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June 7, 1996

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Marketing Department
Phone 510 842 9500

Ms. Jennifer Eberle
Alameda County Health Care Services
Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: **Former Gulf Service Station #0006**
460 Grand Avenue
Oakland, California

orig. RA

Dear Ms. Eberle:

Enclosed is a copy of the RBCA Tier 2 Risk Evaluation, dated May 20, 1996, that was prepared on this site by Chevron Research and Technology Company (CRTC) and for the Chevron Products Company. The exposure pathway that was considered in this evaluation was the inhalation of vapors by an adult resident receptor in an enclosed -space migrating from the soil and groundwater plume beneath the site. Benzene is used as the chemical of concern in this evaluation because of its known carcinogenic properties. Known groundwater and soil data was used to generate the risk evaluation and for those areas that did not have site-specific data available, conservative parameter values were used based on ASTM RBCA E-1739-95 guidance in Tables X2.6 and X2.7.

Based on the results of the Volatilization Factor equation for groundwater into enclosed -spaces, vapors from the dissolved hydrocarbons in the groundwater beneath the site would not represent a health risk to any future residential occupants at the site(refer to the calculations in the report). Based on the results of the Volatilization Factor equation for subsurface soil into enclosed-spaces, the vapors from the hydrocarbons present in the soils beneath about 10% of the site could represent a health risk to future residential occupants at the site(refer to the calculations in the report).

Based on this risk evaluation, the groundwater beneath the site pose no human health risk. The majority of the soils on the site, about 90%, pose no human health risk. This was due to the extensive removal of hydrocarbon impacted soils from the site. The soils that could pose a human health risk are located in a 15 foot area northward from the sidewalk on Grand Avenue(refer to Fig.3). Also note that the soils in this area will continue to degrade over time due to the natural attenuation processes.

Therefore, based on this risk evaluation that there is no human health risk from the groundwater beneath the site, Chevron requests that the groundwater monitoring wells be closed and abandoned. Chevron also requests closure and developability of this site due to the fact that about 90% of the soils pose no human health risk. Because the 15 foot setback area along Grand Avenue could pose a human health risk, Chevron will agree to work with the land owner and Health Care Services to develop mitigation measures for any future site development. (These measures to include those outlined in this risk evaluation.) ? ?

If you have any questions or comments, please call me at (510) 842-9136.

June 7, 1996
Ms Jennifer Eberle
Former Gulf Service Station # 0006

Sincerely,
CHEVRON PRODUCTS COMPANY

Philip R. Briggs
Site Assessment and Remediation Project Manager

Enclosure

cc. Mr. John C. Gibson,
Adams & Gibson
160 Sansome Street, Suite 1200, San Francisco, CA 94104-3718

Mr. Jon Robbins, Chevron, CHVPK/V1156

Ms. Bette Owen, Chevron

MEMORANDUM

May 20, 1996
Richmond, California

Risk Evaluation - Soil and Groundwater
Former Gulf Service Station #0006
460 Grand Avenue, Oakland, CA

Mr. Phil Briggs:
San Ramon, California

This RBCA Tier 2 Risk Evaluation is presented to fulfill the commitment made by Chevron in the August 25, 1995 letter to Ms. Jennifer Eberle of Alameda County Health Care Services and in a subsequent telephone conversation on April 29, 1996. The exposure pathway considered in this risk evaluation was the inhalation of vapors by an adult resident receptor in an enclosed-space emanating from the soil and groundwater plume beneath this site. Benzene is the chemical of concern for this evaluation because of its' carcinogenic properties. Site-specific groundwater monitoring and soil data were used to generate this risk evaluation. Where site-specific data was lacking, conservative estimates of parameter values were used based on ASTM RBCA E-1739-95 guidance in Tables X2.6 and X2.7. Two scenarios for soil and groundwater, Conservative and Plausible, were modeled for this site based upon site soils and groundwater data.

The Conservative scenario for groundwater vapor volatilization is represented by the maximum groundwater detection (63 ppb in well C-2 on 12/16/92). The Conservative scenario for soil volatilization is represented by only considering the soil detection's from site excavation activities above the method detection limit (7 of 15 samples) in the 0-5.5' interval. The 0-5.5' interval was selected based upon historical groundwater data as representative of the expected vadose zone at this site for the long term.

