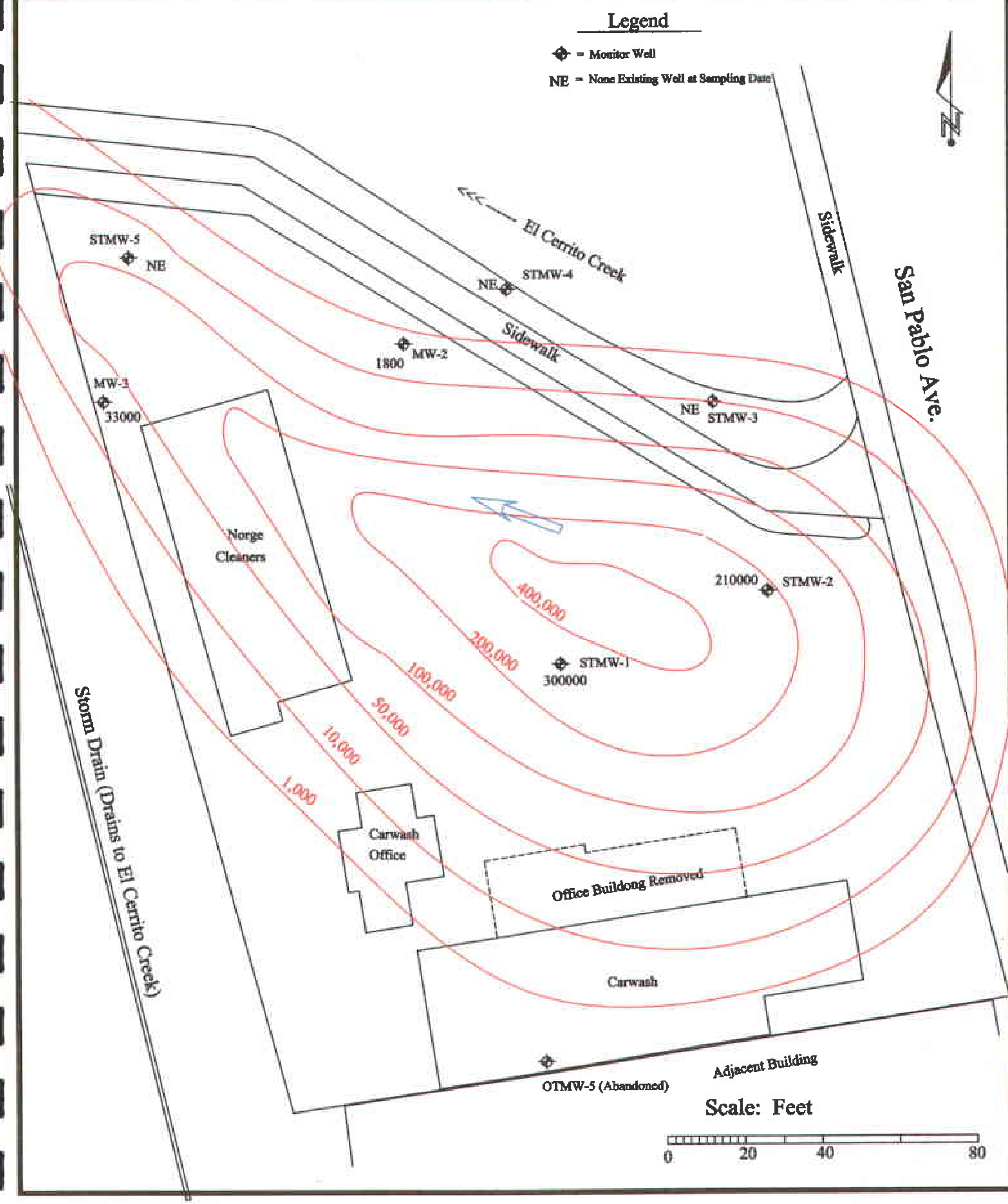
Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 23 Isocontours of TPH-g in Groundwater, August 1993



