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Consulting Services

April 3, 1997

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

RE: *Draft Preliminary Design Report*, Fueling Area, UPRR Oakland TOFC Railyard

Dear Ms. Eberle:

In response to your letter dated March 21, 1997, enclosed is a copy of the *Draft Preliminary Design Report*, dated September 5, 1991, for updating your file of the Union Pacific Railroad (UPRR) Fueling Area at the Oakland trailer-on-flat-car (TOFC) facility at 1717 Middle Harbor Road in Oakland, California.

If you have any questions or require additional information, please contact Harry Patterson of UPRR or Denton Mauldin at (303) 938-5539.

Sincerely,

Denton Mauldin, P.E.
Project Manager

for M. Gallup

Mark Gallup, P.E.
Senior Project Manager

cc: Harry Patterson, UPRR

Enclosure
DM/tjh

oakfa\pdesign.ltr, 96199, April 3, 1997

5665 Flatiron Parkway Boulder, Colorado 80301-2800
Phone 303.938.5500 Fax 303.938.5520

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PRELIMINARY DESIGN REPORT
GROUNDWATER TREATMENT AT
UNION PACIFIC RAILROAD'S
OAKLAND, CALIFORNIA TOFC YARD

PREPARED FOR: UNION PACIFIC RAILROAD

BY: USPCI, INC.

September 5, 1991

Job Number: 96199

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1. INTRODUCTION

This report presents a preliminary design for treatment of contaminated groundwater produced by a hydrocarbon recovery system at Union Pacific Railroad's (UPRR) Oakland, California rail yard. The report documents the design basis for the groundwater treatment system, analyzes various treatment alternatives, describes the selected treatment alternative, and provides a treatment system implementation schedule. Information regarding the installation of three groundwater recovery wells, is also covered in this report.

UPRR's Oakland rail yard is located at 1717 Middle Harbor Road in Oakland, California. Operations at this facility consist of loading and unloading over-the-road trailers onto flatcars (TOFC) for rail transport. The facility also includes a small re-fueling rack for diesel locomotives. The site is bordered on the south and west by the Oakland Estuary and on the north by the Navy Supply Center.

Information on hydrocarbon contaminated soil and groundwater at the rail yard is summarized in USPCI's report, **"Hydrocarbon Investigation and Remedial Design at Union Pacific Railroad's Oakland, California TOFC Yard, June 10, 1991"**. As recommended in the remedial design, a hydrocarbon recovery system consisting of three recovery wells equipped with individual total fluid pumps was installed at the rail yard during the month of June 1991. The recovery wells serve to depress the groundwater surface and recover free diesel product.

The remedial design proposed in the June 10, investigative report, recommended discharging the groundwater/diesel mixture produced by the total fluid pumps to a permitted on-site oil/water separator. Water produced by the separator would then be discharged to the East Bay Municipal Utility District (EBMUD) sanitary sewer system. However, specific EBMUD permit requirements for groundwater remediation systems prevented discharge to the on-site separator without substantial design and permit modifications. This report presents an updated treatment design which will meet EBMUD's permit requirements.

2. RECOVERY WELL INSTALLATION

A total of three recovery wells were installed in the Oakland TOFC Yard on June 17 through June 19, 1991. The Oakland recovery wells (ORW-1, ORW-2 and ORW-3) were installed immediately adjacent the locomotive fueling facility, in the Northern portion of the yard (see Figure 2.1). The boring logs and well completion diagrams are displayed in Appendix A.

The soil borings and monitoring well installations were completed under the technical supervision of a USPCI geologist. The on-site geologist was present at all times during drilling to: 1) technically supervise the drilling subcontractor; 2) maintain a continuous log of materials penetrated by the borehole; 3) obtain and document soil samples; 4) test soil samples, drilling cuttings, and atmospheric conditions within the workplace with an organic vapor monitor (OVM); and 5) oversee implementation of USPCI's Health and Safety Plan. In addition to the USPCI geologist, a California Registered geologist was periodically on-site to review and approve the boring and well installations.

2.1 DRILLING AND SOIL SAMPLING

Soil borings were performed using a truck-mounted drilling rig equipped with 12-inch and 8-inch diameter hollow-stem augers. This drilling method was performed without the introduction of drilling fluids and allowed for the collection of relatively undisturbed soil samples through the hollow stem of the auger. Soil samples were obtained using a split spoon sampler which was lowered through the hollow stem of the auger and driven 18 inches using a 140-pound hammer at a 30-inch drop. Blow counts were recorded at 6-inch intervals for each sample driven. The sampler was fitted with 2.5-inch diameter, 6-inch long brass sleeves. The exposed ends of each soil sample were covered with Teflon sheets and fitted with plastic end caps. Labels were attached to each sample and included the following information: (1) boring number; (2) sample number; (3) date and time; (4) collector's name; (5) owner; and (6) location. All samples were stored in the field in pre-cooled ice chests and transported to the analytical laboratory by direct delivery. Chain-of-custody records were maintained during the sampling program and transmitted to the laboratory with the samples.

