LAWRENCE
& ASSOCIATES
ENGINEERING GEOLOGY
CIVIL ENGINEERING
GROUNDWATER HYDROLOGY

003027.00
Task 6

May 25, 2006

Mr. Bob Pace
Pace In/Out
P.O. Box 483
Keno, OR 97627

Dear Mr. Pace:

SUBJECT: WORK PLAN FOR CONDUCTING A PILOT STUDY FOR SOIL VAPOR EXTRACTION AND OZONE INJECTION, ADDENDUM NO. 1, PACE IN/OUT, DORRIS, CALIFORNIA

INTRODUCTION

This letter serves as the *Work Plan for Conducting a Pilot Study for Soil Vapor Extraction and Ozone Injection, Addendum No. 1, Pace In/Out, Case No. 1TSI171, 336 Main Street, Dorris, California,* dated May 25, 2006. This work plan addendum was requested by the California Regional Water Quality Control Board, North Coast Region (NCRWQCB), in correspondence dated April 24, 2006. The project site is located as shown in **Figure 1**.

In their correspondence, the NCRWQCB conditionally concurred with our recommendation to implement soil vapor extraction (SVE) and ozone injection as presented in Lawrence & Associates' (L&A) the *Work Plan for Conducting a Pilot Study for Soil Vapor Extraction and Ozone Injection, Pace In/Out, Case No. 1TSI171, 336 Main Street, Dorris, California,* dated February 23, 2006. The NCRWQCB also requested an assessment of soil-vapor pathways and additional water-quality analysis for during the pilot study, to be outlined in a written response to be submitted by May 31, 2006.

The following work plan addendum addresses the NCRWQCB requests as presented below.

ASSESSMENT OF SOIL VAPOR PATHWAYS

Equipment Installation

The pilot system will involve the installation of the following wells, in the locations shown in **Figure 2**:

- Three 1-inch diameter soil-gas monitoring wells (see **Figure 3** for construction details), located two feet deep, immediately next to the building.

The soil-gas monitoring wells will be drilled with a CME-55 drill rig using hollow-stem augers. The borings will be logged using the Unified Soil Classification System.

Evaluation of Soil Vapor Pathways

Soil-vapor extraction (SVE) involves installing extraction wells in the unsaturated portion of the subsurface, piping the wells to a blower and extracting hydrocarbon vapor from air at moderate or high rates. The process is considered bioventing if injecting air, or extracting air at a low enough rate to introduce and distribute oxygen to the subsurface without removing significant amounts of hydrocarbon mass that require substantial treatment costs. Because injection bioventing can theoretically cause higher chemical concentrations in indoor air adjacent to the treatment area, only extraction is proposed as a corrective action alternative for this site.

Soil vapor pathways will be investigated as previously described in *Work Plan for Conducting a Pilot Study for Soil Vapor Extraction and Ozone Injection, Pace In/Out, Case No. 1TSI171, 336 Main Street, Dorris, California,* dated February 23, 2006, and will be supplemented with additional data collected from the soil-gas monitoring probes described above. During the air injection/extraction tests described in the February 23, 2006 work plan, the three soil gas probes will be field monitored at regular intervals for total hydrocarbons, oxygen (O_2), and carbon dioxide (CO_2) before, during, and after the test.

Data obtained during the air injection/extraction tests will be analyzed to determine the potential for migration of soil gases and impacts to indoor air.

The soil gas probes also will be field monitored for total hydrocarbons, O_2, and CO_2 immediately before and after the ozone injection portion of the pilot study, and on a weekly basis during the test. Immediately before termination of the ozone injection test, soil vapor from each of the three probes will be collected in one-liter Tedlar™ bags and submitted to a state-certified laboratory and analyzed for total petroleum hydrocarbons as gasoline (TPH-g); benzene, toluene, ethylbenzene, and total xylenes (BTEX); and five oxygenates. Field and laboratory data will be evaluated to determine the influence of ozone injection on soil gas and the potential for impacts to indoor air.

AMENDED WATER-QUALITY TESTING PARAMETERS

Ozone injection will be initiated in the four sparge points while monitoring will be performed as detailed in the revised **Table 1**.

