REMEDIAL APPROACHES AND CONCEPTUAL DESIGN

SUBJECT SITE:

INGERSOLL RAND MAINTENANCE FACILITY
1944 MARINA BOULEVARD
SAN LEANDRO, CALIFORNIA

PREPARED FOR:

INGERSOLL RAND CORPORATION
1495 VALLEY CENTER PARKWAY
BETHLEHEM, PENNSYLVANIA

PREPARED BY:

IT CORPORATION
4585 PACHECO BOULEVARD
MARTINEZ, CALIFORNIA 94553

AUGUST 1991

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Approved by: William Schaal Date 7 August 1991

William Schaal
Project Manager

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1.0 Introduction

In May 1989 Ingersoll Rand Corporation (IR) filed an unauthorized underground storage tank (UST) release report with the San Leandro Fire Department. The release report was for the IR maintenance facility located at 1944 Marina Boulevard, San Leandro, California. International Technology Corporation (IT) conducted subsurface investigations to assess the impact the release may have had on soils and groundwater. The investigation involved excavation, soil borings, and monitoring well installations. Following this, IT performed a soil vapor extraction (SVE) pilot test. The purpose of this document is to present remedial strategies with cost estimates to assist IR in maintaining a responsible environmental program that will lead to site closure granted by California State regulatory agencies.

Investigation activities have shown the following.

- Gasoline adsorbed to unsaturated zone soils in an area approximately 150 feet by 180 feet by 4 feet, encompassing the area from which the gasoline and waste oil USTs were removed (Figure 1).
- Traces of free product too thin to measure in groundwater monitoring well MW3. Well MW3 is located in the vicinity once occupied by the removed gasoline UST.
- Dissolved concentrations of gasoline in groundwater monitoring well MW-4. Well MW4 is positioned at the property border downgradient from the reported fuel release point.
- Dissolved concentrations of trichloroethane (TCE) in groundwater from monitoring wells MW1 and MW2. Wells MW1 and MW2 were installed side-gradient from the reported fuel release point.

Results from the SVE pilot test indicate that contamination in the unsaturated zone soil can be effectively mitigated by SVE and a treatment system. This process induces air flow through unsaturated zone soils to vaporize the hydrocarbons adsorbed to soil. The air stream, loaded with volatilized hydrocarbons (in gaseous state), is then treated at the surface. This in situ technique for treating unsaturated zone soils is rapid, cost-effective, and only minimally disruptive during installation. Due to site-specific parameters, identity of adsorbed hydrocarbons, and concentrations of adsorbed hydrocarbons, the need for excavation is eliminated. This is especially pertinent at the subject site because soil borings established the

presence of adsorbed phase hydrocarbons beneath the northwest portion of the maintenance shop. Additionally, documented studies show that SVE indirectly removes volatile organic compounds from groundwater. SVE is often used in tandem with systems that directly treat groundwater, providing noticeable reductions in remediation periods and expenses.

2.0 Remedial Approach

It is advised that remediation proceed through a four-step program.

1) Examine monitoring well MW3 for the presence of free product floating on the surface of the groundwater. If free product is present, then remove and establish a periodic cycle for the tasks in this step. If free product is not existent, then advance to step two.

2) Install and operate the SVE system to remediate contaminated soils in the unsaturated zone.

3) Define the lateral extent of dissolved hydrocarbons in groundwater using temporary well points.

4) Design, install, and operate an appropriate groundwater pump and treat system.

A visible trace of free product was reported present in monitoring well MW3 on 16 November 1990. In the event that free product presently exists on the surface of the groundwater, it must be removed as much as possible from the wells it is observed in. If product is present during remediation, then a non-optimal rate for treatment of dissolved hydrocarbons in groundwater and adsorbed hydrocarbons in soil will result. Because product has historically been reported in an amount too thin to measure, it is assumed that a product recovery pump will not be necessary and that product removal can be completed with a hand bailer or vacuum. Although SVE will be relied upon to remove product that cannot be recovered from monitoring wells, application of this technique expressly for product removal will incur additional expense to treat the hydrocarbon-laden air stream and lengthen the duration required for subsurface remediation.