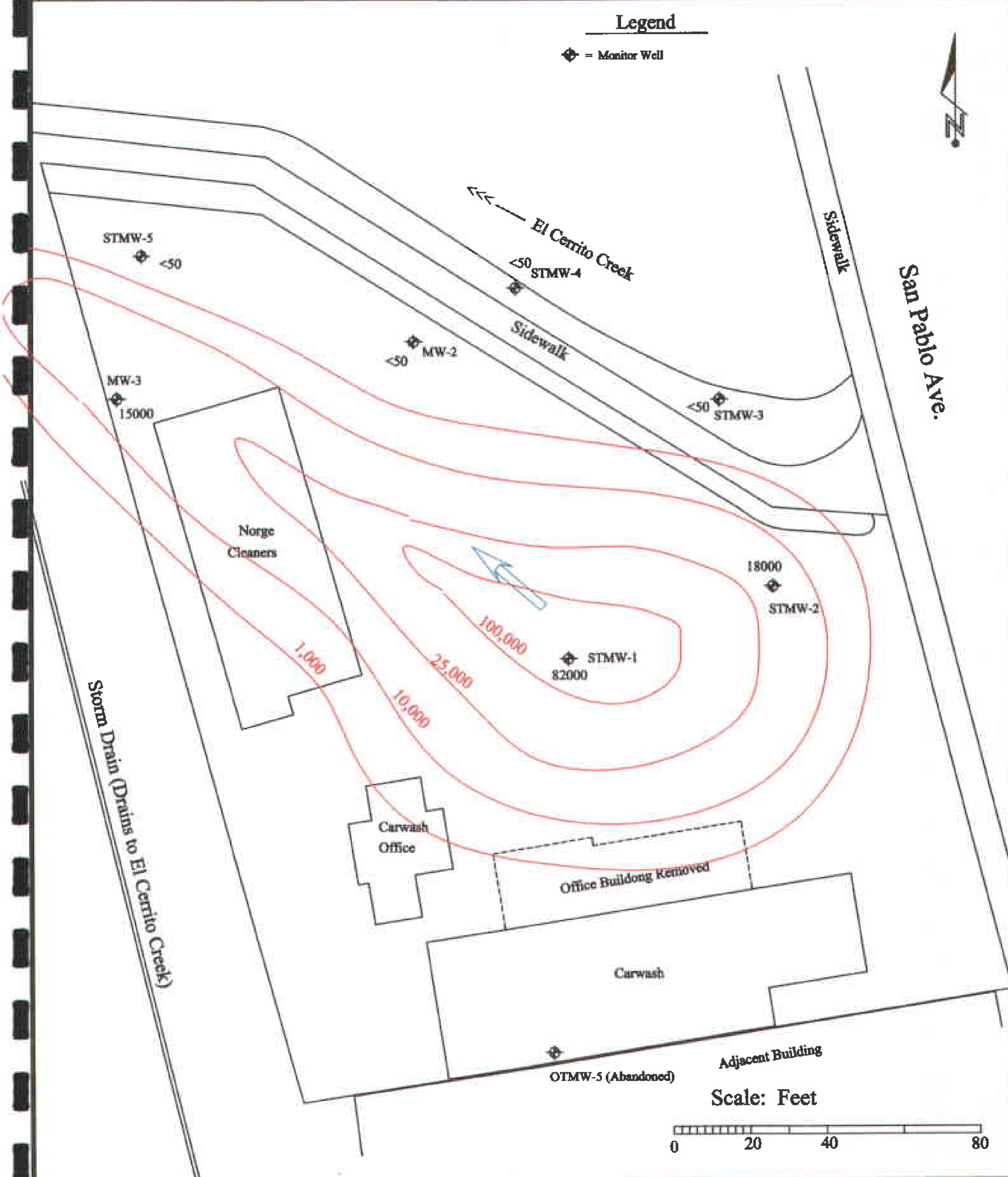
Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 24 Isocontours of TPH-g in Groundwater, August 1994