The Plausible scenario for groundwater is represented by the current groundwater conditions at the site. Well C-2 had a benzene concentration of 0.93 ppb on 12/12/95. The Plausible scenario for soils at the site is represented by taking the average of all 15 samples in the 0-5.5' interval. If a sample was non-detect, then the value was assumed to be 1/2 the method detection limit or 0.0025 mg/Kg.

Based on the results of the Volatilization Factor equation for groundwater into enclosed-spaces (VFwesp equation in Table X2.5 of the ASTM Risk-Based Corrective Action guidance document E 1739-95), vapors from the contaminated groundwater beneath this site would not represent a health threat to future residential occupants at this site. The risk value generated by utilizing the output from the VFwesp equation for the Plausible scenario is 8.3×10^{-9} for the current 0.93 ppb benzene concentration in well C-2 and 5.5×10^{-7} for the Conservative scenario (63 ppb in C-2). Both of these risk values are below the 1×10^{-6} standard and would not represent a threat to human health.

Based on the results of the Volatilization Factor equation for subsurface soil into enclosed-spaces (VFsesp equation in Table X2.5 of the ASTM Risk-Based Corrective Action guidance document E 1739-95), the vapors from contaminated soils beneath this site could represent a health threat to future residential occupants at this site. The risk value generated utilizing output from the

the 1.3 hit was already excavated (sample 1X-3)

VFsesp equation ranges from 8.4 x 10^{-4} (Conservative scenario) to 4.1 x 10^{-4} (Plausible scenario). The critical factors in elevating the expected health risk at this site were the shallow depth to impacted soils of 4.6' and the presence of 1.2-1.3 mg/Kg of benzene in two of the pump island excavation sidewall samples. These risk values are above the 1x 10^{-6} risk threshold for residential occupancy and are close to, but above, commercial/industrial occupancy risk values of 1 x 10^{-4} for this site.

Based upon this risk evaluation, the groundwater at this site would not represent a risk to human health. Soils over the vast majority (>90%) of this site pose no risk to human health because of the extensive excavation removal of contaminated soils. The soils located in a 15' zone from the Grand Ave. sidewalk northward at this site could represent a vapor inhalation health threat to residential and commercial/industrial occupants (Fig. 3).

To address this modeled soil vapor threat, Chevron should work with the land owner and Regulatory Agency to develop mitigation measures during and after site development. These measures may include: 1) Restricting site commercial or residential development directly over the impacted soil located in a setback zone 15' from the Grand Ave. sidewalk (Figure 3); 2) Excavating out the impacted soil within the 15' setback zone during site development, if warranted; 3) Conducting a soil vapor survey along the Grand Avenue side of the site to measure in-situ volatile vapor constituents present in the subsurface; and lastly, 4) Placement of a vapor barrier beneath any site development located over impacted soils in the 15' setback zone located along Grand Avenue.

It is recommended that Chevron pursue site soils and groundwater closure or request a letter of developability from the Alameda County Health Services and agree to work with the landowner and County to address site soil environmental concerns once a buyer for the property has been located. It is important to note that extensive excavation has removed the soil contamination sources (UST/piping etc.) and that the remaining residual soil contamination is confined to a 15' zone along Grand Ave. and that soil contaminant concentrations will continue to decay with time due to natural degradation processes.

ASTM RBCA Equations and Input Parameters

A) VFwesp Calculation (Table X2.5) - Groundwater to Enclosed-Space Vapors

1) This calculation derives the amount of volatilization of contaminants within a groundwater plume that will migrate through the soil column and into an enclosed-space (residence/commercial building). The concentration of vapors within an enclosed-space is dependent upon the concentration of contaminant (benzene) in the groundwater plume. This concentration is the known maximum (63 ppb) and current (0.93 ppb) benzene concentration in well C-2.

2) The input parameters for this equation are site specific for porosity (0.38), thickness of capillary (50cm) and vadose zones (100cm) and depth to groundwater (141cm). Chemical specific physical parameters and reasonable assumptions for the remaining variables of the equation are given in Tables X2.6 and X2.7 of the ASTM E 1739-95 guidance document. A value for VFwesp was then calculated.

3) To calculate the intake exposure of benzene it is assumed that the exposure will occur for 30 years at 350 days/year at a inhalation rate of 15m^3/day for a 70 Kg adult with a 70 year lifetime at 365 day/year.

4) The Risk is then calculated for maximum and current benzene concentration in well C-2 (Conservative and Plausible scenarios) by multiplying the intake exposure by the cancer potency factor for benzene of 0.029.

