GILES ENGINEERING ASSOCIATES, INC.
CONSULTING GEOTECHNICAL, ENVIRONMENTAL AND CIVIL ENGINEERS
W228N683 WESTMOUND DRIVE/WAUKESHA, WI 53186/414-544-0118

MILWAUKEE, WI
LOS ANGELES, CA

February 2, 1988

Quaker State Minit-Lube, Inc.
1385 West 2200 South
Salt Lake City, Utah 84119

Attention: Mr. Ronald D. Witzel
Construction Manager

Subject: Geotechnical Engineering Exploration and Analysis
Proposed Minit-Lube
Castro Valley Boulevard at Anita Avenue
Castro Valley, California
GEA Project No. C-880106

Dear Mr. Witzel:

In compliance with your request, a geotechnical engineering exploration and analysis has been conducted for the above referenced project. Transmitted herewith are four copies of the report. Conclusions and recommendations developed from the exploration and analysis are summarized below and discussed further in the accompanying report.

1. At the time of our exploration, the site was occupied by an abandoned gasoline service station. Reportedly, three subsurface fuel tanks and one waste oil tank were removed from the site in June 1987. Apparently, some leakage was noted; particularly associated with the waste oil tank. Loose and soft soils were encountered in our exploratory borings to depths on the order of 12± feet, and fill soils are anticipated in the tank backfill region to depths of 12± feet. Encountered fill soils consisted of a uniform fine sand with a greenish gray brown coloration. Underlying possible fill and native soils consisted of fine rounded gravelly silt with traces of sand, encountered to the depths explored. Groundwater was encountered in all of the deeper borings at depths ranging from 8½ to 10± feet below existing grade at the time of exploration. Some evidence of hydrocarbon content in the soils was noted in some of the borings, and discoloration was also noted in the shallow sand fill.

Giles Engineering Associates Inc

2. Although the site is not located within a currently designated Alquist-Priolo Special Study Zone, the site is located relatively close to the active Hayward Fault. Therefore, UBC structural and foundation design is recommended, using UBC seismic Zone 4 design criteria.

3. Based on the reported results of the tank removal monitoring, and the preliminary results of this subsurface exploration, the site is considered to have a moderate potential for hydrocarbon contamination. However, upon completion of additional analytical testing, an addendum report will be presented including an interpretation of the test results and the discussion as to the relative potential hydrocarbon contamination risk on this site. Alteration of construction recommendations included herein may be required, depending on the test results pending, conditions encountered during construction and/or regulations concerning hydrocarbons in the soil and groundwater.

4. Of primary geotechnical concern for this project is the very loose or very soft soils encountered at the removed fuel tank excavation, located below the foundation influence zone for the proposed building. It is recommended that these soils be excavated and recompacted for adequate foundation and slab support. Recommended removal depths may extend as deep as 12± feet below existing grade, requiring excavation below the encountered groundwater level. Therefore, specialized dewatering and excavation bottom stabilization measures may be required. The use of point wells in conjunction with uniform crushed rock and a geotextile may possibly be required to stabilize the excavation bottom.

5. Conventional spread footings may be constructed to provide support for the proposed structure, founded on compacted certified fill and/or <u>suitable</u> bearing undisturbed native soils. Groundwater was encountered as shallow as 8½ feet below existing grade, a drainage system is recommended to reduce the effects of potentially rising groundwater and surface water infiltration. Non-expansive, free-draining backfill is recommended. A conventional slab-on-grade is recommended for both the basement grade and at grade portion of the structure. Similarly, a conventional trash corral is also recommended. A pier foundation is recommended for support of the proposed sign such that the proposed sign foundation does not surcharge the Minit-Lube building foundation or basement walls. It is recommended that an experienced Geotechnical engineer monitor all demolition and

construction for this site to confirm that adequate removals are performed, and that soils are adequately and properly placed and compacted at the recommended moisture content and to the specified densities.

6. Asphalt pavement sections are recommended herein, consisting of either a full-depth asphalt pavement placed directly upon the properly prepared subgrades or a asphalt surface over an aggregate base section. Pavement subgrade should be scarified and moisture conditioned to near optimum moisture content prior to compaction. It is important that a well-graded and moisture conditioned subgrade be properly compacted for adequate pavement support.

7. Construction problems are anticipated on the proposed site due to the moisture sensitive nature of the encountered soils, volatile organic compound content, and the relatively shallow groundwater. Special measures may be required to manage difficult subgrade conditions.

Giles Engineering Associates Inc

To assist in understanding the intent of the enclosed report and to help identify potential construction cost "extras"; two inserts have been enclosed in the Appendix for your use. We appreciate the opportunity to be of service on this project. If we may be of additional assistance should geotechnical problems occur or to provide monitoring and testing during construction, please do not hesitate to contact us at any time.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

Thomas Benson Jr. 8-3-88

Thomas C. Benson, Jr., P.E.
Branch Manager
RPE No. C-037896

714-666-167

Jeffrey S. Miller

Jeffrey S. Miller, P.E.
Director
Geotechnical Engineering

12/31/89

Terry L. Giles, P.E.
President
RPE No. C-032654
RGE No. 00342

Encl: GEA Report No. C-880106

Distribution: (1) Mr. John Kosinski
National Director of Construction
(2) Tarlos and Associates
Attn: Mr. John Tarlos

TCB/psl
CA11

GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS
AND PRELIMINARY HYDROCARBON CONTAMINATION EVALUATION

PROPOSED MINIT-LUBE
Castro Valley Boulevard at Anita Avenue
CASTRO VALLEY, CALIFORNIA
GEA PROJECT NO. C-880106

## INTRODUCTION

The scope of geotechnical services for this project included a site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the foundation, floor slab, basement, trash corral, sign, and pavement design for the proposed development. This scope of services also addressed the risk of petroleum contamination on this site at the present time, and included a brief discussion of potential site-specific seismic hazards.