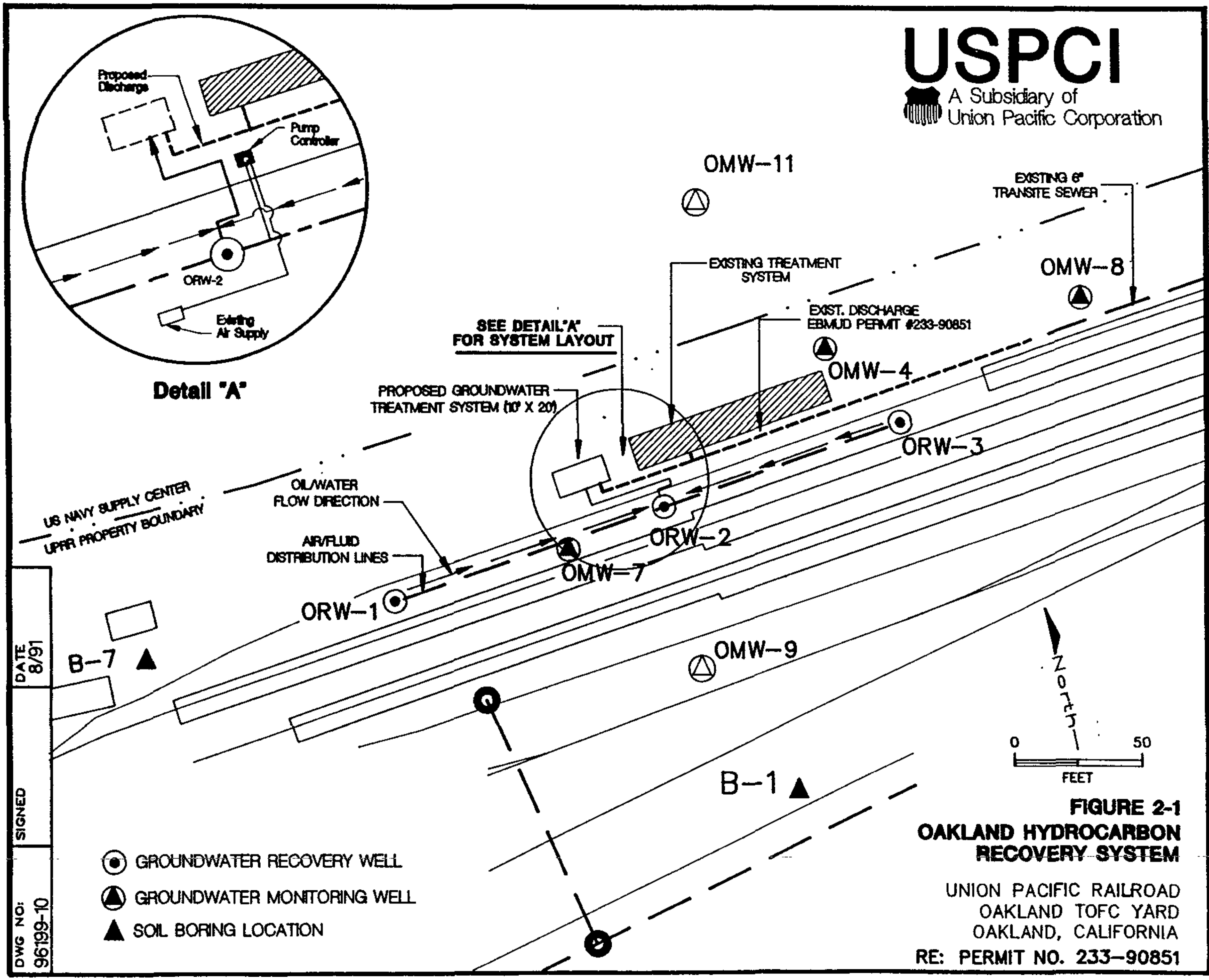

FIGURE 2-1
OAKLAND HYDROCARBON RECOVERY SYSTEM

Prior to initiating each boring, the downhole equipment, including auger sections and sampling equipment, was thoroughly steam cleaned. The split spoon sampling equipment was either steam cleaned or washed in a dilute trisodium phosphate (TSP) solution and rinsed in de-ionized water before retrieving each sample. Soil cuttings generated during the drilling of on-site monitoring well borings were stockpiled near the boring location and left on site.

2.2 RECOVERY WELL INSTALLATION AND GROUNDWATER SAMPLING

The exploratory borings were initially drilled using 8-inch diameter augers. Upon collection of the necessary soil samples, the borings were then re-drilled using 12-inch diameter augers and the recovery wells were installed through the hollow stem of the auger. The recovery well casing consisted of 6-inch diameter flush threaded schedule 40 PVC. Ten feet of well screen with 0.010-inch slot size was fitted at the bottom end of the well casing, such that 8 to 9 feet of the screen extends below saturated sediments as encountered during drilling.

The annular space between the well screen and borehole was filled with pre-washed silica sand. The sand was installed through the hollow stem of the auger to a position approximately one foot above the top of the well screen to form a filter pack. A bentonite seal was then be placed above the filter pack. The remainder of the borehole was backfilled to near ground surface with a cement-bentonite slurry. The wells were completed slightly below grade, and a flush mount steel protective cover "utility box" was installed over each of the three recovery wells. (Refer to Appendix A for details.)

The wells were developed using the surge and bail technique. Approximately 150 gallons of groundwater was removed from each of the recovery wells during development. Measurements of temperature, pH and conductivity of the produced water were taken at regular intervals during development, and development proceeded until these parameters stabilized and produced water was relatively free of sediment. The water produced during well development was placed in a 55-gallon barrel and transferred to the existing on-site oil/water separator for treatment.

2.3 INSTALLATION OF TOTAL FLUIDS PUMPS AND CONTROLS

Each recovery well is equipped with an Ejector System WETB air displacement, total fluids pump and U-3000 series controller. Air displacement pumps were selected to minimize mixing of free diesel product and groundwater in the discharge stream, enhancing the separation capability of the oil/water separator. Individual well head controllers are located within the surface well covers to control the operation and discharge from each well. Groundwater and free product from each well will be discharged through a buried manifold pipe (1.5 inch flexible discharge hose) to a point on the surface adjacent to the on-site oil/water separator.

The entire recovery system is pneumatically operated and intrinsically explosion proof. Air for the pumps is supplied by a buried one-inch air hose from the existing air system at the rail yard. A pneumatic control panel is mounted on the surface adjacent to the existing on-site oil/water separator to control operation of the recovery system and regulate the air supply. A tank full shut off switch is connected to the control panel and will activate a solenoid valve in the main air supply, shutting down operation of the system if oil levels approach near full conditions in the proposed product recovery tank.

3. GROUNDWATER TREATMENT DESIGN BASIS

The operation of total fluids pumps in each of the recovery wells serves to lower the water level in the well, creating a cone of depression in the surrounding groundwater surface. Free diesel product, which floats on top of groundwater, will then migrate toward each well and be recovered by the pumps. The pumps discharge a mixture of free diesel product and groundwater to the surface. In addition to free diesel product, groundwater in the vicinity of the recovery wells also contains low levels of dissolved contaminates associated with petroleum hydrocarbons (BTEX, TPH), polynuclear aromatic hydrocarbons (Naphthalene, Fluorene, etc.), and a solvent (1,1,1-Trichloroethane). The groundwater from the recovery wells must be treated prior to discharge to the sewer system to separate and recover the free diesel product, and to remove the dissolved contaminates to permit levels.

An on-site rail yard wastewater treatment system (oil/water separator) is currently operating and discharging treated industrial wastewater to the sanitary sewer under the provisions of Industrial Discharge Permit Number 233-90851, issued by EBMUD. As originally conceived in the June 10, 1991 Investigation Report, the groundwater/diesel mixture produced by the recovery wells would be discharged to the existing separator and, with minor permit modifications, effluent water from the separator would be discharged to the sanitary sewer.

Further investigation revealed that EBMUD requires a separate and specific discharge permit for groundwater remediation systems. The permit restrictions placed by EBMUD on the discharge from groundwater remediation systems are more stringent than those which currently exist for the industrial discharge permit at the rail yard. Specifically, the existing industrial permit does not place restrictions on the concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds in effluent water discharged to the sanitary sewer. In accordance to EBMUD requirements, effluent water from groundwater remediation systems must have BTEX concentrations below specific limits to discharge to the sanitary sewer. A list of the constituents found in the groundwater which exceed the sanitary sewer discharge requirements of the EBMUD, along with the associated concentration limits or treatment target values is presented in Table 3-1. A summary of the design basis is also included in Table 3-1. As indicated in the

Table 3-1. Design Basis Summary

FLOW RATE		50 gpm
LENGTH OF OPERATION		3 Years
ENVIRONMENTAL CONCERNS:		
Security		Fenced Equipment
Weather		Equipment housing not necessary
GROUNDWATER CONTAMINANTS:		
CONSTITUENT	GROUNDWATER CONCENTRATION (ppb)	EBMUD DISCHARGE LIMIT (ppb)
Barium	70	74
Carbon Disulfide	15	Not Regulated
1,1,1-Trichloroethane	7	18
Naphthalene	100	5
2-Methylnaphthalene	170	5
Fluorene	14	5
Phenanthrene	29	5
Bis(2-Ethylhexyl)phthalate	39	17
Benzene	27	5
Toluene	44	22
Ethylbenzene	53	5
Xylenes	160	23
Total Petroleum Hydrocarbons (as diesel)	41	Not Regulated

table, the constituents that will not have to be reduced are barium, carbon disulfide, 1,1,1-trichloroethane, and total petroleum hydrocarbons as diesel.
Although it is possible to combine discharge from the groundwater remediation system and the existing industrial wastewater stream, the industrial wastewater will be required to meet the more stringent discharge requirements for the groundwater remediation system. To prevent mixing of waste streams, a separate treatment system for the groundwater remediation system is recommended.

