CORRECTIVE ACTION PLAN
TONY'S EXPRESS AUTO SERVICE
3609 INTERNATIONAL BOULEVARD
OAKLAND, CALIFORNIA

Project 99-2330

July 1, 1999

Prepared for:

Tony's Express Auto Service
3609 International Boulevard
Oakland, California

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EXECUTIVE SUMMARY

SOMA Environmental Engineering, Inc. on behalf of Mr. Abolghassem Razi, the owner of the property has prepared this report. The property is known as Tony's Express Auto Service facility located at 3609 International Boulevard, Oakland, California.

This report evaluates different groundwater extraction, air sparging and vapor extraction and treatment technologies for selection of the most effective, feasible and economical technology for restoration of groundwater quality beneath the site. The selection criteria were cost, effectiveness, cleanup period and implementability. The results of our investigation indicated that installation of a French drain for groundwater extraction purposes is the most effective and feasible solution. The results of groundwater flow modeling conducted by SOMA (June 1999) indicated that the proposed French drain would create a sizeable capture zone and prevent further migration of groundwater chemical plume.

Comparison of different groundwater treatment technologies indicated that using granulated activated carbon with a dual carbon vessel is the most effective, feasible and economical alternative for treating of petroleum impacted groundwater beneath the site. While the chemical plume will be contained by the groundwater extraction system, the on-site contained plume will be remediated using air sparging. The results of our evaluation indicated that the combination of the pump-and-treat with air sparging technique is the most cost saving, feasible and effective alternative in remediation of petroleum impacted soils and groundwater beneath the Site.

1.0 INTRODUCTION

SOMA Environmental Engineering, Inc. (SOMA) has prepared this Corrective Action Plan (CAP) report on behalf of Mr. Abolghassem Razi, the owner of Tony's Express Auto Service facility, located at 3609 International Boulevard, Oakland, California (the Site).

The auto service facility is located at the intersection of International Boulevard and 36th Avenue (Figure-1). The Site is bounded by International Boulevard to the north, 36th Avenue to the west, the Las Bougainvilleas residential units and 12th East to the south, and Bonanza hardware store to the east. Figure-2 presents the on-site map along with the adjacent properties.

This CAP report was prepared based on the previous studies conducted beneath the Site. The previous studies concluded that the groundwater beneath the Site, especially in the vicinity of the fuel storage tanks are highly contaminated with petroleum hydrocarbon chemicals such as benzene, toluene, ethylbenzene, and xylene (BTEX) and methyl tertiary butyl ether (MTBE). Various remedial alternatives for soil remediation, groundwater extraction, treatment, and disposal were evaluated in this CAP report and the most technically and economically feasible alternative has been selected and recommended.

1.1 Background

Currently, the Site is used as a gasoline service station. The environmental investigation at the subject property started since 1992, when Mr. Razi, the property owner retained Soil Tech Engineering, Inc. (STE) of San Jose to conduct a limited subsurface investigation. The purpose of STE investigation was to determine whether or not the soil near the product lines and underground storage tanks (USTs) have been impacted with petroleum hydrocarbons.

In July 1993, STE removed one- single-walled 10,000-gallon gasoline tank and one single-walled 6,000-gallon gasoline tank along with a 550-gallon waste oil tank from the Site. These tanks were replaced by double-walled USTs. Currently, there are one-10,000 gallon double-walled gasoline tank and two-6,000 gallon double-walled gasoline tanks beneath the Site.

Due to the presence of elevated levels of TPH-g, ACEHS requested a workplan for subsurface investigation. In August 1993, STE drilled thirteen soil borings and converted three of them into groundwater monitoring wells of MW-1, MW-2 and MW-3. To allow for future in-situ remediation of impacted soils, STE drilled four vertical 6-inch diameter soil vapor extraction probes. In addition, two horizontal perforated pipes were installed connecting four soil borings together through a manifold. The manifold was connected to a vault in front of the northeast corner of the site building.

In December 1997, Mr. Razi retained Western Geo-Engineers (WEGE) to conduct additional investigation and perform groundwater monitoring on a quarterly basis. The results of WEGE groundwater monitoring events indicated elevated levels of petroleum hydrocarbons and MTBE in the groundwater.

In May 1998, WEGE conducted a pilot testing on four vapor extraction wells installed by STE. The pilot testing took about 5 days during which vapor flow rates were monitored and vapor samples were collected. Unfortunately, the report is not clear enough to capture the area of vacuum (negative pressure) within the vadose zone and comment the effectiveness of the four vapor extraction wells installed by STE. However, the results of testing sounds are encouraging for utilizing them as future vapor extraction wells.

In April 1999, Mr. Razi retained SOMA to conduct additional site investigation at the Site. In May 1999, SOMA conducted a pumping test, groundwater flow and chemical transport to evaluate the groundwater conditions and design a groundwater extraction system at the Site. Using the results of previous site investigation, SOMA conducted a risk based corrective action (RBCA) at the Site. The results of the RBCA study indicated that elevated levels of petroleum chemicals in soil and groundwater impose an unacceptable health risk to the site workers and the off-site residents. SOMA further used the State Water Resources Board's Interim Guidance Document in order to define the regulatory status of the Site. Based on SOMA (June 21, 1999) the site fits into a "High Risk" petroleum release category. This document presents the most feasible, effective and yet cost effective alternative for site remediation in order to meet the proposed cleanup levels by the RBCA.

1.2 Site Hydrogeology

Based on the results of previous investigations, groundwater was encountered at depths ranging between 7 and 14 feet beneath the Site. Figure 2 shows the location of on-site and off-site groundwater monitoring wells. The historical static water level elevations measured at different monitoring wells have been reported in the previous groundwater-monitoring reports. The groundwater elevation contour map based on the recent water levels measured in the June 1999 monitoring event is presented in Figure 3. As shown in Figure 3, groundwater flows from the north to the south with an average gradient of 0.014 ft/ft. Based on the results of the pumping test conducted by SOMA, hydraulic conductivity of the saturated sediments ranges between 1.5 and 18.3 feet /day. Assuming the effective porosity of saturated sediments to be 0.35, the groundwater flow velocity range between 22 feet and 267 feet per year.