## SITE AND PROJECT DESCRIPTION

The proposed development parcel is located in the northwest corner of the intersection of Castro Valley Boulevard and Anita Avenue in Castro Valley, Alameda County, California. The proposed parcel is roughly rectangular in plan with dimension on the order of 80 feet north-south by 100 feet east-west. At the time of this subsurface exploration the proposed parcel was occupied by an abandoned gasoline service station and was surrounded by a chain link fence. A single story metal service station building was located in the north central portion of the parcel, and the associated two fuel pump islands and overhead canopy were located directly to the south of the existing service station building (as shown on Figure 1). Much of the remainder of the site was covered with asphalt pavements; however, a large area of asphalt pavement had been removed in a region directly to the east of the fuel pump islands, which is understood to be the zone where subsurface fuel tanks were removed. This site slopes gently to the the southwest with on the order of 2 feet of relief from the northeast corner to the southwest corner. This is generally consistent with the surrounding topography which slopes down towards the San Francisco Bay to the west.

It is understood that the proposed new structure will consist of a three-bay Minit-Lube masonry building with exterior dimensions of approximately 64 x 32 feet. The structure will have a partial basement under the bays approximately 7½ feet below the finished first floor level. The remainder of the building (office, waiting room, and storage) will be constructed at grade without a basement. Most of the structure will be supported by perimeter bearing walls with the loading anticipated to be a maximum of approximately two kips per lineal foot. Several interior pipe columns are included in the design for support of the service area floor. Maximum column loads are estimated to be 20 to 25 kips. The basement floor slab and the slab-on-grade are presumed to be subjected to a maximum design live load of 200 pounds-per-square-foot (psf) considering product storage. For design purposes, the parking lot area is anticipated to be subjected to moderate automobile traffic consisting of approximately 500 light vehicles per day with only occasional heavy supply and garbage trucks, for a design period of ten years.

First floor elevation of the proposed Minit-Lube building is understood to be at elevation 168.5 feet above sea level, as shown on the"Grading Plan" by Michael J. Majors Civil Engineers, Inc., dated December 8, 1986. The floor of the basement or service pit which is about 7½ feet below the first floor would therefore be at about El. 161 feet. The existing ground surface in the proposed building area ranges from a elevation of about 167 to 169 feet and would therefore require only minor general grading with some increase in grade to facilitate surface drainage away from the proposed structure.

SITE HISTORY

It is understood that the site was a previously operating Texaco service station. A report by Geonomics Inc. dated June 30, 1987, documents the removal of four fuel tanks and one waste oil tank on the proposed site. A 300-gallon waste oil tank which was located directly to the south of the existing service station building was removed. In addition, 10,000-gallon, 7,500-gallon and 5,000-gallon gasoline tanks were removed in a region southeast of the service station building, located from east to west respectively. As stated in the June 30, 1987 "Soil Sampling Report - Underground Storage Tanks" by Geonomics Inc.

> "The water table was encountered at 11.0 feet, approximately one foot above the bottom of each of the three large tanks. It was decided, therefore, to collect soil samples from native soils adjacent to both ends of those tanks, immediately above the water table. A sheen was showing on the surface of the water in the vicinity of tank C (western-most tank). There was sheen on the surface of the water in the vicinity of tank B but less than that near tank C. The two composite samples were collected at the request of Castro Valley Fire Department Battalion Chief, Dennis Wade."

Test results reported in the above referenced report indicated that total hydrocarbons on the order of 100 parts per million were located adjacent to the western-most fuel tank. A sample was also obtained from a spoil pile located on the west end of the site which was reportedly excavated from around the gasoline tanks. Total hydrocarbons were reported to be 15 parts per million for this sample. Significant diesel and waste oil, and total oil and grease, along with hydrocarbons were also detected in the soils around the waste oil tank. Total xylene on the order of 1500 parts-per-billion (ppb) were reported for a sample obtained from the waste oil tank pit excavation.

Reportedly the fuel tanks were removed and the above described soil samples obtained on June 16, 1987. The 10,000-gallon tank was reportedly a fibreglass tank at a depth of 12 feet below grade. The 7,500-gallon and the 5,000-gallon gasoline tanks were "unwrapped steel" tanks also buried at a depth of 12 feet, reportedly. The 300-gallon waste oil tank was also a "unwrapped steel" tank buried at a depth of 5 feet below grade. The fibreglass tank was reported in "good condition, no holes observed". However the steel tanks were reported to have "some rust and pitting but no holes observed. There was gasoline-soaked soils around the vapor recovery line which was connected to the fill riser. Some rust noted at water line approximately one foot above bottom, otherwise good condition." However, the waste oil tank was reported to be "very rusted and corroded. Multiple holes observed".

GEA is unware of any activity on the site since June 30, 1987, and prior to this exploration. It is not known if clean-up was ever started on site or completed.

FIELD AND LABORATORY TESTING

Six soil test borings were drilled to depths of 5 to 20 feet for this project. Borings were backfilled with the excavated site soils upon completion of drilling and sampling. Test boring logs (Record of Subsurface Exploration) and Boring Location Plan, Figure 1, are enclosed in the Appendix. The method of estimating the boring locations in the field is also indicated on the Boring Location Plan. Elevations shown on the logs were estimated using the "Topo & Boundary Survey" by Michael J. Majors Civil Engineers, dated October 27, 1986, and are presumed accurate to within 1.0± foot.

Field exploration for this project consisted of performing Standard Penetration Tests (SPT) in general accordance with ASTM D-1586 Standard Test Method. The SPT test provides an approximation of the relative density of granular soils and the comparative consistency of cohesive soils, thereby providing a method of evaluating the subsoils relative strength and settlement characteristics. In addition, to provide relative soil design parameters, a soil sample is also obtained from the SPT sampler for classification of the subsoils and soil laboratory testing. Soils obtained from the field exploration were originally classified in the field by the GEA drilling crew and again reviewed in the laboratory by a soils engineer in general accordance with the Unified Soil Classification system (ASTM D-2488-75).

A soil mechanics laboratory testing program was conducted on selected representative samples obtained from the subsurface exploration. A natural moisture content profile was determined for the subsoils along with an evaluation of their strength characteristics by performing unconfined compression and calibrated penetrometer resistance tests. Laboratory testing performed was chosen to evaluate a combination of strength and settlement characteristics of the subsoils.

In addition to the above described geotechnical testing, all recovered soil samples were tested with a Photoionization Detector (PID) equipped with a 10.2 eV lamp calibrated to benzene. The vapor analysis consisted of sampling the sample jar head space to test for the presence of volatile organic compounds such as those found in gasoline and higher concentrations of motor oil.