Table 1
Pilot Test Sampling Summary

Period	Locations	Frequency	Analytes
Background	All onsite monitoring wells	Once (regular quarterly round prior to starting ozone system)	DO*, ORP*, pH*, EC*, temperature*, TPHg, TPHd, BTEX, 5 oxygenates, chlorinated hydrocarbons
	MW-1, MW-2, and MW-3		**
Pretest	All onsite monitoring wells	Immediately prior to starting ozone system	DO*, ORP*
Week 4	All onsite monitoring wells	End of Week 4	DO*, ORP*
Week 8 (shutdown)	MW-1, MW-2, and MW-3	Once at end of test	**
	All onsite monitoring wells	Once at end of test (coincide with regular quarterly round)	DO*, ORP*, pH*, EC*, temperature*, TPHg, TPHd, BTEX, 5 oxygenates, chlorinated hydrocarbons

Footnotes: * Field tested.
**Major ions including bicarbonate, carbonate, nitrate, sulfate, calcium, sodium, potassium, and magnesium; metals including dissolved ferrous iron, manganese, chromium VI, dissolved vanadium, dissolved selenium, dissolved molybdenum; bromate and bromide; alkalinity; COD and BOD; methane; heterotrophic plate counts; and ammonia as nitrogen. The reporting limit for chromium VI will be no higher than 5 µg/L and the reporting limit for bromate will be no higher than 10 µg/L.

SCHEDULE

The following schedule for implementing the pilot study will be observed:

Work Item	Time after pilot study is approved by NCRWQCB
Submit budget for pilot study to Underground Storage Tank Cleanup Fund for preapproval	1 month
Obtain preapproval	3 months
Conduct pressure radius of influence test	4 months
Complete installation of bioventing/SVE wells, ozone sparge points, and soil-gas probes, and sparge point trenching	7 months (trenching subject to weather delay)
Complete air extraction/injection tests	9 months
Complete ozone injection test	12 months
Submit pilot study report to NCRWQCB	14 months

Please contact me at (530) 244-9703 if you have any questions about this work plan addendum.