2.0 ALTERNATIVE EVALUATION CRITERIA

Soil and groundwater remedial alternatives are screened using the following criteria:

Effectiveness

Effectiveness is the ability of each alternative to provide protection to public health and the environment. The evaluation of each alternative is based on the effectiveness of the alternative to handle the estimated volume of media and to meet the removal action objectives (RAOs).

Implementability

Implementability of an alternative is based on the technical and institutional feasibility of implementing a particular option. Technical feasibility includes the availability of treatment, storage and disposal services. It also includes the availability of necessary equipment and skilled workers to implement the process. Institutional feasibility includes obtaining the necessary permits or regulatory concurrence.

Cost

Costs used during the analysis are the estimated amounts to implement each alternative. The focus was to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives would be sustained.

Cleanup Period

The amount of time required to clean a site varies greatly between remedial options. When considering how the cleanup period effects the specific site, the first thing that must be considered is the risk to nearby properties, including industry and residential units.

3.0 SOIL TREATMENT ALTERNATIVES

The results of our evaluation indicated that elevated levels of petroleum chemicals remain in soil and groundwater. Based on our calculation there are 2,265 pounds of TPH-g that exists in soil and groundwater beneath the Site. Due to the presence of a significant amount of BTEX and TPH-g in the soil, it is recommended that the soil remediation alternatives be included in the scope of work. The following alternatives were considered for soil remediation at this Site:

1) No Action
2) Soil Excavation using:
    - On-Site Disposal
    - Off-Site Disposal
3) Soil Vapor Extraction with Air Sparging

3.1 No Action Alternative

The "no-action" alternative, as required by the National Contingency Plan (NCP) and Superfund Amendments and Reauthorization Act (SARA), provide a baseline from which to analyze and assess other alternatives. Under this alternative, no remedial alternatives or groundwater remediation will be implemented at the Site.

Based on the results of the ASTM-RBCA study, adverse health effects to on-site mechanic shop/retail workers will be anticipated. This alternative is not effective, since it does not meet the remedial action objective. There would be no reduction of potential exposures to soils.
This alternative does not have any technical concerns, therefore, no barrier or obstacle exists that would impede the implementability of this alternative.

No capital costs will be associated with this alternative. However, the future owner of the Site will be responsible for the continuing costs in connection with preparation and implementation of the Site's health and safety plan during excavation/construction period.

Due to high concentrations of the contaminants in the soil and groundwater and necessity of the immediate remedial action, this alternative was dropped from further consideration.

3.2 Soil Excavation and On-Site or Off-Site Treatment

This alternative considers excavation and on-site or off-site treatment of the contaminated soil.

Hydrocarbon-impacted soils, within the contaminant plume area at this site, are estimated to cover approximately 365 square yards. If excavation of the contaminated soil is conducted to a depth of approximately 14 feet below grade, the volume of the excavated soil is estimated to be about 1700 cubic yards. Excavation of this area will require structural shoring around the excavation. The off-site treatment of the excavated soil requires hauling of about 1700 cubic yard to a class II landfill for disposal.

3.2.1 On-Site Treatment

This alternative involves ventilation of the stockpiled soils using perforated pipes. Two (2) Rotron Regenerative Blowers Model 404 or equal, will be used to provide the required air for soil venting.

The treated soil will be used for backfilling of the excavated area. The backfilled soil will be compacted at 90 to 95 percent relative compaction. Excess soil will be disposed off-site at a Class II or Class III landfill.

Approximately one acre of land will be needed to stockpile and treat excavated soils. In addition this alternative will interfere with on-going business activities at the Site. Therefore, due the lack of enough land area for the treatment facility and interference of this alternative with the on-going business activities, this alternative is not feasible and will be dropped from further consideration.

3.2.2 Off-Site Treatment

This alternative involves excavation and transportation of the contaminated soils to a Class II or Class III landfill for disposal. Clean fill material will be brought to the Site and compacted at 90 to 95 percent relative compaction.

For the following reasons, the soil excavation and off-site treatment is a poor alternative for the following reasons:

- Soil excavation will interfere with on-going business activities and will require closing the auto mechanic shop as well as the gas station for an extended period of time;
- A large amount of shoring will be required to prevent structural damage to the existing building (mechanic shop and retail store);

The clean-up period for this alternative is shorter than the in-situ soil treatment alternatives. It is anticipated that the soil excavation and on-site or off-site treatment period will be approximately four months.

The estimated cost for excavation and disposal of the soil in a permitted landfill under this alternative is $138,000.

3.3 Soil Vapor Extraction

Soil Vapor Extraction (SVE) removes air from the unsaturated subsurface soil (vadose zone) by placing suction or vacuum on a series of vapor extraction wells or vapor extraction trenches or galleries. Introduction of vacuum to the vadose zone will result in volatilization of the volatile organic compounds (VOCs) and their removal by a piping network that is connected to the suction line of a blower. Vapors resulting from SVE operations may require treatment before discharging to the atmosphere, under the Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 47. If the vapor emissions contain more than one pound per day (lb/day) of total petroleum hydrocarbons and one pound per day of benzene, the air permit and off-gas treatment provision will be required. The soil vapor extraction pilot tests, conducted at this site by WEGE in May 1998, has resulted in the off-gas concentration of benzene in ranges higher than one pound per day. Therefore, off-gas treatment of the soil vapor extraction system and obtaining air permit from the BAAQMD will be required before the SVE emissions can be discharged to the atmosphere.

Several vapor treatment technologies including air treatment by catalytic oxidizers, resin bed adsorption systems, and vapor phase activated carbon systems are available. All of the above technologies can be incorporated for the off-gas treatment for the proposed SVE system. However, depending on the volume of the air to be treated and concentration of the contaminants in the SVE emissions, their cost-effectiveness should be justified. For low air volume and low contaminant concentration, the off-gas treatment by the vapor phase GAC will be more cost-effective, compared with the other vapor treatment alternatives.