Please note that this equation and generated risk values assumes that a residence/building will be placed directly over the defined groundwater plume at the site. This situation does not currently exist and it is a situation that can be resolved during site development planning.

B) VFsesp Calculation (Table X2.5) - Subsurface Soil to Enclosed-Space Vapors

1) This equation is used to determine the amount of subsurface vapors that may volatilize from subsurface soils and migrate through the soil and into an enclosed-space (residence/building). Soil sample analysis from the 0-5.5' depth interval was evaluated in two scenarios - Conservative and Plausible. The Conservative scenario used only the 7 detects of 15 samples analyzed and calculated an average benzene value of 0.54 mg/Kg for the site soils. The Plausible scenario averaged the entire 15 soil samples taken and calculated an average benzene concentration of 0.26 mg/Kg for site soils.

2) The input parameters for this equation were porosity (.38), soil bulk density (1.7 g/cm^3), specific physical and chemical parameters for benzene, and the same assumptions/values used in the VFwesp equation taken from Table X2.6 and Table X2.7. A value for VFsesp was then calculated.

3) To calculate the intake exposure of benzene it is assumed that the exposure will occur for 30 years at 350 days/year at a inhalation rate of 15m^3/day for a 70 Kg adult with a 70 year lifetime at 365 day/year.

4) The Risk is then calculated for Conservative and Plausible scenarios by multiplying the intake exposure by the cancer potency factor for benzene of 0.029.

Please note that this equation and generated risk values assume that a residence/building is placed directly over the soil plume. This situation does not currently exist at this site. The site has been extensively excavated and the soil contamination remaining at the site is limited to a very small lateral extent along Grand Avenue based upon the soil analytical data.

VFwesp and VFsesp Calculation

The following equations have been derived using parameters selected from attached Tables X2.5, X2.6 and X2.7 from the ASTM RBCA Guidance document E 1739-95. Assumed Soil, Building, Surface and Subsurface parameters were taken from Table X2.6 (attached) and used to solve equations for the effective diffusion: D^{eff}_s, D^{eff}_{crack}, D^{eff}_{cap} and D^{eff}_{ws} (Table X2.5). These values were then used in the solving of the VFwesp and VFsesp equations (Table X2.5).

The effective diffusion equations were solved and gave the following results: D^{eff}_s was calculated to be 7.28 x 10^{-3} cm^2/s; D^{eff}_{cap} was calculated to be 2.17 x 10^{-5} cm^2/s; D^{eff}_{crack} was calculated to be 7.28 x 10^{-3} cm^2/s; and D^{eff}_{ws} was calculated to be 6.5 x 10^{-5} cm^2/s. These values were then input into the volatilization equations and solved. Solutions for VFwesp and VFsesp were calculated in Step 1 and **VFwesp** and **VFsesp** were calculated as:

3.4 x 10^{-3} mg/m^3-air / mg/L-water and **VFsesp** was calculated as: **0.61 mg/m^3-air / mg/Kg-soil.**

Concentrations of vapors in buildings were then calculated for both VFwesp and VFsesp Conservative and Plausible scenarios in Step 2 above based upon soil and groundwater contaminant levels. Chemical Intake was calculated for each scenario in Step 3 above and a risk value was derived for each scenario in Step 4 above.

Conclusions

Based on site groundwater and soils data, risk values were generated for Conservative and Plausible scenarios. The Conservative scenario is representative of maximum soil and groundwater concentrations seen in site monitor well C-2 and in excavation soil samples taken in the 0-5.5' interval. The Conservative scenario would represent the maximum expected exposure risk at this site. The Plausible scenario is representative of current site groundwater conditions and all excavation soil samples in the 0-5.5' interval. The Plausible scenario would represent the expected exposure risk values for this site.

The risk associated with exposure to the Plausible scenarios for groundwater and soil volatilization into enclosed-spaces were calculated to be 8.3×10^{-9} for the 0.93 ppb benzene concentration seen in well C-2 and 4.1×10^{-4} for the 0.26 mg/Kg benzene soil concentration. The risk associated with exposure to the Conservative scenarios for groundwater and soil volatilization into enclosed-spaces were calculated to be 5.5×10^{-7} for the maximum 63 ppb benzene concentration in well C-2 and 8.4×10^{-4} for the 0.54 mg/Kg benzene soil concentration.