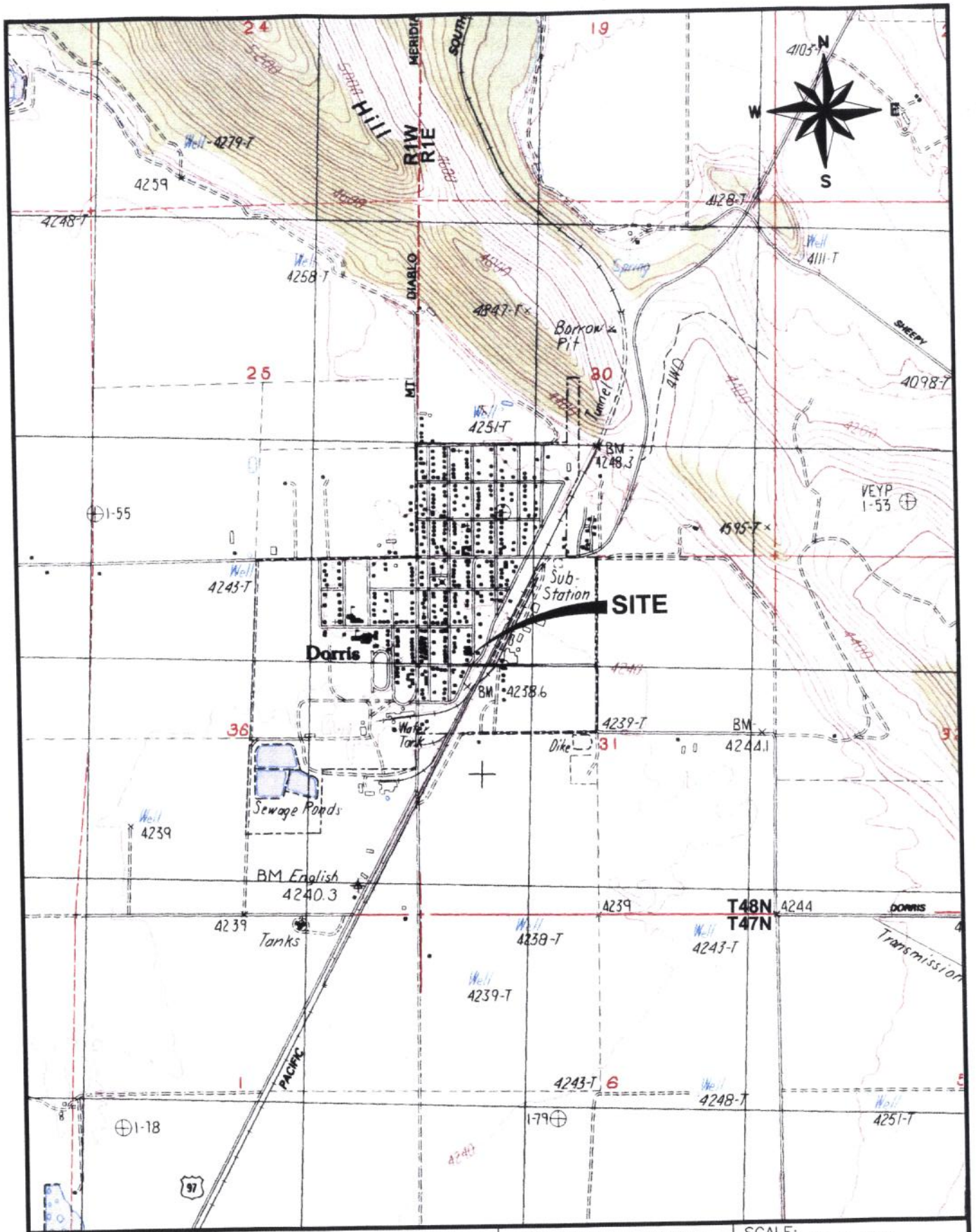
Sincerely,

Bryan W. Gartner
Senior Geologist

PROFESSIONAL GEOLOGIST
BRYAN W. GARTNER
No. 5634
Exp 9/30/07
STATE OF CALIFORNIA

enc. **Figure 1**. Site-Location Map
Figure 2. Proposed Wells, Probes, and Points for Pilot Study
Figure 3. Typical Construction Detail For Soil-Gas Probe

cc: Mr. Cody Walker, California Regional Water Quality Control Board, North Coast Region
Mr. John Ellis, Siskiyou County Public Health Department