In order to enhance the volatilization of the VOCs from the groundwater and further removal of the volatilized VOCs from the vadose zone, the air sparging technique can be utilized in combination with SVE. Air sparging is the injection of compressed air into the saturated zone at low flow rates so that the contaminants are stripped from the groundwater and move up to the unsaturated zone with the air bubbles moving up towards the vadose zone. The target contaminant groups for air sparging are volatile organic petroleum hydrocarbons. In addition to the VOC volatilization, air sparging will enhance the bacterial activities by providing the dissolved oxygen in the groundwater. Therefore, the added benefit of biodegradation of the contaminants can be utilized in air sparging.

This alternative will be effective in removing the VOCs by volatilization of the petroleum hydrocarbons. Also, it will enhance the soil remediation by enhancing the biological remediation as a result of the aeration of the soil.

This alternative is technically feasible because of the following reasons:

- No need for the soil removal;
- No interference with the business activities at the site during the remediation period;
- No interference with the other underground utilities;
- No nuisance for the traffic and the adjacent businesses.

The cleanup period for the SVE alternative is relatively longer compared with the ex-situ alternatives. Theoretically, it will take approximately 1 year to remove TPH-g from the vadose zone. This is based on the assumption that the total mass of TPH-g remaining in the soil is about 1100 pounds and the removal rate trough SVE is about 3-4 pounds per day (WEGE, May 1998).

The capital cost for a SVE and air sparging system for this site is approximately $25,000. The cost-effectiveness of this alternative can be evaluated after comparison of its cost with costs of the other alternatives.

4.0 GROUNDWATER REMEDIATION ALTERNATIVES

Due to contamination of the groundwater by BTEX and MTBE, and the subsequent health hazards, groundwater remediation at the Site should be implemented. The following three alternatives were considered for groundwater remediation including extraction schemes and treatment technologies:

1) No Action
2) Bio-remediation
    - Natural Attenuation
    - In-situ Bio-remediation
3) Pump-and-Treat

For Extraction of groundwater using:

- Groundwater Extraction Wells
- French Drain

For treating extracted groundwater using:

- On-site treatment by dual GAC
- On-site treatment by air stripping
- Off-site disposal of untreated groundwater

4.1 No Action

The "no-action" alternative, as required by the National Contingency Plan (NCP) and Superfund Amendments and Reauthorization Act (SARA), provide a baseline from which to analyze and assess other alternatives. Under this alternative, no remedial alternatives or groundwater remediation will be implemented at the Site.

Based on the results of the ASTM-RBCA study, adverse health effects to on-site workers and off-site residents will be anticipated. This alternative is not effective since it does not meet the remedial action objective. There would be no reduction of potential exposures to groundwater.
This alternative does not have any technical concerns, therefore, no barrier or obstacle exist that would impede the implementability of this alternative.

No capital costs will be associated with this alternative. However, the future owner of the Site will be responsible for the continuing costs such as preparation and implementation of the Sites Health and Safety Plan during excavation/construction period.

Due to high concentrations of the contaminants in the soil and groundwater and necessity of the immediate remedial action, this alternative was dropped from further consideration.

4.2 Bio-remediation

Under this alternative, groundwater cleanup will be achieved as a result of biodegradation of the petroleum hydrocarbons. Groundwater bio-remediation at this site can be considered in the following two scenarios:

4.2.1 Natural Attenuation

Natural Attenuation, in fact, is same as the no action alternative, where petroleum hydrocarbons are degraded as a result of indigenous bacteria, as time goes on. Natural attenuation is a very slow process and is generally acceptable where the contaminated site does not pose an imminent health risk to the public and also the concentrations of the contaminants in groundwater are not very high. Therefore, this scenario is not effective and therefore cannot be considered for this Site.

4.2.2 In-Situ Bio-remediation

In situ bio-remediation involves application of nutrients such as nitrates and phosphates and also application of air to the saturated zone for aerobic bacterial growth and digestion of hydrocarbons as carbon sources. In-situ bio-remediation is a relatively slower process compared to the pump-and-treat alternatives. Moreover, due to low hydraulic conductivity and air-filled porosity of the saturated sediment uniform transfer of dissolved oxygen and nutrients will be problematic. Therefore, this scenario is not considered feasible.

4.3 Pump-and-Treat

Pump-and-treat is a groundwater remediation technology where groundwater is pumped and treated in an above ground facility. The treated water is discharged into a storm water or sewage collection system or is injected back into the aquifer. Based on the results of the groundwater flow modeling, groundwater remediation by pump-and–treat alternative can be achieved by installing a French drain, and is considered a viable alternative for clean–up of this Site. This alternative is considered for further evaluation.

Groundwater pumping can be implemented by any of the following two scenarios for groundwater extraction:

- *Using Groundwater Extraction Wells*
- *A French Drain*

4.3.1 Groundwater Extraction Wells

This scenario considers groundwater to be pumped from several recovery wells. However, due to the presence of fine-grained sediments beneath the Site, the groundwater pumping rate from the recovery wells will be quite low (less than 0.5 gallons per minute (gpm) SOMA groundwater flow modeling, June 1999). Therefore, the technical feasibility of this alternative cannot be justified and will be dropped from further evaluation.

4.3.2 French Drain

Under this scenario, a French drain (interceptor trench) will be installed perpendicular to the groundwater contaminant plume (in a west-east direction), to capture the contaminated groundwater. The French drain will be backfilled with clean pea gravel, while an extraction well will be installed at the center of the French drain to extract chemically impacted groundwater. Based on the results of the groundwater flow model conducted by SOMA, the optimum length of the French drain will be 80 feet, with a width of 6 feet, and depth of 20 feet. The results of the groundwater flow modeling, using MODFLOW, indicated that the French drain would create a sizeable capture zone and will remove up to 8 gpm of contaminated groundwater beneath the Site under steady state conditions. Due to the low extraction rate of groundwater, a pneumatic pump is more suitable than an electric pump. The French drain can be constructed at on-site in the alley behind the mechanic shop. Due to the ease of construction, availability of enough space for construction of the proposed length of the trench, and avoiding clearing and grubbing, the installation of the French drain in the alley is a more desirable alternative.