SVE pilot study test data indicate that the SVE remedial system can be implemented from a single existing soil vapor collection point. The proposed conceptual design assumes that a 145-foot radius of influence can be achieved from vadose well VW3. Vadose well VW3 is considered to be strategically located because it is centrally located within the adsorbed phase plume (Figure 1). The specified radius of influence should be sufficient for effective remediation of soils impacted by the gasoline spill reported in 1989.

The SVE treatment system will require a blower to induce appropriate air circulation in the subsurface and vapor abatement equipment to treat the recovered hydrocarbon-laden air

stream. To induce the assumed 145-foot radius of influence of vacuum in the vadose zone, the blower must be capable of sustaining an air flow of 60 to 80 standard cubic feet per minute (scfm) and a vacuum of 25 to 45 inches of water. It is likely that once operating, air flow and vacuum will respectively be reduced to 20 to 40 scfm and 5 to 10 inches of water. Recovered soil vapor will be routed through activated granular carbon. Carbon will initially be provided in 400-pound (lb.) vessels. During the two weeks following system startup, an assessment will be made as to whether 400 lb. vessels are the most appropriate size for soil vapor abatement at the subject site. Because TCE and trichloroethane (TCA) were found in SVE pilot test carbon during analyses for disposal of soil vapor treatment options are limited to carbon. Chlorinated compounds like TCE and TCA will adhere to the catalyst material in low temperature thermal oxidation incinerators, rendering them ineffective for proper contaminant destruction. High temperature incinerators are costly to acquisition and operate, potentially dangerous due to their high operation temperatures, and are very difficult to permit with the Bay Area Air Quality Management District (BAAQMD). BAAQMD assesses each proposed treatment system with a computational risk screen. The risk screen addresses gaseous constituents in system effluent vented to the atmosphere. With respect to benzene, the current acceptable discharge concentration is less than 0.05 pounds per day. This threshold is very obtainable for soil vapor treatment using activated carbon at the subject site.

Blower and carbon vessels should be secured in a fenced compound with concrete slab flooring. Proposed slab dimensions are 10 feet by 10 feet by 6 inches. Fence height should be 6 feet and be comprised of chain link fencing. For convenience and ease of system installation, proposed compound location is beside soil vapor recovery well VW3. Electrical utilities shall be supplied to the compound from the maintenance shop via buried cable. All electrical utilities will be installed by a certified electrician to provide 110 volts (V) at 10 amps (A) and 230V at 20A. Prudence dictates that all electrical utilities have hazardous duty ratings.

Investigative efforts have revealed the presence of dissolved hydrocarbons in groundwater. Petroleum fuel hydrocarbons have been detected near the UST release point and at the downgradient property border. Chlorinated petroleum hydrocarbons have been detected near the northern property border and the southernmost well--both of which are side gradient to the UST release point. Further delineation of dissolved phase contaminants is necessary for the development of comprehensive groundwater remedial action plans. A rapid cost-effective approach for further delineation of groundwater contaminants can be realized through

utilization of temporary wells. Such wells are installed by driving them to desired depths in the subsurface with a hydraulic ram. Typically these wells provide 3- or 5-foot screen intervals and possess a 1.75-inch outer diameter. Once enough groundwater has been collected from these wells to satisfy analytical methodology requirements, the wells are removed with hydraulic equipment. Generally, temporary wells remain emplaced for less than one day. Drilling refuse and purge water from well development are not generated using the methods described for this type of temporary well, thus the expenses associated with disposal of such materials is eliminated. Holes are backfilled to surface with grout or neat cement using a tremie pipe. These filler materials and filling techniques are mandated by regulatory agencies because they provide a competent non-reactive seal between surface and subsurface. The use of a tremie pipe to emplace backfill material is the surest method for filling the holes from bottom to top without experiencing bridging. Compared to conventional permanent wells, temporary wells allow for groundwater sampling without incurring typically higher permitting, construction, and disposal fees. Because further delineation is more desired at this time than continuous monitoring, temporary wells are more appropriate than costlier permanent wells.