The risks associated with the groundwater volatile vapor inhalation exposure scenarios are below the 1×10^{-6} risk standard, indicating no threat to human health for exposures to volatile contaminants from the groundwater. The risks associated with the soil volatile vapor inhalation exposure scenarios are above the residential risk value of 1×10^{-6} and close to the commercial/industrial value of 1×10^{-4}.

Recommendations

Based upon this risk evaluation, the groundwater at this site would not represent a risk to human health. Soils over the vast majority (>90%) of this site pose no risk to human health because of the extensive excavation removal of contaminated soils. The soils located in a 15' zone from the Grand Ave. sidewalk northward at this site could represent a vapor inhalation health threat to residential and commercial/industrial occupants (Fig. 3).

To address this modeled soil vapor threat, Chevron should work with the land owner and Regulatory Agency to develop mitigation measures during and after site development. These measures may include: 1) Restricting site commercial or residential development directly over the impacted soil located in a setback zone 15' from the Grand Ave. sidewalk (Figure 3); 2) Excavating out the impacted soil within the 15' setback zone during site development, if warranted; 3) Conducting a soil vapor survey along the Grand Avenue side of the site to measure in-situ volatile vapor constituents present in the subsurface; and lastly, 4) Placement of a vapor barrier beneath any site development located over impacted soils in the 15' setback zone located along Grand Avenue..

It is recommended that Chevron pursue site soils and groundwater closure or request a letter of developability from the Alameda County Health Services and agree to work with the landowner and County to address site soil environmental concerns once a buyer for the property has been located. It is important to note that extensive excavation has removed the soil contamination sources (UST/piping etc.) and that the remaining residual soil contamination is confined to a 15' zone along Grand Ave. and that soil contaminant concentrations will continue to decay with time due to natural degradation processes.

Please contact me at CTN 242-7086 with questions or comments regarding this risk evaluation for this site.

Curtis A. Peck
Lead Hydrogeologist

Attachments
1) Figure 3
2) Site Soil Data - Excavation Reports
3) Site Groundwater Data - 12/95
4) Tables X2.1, X2.5, X2.6 and X2.7 of ASTM E-1739-95

cc: J. M. Randall
T. E. Buscheck
U. Kelmser
J. N. Stambolis

#G-0006 ASTM RBCA - Volatilization Factor for Enclosed-Spaces

ADULT RESIDENT RECEPTOR - Benzene

EQUATIONS - Volatilization from Groundwater to Enclosed-Space (VFwesp) - Benzene

$$\text{VFwesp} = \frac{\dfrac{[(6.5 \times 10^{-5}\ cm^2/s) / (150\ cm)]}{(0.22)\quad [(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)]}}{1 + \dfrac{[(6.5 \times 10^{-5}\ cm^2/s) / (150\ cm)]}{[(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)]} + \dfrac{[(6.5 \times 10^{-5}\ cm^2/s / (150\ cm)]}{[(6.5 \times 10^{-5}\ cm^2/s) / 15\ cm) \times 10^{-01}]}} \times 1000\ L/m^3$$

should be $\times .01$ instead

$$\text{VFwesp} = \frac{(0.22)\ (1.55 \times 10^{-5})}{1 + [(1.55 \times 10^{-5}) + (4.9 \times 10^{-7})]} \times 1000\ L/m^3$$

$$\text{VFwesp} = \frac{(3.4 \times 10^{-6})}{1 + 1.6 \times 10^{-5}} \times 1000\ L/m^3$$

$$\text{VFwesp} = (3.4 \times 10^{-6}) * 1000\ L/m^3$$

VFwesp = 3.4 x 10^{-3} $\frac{mg/m^3\text{-air}}{mg/L\text{-water}}$

2) C building = (VFwesp) x (C water)

2a) C building Plausible = for 0.93 ppb benzene (12/95)

$$\text{C building} = 3.4 \times 10^{-3} \left[\frac{mg/m^3\text{-air}}{mg/L\text{-water}}\right] \times (9.3 \times 10^{-4}\ mg/L)$$

= **3.16 x 10^{-6} mg/m^3-air at 0.93 ppb groundwater benzene concentration**

2b) C building Conservative = for 63 ppb (12/92)

$$\text{C building} = 3.4 \times 10^{-3} \left[\frac{mg/m^3\text{-air}}{mg/L\text{-water}}\right] \times (6.3\ mg/L)$$