As discussed in Section 2 of this report, three groundwater recovery wells were installed to depress the groundwater surface and to recover free product. Each well is equipped with a total fluids air lift pump, which is capable of a maximum discharge of 7 gallons per minute (gpm), or approximately 21 gpm for the three wells combined. Depending on aquifer characteristics and system performance, additional recovery wells may be required in the future to optimize or accelerate product recovery. Therefore, it is necessary to design a treatment system that is capable of handling greater than 21 gallons per minute. It is estimated that a groundwater treatment system with a flow capacity of 50 to 100 gpm will be capable of handling the additional flow of future recovery wells. A design flow of 50 gpm will be used to determine the groundwater treatment alternative and the associated operating costs. However, the groundwater treatment system will be capable of adapting to a flow of 100 gpm with minor modifications.

The groundwater treatment system design will consists of all the process elements and controls which will be used to reduce the groundwater concentrations to acceptable levels. It is anticipated that groundwater will be extracted for a period of three to five years. A value of three years will be used for economic evaluations.

4. TREATMENT ALTERNATIVE ANALYSIS

Various treatment technologies were evaluated to determine the most technically and economically viable groundwater treatment alternative. The following technologies were evaluated:

- o Ultraviolet/oxidation treatment,
- o Biological treatment,
- o Air stripping, and
- o Granular activated carbon adsorption.

As mentioned previously, liquid phase petroleum product was detected in some of the monitoring wells. Therefore, an oil/water separator will be incorporated into the treatment process, prior to the use of each of the above technologies. A summary of the treatment alternative analysis results are provided in Table 4-1.

4.1 ULTRAVIOLET/OXIDATION TREATMENT

An ultraviolet/oxidation groundwater treatment system uses a combination of ultraviolet radiation, ozone, and hydrogen peroxide to oxidize organic compounds in water. The hydraulic retention time, oxidant dose, ultraviolet radiation intensity, and pH are adjusted to provide the desired removal efficiency.

The cost for purchasing an ultraviolet/oxidation treatment system is approximately $200,000. The system has an operating and maintenance cost of approximately $45 per day. This is equivalent to a capital and operation cost of approximately $250,000 (3 year operation). Although the ultraviolet/oxidation treatment system is technically feasible, it is cost prohibitive and will not be considered further.

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Table 4-1. Comparison of Treatment Alternatives

Treatment Alternative	Technically Viable	Capital Costs ($)[a]	Three Year Operating Cost ($)	Comments
Ultraviolet/Oxidation	yes	200,000	50,000	Cost prohibitive
Biological Treatment	no	--	--	Not technically viable
Air Stripping	yes	--	--	Possibility of adding emission controls. Associated time delays.
Granular Activated Carbon	yes	15,700	120,800[b]	Cost effective and technically viable.

[a] The capital costs only pertain to the treatment alternative considered. It does not include the oil/water separator or the controls to allow continuous operation.

[b] The operating costs do not include the electricity costs associated with the controls to allow continuous flow.

4.2 BIOLOGICAL TREATMENT

A biological treatment unit could be used to reduce levels of contaminants by increasing aerobic bacteria populations in a fixed environment. The bacteria populations are cultivated by monitoring and maintaining adequate dissolved oxygen concentrations in water, adjusting the pH (if necessary), and maintaining a sufficient amount of nutrients. In typical biologic treatment scenarios, concentrations of volatile organics in groundwater are reduced from greater than 500 parts per million (ppm) to approximately 100 ppm. To reduce the volatile organic concentrations further, granular activated carbon is frequently employed. It is possible to design a system that could biologically reduce concentrations to the parts per billion (ppb) range, but retention times or equipment size and monitoring would have to be increased. The attendant treatment costs would also increase significantly. For most groundwater remediation efforts, a concentration of 100 ppm is the practical biological treatment effluent level.

The concentration of contaminants in groundwater at the Oakland rail yard that need to be reduced are in the parts per billion (ppb) range. Due to the presence of influent contaminant concentrations below the practical biological treatment effluent level, this treatment technology is not considered technically viable and will not be considered further.

4.3 AIR STRIPPING

Air stripping removes dissolved volatile compounds from groundwater by enhancing the potential for the compound to volatilize from the dissolved phase in water to a gaseous phase in air. This is accomplished by using packed towers which increase the contact between air and the water waste stream. Mass transfer operations employing packed towers require that the groundwater be distributed over the top of the packing and the air be forced counter current to the flow of water from the bottom of the packing. The water trickles over the packing creating a large contact surface for air and water. Most air stripping technologies have a removal efficiency of greater than 99 percent, which is independent of the influent concentration.

Inherent problems in the design of air stripping systems are related to off-gas emissions with concentrations of volatile compounds. These emissions may result in required air discharge permits, air monitoring, and air emission controls. Also, the potential for fouling or scaling caused by dissolved solids or metals in the influent water may mandate a pretreatment device and increased maintenance, which will increase the cost.

The Oakland rail yard is located in the Bay Area Air Quality Management District (BAAQMD). Pursuant to Rule 8, Regulation 47 of the BAAQMD, if air stripping is employed at the rail yard, an air discharge permit will be required. In addition, a screening level health risk assessment is required to prove that emissions from the air stripper do not create a health hazard. If the benzene emission rate exceeds one pound per day, an emission control device will be required. Vapor phase granular activated carbon is the most likely implemented emission control device. If vapor phase carbon is required to meet air emission standards, it will be more cost effective to remove contaminants from water with carbon, rather than removing the contaminants from water with an air stripper and then removing contaminants from air with carbon.

Due to the additional permit required, time delays associated with obtaining those permits, the possibility of adding emission controls to the off gas, and additional costs associated with using an air stripping technology, this alternative will not be considered further at this time.

4.4 GRANULAR ACTIVATED CARBON

Liquid phase granular activated carbon (GAC) is used to remove, by adsorption, the dissolved compounds in a waste water stream. In general, this method is used in groundwater remediation programs with low to moderate water flow rates, low contaminant concentrations, or intermittent operation. In many cases, liquid phase GAC is capable of removing dissolved compounds to below analytical detection limits. GAC is a proven, low maintenance technology which does not produce an off-gas. The disadvantage to using GAC is the disposal liability associated with spent carbon.

