Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

April 10, 2007

Stephen Tan, Esq.
Cascadia Law Group
1201 Third Avenue, Suite 320
Seattle, WA 98101

Re: Evaluation of Migration Potential Due to Proposed Clark Public Utilities Fruit Valley Well Field
Support Terminals Operating Partners, L.P. (STOP) Vancouver #2 Terminal
5420 Fruit Valley Road, Vancouver, Washington
ACA Project No. 1126-02

Dear Stephen:

As requested, this letter provides an initial evaluation of the potential migration of fuel and related constituents detected in shallow groundwater beneath the STOP #2 Terminal ("the Terminal") if Clark Public Utilities (CPU) implements groundwater extraction at its proposed Fruit Valley well field. The proposed Fruit Valley well field is located approximately 1,000 feet northwest of the Terminal (Figure 1). CPU is currently completing evaluations to finalize the design of the well field.

Background

CPU Proposed Fruit Valley Well Field. CPU has proposed installing and operating a domestic water supply well field on land currently owned by the Washington Department of Fish and Wildlife (WDFW). The proposed well field has conceptually been designed to consist of four extraction wells each pumping at 3,500 gallons per minute (gpm) for a total of 20 million gallons per day (MGD; Pacific Groundwater Group [PGG], 2001). The wells would be installed and screened within the Pleistocene Alluvial Aquifer (PAA) with anticipated depths of approximately 170 feet and screened intervals from 70 to 170 feet below grade. Prior to finalizing the design of the system, CPU plans to conduct a 3 to 7 day constant-rate aquifer test to better assess the transmissivity of the PAA.

Current Environmental Conditions of the Terminal. The Terminal has been used to store and transfer liquid fertilizers, petroleum, alcohol, and fuel additives since 1957. A site plan showing the layout of the facility is shown on Figure 2. Evidence of a potential fuel release to soil was observed during the decommissioning of an underground petroleum storage tank at the vapor recovery unit in 2001. Several investigations have been conducted at the Terminal since 2001 to assess the extent of soil and groundwater impacted by fuel-related constituents (AMEC, 2002a; SECOR, 2003). Results of these investigations indicated the presence of fuel and oxygenate (e.g., methyl tert-butyl ether [MTBE]) constituents in soil and/or groundwater east of the truck loading rack and near the former

9615 Southwest Allen Boulevard, Suite 106
Portland, Oregon 97005-4814
(503) 924-4704 Portland
(360) 567-3977 Vancouver
(503) 924-4707 Fax
www.ashcreekassociates.com

vapor recovery unit. Copies of figures from reports by AMEC and SECOR summarizing the results of the previous investigations are contained in Attachment A. As shown on the figures, the lateral extent of fuel-related constituents in soil and groundwater has been defined and does not extend off-site. The adjacent property to the north (the Firestone property) is used to grow berry crops and shallow wells are used to supply the irrigation water for the property. Recent samples collected from the irrigation wells at the adjacent Firestone property and analyzed for fuel and related constituents were non-detect (i.e., no chemicals were detected above the laboratory method reporting limits), supporting that the release at the Terminal has not impacted groundwater beneath the Firestone Property.

Geology and Hydrogeology. Lithology at the Terminal is reported to consist of silty, fine sand or sandy silt to a depth of approximately 10 feet underlain by a fine- to medium-grained sand to depths explored (approximately 50 feet below grade; AMEC, 2002b). The depth to groundwater ranges between 18 and 28 feet below grade (AMEC, 2002a). Lithologic logs from CPU test wells installed at the Fruit Valley well field indicate the presence of approximately 25 feet of silt or silty sand underlain by fine- to medium-grained sand (PGG, 2003a). The sand layer contains some silt in some locations and extends to a depth of 55 to 65 feet below grade. These upper layers were recorded as the Recent Alluvial Aquifer (RAA). Sand and/or gravel layers of varying thicknesses were reported below the RAA in the CPU test wells and were recorded as the PAA.

PGG developed a numerical groundwater model to assist in the conceptual design of the well field (PGG, 2001). PGG estimated the transmissivity of the PAA at 1.5 to 3 MGD per foot and the hydraulic conductivity of the PAA to be 2,675 feet per day (ft/d) based on tidal responses observed in the CPU test wells. Based on predictions from the numerical model, approximately 9 feet of drawdown would be observed in the four extraction wells in the well field, assuming a constant flow rate of 3,500 gpm per well. Figure 15 of the PGG report (2001) presents the predicted distribution of drawdown around the well field; a copy of the figure is contained in Attachment B. According to the figure, the predicted drawdown at the Terminal would be approximately 3 feet.

Evaluation of Potential Chemical Migration

Groundwater within the RAA is found in the fine- to medium-grained sand layer. This soil overlies a fine- to medium-grained sand at the top of the PAA. According to PGG (2003b), horizontal gradients in the RAA and underlying the PAA are similar, and it is reasonable to assume that pumping from the PAA will cause similar effects on the gradient within the RAA as in the PAA. It is currently unknown whether fuel constituents detected in shallow groundwater beneath the Terminal (i.e., within the RAA) have migrated to the PAA. Therefore, pumping from the Fruit Valley well field could have three potential consequences:

1) Increased lateral transport within the PAA, if fuel constituents from the Facility are currently present in the PAA.
2) Increased lateral transport within the RAA.
3) Increased vertical migration from the RAA to the PAA.