Soil parameters indicating the engineering characteristics of the materials encountered in the test borings as determined by the field and laboratory testing, and PID test results are presented on the logs and figures enclosed in the Appendix of this report with the symbols and notations defined on the General Notes enclosed as the last page of the Appendix. All Geotechnical field and laboratory testing was performed in general accordance with standard sampling and testing methods.

## SUBSURFACE CONDITIONS

Asphalt pavement was penetrated in Boring Nos. 3, 4, and 6 with thicknesses ranging from 1½ to 2± inches. Underlying the asphalt pavement and encountered at the surface in the remaining borings was a crushed aggregate base with thicknesses ranging from 2 to 3 inches. Fill soils were encountered in Boring Nos. 1, 2, 4, 5, and 6 to depths ranging from 1 to 4± feet below existing grade. Soils suspected of being fill were encountered in Borings Nos. 1, 2, 3, 4, and 6, to depths ranging from 3 to 10± feet below existing grade. However, as described in the Site History section above, tanks were buried as deep as 12± feet below existing grade, and therefore, fill soils to depths of 12± feet are anticipated in the fuel tank exhumation areas. Fill soils encountered in Boring Nos. 1, 2, and 5 consisted of a greenish gray brown fine sand with a trace of silt, but was relatively uniform, to depths of 4± feet below grade. Underlying soils which were suspected of being fill consisted primarily of brown to dark brown and occasionally black fine rounded gravelly silt, with traces of fine to coarse sand and clay. Encountered fill and possible fill soils consistencies were relatively variable with very soft to loose soils encountered at depths ranging from the surface to possible 12± feet below existing grade, as primarily indicated by the very low Blow Counts in Boring No. 2, but also encountered in Boring Nos. 1, 5, and 6.

Underlying native soils were similar to the gravelly silt soils described above which were suspected of being fill. Brown fine rounded gravelly silt with traces of clay and fine to coarse sand was encountered to the depths explored. Some dark brown to black clayey silt and gravelly silt was also encountered interbedded with the dark brown to brown clayey silts.

The near-surface fill soils which consisted of greenish gray brown fine sand was suspected to have at least at one time contained hydrocarbon content due to their coloration. Similarly, a strong petroleum odor was noted in the sample obtained at a depth of 8½ to 10± feet in Boring No. 2 (PID = 140ppm). A slight petroleum odor was also noted in relatively shallow samples obtained in Boring No. 3 (PID = 5ppm).

Free water was encountered in all of the five deeper borings at depths ranging from 8½ to 10± feet below existing grade, upon completion of drilling for this exploration. The free water levels were initially encountered at a lower depth, but the water levels rose with time until the water was measured and the borings were backfilled. As stated in the Site History section of this report, groundwater was reported at a depth of 11 feet below grade on June 16, 1987. This seems consistent with the typical seasonal fluctuation with groundwater rising during the winter months and lowering during the summer months. Additional fluctuation, of the groundwater level is anticipated and it is also possible that perched or shallow groundwater may be encountered due to local infiltration into relatively permeable layers which overlie less permeable layers.

The above described subsurface conditions have been simplified somewhat for ease of report interpretation. A more detailed description of the subsurface conditions at the test boring locations are described on the test boring logs enclosed in the Appendix.

## CONCLUSIONS AND RECOMMENDATIONS

The conditions imposed by the proposed building, trash corral, sign, and pavement have been evaluated on the basis of the engineering characteristics of the subsurface materials encountered in the borings and their anticipated behavior both during and after construction. Conclusions and recommendations for foundation, floor slab, basement, trash corral, sign, and pavement design along with construction considerations and site preparation requirements are discussed in the following sections of this report. Potential seismic and hydrocarbon contamination risk for this site are also discussed below. Alteration of recommendations presented herein may be required, depending upon the necessary actions regarding subsurface hydrocarbon content on-site.

Site Development Considerations

a) Seismic Design Considerations

Research of the available geologic information indicates that the site is considered to be subject to lateral ground acceleration in the event of a seismic occurrence due to the proximity to fault systems in the local area that experienced movement since Quaternary time (approximately 2 million years ago). The most significant Quaternary fault system in the area is the Hayward Fault System which is located approximately one to two± miles to the west. This site is not, however, located in an area currently designated for special studies under the Alquist-Priolo Special Study Act of 1972, and does not appear to represent a significant fault rupture hazard potential.

The subgrade soils encountered on this site generally consist of cohesive deposits and the long term water table is considered to exist at a depth greater than nine± feet. Based on the cohesive characteristics of the subsoils, these soils are considered to have a relatively low potential for liquefaction under nominal seismic activity. Special structural design for liquefaction is, therefore, not considered to be necessary for this site and structure.

The site is situated in a historically active seismic zone of California and will be subject to lateral accelerations and ground shaking during a seismic event. All foundation designs must therefore be performed in accordance with the Uniform Building Code (Zone 4) and local governing regulations. Foundation lateral load resistance recommendations are presented later in this report.

b) Hydrocarbon Contamination Considerations

The site was previously developed as a gasoline service station with three large fuel tanks and a waste oil tank. As discussed in the Site History section above, all four tanks were removed on June 16, 1987. As reported by Geonomics Inc. in their report dated June 30, 1987, total hydrocarbons on the order of 100 parts per million were measured in a sample obtained on the west side of the removed fuel tanks. Also, it was reported that the 300-gallon waste oil tank was very rusted and corroded and had multiple holes observed. Consistent with this tank failure, samples obtained adjacent to the waste oil tank exhibited levels as high as 5300 parts per million of diesel and waste oil and 16,000 parts per million of total oil and grease. Total xylene of 1500 parts per billion (ppb) were also reported for a sample obtained directly below the 300-gallon waste oil tank. At the time of the tank removal it was reported that "the water level was encountered at 11 feet, approximately 1 foot above the bottom of each of the three large tanks." "A sheen was showing on the surface of the water in the vicinity of tank C (the western-most tank). There was sheen on the surface of the water in the vicinity of tank B, but less than that near tank C."