Due to the advantages of the French drain over the other extraction alternative, this alternative is recommended as the most feasible groundwater pumping alternative. Technical specifications and other design considerations for the interceptor trench will be discussed in detail, in the proceeding sections of this report.

In the pump-and-treat alternative, pumped groundwater from subsurface is treated in an above ground treatment facility and permitted to be received by a Publicly Owned Treatment Work (POTW), injected back into the aquifer, or shipped off-site for treatment/disposal. As discussed in the previous sections, the major groundwater contaminants at this site are BTEX and MTBE. Since these compounds are fairly volatile and can be removed by activated carbon, other treatment alternatives, because of their higher capital and operation costs were not considered in this report. The following scenarios were considered for treatment of groundwater at the Site:

4.3.3 On-Site Treatment by Dual Granular Activated Carbon (GAC)

With this scenario, the contaminated groundwater will be pumped into GAC vessels, to pass through the activated carbon column inside the vessel. Activated carbon is an effective adsorbent because of its large surface area. Its large surface area is created by porous structure of GAC. Activated carbon is effective in adsorption of both MTBE and BTEX.

4.3.4 Groundwater Treatment by Air Stripper

Air stripping is a common method for treatment of the contaminated groundwater. BTEX and MTBE compounds are volatilized in an air stripper, as a result of the air bubbles blown in the water, countercurrent to the flow of water. The violent agitation that occurs as the bubbles pass through the water causes froth that allows a mass transfer of the organic hydrocarbons or volatilization of the hydrocarbons. A low profile air stripper is comprised of a blower, a storage chamber at the bottom of the unit and a transfer pump to transfer water from the chamber to the trays. At the bottom of each tray there are pores for blowing air into the water. Air strippers are supplied in carbon steel, stainless steel, and polyethylene.

Air strippers are very effective in the removal of BTEX. However, MTBE is difficult to remove by air stripping. In fact, volatilization of an organic compound depends on the Henry's Law Constant of the compound; the higher the Henry's Law Constant, the more easily the compound may be stripped. Due to the presence of MTBE in the groundwater, air stripper may be ineffective to meet the discharge limits for MTBE. Therefore, if the air stripper scenario is selected, a polishing GAC unit will be recommended to follow the air stripper unit.

Another disadvantage of air strippers is the requirement for off-gas treatment. There are stringent limits on atmospheric emission of total allowable mass of VOCs. In some cases vapor treatment units utilizing GAC are used for off-gas treatment. In larger systems, thermal or catalytic oxidizers are used for off-gas treatment. However, for this small treatment system GAC treatment of off-gas vapor will be preferable.

4.3.5 Off-Site Disposal of Untreated Groundwater

Under this alternative, groundwater will be pumped and hauled off-site for disposal. This alternative is the same as the pump-and-treat alternative except that on-site treatment and disposal systems are not provided. The pumped groundwater is stored in an above ground storage tank and a tanker trailer periodically removes the stored water for off-site treatment and disposal.

Assuming that about 8,000 gallons of groundwater per day is removed from the French drain and assuming an average cost of $0.30 per gallon for off-site disposal, the annual cost of disposal will be:

$$Total\ Annual\ Cost = 8{,}000\frac{gal}{day} x\, 365\frac{day}{yr} x\, \$0.3\frac{\$}{gal} = \$876{,}000\ per\ year$$

5.0 SELECTION OF PRESENTED ALTERNATIVES

Based on the result of groundwater flow modeling, installation of a French drain is the most effective alternative for extraction of chemical-impacted groundwater at the Site. Therefore, since other alternatives such as using groundwater extraction wells are not feasible and bio-remediation is a slow process which would take too long during which the contamination will continue to migrate off-site, the French drain was selected for groundwater extraction purposes. However, due to the feasibility and effectiveness of various treatment technologies the cost effective treatment alternative will be selected for treating extracted groundwater. For each alternative, the capital costs along with associated present value of annual operation and maintenance (O&M) costs over the next 10 years with 7% interest rate will be used to calculate the cost of implementation of that alternative. The following table compares the capital and O&M costs for the alternatives:

5.1 Cost Comparison of the Selected Groundwater Treatment Alternatives:

Soil Treatment Option	Capital Cost	Annual O&M Cost
SVE with Air Sparging	$25,000.00	$10,000.00

Groundwater Treatment Option	Capital Cost	Annual O&M Cost
Dual GAC System	$20,000.00	$ 10,000.00

Off-Site Disposal	$900.00	$876,000.00

As the cost table indicates, the SVE with air sparging is the only feasible alternative for soil remediation at this Site. This alternative would cost $25,000 for installation and $10,000 for operation and maintenance cost on an annual basis.

For the treatment of extracted groundwater, it appears that the off-site treatment is significantly more expensive than on-site treatment. **<u>Therefore, the combination of air sparging with pump-and-treat at on-site treatment system sounds more feasible, effective, fast and cost effective option.</u>**

6.0 REFERENCES

SOMA Environmental Engineering, Inc. (June 21, 1999), "Further Site Characterization and Conducting Risk Based Corrective Action at Tony's Express Auto Service Site, 3609 International Boulevard, Oakland, California"

SOMA Environmental Engineering, Inc. (June 30, 1999), "Second Quarter 1999 Groundwater Monitoring Report, 3609 International Boulevard, Oakland, California"

Soil Tech Engineering, November 8, 1993 "Interim Corrective Action & Preliminary Soil and Groundwater Investigation for Tony's Express Auto Service Station located at 3609 East 14th Street, Oakland, California

Western Geo-Engineers, July 13, 1998 "Results of Five Day Vapor Extraction Pilot Test at Tony's Express Auto Service Site, 3609 International Boulevard, Oakland, California"