Eight temporary wells are proposed for collection of groundwater for chemical analysis (Figure 2). Four of these wells are to be located on property downgradient of the subject site. This property is leased by a party unrelated to IR. Additional to the retrieval of groundwater samples, an advisable option would involve the collection of soil vapor samples while installing some of the temporary wells. Analysis of soil vapor samples from four temporary well locations may provide useful information regarding the presence of the gaseous phase chlorinated compounds detected in SVE pilot test carbon. All samples of groundwater and soil vapor will be analyzed by a state certified laboratory using modified Environmental Protection Agency (EPA) Methods 8010/8015/8020. A comprehensive listing of the analytes included in these methods is provided in Table 1.

Presently it appears that groundwater treatment will most likely be necessary. The presence of chlorinated compounds in groundwater will disallow any in situ bioremediation techniques. This is mostly because the degradation product formed by microbial activity on TCE and TCA is vinyl chloride. Vinyl chloride is another chlorinated hydrocarbon regulated as a hazardous substance--one that is not degradable by microbes. All acceptable treatment programs will require the recovery of groundwater from the subsurface and treating it. Treatment options successful at removing hydrocarbons from groundwater at the

concentrations presented at the subject site are air stripping and filtration through carbon medium (also termed carbon adsorption). Air stripping takes advantage of the volatilities of petroleum hydrocarbons and removes hydrocarbons by transferring them to an air stream. Due to present Bay Area Air Quality Management District (BAAQMD) guidelines, the air stream must undergo abatement prior to atmospheric discharge. Carbon adsorption is a selective removal process in which activated carbon provides a very high efficiency for the removal of contaminants from a water stream.

Results from aquifer pumping tests in November 1990 indicate that the water-bearing zone produces minimal volumes of water. This knowledge, combined with anticipated results from future contaminant delineation activities, may give rise to multiple groundwater extraction points or trenches. Consideration has been given to the prospect of operating groundwater recovery/treatment systems(s) prior to further delineation of the dissolved phase plume. Because little is known about the properties surrounding the subject site, it may be prudent to curtail groundwater recovery/treatment until further investigation has been completed. It is worth noting that with the installation/operation of the SVE system, IR has the opportunity to remain proactive with respect to remediation of subsurface contamination originating from the subject site. The potential for transporting adsorbed phase contaminants from possible off-site sources is negligible because the vacuum's radius of influence will not exceed that which is necessary to remediate the delineated area of contamination well within the borders of the subject site. Advantageously, there have been documented efficiency enhancements to groundwater pump-and-treat techniques when operating an SVE system simultaneously. Because of this, IR may elect to have the operation of the SVE system extended beyond the duration required to remove the hydrocarbons adsorbed to soil.

3.0 Permits and Authorizations

Installation and operation of the SVE system for the in situ remediation of contaminated soils will require permits and/or review from the Office of San Leandro City Development (City Development), BAAQMD, Regional Water Quality Control Board (RWQCB), and Alameda County Department of Environmental Health Hazardous Waste Program (Alameda Health Department). City Development issues building permits in the interest of insuring that construction/fabrication is compliant with city codes. Separate permits from City Development address the construction of the concrete floor of the treatment compound and the provision and usage of electricity to/at the compound. By erecting a compound fence no more than 6 feet in height, a fence permit is not required. However, if the compound cannot be located immediately adjacent to vapor extraction well VW3, then City Development may require a plumbing permit for piping routed between blower and well. Although separate permits are required from City Development, the applications are submitted as a single package including engineering design drawings for review by the agency plan checker. Preparation of these permit applications and engineering design drawings will consume 2 months. Review period requires 4 to 6 weeks, but is commonly accomplished in as little as 2 weeks. For each permit for construction, City Development charges a base fee for application review services plus additional fees based on complexity, contract price, et cetera. Bearing this in mind, permit fees with City Development will probably not total more than $1,000.