SITE–LOCATION MAP

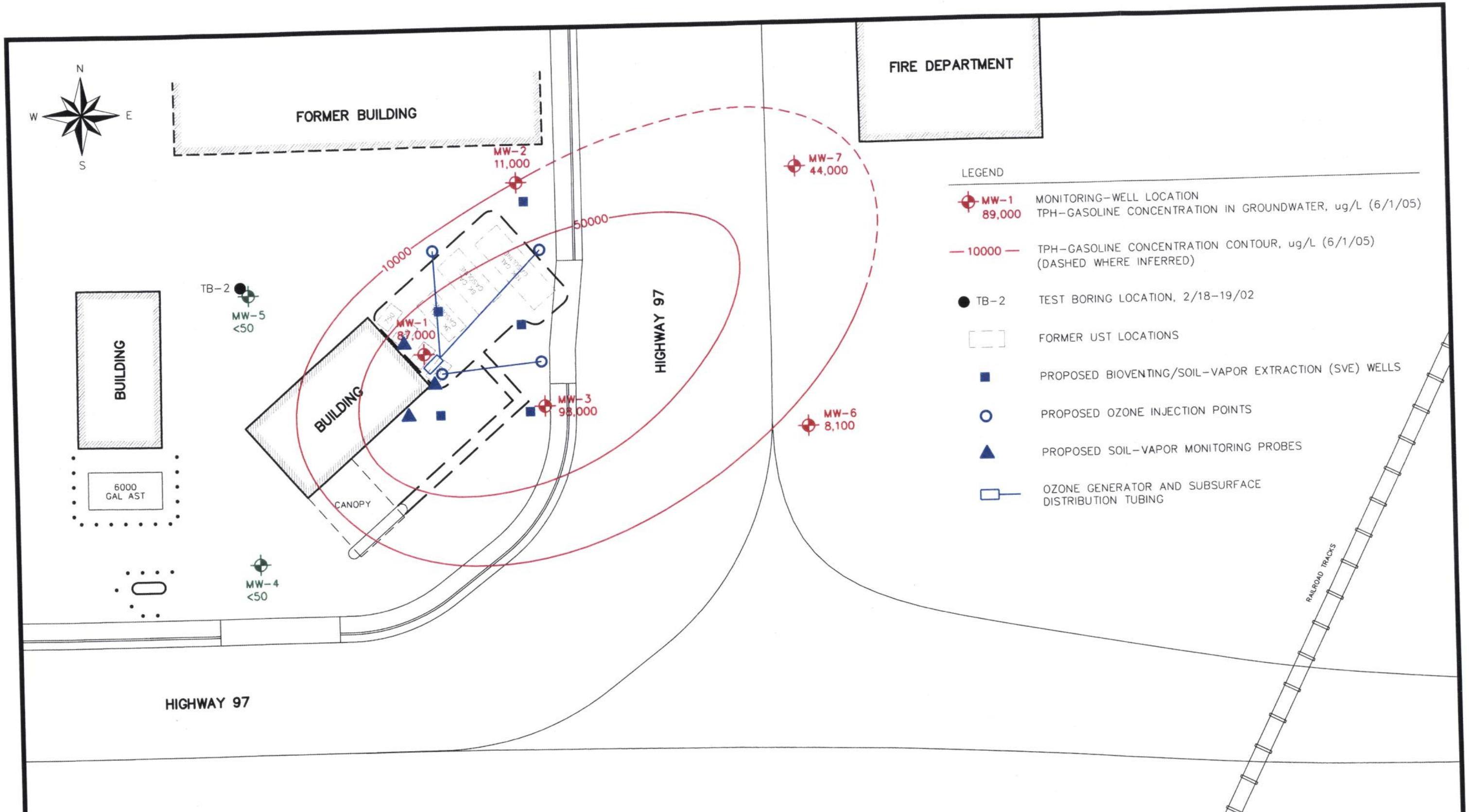
MAP ADAPTED FROM USGS 7.5–MINUTE TOPOGRAPHIC QUAD, DORRIS, CALIF., 1985

LAWRENCE & ASSOCIATES
2001 MARKET STREET, RM. 523
REDDING, CA 96001

PHONE (530) 244–9703
FAX (530) 244–5021

SCALE:	1"=2,000'
DATE:	5/24/2006
JOB NO:	003027.00
CLIENT: ROBERT & JANET PACE	PROJECT: PILOT STUDY
DRAWN BY: J. HOLDEN	FIGURE 1