Figures

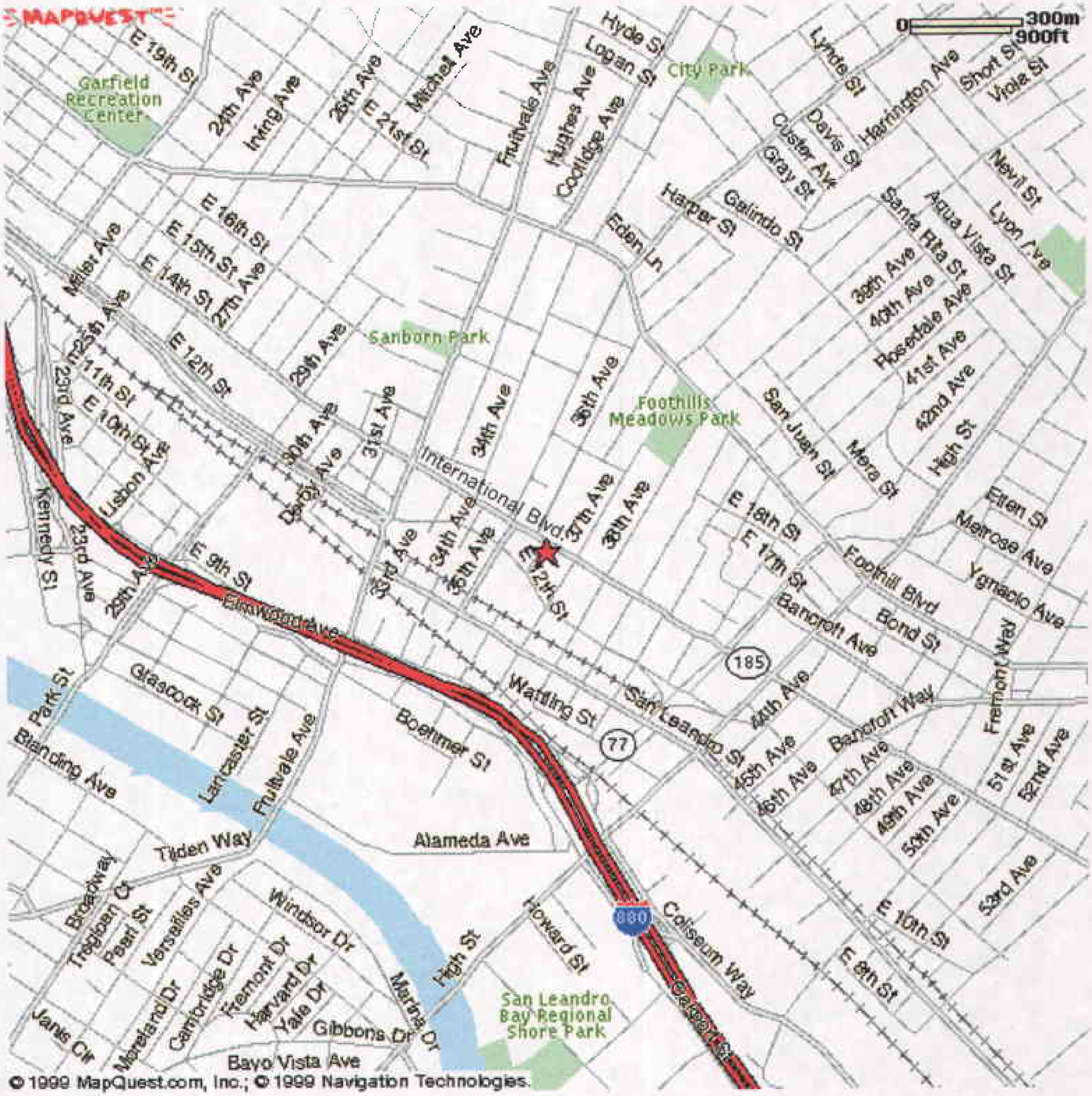

Figure 1: Site Location Map

SOMA ENVIRONMENTAL ENGINEERING, INC.