The BAAQMD requires that the remediation system be permitted for operation. With simple systems like the SVE system proposed in this document, the permit fee generally does not exceed $75 and is usually granted in 2 months or less. By using thermally regenerated (i.e. activated) carbon with the contaminant concentration levels provided by the subject site, system operation will assuredly fall within BAAQMD risk screen discharge mandates.

RWQCB and Alameda Health Department require remedial system plan review. Plan review periods for these agencies on matters such as this normally do not exceed 2 months. Historically, these agencies have not charged fees for review of SVE treatment systems. Their predominant purposes for requiring these reviews are to be appraised of remedial activities and to ascertain that no potential risks to environmental or health are created.

The Fire Department of San Leandro may also require an opportunity to review all plans and drawings. The Fire Department may additionally require a combustion test and a health risk

assessment. Typically, however, systems possessing the degree of simplicity that the proposed SVE system has are rarely subjected to this amount of scrutiny.

The installation/removal/construction related to the installation of the temporary wells require permitting with the RWQCB, Alameda Health Department, and Alameda County Flood Control and Water Conservation District (Alameda Flood Control). A brief remedial investigation plan must be submitted to each of these agencies as part of the permitting application. These regulatory agencies will review the permit applications to insure the proposed approach is sound and that field activities will not threaten the environment. One to 1.5 months are generally required for permit preparation and submittal. With the number of regulatory agencies involved for this geographic location, the estimated review/approval period is likely to require 3 months. Permit fees are expected to total about $500.

To achieve maximum benefit from the expenditure for further delineations, some of the temporary wells must be located within property borders of a neighboring facility. Initial negotiations with neighboring leaseholders to allow for this, begun in June 1991, must be brought to completion. Once authorization from all interested parties have been received, field work will begin within two to four weeks of receipt of approval. Upon examination of the results gathered during further delineation of the groundwater dissolved phase plume, appropriate remedial alternatives will be presented to IR by IT.

4.0 Cost Estimates

The remedial approach proposed for in situ soil treatment is SVE with activated carbon adsorption. This approach has been presented with two options. The options address the costs associated with using different sized supplies of activated carbon. Cost estimates for the two options have been provided in the categories of Design Engineering/Permit Preparation, Construction Activities, and Startup Operations based on 6 months of operation (Table 2). Table 2 also provides estimates for the duration of time required to accomplish tasks outlined in each category. Estimated costs from design through 6 months of continuous treatment system operation range from $50,500 to $60,500. Estimated duration from Design Engineering/Permit Preparation to Operation Startup range from 4 to 5 months. Due to the comprehensiveness of Table 2, discussion is limited to the few specific elements addressed below.

- Actual permit negotiations with permit granting agencies may require more time than estimated. IT will work to honor the estimates provided because they are based on recent direct inquiry to the agencies. However, due to ever changing regulations, it is not always possible to predict permit costs.

- Fifty-five gallon drums of carbon provide the lowest capital cost treatment system. However, disposal costs for the carbon will greatly exceed the costs resulting from the use of thermally-generated carbon in economically-sized larger vessels.

- During the initial 2 weeks of system operation, an assessment will be made as to whether the activated carbon vessels are the most appropriate size for soil vapor abatement at the subject site.

- It may be possible to negotiate operating protocol with the BAAQMD to reduce the number of samples and analyses required which in turn would minimize the overall cost of the project.

Further delineation of groundwater contamination will be achieved economically with temporary wells. These wells, which will remain in place for no more than a day or two, should facilitate the collection of enough groundwater for chemical analysis from each location. A maximum of eight temporary wells have been specified for the purposes of generating the cost estimates provided in Table 3. Estimated costs from preparation to execution of the plan is $22,750. The estimated duration required to complete the tasks identified in Table 3 ranges from 2.5 to 6 months. This is in contrast to a delineation pursued

with eight permanent wells in which the estimated cost to prepare and execute the plan would exceed $53,000 and require 4 to 8 months to accomplish.