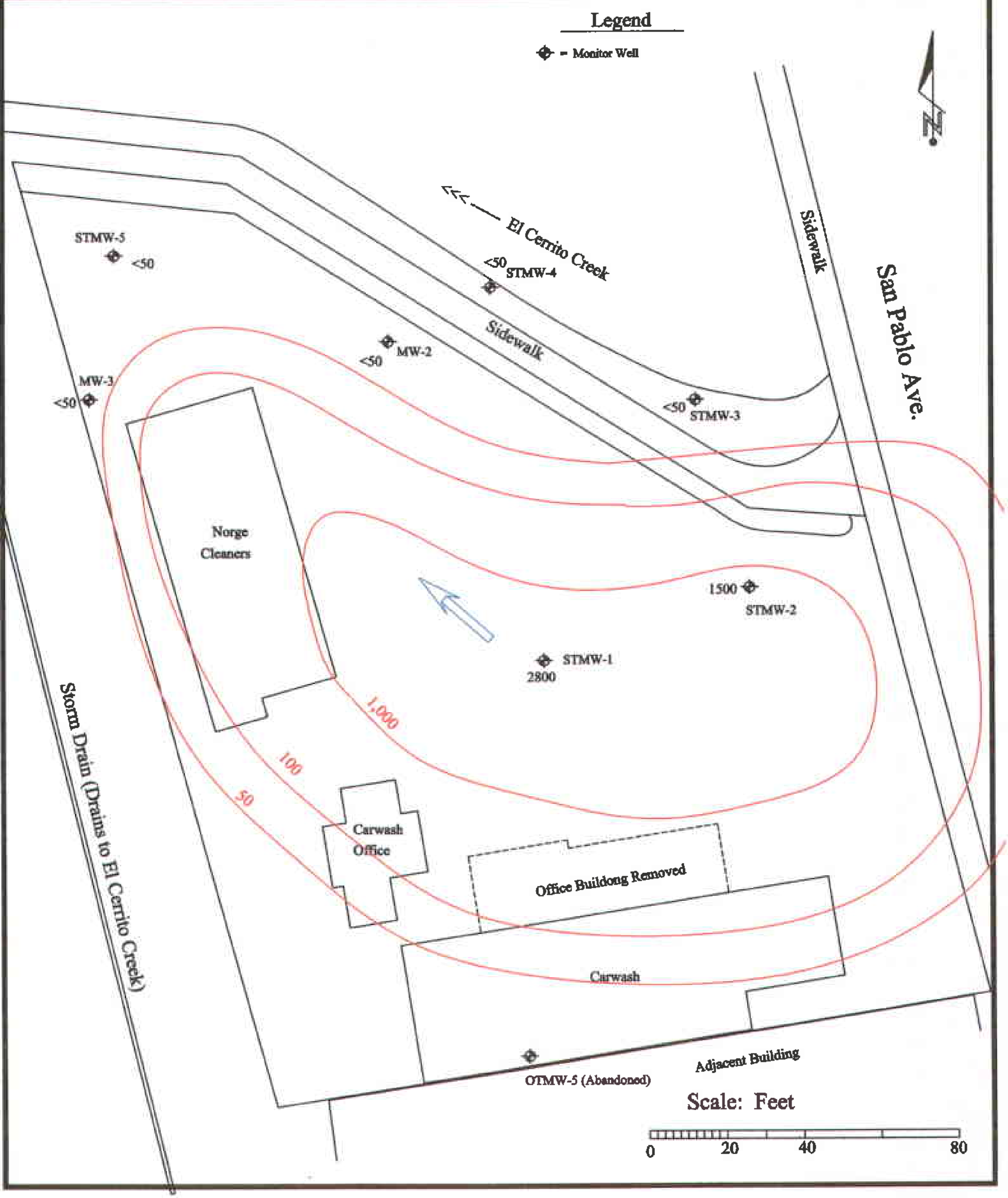
Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 25 Isocontours of TPH-g in Groundwater, August 1995