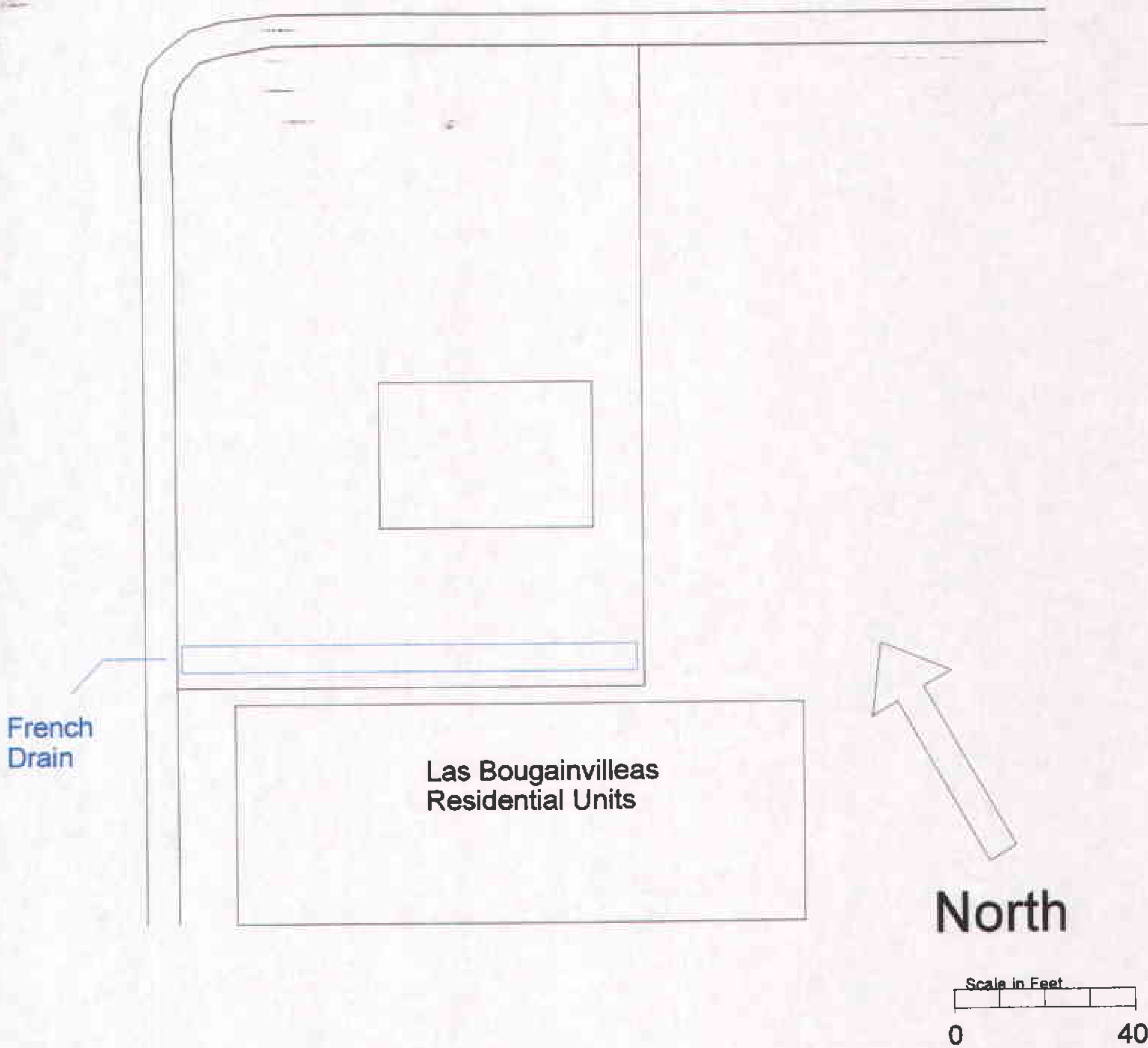

Figure 2: On-Site Map Showing the Location of Proposed French Drain

SOMA ENVIRONMENTAL ENGINEERING, INC.

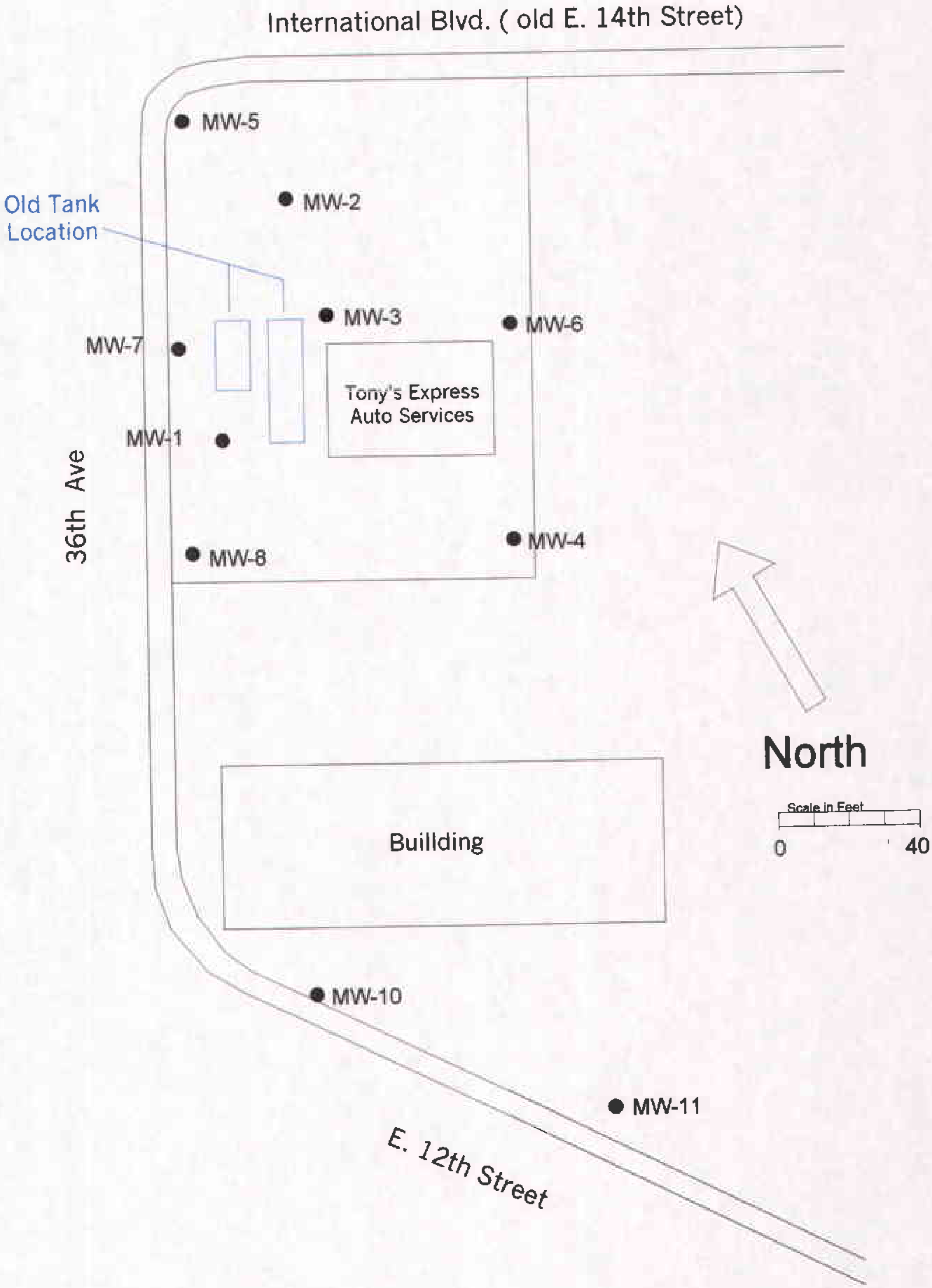

Figure 3: Locations of On-Site and Off-Site Groundwater Monitoring Wells

SOMA ENVIRONMENTAL ENGINEERING, INC.