This current GEA exploration encountered samples with slight to significant petroleum odors in Boring Nos. 2 and 3 at depths ranging from on the order of 1 foot to 12± feet. Further, moderate PID readings were measured in the samples, indicating the presence of volatile organic compounds, possibly including hydrocarbons. Similarly, soils with a greenish gray coloration typically indicative of hydrocarbon content, were encountered in the near surface fill soils in Boring Nos. 1, 2, and 5; however, these sands did not have detectable odors or PID readings.

To further evaluate the potential for hydrocarbon contamination, two samples suspected of containing hydrocarbons were sent to a subcontractor analytical laboratory. However at the time of writing, the test results were not yet available. The report was presented without these test results in an effort to expedite this project. Upon completion of testing, an Addendum letter will be presented including the hydrocarbon content test results, and an interpretation and discussion of the test results with respect to development of the proposed parcel. Some alteration and additions to recommendations presented herein may be required, pending the test results.

It seems apparent based on the above reported site history and preliminary subsurface findings, that at least a waste oil tank previously located on the site had leaked. Similarly, there is some evidence that some minor leaking of the fuel tanks may have also occurred. This past leakage in combination with the relatively shallow groundwater table is cause for concern. It is generally accepted that much lower hydrocarbon levels are allowed in groundwater relative to those which may be allowed in the vadose zone of soils. This is due to the fact that hydrocarbons in the vadose zone of soils may not affect human health. Whereas contamination of groundwater, which may find its way to drinking water supplies, may directly affect human health.

GEA is unaware of any past or current operations to clean-up the site. Information obtained by the current exploration indicates that volatile organic compound concentration on-site is possibly isolated to the former storage tank areas, and that some clean-up in the past may have been done.

Pending the results of the analytical tests being performed, this site is considered to have a low to moderate risk of hydrocarbon contamination. Some remedial action should however be anticipated. Subsoils (fill and/or native soils) may contain unacceptable levels of volatile organic compounds in the former tank area in the proposed building location (and possibly in other areas). Excavation of these affected soils and pumping water, and treatment may be necessary beyond the limits of excavation for normal building construction. Aeration of soils after excavation and re-use as structural fill in areas outside the building area, in-place treatment, water treatment, use of impermeable liners, special below grade wall and drainage system construction, and excavation precautions must be considered. Actions necessary are dependent on the results of the analytical testing, conditions encountered during construction, and requirements of local, state, and federal authorities.

With respect to future liabilities, it should be noted that the waste oil tank had apparently leaked. Since Minit-Lube proposes to install new oil and waste oil tanks on the project, the potential future liability is considered to be relatively high, since similar oil products will be stored on site. Therefore, it is strongly recommended that if Minit-Lube has not yet purchased the property and chooses to do so, that all real estate contracts be written such that the future liability of Minit-Lube be reduced with respect to hydrocarbon and oil contamination on this site. Underground storage tank installation and construction will have to be performed in accordance with the local, state, and federal underground storage tank installation regulations. Site development costs should therefore provide a contingency for future monitoring/testing requirements.

As reported in the June 30, 1987 Geonomics, Inc. report, significant corrosion of the subsurface unwrapped steel tanks have occurred. Corrosion protection of any buried ferrous materials is recommended. However, it may be desirable to evaluate the site soil corrosive potential. Giles Engineering Associates, Inc. (GEA) may perform such tests upon request, including resistivity, pH, and soluble chloride and sulfate content. However, it should be noted that GEA stores samples for no more than 30 days unless specifically requested. Therefore, it is recommended that if additional testing is to be performed on the samples obtained for this exploration, that this additional testing be authorized prior to 30 days from the time of this subsurface exploration.

c) <u>Site Grading and Structural Considerations</u>

A significant grading cost consideration is the complete removal of the existing facilities and structures on this site. The building, canopy and other structures and any concrete slabs or remaining asphalt pavements should be completely demolished and removed from the site. Any subsurface remnants of the tanks, structures, or utilities which are not to be salvaged should also be completely removed. All demolition excavations required to remove these facilities should be observed by an experienced Geotechnical (soils) consultant prior to the placement of any backfill. All removal excavations should expose firm, non-organic, uncontaminated, undisturbed native soils.

Site soils are expected to be significantly moisture sensitive. If site grading is performed during the rainy season, some grading difficulties should be anticipated. It may be required to stabilize the silty and clayey soils with Portland Cement, crushed rock, and/or a geotextile. Adequate site surface drainage, both during and after construction is expected to reduce the problems associated with the moisture sensitive silts and clays.

Of primary geotechnical concern for this project is the presence of potentially uncertified fill to depths of 12± feet and the very loose soils or soft soils encountered in Boring Nos. 1, 2, 4, 5 and 6. Any fill in former subsurface tank areas or in other areas on-site which is not adequately certified and placed under geotechnical engineering control conditions will have to excavated and recompacted to provide adequate support for the proposed site improvements. The proposed basement excavation is expected to extend on the order of 8 to 10± feet below existing grade. However, very loose soils were encountered at depths ranging from near-surface to 10± feet and possibly to a depth of 12± feet. To provide adequate support for the proposed Minit-Lube building, these very loose soils should be excavated down to a suitable firm or stiff subgrade, anticipated to be at a depth on the order of 12± feet. Groundwater was encountered as shallow as 8½± feet below existing grade. Therefore, special dewatering and excavation bottoms stabilization measures will likely be required for the anticipated removal depths of 12± feet. Excavation, dewatering and bottom stabilization requirements will be largely dependent upon the time of year and the relative groundwater level at the time of construction. It is possible that sump pumps placed in the bottom of the excavation may be adequate. However, point well dewatering may also be required such that a quick condition does not occur at the bottom of the basement and loose soil removal excavation. A uniform free-draining crushed rock may be required to be placed at the bottom of the excavation, possibly in conjunction with a geotextile, to stabilize the excavation bottom. <u>These potential excavation difficulties and the need for overexcavation should be considered in the project budget.</u> Due to the anticipated excavation required below the at-grade portion of the building, it may be desirable to construct a full basement, rather than replace and compact fill under the at-grade portion of the building.