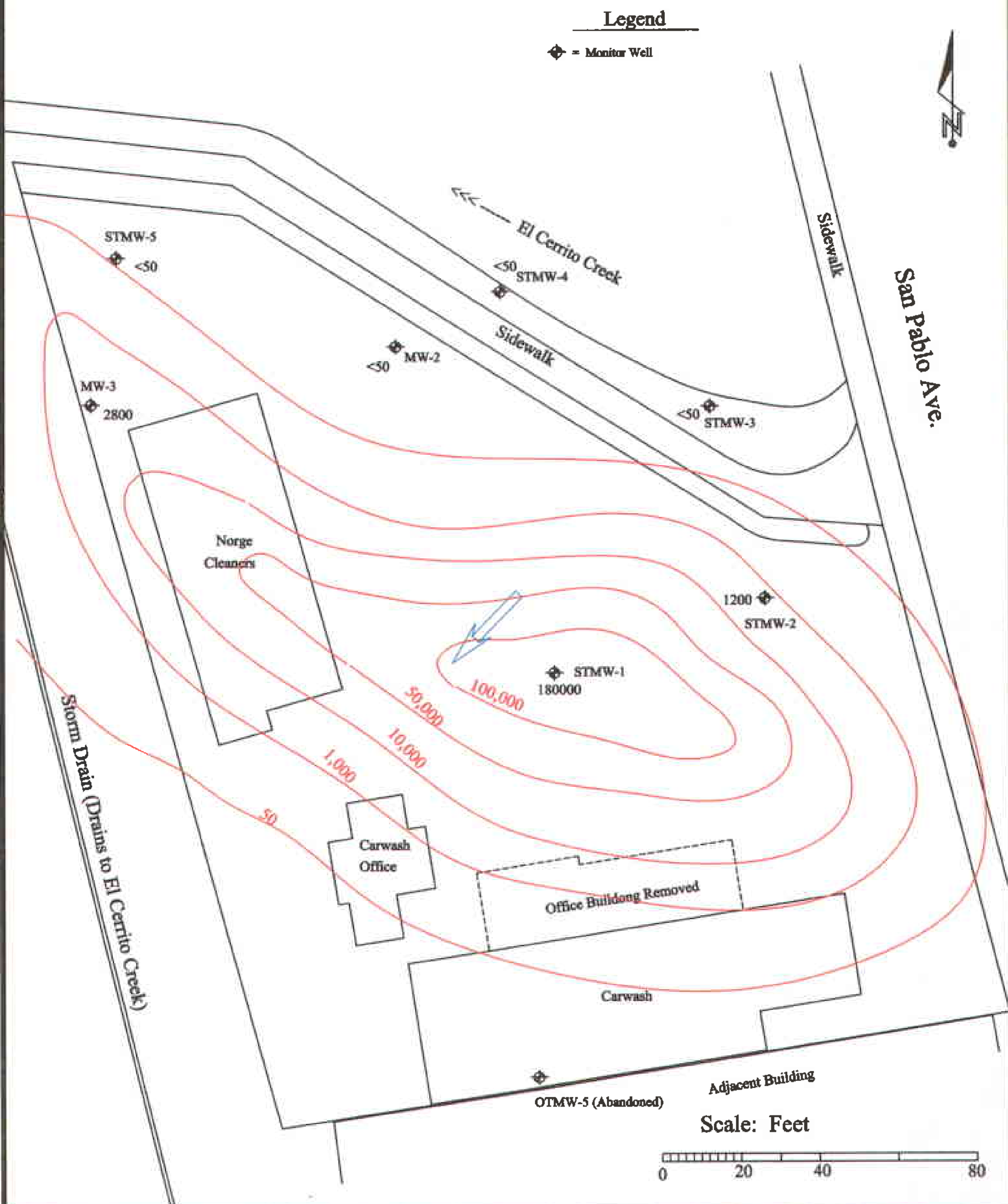
Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 26 Isocontours of TPH-g in Groundwater, August 1997



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 27 Isocontours of TPH-g in Groundwater, April 1999



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/17/2004	Figure 28 Isocontours of TPH-g in Groundwater, Nov. 2003



Enviro Soil Tech Consultants 131 Tully Road San Jose, CA 95112	PROJECT Plaza Car Wash 400 San Pablo Ave El Cerrito, California PROJECT # 8-90-421-SI DATE: 12/10/2004	Figure 29 Isocontours of TPH-g in Groundwater, August 2004