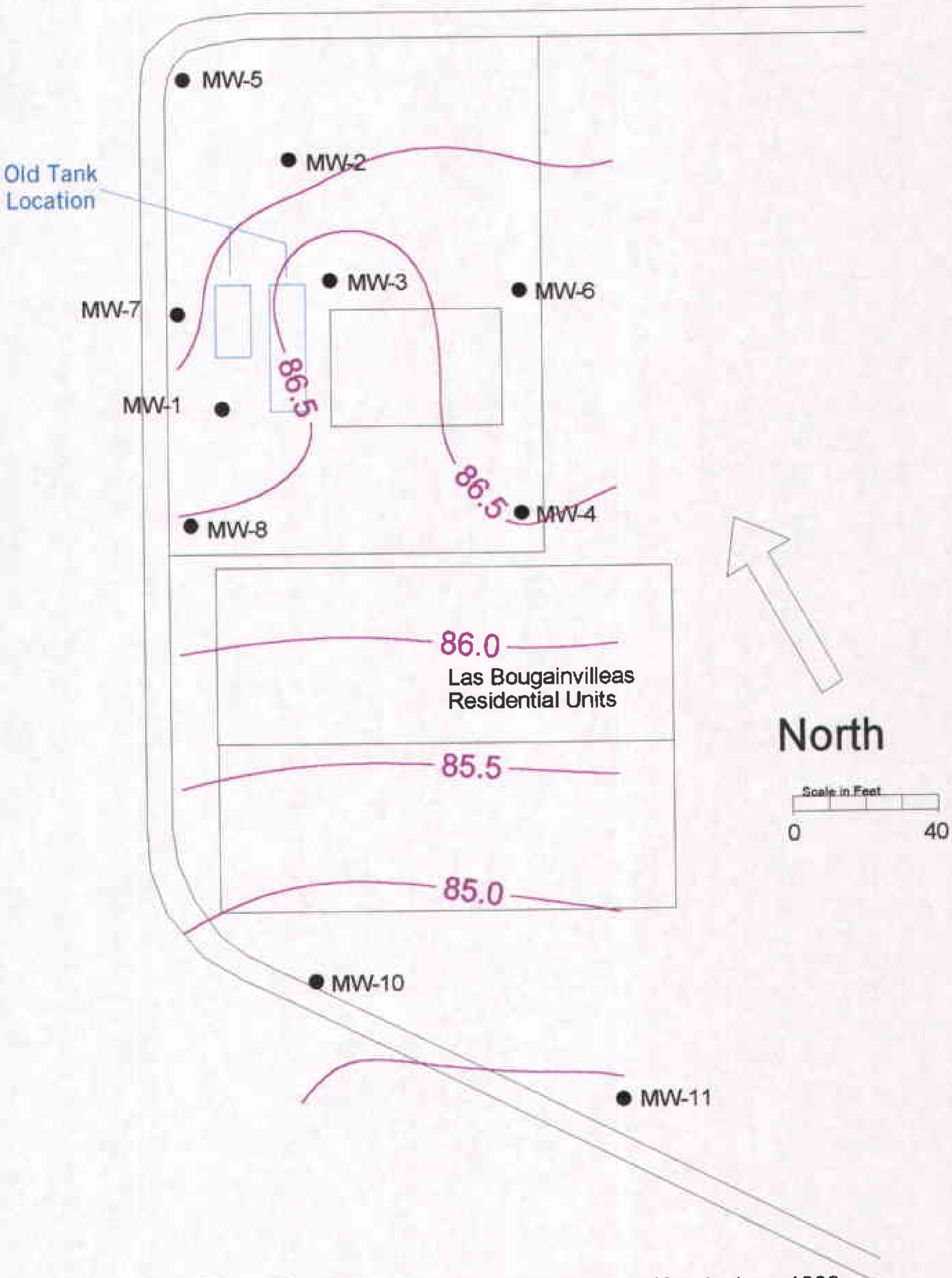

Figure 4: Groundwater Elevation Contour Map in June 1999

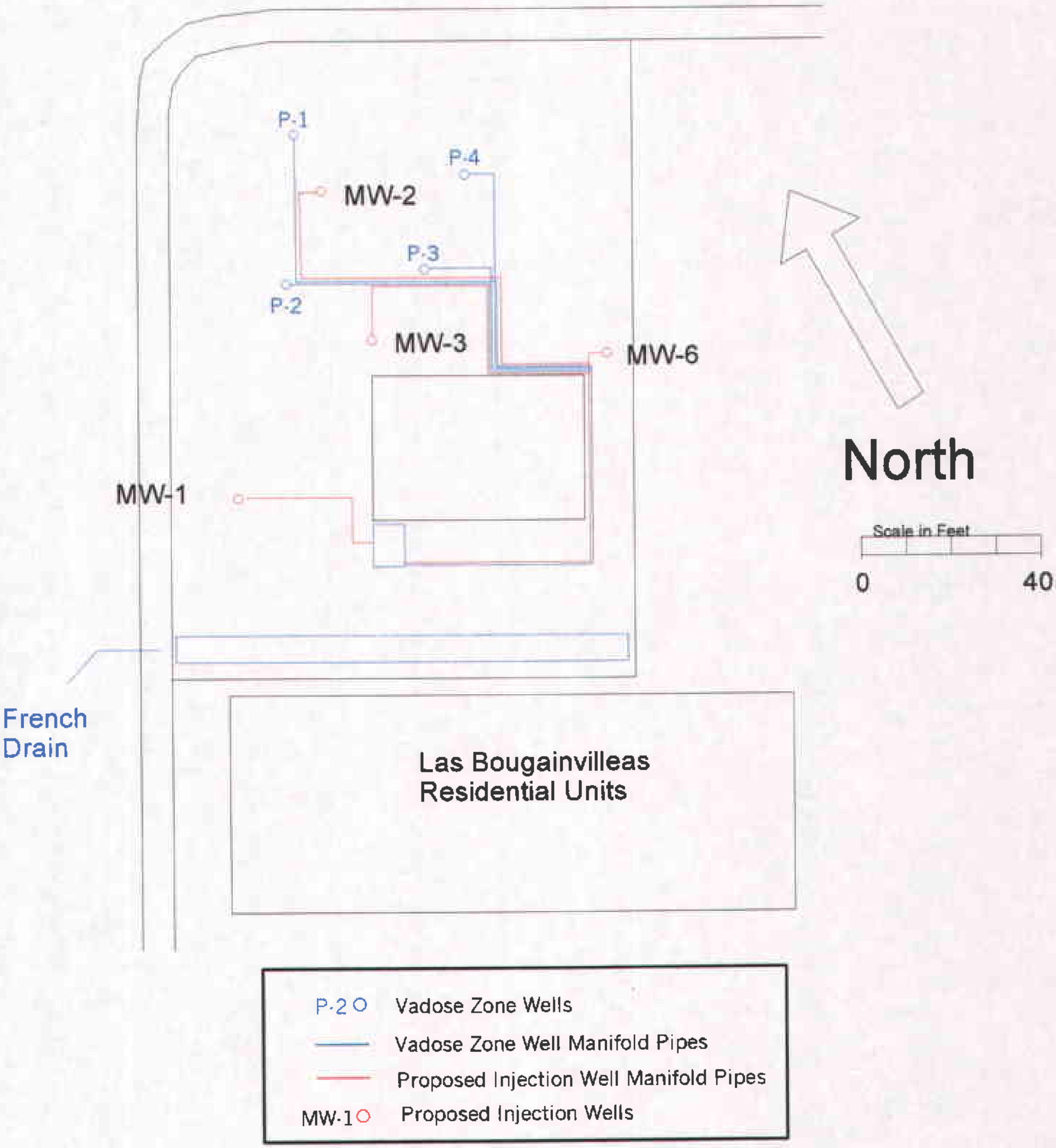