In some cases where loose or soft soils are encountered in the foundation influence zone, a reduced bearing value and increased footing reinforcement is sometimes recommended. However, since the local municipality is not likely to allow construction of structures above uncertified fill and since the soils are extremely loose, this is not considered to be appropriate for this project. Hence, the need for overexcavation as discussed above and later in this report.

Conventional spread footings or monolithically poured footings and slabs may be used for support of the proposed structure. These footings or monolithically poured footings and slabs may be founded at nominal depths on the recompacted soils. It is recommended that non-expansive free-draining granular backfill be used behind the proposed basement walls. This is recommended so that hydrostatic or increased earth pressures on the basement walls are avoided or reduced to acceptable levels. Groundwater was encountered as shallow as Elevation 159'± feet, but may also rise to shallow elevations. Also, water infiltration adjacent to the basement may occur due to perched water or infiltration of irrigation or other surface water. To reduce the potential for structural distress due to build up of water behind basement walls, or under slabs, a drainage system around the perimeter of the basement is also recommended.

Conventional trash corral and pavement designs are recommended. The trash corral should be conventionally reinforced. Pavement sections are recommended consisting of either a asphalt overlaying a well-graded base, or a full-depth asphalt pavement section. Adequate site surface drainage is a key consideration to reduce the potential for distress due to the moisture sensitive subgrade soils.

### Site Preparation

Prior to the start of construction, the existing facilities should be demolished and all rubble should be suitably disposed of off site. All existing tanks and utilities which are not to be salvaged should be completely removed, and permanently and adequately capped at the property line, or rerouted as required. All existing uncertified fill should be excavated exposing undisturbed, uncontaminated native soils. All removal excavations should be observed by an experienced Geotechnical (soils) consultant prior to the placement of any backfill.

Site preparation throughout the parcel will require removal of any existing fill, vegetation (if any), and any unstable organic or other deleterious materials. Existing pavement and base materials should be completely removed from proposed landscape areas. It will likely be desirable to leave the existing pavements in place prior to the completion of the proposed structure, to reduce the potential for construction problems related to the moisture sensitive subgrade soils. Following removal and/or pulverization operations, the subgrade should be proofrolled to detect soft, yielding soils which must be removed. Following proofrolling, the subgrade should be scarified, moisture conditioned, and recompacted in accordance with the enclosed specifications. Low areas and excavations may then be raised to the planned finished grade with compacted fill. All fill to be placed on site should be compacted to at least 90 percent of the ASTM D-1557-78 maximum laboratory density, at a moisture content near optimum moisture for the subgrade soils. Any imported soils should consist of non-organic materials with an Expansion Index (EI) less-than 30. All fill and backfill soils or imported soils should be free of cobbles and boulders larger than 3 inches in largest dimension. Compaction operations should be monitored and tested by a Geotechnical (soils) consultant. Site preparation and structural fill selection, placement and compaction should be performed in accordance with the specifications enclosed in the Appendix of this report (Modified Proctor Procedures).

As discussed above, very loose or soft soils were encountered to depths on the order of 10± and possibly 12± feet below existing grades, particularly in Boring No. 2. Tank removal excavations were reportedly to depths of 12 feet. Hence, it is likely that uncompacted and uncertified backfill was placed in the tank removal areas. These loose soils are not expected to provide adequate support for the proposed building. It is therefore recommended that these soils be excavated down to a suitable firm or stiff native subgrade anticipated to be at a depth of 12 feet, and replaced and recompacted for foundation and slab support. This will require excavation below the encountered groundwater level at the time of this exploration. However, groundwater levels are expected to fluctuate seasonally. In any case some specialized dewatering and excavation bottom stabilization may be required. The use of screened sump pumps may be adequate, however point well dewatering systems may also be necessary. The use of a uniform crushed rock in conjunction with a geotextile may also be required to stabilize a wet, soft and unworkable excavation bottom. If such a condition does in fact occur, it is strongly recommended that GEA be consulted to provide recommendations regarding excavation bottom stabilization. All backfill of removal excavation should be performed as discussed above. It may be prudent to import granular soils which may be more easily compacted than the encountered site silts and clays. As an alternative to overexcavation and recompaction, the foundations may be extended down to the suitable undisturbed native soils. However, slabs-on-grade should be placed on either properly compacted fill or firm/stiff undisturbed native soils. Adequate dewatering is strongly recommended such that the exposed native soils are not disturbed due to hydrostatic pressures and potential boiling of the soils exposed below the groundwater level.

Since the subsoils on this site consist of moisture and disturbance sensitive materials composed of clay, the degree of problems encountered during site grading and construction will be directly depend upon the weather at the time of construction. Special precautions must be taken during basement excavation in order that safe conditions are maintained with respect to caving. Stability of the foundation and basement excavations will be dependent upon excavation methods, weather conditions, construction traffic patterns, duration of exposure, and dewatering requirement and techniques, if required. Special excavating, shoring, bracing, or other embankment stability recommendations are considered beyond the scope of services authorized for this exploration. If embankment stabilization or excavation recommendations are require prior to or during construction, Giles Engineering Associates, Inc. (GEA) can provide recommendations upon request.

Foundation Design Parameters

Following the recommended subgrade and site preparation, the proposed building may be supported by means of conventional wall and column spread footing foundations. A turned-down slab or monolithically poured foundation and floor slab with thickened edges and interior bearing areas construction/design techniques may also be used on this site. Trench footings may be used where the building code allows, and the trench wall soils are stable. Foundations may either (1) be extended in depth through any unsuitable bearing soils to a suitable bearing soil grade (engineered fill and/or native) that has been approved by a geotechnical engineer and/or (2) placed at the typical embedment depths below the basement floor elevation on structural compacted fill used to replace any existing uncertified fill or other unsuitable bearing existing soils from throughout the foundation influence zone. Due to the anticipated removal of unsuitable soils below the at-grade portion of the building, it may be desirable to construct a full basement for the building, to reduce the quantity of fill replacement and compaction. Foundations may be designed for a maximum, net, allowable bearing capacity of 2500 psf for footings. This moderate soil pressure is considered to be economical and reasonable for the lightly loaded structure, and not expected to require significant increases in width. Minimum foundation widths for walls and columns should be 15 and 24 inches, respectively, for strength considerations. Conventional reinforcement may be used if footings are founded on undisturbed native or properly compacted and certified fill soils. Where footings transition from basement footings to the shallower footings which support the at-grade construction, footings should be stepped. Stepping should be provided at a gradient no steeper than 1:1 (horizontal to vertical). Steps should be overlapped as recommended by the structural engineer. Care should be taken to found footings on either undisturbed native soils or properly compacted structural fill. Care should be taken to not interrupt the proposed drainage described below.