Due to the comprehensiveness of Table 3, which also summarizes the duration of time required for Permit Preparation/Submittal, Permit Approval, and Startup once approval has been received, discussion is limited to the few specific elements addressed below.

- The inclusion of the Advisable Option to analyze soil vapor collected during installation of selected temporary wells does not significantly lengthen the duration required to complete this portion of the project. Inclusion of the Advisable Option brings the total estimated cost to $23,750 (an increase of $1,000 for analytical fees).

- Soil vapor collected for chemical analysis during the installation of selected temporary wells may provide data useful in preparing a complete remedial program most favorable to IR. Resultant data may promote a better comprehension of site conditions; facilitate negotiations with regulatory agencies to allow remediation of chlorinated compounds to be limited to "background" concentrations; and/or allow for more refined estimates for time and costs associated with the remediation of soils and groundwater at the subject site.

- Approaches to groundwater treatment are likely to be influenced by the results of the described groundwater delineation exercises. In addition to further delineation of the dissolved plume, results may help determine the volume of groundwater requiring treatment, method of treatment, whether groundwater collection will be most effective from recovery wells or trenches, and the potential for transporting dissolved phase contaminants from possible off site sources.

TABLES

TABLE 1
ENVIRONMENTAL PROTECTION AGENCY METHOD
8010/8015/8020
ANALYSES

Method 8010: Volatile Halocarbons	
and Aromatics	
Benzyl Chloride	1,2 - Dichloropropane
Bromobenzene	Trans - 1,3 - Dichloropropene
Bromodichloromethane	1,1,2,2 - Tetrachloroethane*
Bromoform	1,1,1,2 - Tetrachloroethane*
Bromomethane	Tetrachloroethane*
Carbon tetrachloride	1,1,1 - Trichloroethane*
Chloracetaldehyde	1,1,2 - Trichloroethane*
Chlorobenzene	Trichloroethane*
Chloroethane	Trichlorofluoromethane
Chloroform	1,2,3 - Trichloropropane
2 - Chloroethyl Vinyl Ether	Vinyl Chloride
Chloranethane	
Dibromochloromethane	
Dibromomethane	
1,2 - Dichloro Benzene	
1,3 - Dichlorobenzene	
1,4 - Dichlorobenzene	
Dichlorodifluoromethane	
1,1 - Dichloroethane*	
1,2 - Dichloroethane*	
1,1 - Dichloroethene*	
Trans - 1,2 - Dichloroethene*	
Dichloromethane	

*Denotes analytes of specific project interest

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TABLE 1
(Continued)
ENVIRONMENTAL PROTECTION AGENCY METHOD
8010/8015/8020
ANALYTES

Method 8015: Total Purgeable	Method 8020: Volatile Aromatics
Petroleum Hydrocarbons (TPH)	Benzene*
As Gasoline	Chlorobenzene
Identifies:	1,2 - Dichlorobenzene
Diethyl Ether	1,3 - Dichlorobenzene
Ethanol	1,4 - Dichlorobenzene
Methyl Ethyl Ketone (MEK)*	Ethylbenzene*
Methyl Isobutyl Ketone (MBK)	Toluene*
All Pugeable	Xylenes*
Petroleum Hydrocarbons Reported as Total	
Concentration.*	

*Denotes analyze of specific project interest.