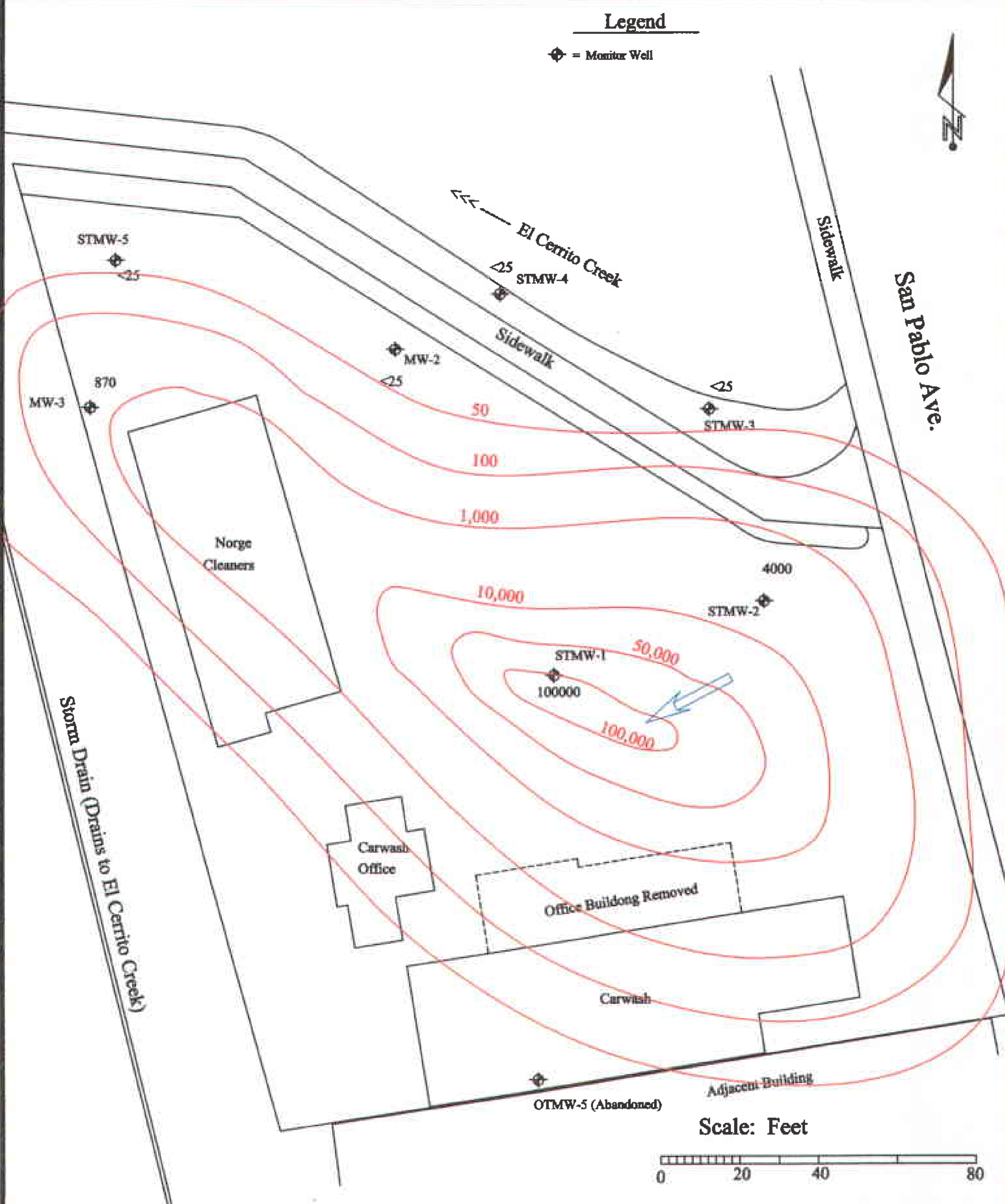


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Figure 30

Proposed Borings