= **2.14 x 10^{-4} mg/mg^3 air at 63 ppb benzene (12/92 C-2 value)**

3) Chemical Intake = (C building) x (Inhalation Rate) x (Days Exposed) x (Years Exposed) / (Receptor Weight) x (Days/year) x (Expected Lifetime)

3a) Plausible Chemical Intake

$$\text{Intake} = \frac{(3.16 \times 10^{-6}\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

= **2.8 x 10^{-7} mg/Kg-day at 0.93 ppb benzene groundwater concentration**

3b) Conservative Chemical Intake

$$\text{Intake} = \frac{(2.14 \times 10^{-4}\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

= **1.9 x 10^{-5} mg/Kg-day at 63 ppb benzene groundwater concentration**

4) Risk Value = Chemical Intake x Cancer Potency Factor (benzene); where CPF = 0.029 mg/Kg-day

4a) Plausible Scenario Risk

= $(2.8 \times 10^{-7}$ mg/Kg/day) x (0.029 mg/Kg-day)

= 8.3 x10^{-9} at 0.93 ppb benzene, the current situation at the site.

4b) Conservative Scenario Risk

= $(1.9 \times 10^{-5}$ mg/Kg/day) x (0.029 mg/Kg-day)

= 5.5 x10^{-7} at 63 ppb benzene, the site maximum.

#G-0006 ASTM RBCA - Volatilization Factor for Enclosed-Spaces

ADULT RESIDENT RECEPTOR - Benzene

EQUATIONS - Volatilization from Soil to Enclosed-Space (VFsesp) - Benzene

$$\textbf{VFsesp} = \frac{(0.22)(1.7)}{(0.12) + (0.83)(1.7) + (0.22)(0.26)} \; \frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{[(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)]}$$

$$\frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{1 + [(1.4e\text{-}4\ s\text{-}1) * (200\ cm)]} + \frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{[(7.28 \times 10^{-3}\ cm^2/s) / 15\ cm](X\ 10^{-01})} \times 1000\ [cm^3\text{-}kg / m^3\text{-}g]$$

Should be X .01 instead

$$VFsesp = \frac{(0.2355)(2.6 \times 10^{-3})}{1 + [(2.6 \times 10^{-3}) + (7.86 \times 10^{-5})]} \times 1000\ cm^3\text{-}kg/m^3\text{-}g$$

$$VFsesp = \frac{(6.1 \times 10^{-4})}{1 + .01} \times 1000\ cm^3\text{-}kg/m^3\text{-}g$$

$$VFsesp = (6.1 \times 10^{-4}) \times 1000\ cm^3/m^3\text{-}g$$

$$\textbf{VFsesp} = 0.61 \; \frac{\textbf{mg/m}^3\textbf{-air}}{\textbf{mg/Kg-soil}}$$

2) C building = (VFsesp) x (C soil)

2a) Plausible Scenario; benzene =0.26 mg/Kg soil in average of 15 soil samples (detects and non-detects)

$$\text{C building} = 0.61 \; \frac{[mg/m^3 air]}{[mg/Kg\text{-}soil]} \times (0.26\ mg/Kg)$$

C building = 0.16 mg/m³-air at 0.26 mg/Kg soil concentration

2b) Conservative Scenario: benzene = 0.54 mg/Kg soil; average of 7 of 15 detects in former tank pit excavation sidewalls

C building = 0.33 mg/m³-air at 0.54 mg/Kg soil concentration

3) Chemical Intake = (C building) x (Inhalation Rate) x (Days Exposed) x (Years Exposed) / (Receptor Weight) x (Days/year) x (Expected Lifetime)

3a) Plausible Scenario

$$\text{Intake} = \frac{(0.16 mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

Intake = 0.014 mg/Kg-day at 0.26 mg/Kg benzene in soil

3b) Conservative Scenario

$$\text{Intake} = \frac{(0.33 mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

Intake = 0.029 mg/Kg-day at 0.54 mg/Kg benzene in soil

4) Risk Value = Chemical Intake x Cancer Potency Factor (benzene); where CPF = 0.029 mg/Kg-day