The cost for implementing a carbon adsorption technology with a project life for three years is approximately $136,500. The amount of carbon used during this time would be approximately

64,000 pounds. The cost of carbon adsorption and the amount of carbon used on a particular project is dependent on the influent contaminant concentrations and the waste stream flow rate. It is anticipated that the initial contaminant concentrations will drop after a month of operation. Costs for a range of influent contaminant concentrations are discussed in Section 5 "Description of Selected Alternative." Calculations of carbon cost and usage are provided in Appendix B.

Due to the low dissolved contaminant concentrations found in the waste stream at the subject site, the lack of an air discharge permit, and low cost compared to the other alternatives, USPCI considers GAC the preferred water treatment technology for groundwater remediation at the Oakland rail yard.

5. DESCRIPTION OF SELECTED ALTERNATIVE

The groundwater treatment system will be located to the west of the existing industrial waste water treatment facility and to the east of the air compressor building (Figure 2-1). The system will primarily consist of an oil/water separator, two liquid phase granular activated carbon (GAC) units, plus the necessary controls to allow continuous and automatic operation of the system. The treatment system will be skid-mounted and surrounded by a locked security fence. The system will be designed to operated automatically, with a minimum of maintenance and support. A process flow diagram has been provided as Figure 5-1.

5.1 DESIGN CAPACITY

USPCI estimates groundwater will be discharged under pressure from the recovery wells to the treatment system at a rate of 15 to 50 gallons per minute. The actual flow rate is dependant on aquifer characteristics, degree of groundwater depression, and number of operating recovery wells. With the currently installed pumps, the existing three recovery wells can collectively discharge up to 21 gallons per minute.

Depending on the radius of influence for the three existing recovery wells, additional recovery wells may be required in the future. The number of additional recovery wells (if any) which may be required can not be determined without conducting a pump test (or series of pump tests) to further define local aquifer characteristics. The pump test(s) and resulting hydrologic evaluation will cost approximately $15,000 and require 4 to six weeks to complete.

USPCI estimates up to 20,000 gallons of water may be produced during a comprehensive pump test(s). It is not possible to obtain an interim or temporary permit to discharge groundwater produced during a pump test(s) to EBMUD's sanitary sewer system. Groundwater produced during the test must be stored on-site (Baker Tank), or a complete discharge permit for groundwater remediation must be obtained, and a treatment system installed prior to discharge to the sanitary sewer.

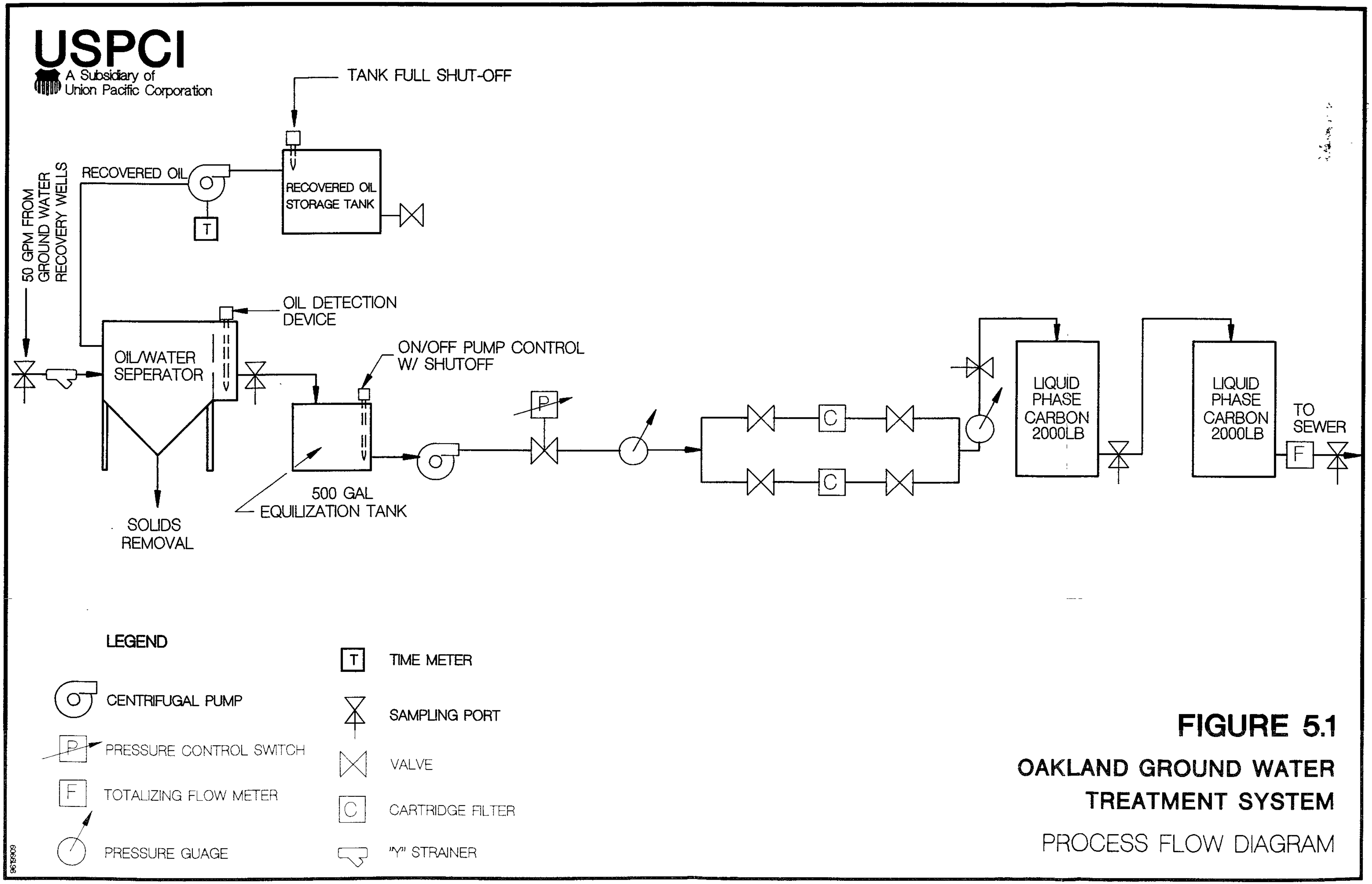


FIGURE 5.1

OAKLAND GROUND WATER TREATMENT SYSTEM

PROCESS FLOW DIAGRAM

Based on the hydrogeology of the Oakland rail yard and the extent of the free and dissolved product plume, USPCI believes that up to three additional recovery wells may be required in the future to obtain adequate hydrologic control of the free and dissolve product plumes. Assuming a maximum discharge rate from each recovery well of approximately 7 gallons per minute, results in a cumulative discharge rate for 6 wells of 42 gallons per minute. Rather than incur the additional cost and design delays associated with conducting preliminary pump tests, USPCI recommends a treatment system be permitted and installed which has a design capacity of 50 GPM and the flexibility to expand to 100 GPM with minor modifications. Following installation of the treatment system, pump tests could be conducted as part of the system start-up, reducing the overall project cost.

The two major components of the treatment system which are most impacted by design capacity are the oil/water separator and the liquid phase GAC unit. To increase the efficiency of the oil/water separator at anticipated flow rates of 15 to 50 gpm and to handle possible increased flow rates of up to 100 GPM, USPCI recommends the separator have a flow capacity of 100 gpm. The incremental capital associated with installation of a 100 gpm oil/water separator versus a 50 gpm separator is approximately $2,000 (20% of separator cost).