Figure 5: Location of Existing Vadose Zone Wells Installed by STE

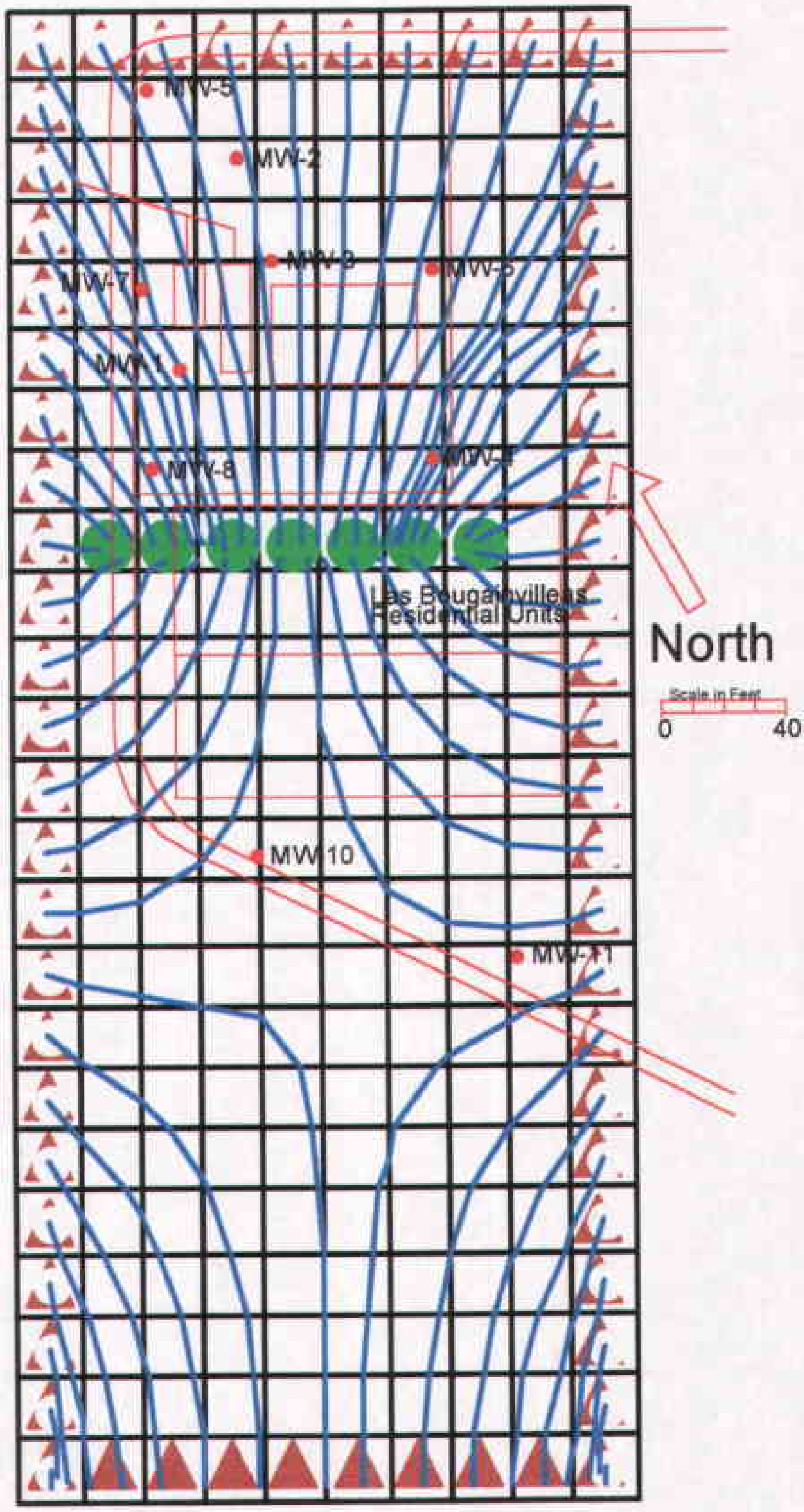

Figure 6: Simulated Capture Zone of the Proposed French Drain