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TABLE 2
COST ESTIMATES: IN-SITU SOIL TREATMENT ALTERNATIVES
INGERSOLL RAND MAINTENANCE FACILITY
1944 MARINA BLVD
SAN LEANDRO, CALIFORNIA

	SOIL VAPOR EXTRACTION WITH ACTIVATED CARBON ABATEMENT (Costs in thousands of $)	
	55 Gallon Drum (Disposable)	Medium Sized Vessel (Regenerative)
DESIGN ENGINEERING & PERMIT PREPARATION (A)		
Engineering Design	2.0	2.0
Design Drawings	2.5	2.5
Permit Fees	1.5	1.5
Permit Preparation & Office Support	1.0	1.0
Project Management	.5	.5
SUBTOTAL	7.5	7.5
Estimated Time for Permit Prep./Submit.	2 mo.	2 mo.
Estimated Time for Permit Approval	1 to 2 mo.	1 to 2 mo.
CONSTRUCTION ACTIVITIES		
Site Preparation	1.0	1.0
IT Supervision & Contracting	2.0	2.0
Equipment	3.0	3.0
Purchasing/Installation & Project Management	.5	.5
SUBTOTAL	6.5	6.5
Estimated Time from Permit Approval to Start-up	2 to 3 mo.	2 to 3 mo.

Notes:
(A) Excludes follow-up agency negotiations, if necessary.

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TABLE 2
(Continued)
COST ESTIMATES: IN-SITU SOIL TREATMENT ALTERNATIVES
INGERSOLL RAND MAINTENANCE FACILITY
1944 MARINA BLVD
SAN LEANDRO, CALIFORNIA

	SOIL VAPOR EXTRACTION WITH ACTIVATED CARBON ABATEMENT (Costs in thousands of $)	
	55 Gallon Drum (Disposable)	Medium Sized Vessel (Regenerative)
Start-up Operation (6 month duration)		
Routine Labor	3.5	3.5
Equipment & Materials	(C) 15.0	25.0
Sampling & Quarterly Reporting (B)	14.5	14.5
Project Management	4.0	4.0
SUBTOTAL	37.0	47.0

Notes:
(B) Two air samples weekly.
(C) Excludes disposal fees.

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TABLE 3
COST ESTIMATE: FURTHER GROUNDWATER CONTAMINATION DELINEATION
INGERSOLL RAND MAINTENANCE FACILITY
1944 MARINA WAY
SAN LEANDRO, CALIFORNIA

Groundwater Contamination Delineation	Estimated Cost (Costs in thousands of $)
Investigative Plan	.25
Permit Fees	.5
Permit Preparation & Office Support	1.0
Temporary Well Installation/Removal/Construction (A)	6.0
Analytical Services (B)	13.5
Reporting & Project Management	1.5
SUBTOTAL	22.75
OPTION: Soil Vapor Collection during Temporary Well Installation	
Sample Collection (C)	.5
Sample Analyses (C)	.5
TOTAL with Option	23.75
Estimated Time for Permit Prep./Submit.	1 to 1.5 mo.
Estimated Time for Permit Approval	1 to 3 mo.
Estimated Time from Permit Approval To Start-up	2 to 4 wk.

Notes:
(A) Two days with eight well maximum.
(B) Eight sample estimate.
(C) Four sample estimate