Suitable soils for direct foundation support or structural fill subgrade and indirect foundation support should have at least a stiff consistency (average qu greater than or equal to 1.0 tsf) for cohesive soils or a firm relative density (average N value greater than or equal to 11) for non-cohesive soils for the recommended maximum bearing pressure. Soils suitable for support of the recommended foundation system are anticipated to be available at a depth of about 12 feet below the existing grade in the recommended tank areas.

Anticipated depths to suitable bearing for direct foundation or structural fill support is tabulated below for each boring drilled for this exploration:

| BORING NUMBER | SUITABLE BEARING SOILS DEPTH TO (feet) ** | ELEVATION (feet) |
|---|---|---|
| 1 | 10± * | 158± * |
| 2 | 12± * | 156± * |
| 3 | 11± * | 158± * |
| 4 | 8± * | 160± * |
| 5 | 12± * | 156± * |
| 6 | 3± | 166± |

* Removals on the order of 12 feet below current grade are anticipated in removed tank zones. However, additional excavation may be required to remove all uncertified fill, loose/soft, or contaminated soils.

** Below existing grade at the time of this exploration

These values may be interpolated for quantity estimates, only. However, it should be noted that fill soils are expected to be located primarily in tank backfill areas (see Figure 1).

Due to the potential variability of the existing soil and existing building, it is recommended that the suitability of the foundation bearing grade or structural fill subgrade be determined by a Geotechnical (soils) engineer at the time of construction to ensure that the foundation system is supported on suitable bearing soils as recommended herein. As indicated earlier, all uncertified existing fill soils and/or organic soils should be completely removed from foundation bearing areas. If unsuitable bearing soils are encountered at the proposed foundation grades, they should be removed to a suitable bearing subgrade and to a lateral extent in accordance with Item No. 3 (0.5:1 horizontal to vertical) of the enclosed specifications, and the excavation backfilled with structural fill to develop a uniform bearing grade. Otherwise, foundations may be extended by thickening the footing pad. Significant overexcavation costs are recommended to be budgeted for this project, due to the potential variability as a result of existing and past site development.

Minimum foundation embedment depth for the UBC is understood to be 12-inches. However, footings which support the at grade portion of the building should be founded at least 24-inches below adjacent exterior grade due to the moisture sensitive nature of the foundation soils. Perimeter basement wall foundations at nominal depth below the basement floor will automatically meet embedment requirements. Footings and their excavations must be protected against weather damage both during and after construction and all foundations must be supported on suitable bearing soils.

Post-construction total and differential settlements of a foundation system designed and constructed in accordance with the enclosed recommendations are estimated to be less than 1.0 and 0.5 inches, respectively, which is considered within tolerable limits for the proposed structure.

b) Lateral Load Resistance

Lateral load resistance for cohesive soils will be developed by a combination of adhesion acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. Passive pressure and adhesion may be used in combination, without reduction, in determining the total resistance to lateral loads. A one-third increase in these adhesive and passive values may be used for short term wind or seismic loads.

A lateral sliding adhesive resistance of 150 pounds-per square-foot (psf) of contact area on soils may be used for horizontal footing surfaces poured on the recommended properly recompacted or undisturbed encountered soils.

Allowable passive earth pressure of 250 psf per foot of footing depth below the lowest adjacent final grade (pcf) may be used for the sides of footings placed against properly compacted backfill or poured against undisturbed encountered soils. The maximum recommended allowable passive pressure is 1500 psf.

Slabs-On-Grade Design Parameters

Basement and at grade slabs-on-grade may be designed as conventional slabs-on-grade supported by newly placed structural compacted fill, as recommended in the above Site Preparation section. If desired, the floor slab may be poured monolithically with the perimeter foundations with thickened sections for exterior walls and interior columns and/or structurally isolated and designed as separate units. The floor slab must be supported by a typical 4 to 6 inch compacted uniformly graded, well draining, clean, granular base placed on a suitably prepared subgrade at basement grade. A slab subdrainage system should be installed as recommended in the following Below Grade Walls and Drainage System section. All footing excavations and utility trenches should be completely backfilled and properly compacted prior to the slab pour. A polyvinyl sheet should be placed immediately below the floor slab to serve as a vapor barrier in areas where moisture might present a problem with floor coverings. If the materials underlying the polyvinyl sheet contain sharp, angular particles, a cushion layer of sand approximately 2 inches thick or a non-woven geotextile should be provided to prevent puncture.

With proper site preparation and monitoring, the post-construction total and differential settlement of the floor slabs constructed as recommended and structurally isolated from footings is estimated to be less than 0.5 and 0.3 inches, respectively, which is considered within tolerable limits for the proposed structure. Slabs poured monolithically with footings are expected to settle similar to the estimates presented in the above Foundation Design Parameters section.

Below Grade Walls and Drainage System

The hydrostatic water table is considered to be at Elevation 159½± feet (8½± feet below grade at the time of this exploration). Change in the water level will, however, occur seasonally and with varying precipitation, and surface water may also accumulate or be trapped adjacent to below grade walls within the backfill. Therefore, to reduce the potential for excessive hydrostatic pressure build-up against the below-grade walls resulting from groundwater accumulation, a permanent subdrainage system as depicted on Figure 2, "Schematic Drainage System" is recommended.