The liquid phase GAC unit is the most costly component of the treatment system and the most sensitive to design capacity. Two, series linked GAC vessels (2,000 pounds each) are recommended to treat up to 50 gpm of contaminated groundwater.. If additional GAC capacity is required in the future, two additional 2,000 pound vessels can be added in parallel to the original vessels. The incremental capital associated with adding additional GAC capacity is approximately $16,000 (100% of GAC cost). Additional details on GAC capacity and usage are included in the following discussion.

5.2 SYSTEM DESCRIPTION

Prior to the oil/water separator, the groundwater/oil mixture from the recovery wells will flow through a "Y" strainer to remove coarse sediment and debris. From the "Y" strainer the groundwater/oil mixture will flow into a 100 gpm oil/water separator. Oil recovered by the oil/water separator will be discharged by a oil transfer pump to an existing buried 10,000 gallon product recovery tank. The recovery tank also receives waste oil from the permitted oil/water separator associated with the industrial waste water treatment system at the railyard. To estimate the volume of oil pumped from the separator to the recovery tank, the oil transfer pump will be connected to an electrical hour meter, which will record the duration of pumping. By knowing the pumping duration and the flow rate of the oil transfer pump, the volume of oil pumped to the existing 10,000 gallon recovery tank can be estimated. The recovery tank will be equipped with a tank full shut off switch. The tank full switch will automatically stop the operation of the recovery system if oil levels in the recovery tank approach near full conditions.

A conductivity probe will be added to the oil/water separator to detect the presence of oil in the clean water outlet chamber of the separator. Normally, water flows over a weir and into a clean water outlet chamber, near the effluent side of the separator. If oil is not separated in the oil/water separator, then it will collect in the clean water outlet chamber and float on the effluent water. Oil floating on the water in the clean water outlet chamber will cause the oil/water interface to lower. The conductivity probe will be able to detect when the oil/water interface is lowered by a specific amount. If the conductivity probe detects the lowering of the oil/water interface, a solenoid valve on the air supply line to the groundwater pumps will be activated. This will stop the pumping of the groundwater pumps and shut down the operation of the recovery system until the problem with the oil/water separator has been rectified.

After the oil/water separator, the water will eventually flow through the two GAC vessels in series. However, water will not flow from the oil/water separator to the GAC vessels without the aid of a pump. Therefore, a transfer pump will be placed between the two devices. Rather than matching flows of the groundwater recovery pumps and the transfer pump, an equalization tank will be used to store the flow from the separator. The addition of an equalization tank will allow intermittent flow of the transfer pump at a higher flow rate. The size of the 500 gallon equalization tank is based on a retention time of 5 minutes (100 gallons/minute times 5 minutes equals 500 gallons). The equalization tank will be equipped with on/off transfer pump float control and a high level shut off. The flow rate of the transfer pump will be controlled with a pressure control valve and the on/off float controls.

After the transfer pump, there will be two cartridge filters piped in parallel. The cartridge filters will be equipped with pressure gauges before and after to determine the pressure differential caused by friction losses from the filter. One filter will be used during operation and the other will be used for a change-out bypass.

There will be two 2,000 pound liquid phase GAC vessels piped in series. A totalizing flow meter will be installed after the GAC vessels. The measured flow of the treatment system will be used to determine discharge fees. The piping used adjacent to the carbon vessels will have quick disconnect fittings and be made of 2 inch flexible polyethylene hose. All other piping will be made of cast iron.

Sampling ports will be provided before and after the oil/water separator, before the first carbon vessel, between the two carbon vessels, and prior to the discharge to the sanitary sewer. The influent and effluent concentrations of the first carbon vessel will be monitored to determine breakthrough. Once breakthrough occurs, the second carbon vessel will become the first vessel and a vessel with virgin carbon will be placed behind it. To estimate the carbon usage, influent GAC vessel samples will be collected weekly during the first month. To confirm that breakthrough has not occurred, samples will be collected from the effluent of the first GAC vessel on a weekly basis during the first month of operation.

Additional sampling will be required by EBMUD. However, sampling frequencies are determined by EBMUD permit requirements. The frequency of water sample collections is based on the concentration of the contaminants in the groundwater, the design capacity of the system, and level of preventive maintenance.

The groundwater treatment system will be equipped with a remote monitoring system. The monitoring system will be able to provide information about the status of float controls and pumps.

5.3 ASSOCIATED COSTS

Installation costs of the proposed 50 gpm groundwater treatment are anticipated to be approximately $90,400 (see Table 5-1). This cost includes the design, permitting, procurement, installation, start-up, and performance testing of the groundwater treatment system. A 100 gpm flow rate modification with carbon addition is anticipated to cost approximately $26,300. Installation cost estimates of the 50 gpm system and the 100 gpm flow rate modification have been provided in Table 5-1.

The operating costs are based on the electricity, the discharge fee, and carbon usage. Electrical costs of the treatment system will be provided when the final design is completed. The discharge fee is based on the flow rate of the treatment system. The annual discharge fee is based on the permit application fee, the treatment fee, the one-time service connect fee, and the monitoring and testing fee, which are determined by EBMUD. The permit application fee is $2,200. For a discharge flow rate of 21 gpm, the annual treatment fee would be approximately $4,000 and the one-time service connect fee would be approximately $52,100 (Appendix C). The monitoring and testing fee, which is determined by the frequency and method of sample collection, can range from $1,570 to $2,650 per year. Due to the presence of polynuclear aromatic hydrocarbons, the annual monitoring and testing fee could exceed $2,650. All of the fees, excluding the permit fee, are invoiced on a monthly basis.

Carbon usage is based on the influent contaminant concentrations and the waste stream flow rate. It is anticipated that the initial concentrations of the contaminants will be approximately equal to the concentrations listed in Table 1 and drop to approximately one half the concentration within a month. However, to determine a possible range of three year carbon costs, concentrations of twice and one half the assumed initial concentrations were used. It is estimated that the three year carbon costs, with a flow rate of 50 gpm, will range between $58,500 and $245,500. Calculations of the three year carbon cost are presented in Appendix D. Due to the anticipated drop in influent concentrations, it is probable that the three year carbon costs will be closer to $58,500 than $245,500.

