GROUNDWATER
TECHNOLOGY, INC.
CONSULTING GROUNDWATER GEOLOGISTS

CONSIDERATIONS ON RETRIEVAL OF PRODUCT FROM GROUNDWATER CHEVRON STATION #9-0121 McARTHUR FREEWAY OAKLAND, CALIFORNIA

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CHEVRON - OAKLAND

BACKGROUND

Chevron Station # 9-0121 at McArthur Freeway, Oakland, California has been involved with underground storage tank problems since 1965. At this time the original tanks were removed and replaced with steel tanks double wrapped in asphalt. In 1980, these tanks were replaced with fiberglass tanks. Reportedly dozens of truck loads of product contaminated soil were removed from the site during this operation.

Action taken by Chevron included Kentmore tests on all tanks and lines and construction of 6 wells for product recovery by vacuum pumps and suction pumps. These attempts proved only partially effective as evidenced by the continued problem of product and vapor infiltration to an adjacent office basement after periods of prolonged rainfall.

On June 12, 1981 Chevron contracted Groundwater Technology, Inc. (GTI) to analyze the apparent groundwater contamination problem including definition of the source of product, areal extent of product contamination, direction of product movement, direction of groundwater movement, and effectiveness of previous clean-up program.

In mid July, G.T.I. supervised the installation of 4 (four) additional observation wells and conducted a detailed sampling survey to delineate the extent of the problem.

The following report is based upon activities taken by G.T.I. while onsite, plus analysis of data collected at that time as well as previous information collected by Chevron and it's sub-contractors.

TOPOGRAPHIC SETTING

The Chevron Oil Company gasoline service station occupies a portion of a gently sloping area at the base of a hill near the shore of Lake Meritt, a manmade lake less than 1000' to the southwest. The site slopes towards the northwest in the direction of Lake Meritt.

GEOLOGY

The area at and surrounding the Chevron Oil Company service station is underlain by unconsolidated sediments. Information collected from construction of the observation wells show this to be a fine silty-to-sandy clay of low permeability. Geologic materials encountered while drilling to the rear or southeast were somewhat sandy while wells located toward Lake Meritt exhibited profiles most similiar to the typical Bay Mud Unit.

HYDROGEOLOGY

Groundwater conditions at the site, as impacted by the product loss, are underwater table conditions with the upper liquid surface free to rise and fall in response to local recharge from precipitation. Subsurface conditions, as determined from review of available data and assessment of drill logs, indicate a relative low soil permeability and accordingly groundwater turnover through the area.

Changes to native soil permeability via manmade modifications (i.e.- Excavation for foundations and backfill for tanks) have apparently created localized zones that are more permeable. These same zones of modified/improved permeability appear to act as artificial collection areas for past product losses. Review of the collected data indicates the presence of weathered hydrocarbons coincident with these locations.

Groundwater movement within the area is apparently further modified by the existence of a 7' diameter sewer system lying to the rear (northwest) of the property.

OBSERVATIONS

- Four (4) additional observation wells are designated D,E,F. and G (See Fig. 1).

1. The wells were drilled between 14' and 21' below surface.

2. All wells were cased with field slotted 8" diameter PVC casing to within 4" of land surface. Slots were spaced and staggered to provide optimum communication with water and oil bearing zones.

3. All wells were backfilled with clean pea gravel up the annulus between casing and well bore to within 6" of surface, and then grouted with cement to prevent surface water inflow to the wells.

- The top of the casing of each well was surveyed to a permanent control point (Benchmark) located on the westerly curb of Lakeshore Avenue.
  Casing elevations for each well are shown in Table #8 as well as water level measurements on 4 (four) separate dates.

- Subsurface conditions (well logs and drilling diary are shown in the appendix tables 1 - 7).
  (a) Generalized log for all wells is 0 - 2' fill, 2'-21' yellow brown to blue gray sandy clay.

(b) Odors of hydrocarbon (weathered gasoline) mixed with soil were encountered at 1-3 feet in well D, and from 7 to 10' in E,F, and G in blue-to-green gray clay. These zones of clay mixed with weathered product coincide with the water level encountered at each well.

4. Review of water level information indicates a generally northwesterly direction of groundwater flow. Figs. 2&3

The apparent reverse gradient anomally at wells E, F,and G is explained by the 7' storm sewer across the rear of the property Fig. # 2 which acts as an apparent groundwater sink or discharge zone.

