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A.P.A. Fund, Ltd.
c/o Mr. Nicholas Molnar
1904 Franklin Street, Suite 501
Oakland, California 94612

Conceptual Approach to Soil and Groundwater Remediation
2801 MacArthur Boulevard
Oakland, California

Dear Mr. Molnar:

This letter records our conclusions regarding soil and groundwater remediation alternatives for the referenced site. Subsurface Consultants, Inc. (SCI) recently completed a supplemental soil and groundwater investigation and presented the results in a report dated July 14, 1993. Based upon the conclusions and recommendations presented in that report, we have performed an evaluation of remediation alternatives for the site. The following discussion regarding remediation alternatives is based on the information available. Specific clean up goals have not yet been established.

<u>Soil Remediation</u>

There are several options that are available to remediate gasoline contaminated soils. The alternatives considered include (1) excavation and off-site disposal, (2) in-situ bioremediation and (3) soil vapor extraction (SVE). We have evaluated the primary benefits/limitations of each alternative and have concluded that the most cost-effective and practical approach to soil remediation will be soil vapor extraction. For completeness, we have briefly summarized the most significant limitations for the other alternatives in the following sections.

Excavation and Off-Site Disposal

The physical removal of the gasoline contaminated soil by excavation is the alternative that has the highest likelihood of achieving remediation goals within the shortest time period. However, this approach is extremely costly and disruptive. For a variety of reasons, we conclude that the high cost of this alternative will not justify the environmental benefits to be gained. A brief summary of site conditions which would significantly affect costs are presented below.

Soil contamination exists over a relatively large area and is primarily at depths of 30 to 35 feet, generally coincident with the groundwater table. Excavation of these soils would necessitate the removal of the existing building, as well as approximately 20,000 cubic yards of soil. Roughly 70 percent of the soils would likely be "clean" soils, which would need to be removed in order to access the affected soils.

It would not be possible to stockpile the clean excavated soils on-site because of space limitations. Therefore, it will likely be necessary to dispose of all soils at an off-site location and import significant quantities of clean material to backfill the excavation.

In addition, because the affected soils generally extend several feet below groundwater, it would be necessary to install a dewatering system in order to excavate the affected soils and to treat the extracted groundwater.

In-situ Bioremediation

In brief, bioremediation is a process by which organic contaminants are broken down by the action of soil bacteria. Bacteria capable of degrading hydrocarbons exist naturally in soil. Therefore, by increasing the numbers of bacteria in the contaminated soil through the injection of bacteria and/or, nutrients and oxygen, degradation of the hydrocarbons can be accelerated. The groundwater displaced by the injected bacteria and nutrients matrix must then be extracted through a series of extraction wells.

The effectiveness of in-situ bioremediation depends significantly on the soil conditions. Where the soils are clayey and possess low hydraulic conductivities, such as at this site, it is physically impractical to circulate sufficient groundwater through the contaminated soils to make the process viable. For this reason, we conclude that in-situ bioremediation is not an appropriate option to remediate the contaminated materials at this site.

Soil Vapor Extraction (SVE)

As stated previously, we conclude that SVE represents the most practical and cost effective option with regard to soil remediation. In brief, soil vapor extraction consists of removing gasoline vapors from the soil through wells to which a vacuum is applied. The vapor stream is generally treated by granular activated carbon or thermal destruction prior to discharge to the atmosphere. Soil vapor extraction is a relatively cost efficient method of removing gasoline from soil, with minimal disruption to on-site business activities. However, the clayey soils underlying the site are very stiff and likely possess low permeability. For this reason, it will likely be necessary to utilize a relatively large number of vapor extraction wells that are spaced at close intervals. For preliminary planning purposes, we have assumed that the vapor extraction wells will be spaced on approximately 20 foot centers. On this basis, for the given area of contamination, approximately 42 wells would be required. This estimate may have to be revised based on more detailed review or pilot studies prior to design of a final system. The wells would be connected to a vacuum blower via a piping network. Installation of the system would create minor disruptions to business operations for approximately one month. However, once the system has been installed, little or no impact on normal business activities should be anticipated.

The effectiveness of SVE depends significantly on the soil conditions. The affected soils consist largely of stiff clays with low permeability, containing relatively thin dense clayey sand layers. It is our opinion that SVE will have the ability to reduce gasoline concentrations in soil, but may not be capable of uniformly reducing hydrocarbon concentrations. It may become necessary to modify the SVE system, i.e. add vapor extraction wells, after some period of operation to locally improve system effectiveness.

In order to improve system efficiency with regard to the contaminated soils that are currently below groundwater, we judge that it will be necessary to (1) locally lower groundwater levels in the area of remediation, or (2) utilize methods such as air sparging. Lowering groundwater levels will require the installation of several groundwater extraction wells and water treatment equipment. Permits would be required from the East Bay Municipal Utility District (EBMUD) to discharge treated groundwater into the sanitary sewer. If air sparging is utilized, air injection wells would need to be installed. These two options are described and evaluated in the context of groundwater remediation in the following section.

For planning purposes, we suggest that an SVE operation period of from 12 to 24 months be assumed. The system could be installed within a four to six week period.

<u>Groundwater Remediation</u>

In our opinion, there are several options available which could be used to remediate contaminated groundwater. Again, the effectiveness of many of the alternatives will vary, depending on the soil conditions. We judge that the most practical and cost effective options will involve (1) groundwater extraction and treatment, or (2) air sparging. Based on our preliminary evaluation, we judge that air sparging is the most desirable alternative.

Air sparging is a method which calls for air to be injected below the groundwater table. The contaminants are volatilized and are then captured by the SVE system installed for soil remediation. This method has successfully remediated water in soils of this nature.

Groundwater extraction would involve the installation of several groundwater extraction wells. The very low yields of the wells currently on-site indicate that extraction may not be effective. Additionally, it would be necessary to treat the groundwater prior to disposal. Consequently, an on-site groundwater treatment system would be needed.

Recommendations

We recommend that a more detailed engineering evaluation of our recommended remedial alternatives of soil vapor extraction and air sparging be performed to assure that the most appropriate option is selected and to prepare design and construction documents. Additionally, we recommend that the ACDEH review our proposed conceptual approaches to soil and groundwater remediation. Their approval should be obtained prior to proceeding with system design.

If you have any questions, please call.

Your very truly,

Subsurface Consultants, Inc.

James P. Bowers
Geotechnical Engineer 157 (expires 3/31/95)

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