Table 5-1. Installation Cost Estimate

Installation Cost Item	50 gpm ($)	100 gpm[a] ($)
Capital Costs:		
Piping and Valves	1,500	1,500
Electrical Controls and Control Box	4,000	--
Remote Monitoring System	3,500	--
Pumps, Gauges, and Filters	6,500	1,500
Oil/Water Separator (100 gpm)	11,200[b]	--
Equalization Tank	1,700	--
Granular Activated Carbon	16,000[b]	16,000
TOTAL CAPITAL[c]	44,400	19,000
USPCI Expenses Labor:		
Professional Engineer Review	2,000	--
Project Manager Installation Management Permit Review	 600 1,000	 400 --
Project Engineer Water Sample Collection (for Design) Permit Preparation Finalize Design Prepare and Review Request for Quote Contracting Equipment Procurement System Installation System Start-up Prepare As-Builts Prepare O&M Manual Expenses Air Fare (2 trips) Per Diem (6 days) Miscellaneous Equipment Purchase	 700 1,700 1,000 1,000 750 500 1,850 1,000 2,500 1,000 2,000 800 500	 -- -- -- -- -- 200 500 500 500 300 1,000 130 250

Table 5-1. Installation Cost Estimate

Installation Cost Item	50 gpm ($)	100 gpm[a] ($)
Project Geologist		
Aquifer Test (during Start-up)	1,850	--
Expenses		
Air Fare	1,000	--
Per Diem	400	--
Equipment Rental		
Data Logger	500	--
Water Level Indicator	250	--
Labor (Continued):		
Field Engineer		
System Installation	1,000	--
Expenses		
Air Fare	1,000	--
Per Diem	260	--
Subcontractors:		
Analytical		
Pre-Design	400	--
Start-up (2 samples @ $1,800/sample with 24-hr turnaround)	3,600	--
		--
Fence	2,000	--
Concrete Pad	2,000	--
Electrician and Plumber	2,000	
TOTAL USPCI	34,200	3,800
INSTALLATION SUBTOTAL	78,600	22,800
CONTINGENCY (15%)	11,800	3,500
INSTALLATION TOTAL	90,400	26,300

[a] Incremental costs associated with upgrading.

[b] Capital cost items over $10,000 have freight included.

[c] Total Capital cost does not include spill containment devices. All totals rounded up to the nearest $100.00.

6. SCHEDULE

Prior to constructing the groundwater treatment system, a sample of groundwater will be collected and analyzed for (Anions, Metals, Total Dissolved Solids, and Alkalinity) to determine if any additional controls are necessary to prevent the precipitation of dissolved solids. Once the final design is determined, the equipment will be ordered and the water discharge permit will be prepared and submitted. It is anticipated that the delivery of the equipment will take 4 to 6 weeks and the issuance of a water discharge permit will take 4 to 8 weeks. Once the equipment arrives, the system will be assembled and mounted on a skid and shipped to the site. A schedule is attached as Appendix E.

APPENDIX A

RECOVERY WELL COMPLETION LOGS

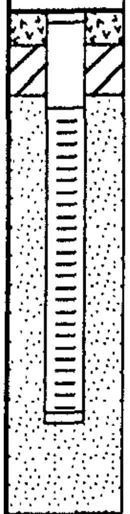
USPCI

A subsidiary of Union Pacific Corporation

LOG BORING NO. ORW-1

WELL NO. ORW-1

CLIENT: UP RAILROAD	JOB NUMBER: 96199
PROJECT: OAKLAND, UPRR YARD	LOCATION: OAKLAND, CALIFORNIA
DRILLED BY: PC EXPLORATION / DRILLER: JOE	METHOD: 12" HSA
DATE START: 6/17/91 / DATE COMP: 6/17/91 / SURF. EL:	TD: 15.0 BGS
LOGGED BY: K.V. ROSE / MEAS. PT. EL.:	DEPTH TO WATER: 3.5 FT.



DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA	SAMPLE NUMBER	SAMPLE ANAL
0	0.0 to 1.5 RAILROAD BALLAST, GRAY LIMESTONE GRAVEL, NO STAINING	AF	110 ppm		TPH
	1.5 TO 3.0 DARK GRAY, GRAY (STAINED) SANDY SILT WITH SOME GRAVEL, MOIST, STRONG DIESEL ODOR FREE PRODUCT AT 3.5'	ML	241 ppm	ORW1-4.5	18000 ppm
5	3.0 TO 11.0 DARK GRAY, GRAY FINE TO MEDIUM SAND, TRACE CLAY, SILT AND COARSE SAND, TRACE SHELLS, WET AT 3.5, STRONG DIESEL ODOR	SM			
10	AS ABOVE, TRACE GRAVEL, WET, STRONG ODOR		111 ppm		
	DARK GRAY, GRAY SILTY FINE SAND WITH SOME CLAY AND MEDIUM SAND, TRACE COARSE SAND, WET, SLIGHT DIESEL ODOR	SC	161 ppm	ORW1-14	<10 ppm
15					

BORING COMPLETED TO 15.0 FEET ON JUNE 17, 1991
GROUNDWATER ENCOUNTERED AT 3.5 FEET

****
MONITOR WELL INFORMATION
****

BLANK CASING: 0.0 TO 2.9 FT
8" SCH. 40 PVC

SCREEN CASING: 2.9 TO 12.25 FT
FACTORY SLOTTED 0.010"

SAND PACK: 2.5 TO 15.0 FT
7.0 SACKS #3 MONTEREY SILICA SAND

BENTONITE SEAL: 2.5 TO 1.0 FT
1 BUCKET 3/8" PELLETS

CONCRETE SEAL: 0.0 TO 1.0 FT
1.0 SACKS CMIX

FLUSH MOUNT: 0 TO 1.2 FT

DPT scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

USPCI

A subsidiary of Union Pacific Corporation

LOG BORING NO. ORW-2

WELL NO. ORW-2

CLIENT: UP RAILROAD	JOB NUMBER: 96199
PROJECT: OAKLAND, UPRR YARD	LOCATION: OAKLAND, CALIFORNIA
DRILLED BY: PC EXPLORATION / DRILLER: JOE	METHOD: 12" HSA
DATE START: 6/18/91 / DATE COMP: 6/18/91 / SURF. EL.:	TD: 14.0 BGS
LOGGED BY: K.V. ROSE / MEAS. PT. EL.:	DEPTH TO WATER: 4.0 FT.

WELL COMP	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA	SAMPLE NUMBER	SAMPLE ANAL
	0	0.0 to 1.0 RAILROAD BALLAST, GRAY LIMESTONE GRAVEL, NO STAINING	AF	125 ppm		TPH
		1.0 TO 2.5 DARK GRAY, GRAY (STAINED) SANDY SILT WITH SOME GRAVEL, MOIST, SLIGHT DIESEL ODOR, STRONG DIESEL ODOR AT 2'	ML			
	5	2.5 TO 10.0 DARK GRAY, GRAY FINE TO MEDIUM SAND, TRACE CLAY, SILT AND COARSE SAND, WET AT 4.0, STRONG DIESEL ODOR	SM	193 ppm	ORW2-5.0	<10 ppm
		AS ABOVE, TRACE SHELLS, WET, SLIGHT ODOR				
	10	DARK GRAY, GRAY SILTY FINE SAND WITH SOME CLAY AND MEDIUM SAND, TRACE INTERBEDDED MED. TO COARSE SAND, WET, NO DIESEL ODOR	SC	88ppm		
				0ppm	ORW2-14	<10 ppm
	15	BORING COMPLETED TO 14.0 FEET ON JUNE 18, 1991				
		GROUNDWATER ENCOUNTERED AT 4.0 FEET				

****
MONITOR WELL INFORMATION
****

BLANK CASING: 0.0 TO 3.0 FT
8" SCH. 40 PVC

SCREEN CASING: 3.0 TO 13.0 FT
FACTORY SLOTTED 0.010"