5. All newly installed wells (wells D,E,F and G) on the periphery of the property were void of free product accumulation.

6. Wells A,B,C,H,I and J obtained less than 1" of weathered product on the water table. Well C contained the most product, with up to .5" retrieved in the sample August 4, Fig. # 4 shows product accumulation centered at the tank area and along the office building foundation to the west. (Table # 8)

PUMP TEST

On August 4, well H was subjected to a pump test. (Table 9) Due to the low permeability of the bay mud silt and clay, the well ran dry after pumping for 50 minutes at 1 gpm. Wells B and I, 15' and 8' away respectively evidenced a slight drop in water level (.05'. No drawdown was detectable in the other wells on the property.

SUMMARY

The data collected to date shows:

- Free product is restricted to the center and west of center of the gas station apparently restricted to the backfill material at these locations. Communication between these two locations probably occurs during high water table conditions via the product delivery line trenches.

- Low permeablility of the bay mud and proximity of product plume to excavated tank storage and pipelines indicates that the density change due to excavation and back filling favors accumulation at these points and limits movement outside the immediate back filled zones.

- The adjacent building with odor complaints is down gradient (watertable) from central pits, such that the building foundation apparently traps product.

- Volume of product remaining in the area is small as evidenced by the small accumulations at each of the observation wells. Based upon the data a crude calculation allowing for worst case conditions would indicate significantly less than 300 gallons of free product to be on site.
  (i.e.) Assume area 40' x 40' by 1/2" gasoline saturation @ 25% porosity in gravel yields 120 gallons of product in the tank pit with the area adjacent to the building representing a smaller volume of free product.

- It is likely that a certain volume of product is physically bound to the heavy silts and clays outside the backfilled zones where it is periodically released by fluctuating water levels in the area, subsequently accumulating in the back filled zones.

- The volume of remaining product is limited so that any recovery will be relatively cost intensive per unit of product removed.

RECOMMENDATIONS

- Physical removal and recovery of the product will be necessary to abate the persistent problems of odors, dissolved and free product accumulating in the tank pit. and building sump.

- Physical retrieval of the limited volume could best be accomplished via installation of a two pump recovery system (See Fig # 5) where a well is drilled to some depth below the water table and two pumps are installed. The well should be constructed of well screen or perforated casing and 1 (one) pump used to lower the water table (create a cone of depression) and the other pump used to remove free product accumulating within the cone of depression.

- As the permeability of the insitu material is relatively low, as determined by our brief pump test, it may not be feasible from a time vs. site physical conditions to successfully retrieve the product with one recovery well.

  1. Ideally 1 (one) well located in the area of the existing tank pit could be deployed using a sufficiently deep drawdown and area within the pumping cone to contain and retrieve the product.

  2. Based upon site conditions recovery with one well and associated drawdown could prove a problem i.e. lowering water and product level- below the back filled material into the underlying muds and silts where it could become physically bound to the organics and fine grained sediments.

- To avoid this possible scenario two recovery wells one located adjacent to the tank pit and one in the vicinity of the existing recovery system could be employed utilizing less drawdown and smaller pumping cones of depression.

- As the quantity of product remaining is small and the rate of turnover is likely to be small it is recommended that Oil Recovery Systems, "filter scavenger" and "water table depression pump" be used.

  1. To utilize the "filter scavenger" and "water table depression pump" (WTDP) requires a 24" diameter well casing and screen. This normally entails construction of a 30" diameter hole with backfill of the annulus between hole and casing with appropriately sized sand/ gravel pack.

- As the site is an active service station all recovery equipment, electrical and plumbing hook-ups will have to be located out of active traffic routes or be buried below grade.
  1. As the 1 (one) recovery site is to be located in the tank pit a below ground chamber with plumbing and electrical hook-up will have to be developed. This will have to include a below grade discharge line for water and product recovered.
  2. The second recovery location adjacent to the existing tank and manifold system could be developed above grade for the most part but should consider below ground construction to avoid damage from unauthorized third parties.

- Well depths and construction will have to be designed with the overall clean-up concept in mind i.e. 1 (one) recovery well or 2 (two) wells and considerations to minimize dissolved gasoline in the discharge. Current thinking envisions wells at 20-25' total depth with maximum drawdown to 12'-15'.

- Local Governing Agencies and Authorities will have to be contacted to obtain necessary permits and approvals for construction of the system and to allow discharge of the water.