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FIGURES

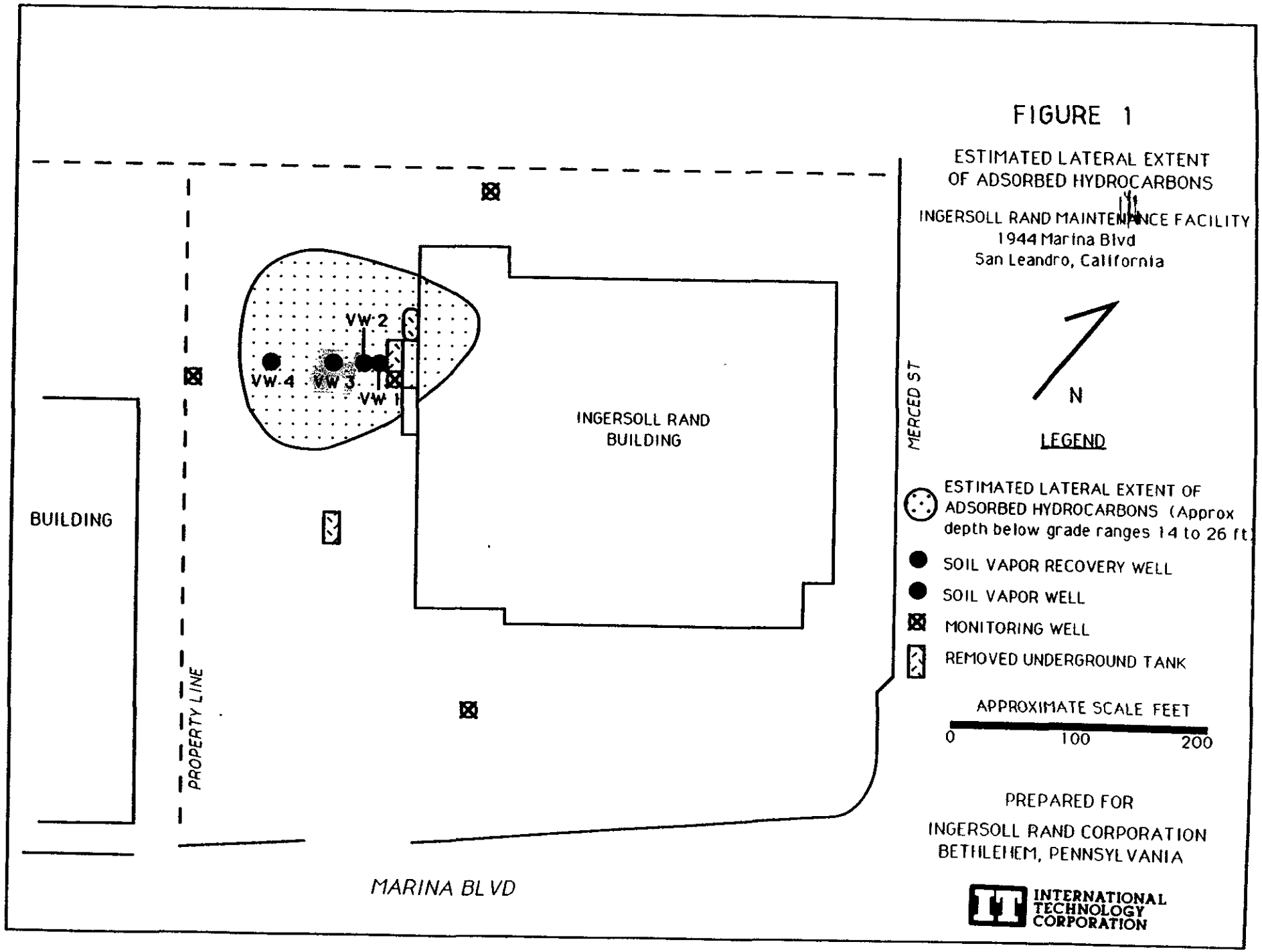
FIGURE 1
ESTIMATED LATERAL EXTENT
OF ADSORBED HYDROCARBONS
INGERSOLL RAND MAINTENANCE FACILITY
1944 Marina Blvd
San Leandro, California
N
VW-2
VW-4
VW-3
VW-1
INGERSOLL RAND
BUILDING
BUILDING
MERCED ST
PROPERTY LINE
MARINA BLVD
LEGEND
ESTIMATED LATERAL EXTENT OF
ADSORBED HYDROCARBONS (Approx
depth below grade ranges 14 to 26 ft)
SOIL VAPOR RECOVERY WELL
SOIL VAPOR WELL
MONITORING WELL
REMOVED UNDERGROUND TANK
APPROXIMATE SCALE FEET
0
100
200
PREPARED FOR
INGERSOLL RAND CORPORATION
BETHLEHEM, PENNSYLVANIA
INTERNATIONAL
TECHNOLOGY
CORPORATION