SAND PACK: 2.5 TO 14.0 FT
6.0 SACKS OF #3 MONTEREY SILICA SAND

BENTONITE SEAL: 2.5 TO 1.0 FT
1 BUCKET 3/8" PELLETS

CONCRETE SEAL: 0.0 TO 1.0 FT
1.0 SACKS CMIX

FLUSH MOUNT: 0 TO 1.2 FT

DPT scale: 20, 25, 30, 35, 40

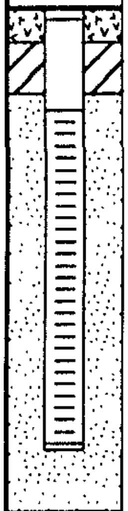
USPCI

A subsidiary of
Union Pacific Corporation

LOG BORING NO. ORW-3

WELL NO. ORW-3

CLIENT: UP RAILROAD		JOB NUMBER: 96199
PROJECT: OAKLAND, UPRR YARD	LOCATION: OAKLAND, CALIFORNIA	
DRILLED BY: PC EXPLORATION	DRILLER: JOE	METHOD: 12" HSA
DATE START: 6/18/91	DATE COMP: 6/18/91	SURF. EL: / TD: 15.0 BGS
LOGGED BY: K.V. ROSE	MEAS. PT. EL.:	DEPTH TO WATER: 5.0 FT.



DPT	DESCRIPTION	USCS CODE	OVA	SAMPLE NUMBER	SAMPLE ANAL
0	0.0 to 2.0 RAILROAD BALLAST, GRAY LIMESTONE GRAVEL, NO STAINING	AF	19ppm		TPH
2.5	2.5 TO 10.0 GRAY FINE TO MEDIUM SAND, TRACE CLAY, SILT AND COARSE SAND, WET AT 5.0, STRONG DIESEL ODOR	SM	43ppm	ORW3-5.0	<10 ppm
	AS ABOVE, TRACE SHELLS, WET, SLIGHT ODOR	SM	18ppm		
	DARK GRAY, GRAY SILTY FINE SAND WITH SOME CLAY AND MEDIUM SAND, TRACE INTERBEDDED MED. TO COARSE SAND, WET, NO DIESEL ODOR	SC	0ppm	ORW3-14	<10 ppm
15					

BORING COMPLETED TO 15.0 FEET ON JUNE 18, 1991
GROUNDWATER ENCOUNTERED AT 5.0 FEET
****
MONITOR WELL INFORMATION
****

BLANK CASING: 0.0 TO 3.0 FT
6" SCH. 40 PVC

SCREEN CASING: 3.0 TO 13.0 FT
6" FACTORY SLOTTED 0.010"

SAND PACK: 2.5 TO 15.0 FT
6.0 SACKS OF #3 MONTEREY SILICA SAND

BENTONITE SEAL: 2.5 TO 1.0 FT
1 BUCKET 3/8" PELLETS

CONCRETE SEAL: 0.0 TO 1.0 FT
1.0 SACKS CMIX

FLUSH MOUNT: 0 TO 1.2 FT

DPT scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

DRAFT

APPENDIX B

CAPITAL AND OPERATING CARBON COSTS AND USAGE

Subject: Carbon Costs and Usage
Oakland TOFC, CA 96199

Purpose: To estimate the cost associated with carbon adsorption for three years of operation and document the volume of carbon usage.

Method: Information provided by a vendor will be used to estimate the cost associated with carbon adsorption and the volume usage of carbon.

Assumptions:

- The usage rates of carbon between vendors is approximately equal.
- Life of project is three years
- The influent contaminant concentrations are expected to be equal to those listed in Talbe 1.
- The carbon usage rate will be constant during the length of the project.

Calculations:

① Lease vs. buy option for carbon vessel.

$$L = I + Mx$$

L = cost to lease vessel for x number of months.
I = initial monthly cost, $4,900 (attached).
M = monthly lease cost, $300 (attached)
X = lease term, ?.

To determine the the amount of time it would take to pay for a carbon vessel by leasing, let L equal the purchase cost of the vessel ($7,850 - see attached) and solve for "X".

$$\$7{,}850 = I + Mx$$

$$x = \frac{\$7{,}850 - I}{M} = \frac{\$7{,}850 - \$4{,}900}{\$300/\text{mo}} = 9.8 \text{ months}$$

Since the estimated life of the project is 3 years, the carbon vessel should be purchased.

Subject: Carbon Costs and Usage
Oakland TOFC, CA 96199

② Carbon adsorption costs:

$A_3 = 2V + C$

A_3 = adsorption cost for three years of operation

V = carbon vessel purchase price (2 in series).

C = carbon cost for 3 years with influent concentrations equal to Table 1, $120,800 (Appendix D)

$A_3 = 2(\$7,850) + \$120,800$

A_3 = **$136,500**

③ Carbon usage (pounds):

$P = T \times U_R$

P = pounds of carbon used during length of project, lbs.

T = duration of project, 3 years or 1095 days,

U_R = usage rate of carbon, 58.4 lb/day (see attached).

$P = T \times U_R$

P = (1095 days)(58.4 lbs/day)

P = **63,950** lbs

Conclusions: The cost and usage weight of carbon is $136,500 and 63,950 lbs, respectively.

Ted D. Miller Associates, Inc.

2140 South Ivanhoe Street
Denver Colorado 80222
(303) 758-3912
FAX (303) 758-4016

8-9-91

Mr. Denton Mauldin
USPCI
5665 Flatiron Parkway
Boulder, Co. 80301

Phone 303-938-5539
938-5500
Fax 938-5520

Dear Denton:

The following information is in response to your request from Westates Carbon for carbon usage analysis.

The results of the contaminant analysis (as reflected in the attached isotherm) are:

Total Carbon Needed:

58.41 #GAC/Day
.81 #gac/1000 gal water

Based on 50 gpm flow rate

Water temperature 50 degrees F

1 year usage = 365 x 58.41 = 21,321 Pounds of carbon annually.

I would recommend the Westates ASC-2000 unit for this application. This vessel holds 2000 pounds of carbon. Using the ASC-2000 would require change out every 34 days.

Estimated costs would be:

Initial ASC-2000 vessel purchase with virgin carbon......	$7,200.
In bound freight......	650.
ASC-2000 Tank Exchange Service Price....................	2,600.
In bound freight......	650.
Out bound freight.....	650.

The initial cost would be $7,850. with freight.

Each subsequent change out would be $3,900. with freight.

Denton, I will be in touch with you next week to arrainge to bring you the full Westates catalog. In the mean time Mike Klein of your office has a Westates catalog he might share.

Best Regards,

Mark A. Gillin

U. S. POLLUTION CONTROL, INC.
REMEDIAL SERVICES

RECORD OF VERBAL COMMUNICATION

Date 8/26/91

Contact Information

USPCI Author DM

Name Mark Gillin

Company Ted Miller Assoc

Address

ZIP

Phone 303 - 758 - 4016

File Information

Job

Author

Addressee

Prospect

NOTES

1st month $4900

2nd - $300/mo - Lease info for ASC-2000 carbon vessel

Action Required:

DRAFT

APPENDIX C

TREATMENT AND SERVICE CONNECT FEE

U.S. POLLUTION CONTROL, INC.
Remedial Services Division

Sheet No 1 of 2
File
App
Date 9/4/91
By DM

Subject: Treatment and Service Connect Fee
Oakland Rail Yard, CA-96199

Purpose: To determine the annual treatment fee and the one-time service connect fee for discharge of treated water to the East Bay Municipal Utility District (EBMUD) with a flow rate of 21 gallons per minute (gpm).