Lateral pressures that will be subjected to the subgrade walls are dependent upon the excavation bank slope and distance from the basement walls, the type of backfill soil and compaction, the type of soil within the excavation banks, the water level, and the imposed load at the surface adjacent to the subgrade walls. Soils on this site generally consist of low to moderate strength silts and clays. Due to the shallow groundwater, and the potential for loss of soil strength if the silts and clays become wet, it is recommended that non-expansive free draining sands be imported to backfill the basement walls. Free draining sands should contain no more than five percent fines passing the number 200 U.S. Standard Sieve, by dry weight. In addition, a geotextile is recommended to be placed on the excavation bank to prevent the infiltration of fine grained soils into the free draining backfill. An Equivalent Fluid Pressure of 45 psf per foot (pcf) below adjacent grade may be used for the below-grade walls design with the above recommended free draining backfill soil. Use of heavy compaction equipment near the subgrade walls will develop substantial lateral pressures in excess of the value given above. Compaction with hand operated equipment and to at least 85 percent of the maximum density obtained by the Modified Proctor Compaction Test is recommended so that excessive pressures do not develop. However, backfill which is to support slabs or pavements should be compacted to at least 90 percent of the Modified Proctor. Temporary bracing during compaction may be prudent.

As indicated, special precautions must be taken during excavation in order that safe conditions can be maintained in excavations, with respect to caving. Based on the anticipated excavation depths, soil types, and soil strength characteristics encountered at the test boring locations, some widening and/or flattening of the foundation excavations or more specialized stabilization methods will likely be necessary. However, stability will be somewhat dependent upon excavation method, weather conditions, construction traffic patterns, duration of exposure, and the technique and suitability of dewatering. Construction difficulties will likely be encountered due to the existing site developments. Some excavation of unsuitable fill or loose or contaminated soils may be required and should be considered in the project budget and schedule. Specific excavating, shoring, bracing, dewatering, or other embankment stability recommendations are considered beyond the scope of services authorized for this exploration. If embankment stabilization or excavation recommendations are required prior to or during construction, GEA can provide such recommendations upon request.

Trash Corral Design Parameters

The proposed trash corral is understood to be located in the extreme northwest corner of the property in the area of Boring No. 6. Subsoils at Boring No. 6 generally consist of three-feet of fine gravelly silt fill.

The trash corral is understood to consist of a flexible wooden fence, or chain link fence or a more rigid masonry block type enclosure. The planned enclosure proposed for this site is considered to be relatively light and, therefore, a conventional bearing capacity analysis is not considered to be applicable. The trash corral area will, however, be subjected to impact loads imposed by trash removal equipment.

An economical foundation system for the proposed trash corral is therefore considered to consist of a Portland Cement concrete slab to support the fence or masonry wall enclosure. The concrete pad should typically consist of a 6-inch minimum thickness air-entrained concrete slab supported on a 4 to 6 inch well-graded aggregate base and a properly prepared subgrade. Minimum slab reinforcement should consist of No. 3 reinforcing bars placed 24-inches center-to-center, in two perpendicular directions, placed mid-height in the slab. The slab edges should be thickened to 12 inches wide by 18 inches in embedment and reinforced for wall/fence support and should be designed by a qualified structural engineer. GEA can provide such a design upon request. Perimeter thickness and reinforcement will be a function of the type of wall chosen.

Sign Foundation Design Parameters

The structural details and loading requirements of the proposed sign were not available at the time of this report. Therefore, only preliminary recommendations can be provided. However, it is understood that the sign will be approximately 21½ feet tall and is to be located in the vicinity of Boring No. 4, where primarily stiff cohesive soils were encountered.

A typical sign foundation generally consists of a spread footing or drilled pier founded at a depth of about 4 to 6 feet below the adjacent ground surface for over-turning considerations. Based on the soil conditions encountered on this site, a drilled pier is considered to be more suitable for use due to the close proximity of the proposed sign to the building, and the potential for the sign foundation to surcharge the building foundation or basement walls. On a preliminary basis, the pier may be designed for a minimum drilled depth of 6 feet and a vertical load bearing capacity of at least 2,500 pounds per square foot. A lateral load capacity consisting of a passive Equivalent Fluid Pressure equal to 500 pounds per square foot per foot of embedment may be used for design. However, passive resistance should be discounted for the top depth that the pier penetrates below lowest adjacent grade equal to the diameter of the pier. A maximum allowable passive pressure of 3,000 pounds-per-square-foot should not be exceeded using the equivalent fluid passive pressure recommended above.

Due to the potential for variable subsurface conditions on the site as a result of past development, and the critical nature of installation of drilled piers, it is strongly recommended that an experienced Geotechnical (soils) consultant observe pier excavation and installation procedures. It should be noted that the primary cause of drilled pier failure is improper construction procedures. Hence, geotechnical monitoring is strongly recommended.

Pavement Design Parameters

a) Asphalt Pavements

After subgrade preparation is performed as described in the Site Preparation section of this report and the enclosed specifications, the subgrade is anticipated to generally consist of clayey silts and fine sands materials with an estimated R value ranging from 10 to 50 based on the potential moisture sensitive nature of the soils. Since a specific R value test has not been authorized for the preparation of the recommendations, a conservative R value of 10 has been used in the preparation of the pavement design, considering the moisture sensitivity of the soils. It should, however, be recognized that the City/County may require a specific R value test to verify the following design to be used. Alternatively, the City/County may require the minimum code pavement section be used if a specific R value test is not performed. In order to use this R value, all fill added to the site must have pavement support characteristics at least equivalent to the existing soils, and must be placed and compacted in accordance with the enclosed specifications.

It should be noted that the surface of the pavement subgrade should be compacted to a higher density than the underlying soils at a moisture content near optimum for proper pavement support. However, extreme caution must be used in preparing the subgrade. If these soils are too wet, an attempt to compact the soil will reduce rather than improve subgrade conditions. A Geotechnical consultant should therefore be contacted for alternative recommendations if the subgrade soils are wet and yielding at the time of construction.

Site preparation throughout the entire parking areas is anticipated to require moderate to extensive overexcavation considering the presence of the previous construction. A budget for overexcavation and possible subgrade problems should therefore be included in the development costs.

The following table is presented indicating the recommended thicknesses for a flexible pavement structure for asphaltic concrete with a granular base and full depth asphaltic concrete along with the appropriate CALTRANS specifications for proper materials and placement procedures.

Pavement Section Thickness (inches)

| Materials | Granular Base | Full Depth | CALTRANS Specifications |
|---|---|---|---|
| Asphaltic Concrete Surface Course | 1 (b) | 1½ | Section 39, (a) |
| Asphaltic Concrete Binder Course | 1½ (b) | 4 | Section 39, (a) |
| Crushed Aggregate Base Course | 6 | - | Section 26, Class 2 (well-graded) |

(a) Compaction to density between 95% and 100% of the 50-Blow Marshall Density
(b) The surface and binder course may be combined as a single layer placed in one lift if similar materials are utilized.