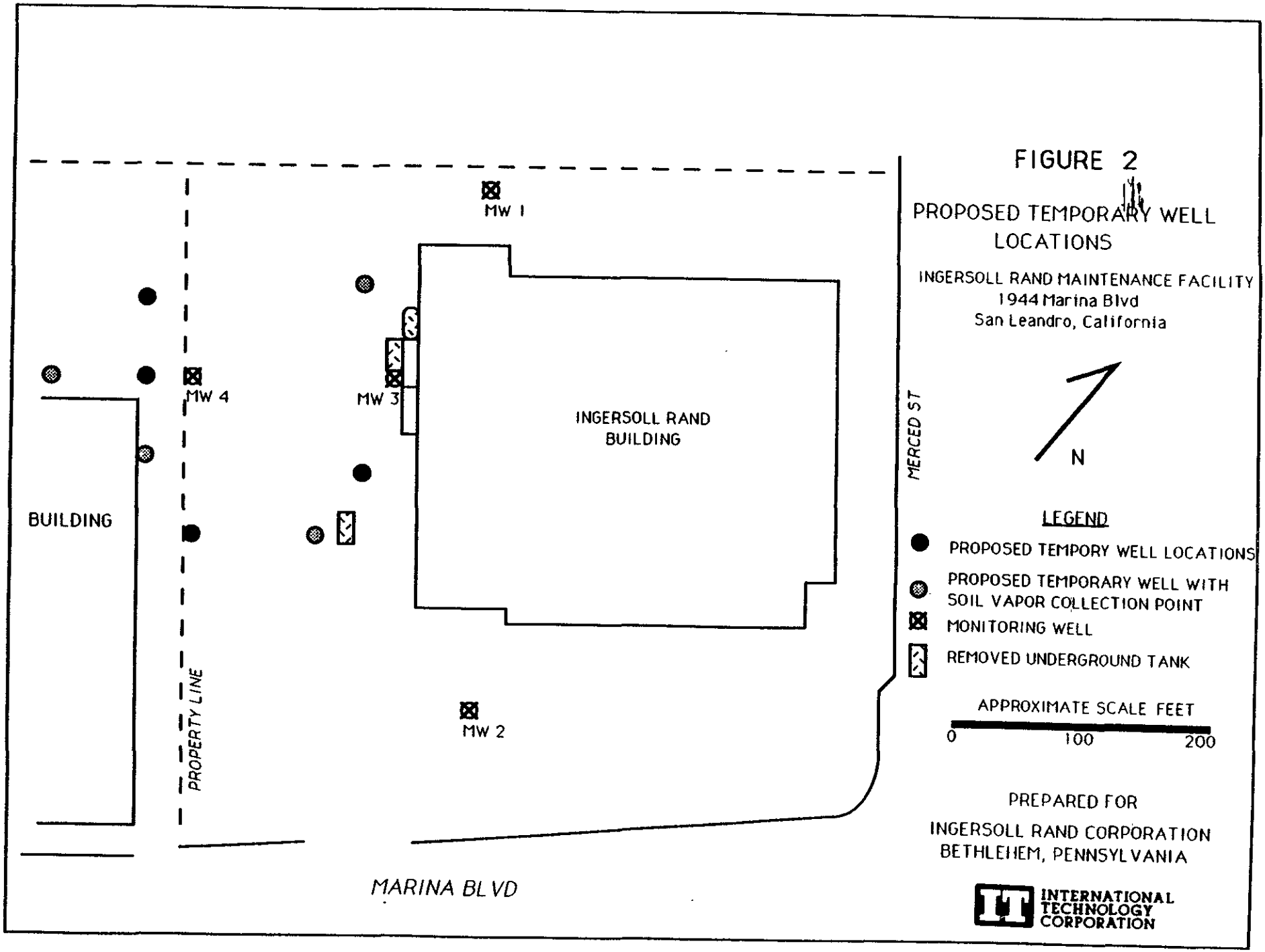

FIGURE 2

PROPOSED TEMPORARY WELL LOCATIONS

INGERSOLL RAND MAINTENANCE FACILITY
1944 Marina Blvd
San Leandro, California