- Considerations that Chevron should entertain are:
  1. Construction of 2 (two) recovery wells with full equipment and hook-up.
  2. Construction of 2 (two) recovery wells equipping only 1 (one) with recovery equipment with continued monitoring to determine on going ground water conditions.

(a) After product removal at prime recovery location, reinstall equipment at secondary recovery point.

3. Develop only 1(one) recovery well with equipment installed to control total area.

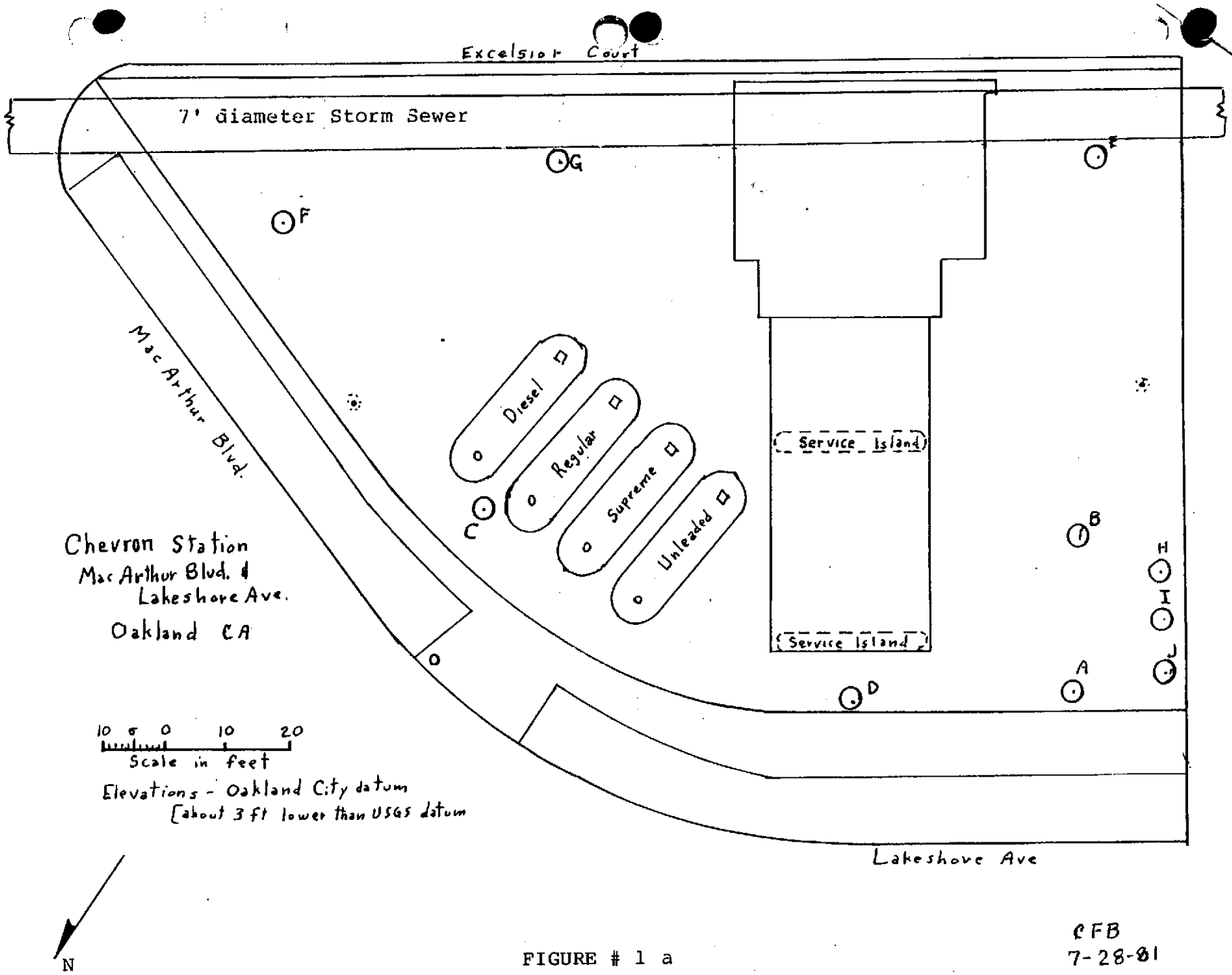

FIGURE # 1 a

CFB
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