Pavement recommendations assume proper drainage and construction monitoring and are based on CALTRANS design parameters for a ten year design. Due to the possible presence of existing fill throughout the proposed pavement areas, some annual maintenance and/or repair of the pavement may be necessary and should be budgeted appropriately.

b) Concrete Pavements

A concrete pad typically about 10 by 30 feet in dimension is recommended in the loading area in front of the trash corral due to the heavy impact loads developed by trash removal equipment in this area. Concrete pads are also recommended in all areas subjected to relatively high vehicular stresses such as entrances and exits to the service bays. The concrete pads should typically consist of a 6 inch thick properly reinforced and air-entrained concrete slab with a 4 to 6 inch compacted well graded aggregate base and properly prepared subgrade.

A possible alternate to the above recommended asphaltic concrete pavement may consist of a Portland Cement concrete which may be less expensive than asphalt with a granular base or a full-depth asphalt. After proper subgrade preparation, a 5½ inch Portland Cement concrete slab thickened to 6½ inches in high stress areas (such as the dumpster loading zone, and lot and service bay entrance and exits) supported on a subgrade prepared in accordance with the enclosed specifications is considered suitable. The concrete should have a 28 day compressive strength of 3,000 psi with 4 to 7 percent air-entrainment. Reinforcing should consist of 6 inch-square ten-gauge welded wire mesh (WWM) to help provide some additional rigidity, considering the moisture sensitive and potentially variable subgrade. Three-quarter-inch diameter smooth dowel bars should be placed at all joints. The dowel bars should be placed 18 inches on-center. Expansion joints should be provided where pavements abut fixed objects, such as light poles and structures. The concrete pavement may be underlain with a well graded granular leveling and mat course. Materials and construction procedures for concrete pavements should be in accordance with CALTRANS Specifications, Section 40.

Construction and Other Design Considerations

The water table was considered to be 8½± feet below existing grade which is considered to be above the depths planned for construction related excavations. Further, storm or irrigation water may become trapped at shallower depths. Where water is encountered, filtered sump pumps placed in the bottoms of excavations or other conventional dewatering methods may be adequate with the anticipated excavations. However, specialized dewatering may be required to extend the excavation down to the anticipated depth of 12± feet below existing grade. A point well dewatering system may be necessary. Stabilization of the excavation bottom using a uniformly graded crushed rock, typically a 3/4-inch crushed rock, possibly in conjunction with a geotextile may be required. It is important that the foundation bearing soils or compacted fill native-subgrade soils not be disturbed or loosened due to potential hydrostatic forces and boiling. Therefore, adequate dewatering may be a critical consideration for this project. It is strongly recommended that GEA provide additional recommendations for excavation dewatering and/or excavation bottom stabilization as required. The degree of excavation dewatering and bottom stabilization difficulties will be directly dependent upon the seasonal water level and the weather at the time of construction.

Foundations excavation and general site stripping will expose a clayey silt and silt subgrade which is considered to be moisture sensitive. If these soils are exposed to moisture, they are considered to be susceptible to significant decrease in strength and increase in settlement characteristics. Soils which are disturbed due to increased moisture content must be removed and replaced with non-expansive (EI less-than 30) material within the planned building areas. The site must therefore be graded to prevent ponding and surface water from running into excavations. Foundations and floor slab concrete should be poured as soon as possible after the concrete has set up. Accumulated water in soils must be dried and recompacted and/or removed and replaced with a structural fill that has been placed and compacted in accordance with the enclosed specifications.

Soils excavated from the site that do not contain excessive organic or other deleterious materials and do not exhibit any petroleum or chemical odors may be reused as compacted fill in the planned parking areas, but are not recommended for use as backfill along the basement walls due to their poor drainage and potential loss of strength characteristics. All subgrade soil recompaction, and placement and compaction of fill soils must include careful control of the moisture content, in accordance with the enclosed specifications.

The property was previously developed as a gasoline station. Therefore, some budgeting for excavation of remnants of the previous structures and areas containing soils with volatile organic content or unsuitable bearing existing fill is recommended and should be planned. Care must be exercised to ensure that all previous foundations, floor slabs, underground utilities, underground tanks, etc., are located and properly removed.

Development of the proposed site entails some demolition, soil, and foundations oriented problems especially with respect to the presence of volatile organic compounds, fill soils, and moisture sensitivity of the existing soils. Recommendations presented in this report are predicated upon site preparation, foundation, basement, floor slab, and pavement construction monitoring and testing performed by an experienced Geotechnical (soils) consultant.

GENERAL COMMENTS

Soils samples obtained during the subsurface exploration will be retained for a period of 30 days. If no instructions are received, they will be disposed of at that time.

This report has been prepared to aid evaluation of this property and to assist the architects and engineers in the structural design. It is intended for use with regard to the specific project discussed herein and any substantial changes in the building, loads, locations, or assumed grades should be brought to the attention of Giles Engineering Associates, Inc. (GEA) so that a determination of how such changes affect these conclusions and recommendations can be made.

Information contained in this report has been based on presently accepted practices in assessing potentially contaminated soil and groundwater from service station related petroleum hydrocarbons. Regulations governing soil and groundwater contamination issues, including action levels for various chemical compounds and required "clean-up" levels where contaminants are present, are presently being developed by federal, state, county, and various regional authorities. Further evolution of standards and guidelines and enforcement responsibility is anticipated, which may alter currently accepted practices. Changes in the present guidelines may require further expenditures for "clean-up" or additional exploration and analysis as a result of previously existing conditions.

Information presented in this report may affect the value of the proposed site, especially where a potential for subgrade contamination exists, and is based on a limited amount of authorized testing. The information disclosed in this report is considered confidential. Release of the report and/or information contained herein must be carefully considered and should not be performed without the consent of Giles Engineering Associates, Inc. (GEA).

Analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, GEA must be contacted immediately to determine if the conditions alter our recommendations.

Conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practice in the field of geotechnical engineering.