4a) Plausible Scenario - Risk

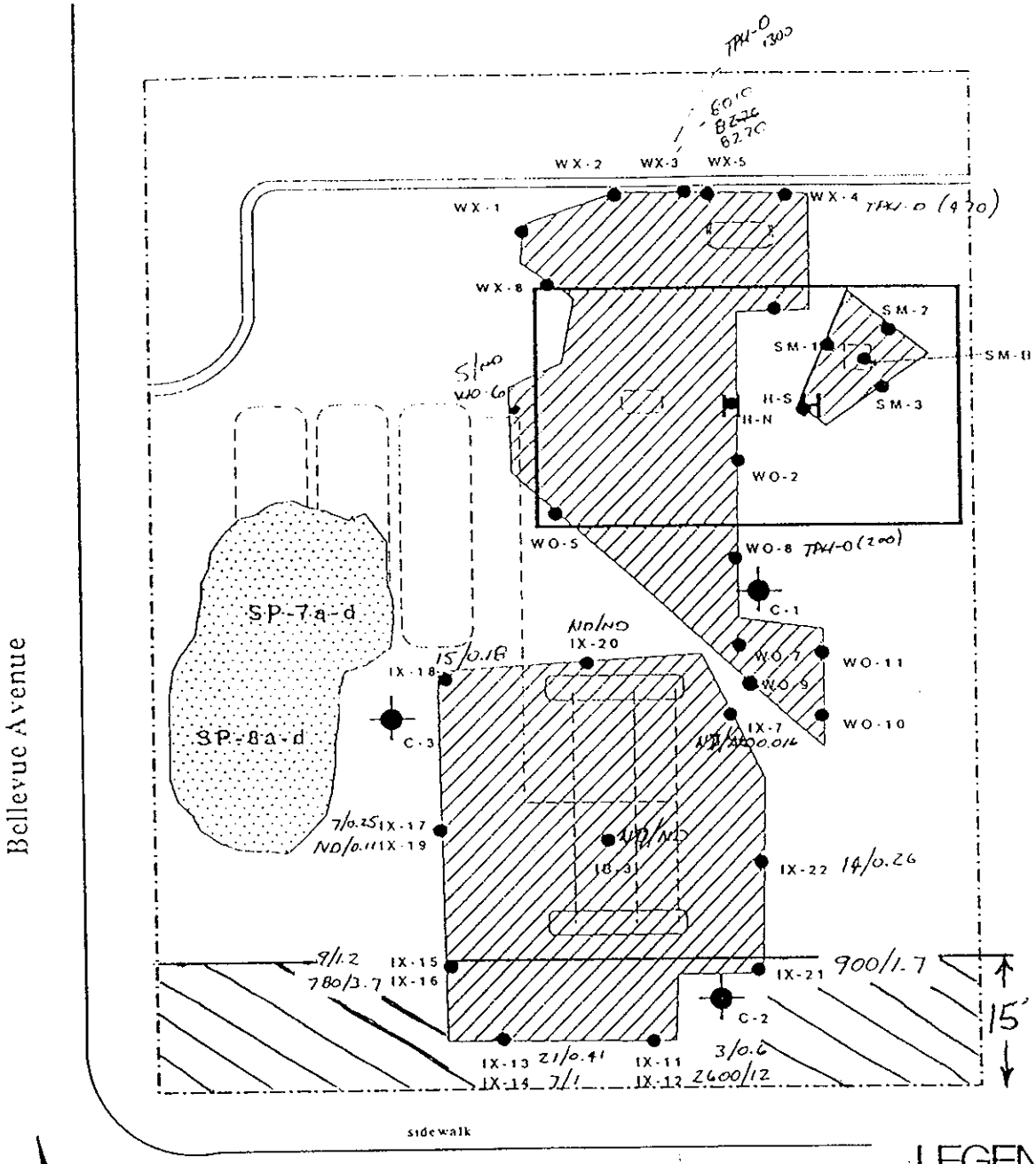
Risk = (0.014 mg/Kg-day) x (0.029 mg/Kg-day)

Risk = $\underline{4.1 \times 10^{-4}}$ at 0.26 mg/Kg benzene in site soil

4b) Conservative Scenario - Risk

Risk = (0.029 mg/Kg-day) x (0.029 mg/Kg-day)

Risk = $\underline{8.4 \times 10^{-4}}$ at 0.54 mg/Kg benzene in site soil



LEGEND

- former product line
- C-2 Monitoring Well
- IX sample location
- excavation limits
- stockpiled soil

Touchstone Developments
Environmental Management

Final Excavation & Sample Locations
460 Grand Avenue
Oakland, California

Figure 3

3-13-94 mjt

Project Number 0006-2