Method: The fees will be determined from the information provided by EBMUD (attached)

Calculations:

① annual treatment fee

$$C_T = Q \times R_T$$

C_T = annual treatment fee, \$.
Q = flow rate, 21 gpm
R_T = treatment charge, \$0.27/100ft³.

$$C_T = 21\frac{gal}{min} \times \frac{\$0.27}{100ft^3} \times \frac{1440\,min}{day} \times \frac{365\,day}{yr} \times \frac{ft^3}{7.48\,gal} = \$3,984/yr$$

for 50 gpm ⇒ $C_T = \$3,984 \times \frac{50\,gpm}{21\,gpm} = \$9,486/yr$

② one-time service connect fee

$$C_S = Q \times R_S$$

C_S = onetime service connect fee, \$.
Q = flow rate, 21 gpm.
R_S = service connect rate, \$41.56/100ft³/month.

$$C_S = 21\frac{gal}{min} \times \frac{\$41.56\,mo}{100ft^3} \times \frac{1440\,min}{day} \times \frac{31\,day}{month} \times \frac{ft^3}{7.48\,gal} = \$52,085$$

for 50 gpm ⇒ $C_S = \$52,085 \times \frac{50\,gpm}{21\,gpm} = \$124,013$

GROUNDWATER PERMIT INFORMATION

EBMUD will require the discharge to be monitored by both the District and the discharger for compliance. The required monitoring frequency reflects the following factors:

- o Concentration of pollutants in the groundwater;
- o Design capacity of treatment unit;
- o Level of preventive maintenance;
- o Frequency of process control samples from the various treatment stages;
- o Consistent compliance with discharge limits;
- o Treatment systems relying on carbon adsorption must collect influent TPH samples and use that information to continually update the estimated remaining carbon capacity.

The District will charge various fees for providing this service. These fees include:

- o Monitoring charges based on the District's current fee schedule;
- o The treatment charge for CARBON treated effluent effective July 1, 1990 is:

  (0.261 $/Ccf + 0.00624(15 mg/l * 0.094 $/lb. + 2 mg/l * 0.159 $/lb.))

  R_T = 0.27 $/Ccf;
- o The capacity fee for CARBON treated effluent effective July 1, 1990 is:

  (40.66 $/Ccf/mo + 0.00624(15 mg/ * 7.38 $/lb./mo + 2 mg/l * 16.45 $/lb./mo))

  R_S = 41.56 $/Ccf/month;
- o A $2,200 Permit fee must accompany the application;
- o Applications should be submitted to:

EBMUD Mail Slot #59
P. O. Box 24055
Oakland, CA 94623
Attention: Joseph G. Damas
Phone: (415)465-3700

APPENDIX D

CARBON OPERATING COSTS BASED ON RANGE OF INFLUENT CONCENTRATIONS

Subject: Carbon Consumption Costs
Oakland, CA TOFC

Purpose: To calculate the first three year carbon consumption costs based on the concentrations of constituents listed in Table 1 of the "Design Report." Values for one half and twice the concentrations will aslo be determined.

Method: The three year carbon consumption costs will be determined by using an adsorption isotherm supplied by Westates Carbon, Inc. and the regeneration cost of $3,900 (Appendix B) Two thousand pounds will be subtracted from the amount of carbon used because a new vessel is supplied with 2000 lbs of virgin carbon

Equation: $C = [(U_c \times T) - 2000 \text{ lbs}] \times R_c$

C = yearly carbon consumption, $.
U_c = carbon usage rate, lb/day
T = duration of concern, 3 years or 1095 days.
R_c = regeneration costs, $3,900/2,000 lb or $1.95/lb.

Assumptions:

- The system will run 24 hours a day and 7 days a week, for 365 days
- Carbon usage rates are approximately equal between various carbon companies (58.4 lb/day - Westates)
- The concentrations listed in Table 1, approximate actual conditions for the first year. (Actually, the concentrations will probably drop to about one half the initial)
- The relationship between carbon loading and influent concentrations is directly proportional and linear; i.e., ½ conc ⇒ $U_c = 29.2$ and 2 conc ⇒ $U_c = 116.8$ lb/d

U.S. POLLUTION CONTROL, INC.
Remedial Services Division

Sheet No 2 of 2

File

App

Subject Carbon Consumption Costs
Oakland, CA TOFC 96/99

Date 8/26/91

By DM

Calculation:

Scenario ① - Influent concentrations are equal to Table 1 in "Design Report"

$C_1 = [(U_c \times T) - 2000] \times R_c$

$C_1 = [(58.4 \text{ lb/day} \times 1095 \text{ d}) - 2000] \times \$1.95/\text{lb}$

$C_1 = \$120,800$

Scenario ② - Influent conc. are equal to ½ of those listed in Table 1

$C_{1/2} = [(\tfrac{1}{2} U_c)T - 2000] \times R_c$

$C_{1/2} = [\tfrac{1}{2}(58.4 \text{ lb/day}) 1095 \text{ days} - 2000] \, \$1.95/\text{lb}$

$C_{1/2} = \$58,500$

Scenario ③ - Influent conc. are equal to twice of those listed in Table 2

$C_2 = [(2U_c)T - 2000] \times R_c$

$C_2 = [2(58.4 \text{ lb/day}) 1095 \text{ days} - 2000 \text{ lbs}] \, \$1.95/\text{lb}$

$C_2 = \$245,500$

Conclusion: With influent concentrations equal to those listed in Table 1, the first three year carbon consumption costs are estimated to be $120,800.

With an influent concentration range of one half to twice of those listed in Table 1, the first year carbon consumption costs are estimated to be between $58,500 and $245,500.

WESTATES CARBON, INC.
2130 LEO AVE.
LOS ANGELES, CA. 90040-1634
(213)722-7500

ISOTHERM REPORT CREATED ON 08/09/91 AT 09:07 BY
CUSTOMER:

LIQUID PHASE DESIGN PARAMETERS
****

Total Flow of Water [gpm] 50.000

LIQUID PHASE DESIGN
****

Component	Concentration [ppm]	#GAC/1000 gal water
TRICHLOROETHANE,1,1,1-	.007	.22
NAPHTHALENE	.270	.05
FLUORENE	.014	.00
PHENANTHRENE	.029	.01
BIS(ETHYLHEXYL-2) PHTHALATE	.039	.06
BENZENE	.027	.19
TOLUENE	.044	.10
ETHYLBENZENE	.053	.15
XYLENE,p-	.160	.04
		1.82

TOTAL CARBON NEEDED
****

58.41 #GAC/day
.81 #GAC/1000 gal water - ASC-2000

.82
59 #/day
55 days

APPENDIX E

SCHEDULE

Oakland Groundwater Treatment

U.S.P.C.I.