P:\P\Dorris Shell\SITE–LOC.dwg J.L.H. 5/24/2006



PROPOSED WELLS, PROBES, AND POINTS FOR PILOT STUDY

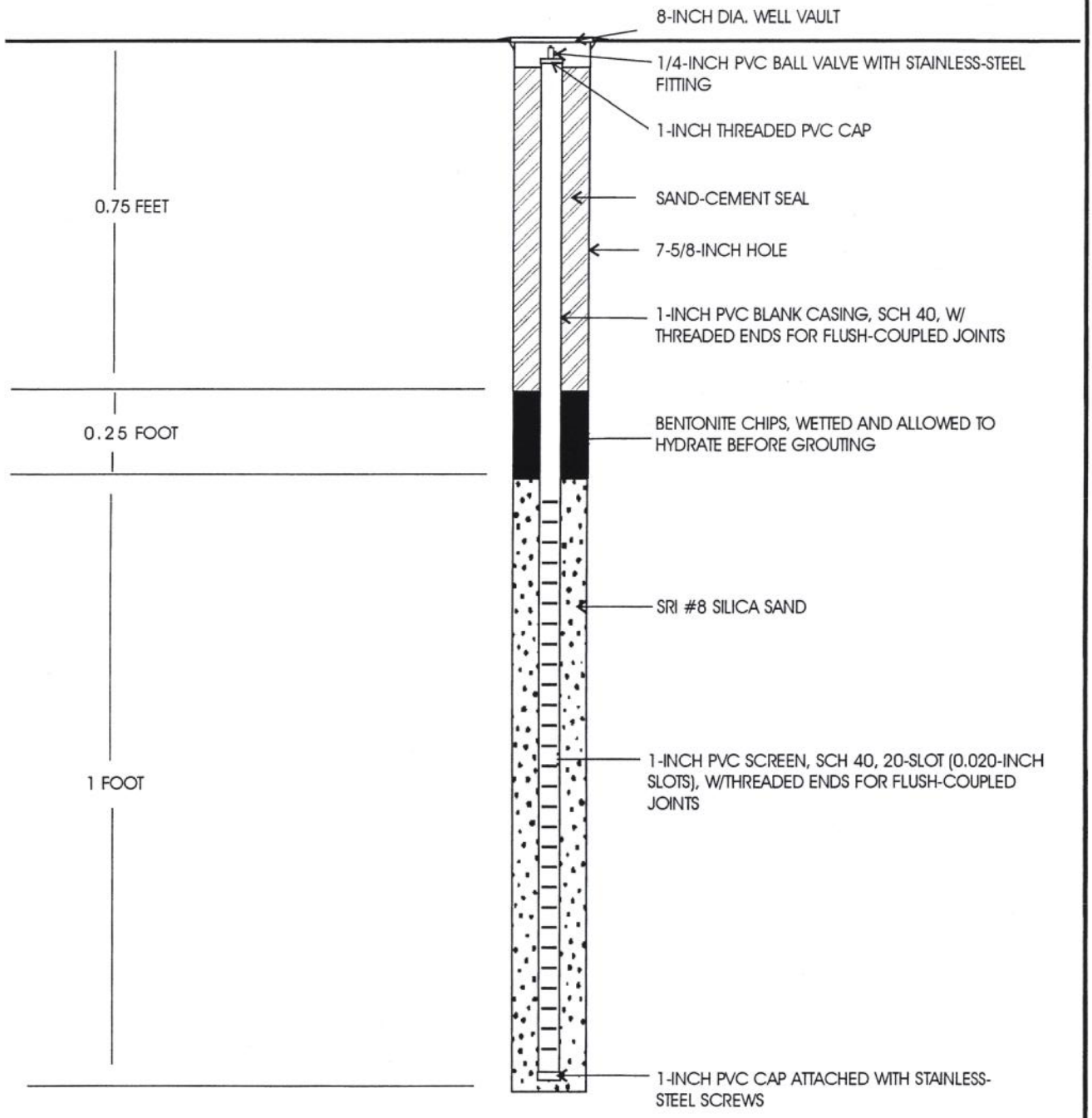
LAWRENCE & ASSOCIATES
2001 MARKET STREET, RM. 523
REDDING, CA 96001
PHONE (530) 244-9703
FAX (530) 244-5021

SCALE:	1"=25'
DATE:	5/24/2006
JOB NO.:	003027.00

FIGURE 2

CLIENT:	PROJECT:	DRAWN BY:	CHECKED BY:
ROBERT & JANET PACE	DORRIS SHELL - PILOT STUDY	J. HOLDEN	B. GARTNER

P:\Dorris Shell\PROPOSED-MAY06.dwg J.L.H. 5/24/2006



TYPICAL CONSTRUCTION DETAIL FOR SOIL GAS MONITORING PROBE		LAWRENCE & ASSOCIATES 2001 Market Street, Room 523 Redding, CA 96001 Phone (530) 244-9703 Fax (530) 244-5021	SCALE: AS SHOWN DATE: MAY 24, 2006 JOB NO.: 003027.00
CLIENT: PACE IN/OUT	PROJECT: PILOT STUDY	DRAWN BY: B. GARTNER	FIGURE 3