Each of these potential pathways were evaluated using the aquifer parameters assumed by PGG (2001 and 2003b), where available, to assess the likelihood that dissolved-phase constituents could be pulled off-site and/or to the well field if the well field is brought on-line as conceptually designed.

Increased Lateral Transport Within The PAA. PGG estimated a hydraulic conductivity of 2,675 ft/d and a porosity of 20 percent for the PAA. The predicted drawdown under a pumping scenario of 20 MGD was 9 feet at the well field and 3 feet at the Terminal, indicating a hydraulic gradient of 0.006 toward the pumping wells. Based on these parameters, the anticipated groundwater velocity between the Terminal and well field once the well field is operational would be approximately 80 ft/d. This indicates that groundwater in the PAA that is currently beneath the release area at the Terminal could be pulled off-site within 6 days and could reach the well field within 12 days. The short timeframe for groundwater to travel from the site to the well field allows significant potential for dissolved-phase fuel constituents to quickly reach the pumping wells, if these constituents are currently in the PAA beneath the Terminal. Constituents such as MTBE that are not as susceptible to retardation or degradation could be pulled off-site and reach the well field at a rate similar to the groundwater (i.e., within 12 days).

Increased Lateral Transport within the RAA. The dissolved-phase fuel constituents at the Terminal do not currently extend more than approximately 300 feet from the release area. The shallow groundwater is found within the fine- to medium-grained sand of the RAA. Although PGG did not provide an estimate of the hydraulic conductivity of this unit in the reports reviewed for this evaluation, a reasonable estimate based on Freeze & Cherry (1979) is 30 to 300 ft/d. Assuming a similar hydraulic gradient (0.006) as is induced in the PAA by pumping at the well field and a porosity of 30 percent for the fine- to medium-grained sand (Freeze & Cherry, 1979), the estimated induced groundwater velocity in the RAA between the Terminal and the well field will be in the range of 1 to 6 ft/d. Under PGG's modeled conditions of the operational well field, MTBE could be pulled off-site in as few as 70 days and could reach the well field in as few as 170 days. Assuming reasonable assumptions regarding retardation and degradation, the fuel constituents could be pulled off-site in less than a year.

Increased Vertical Migration from the RAA. Although PGG did not provide a predicted head difference between the RAA and the PAA once the well field is operational in the reports reviewed, the predicted head difference induced during a 5-day aquifer test with a constant pumping rate of 4,000 gpm was 0.25 feet, equating to a hydraulic gradient of 0.01 over the 25-foot saturated zone of the RAA (PGG, 2003a). Conservatively assuming that the head difference does not further increase when the well field is fully operational and the vertical hydraulic conductivity within the RAA is 1/10 of the horizontal conductivity, the vertical flow from the RAA toward the PAA would be in the range of 0.1 to 1 ft/d. Under this conservative scenario and assuming that the shallow groundwater containing dissolved-phased constituents is within the upper 10 feet of the saturated portion of the RAA (i.e., the lower 15 feet currently do not contain fuel compounds), MTBE could be pulled vertically into the PAA within 15 to 150 days. The fuel constituents could be pulled into the PAA in as few as 30 days. Once in the PAA, the constituents would rapidly be pulled toward the well field, as described above.

Conclusions

The results of this initial evaluation conducted using parameter estimates from CPU's consultant, PGG, indicates that operation of a well field at the Fruit Valley site will have a significant, and potentially quick, impact on the lateral and vertical migration of fuel and related constituents at the Terminal. These constituents are currently contained within the boundaries of the Terminal. As indicated by PGG in a May 2003 letter (PGG, 2003a), fuel constituents have likely been present in soil and/or groundwater at the Terminal for more than 22 years. The extent of the fuel constituents has likely reached equilibrium. Between degradation and a naturally flat groundwater gradient, it is not likely that the extent of the dissolved-phase constituents will increase in size and is likely it will begin to decrease in

extent (if it has not already done so) if no outside stresses are applied to the groundwater gradient (e.g., the proposed well field within 1,000 feet).

Recent sampling of irrigation wells at the Firestone property located directly north of the Terminal confirmed that fuel constituents in groundwater at the Terminal have not migrated off the facility to the northwest (i.e., in the direction of the proposed well field). This initial evaluation supports that implementation of the well field has the likelihood of pulling fuel and/or related constituents in groundwater beneath the Terminal onto the Firestone property and contaminating these wells. There is also the possibility that these constituents could be pulled all the way to the pumping wells at the well field.

Please do not hesitate to call if you have any questions or need further assistance.

Sincerely,

Amanda L. Spencer
Principal Hydrogeologist

Attachments:

References
Figure 1 – Site Location Map
Figure 2 – Site Plan
Attachment A – Concentration Maps from SECOR and AMEC Reports
Attachment B – Figure 15 from PGG (2001).

cc: Mr. Joe Aldridge, NuStar Energy L.P.

References

AMEC, 2002a. *Phase II Environmental Site Assessment - Cenex Harvest State Cooperatives*, May 2002.

AMEC, 2002b. *Subsurface Investigation and Soil Removal Report - Cenex Harvest State Cooperatives*, December 2002

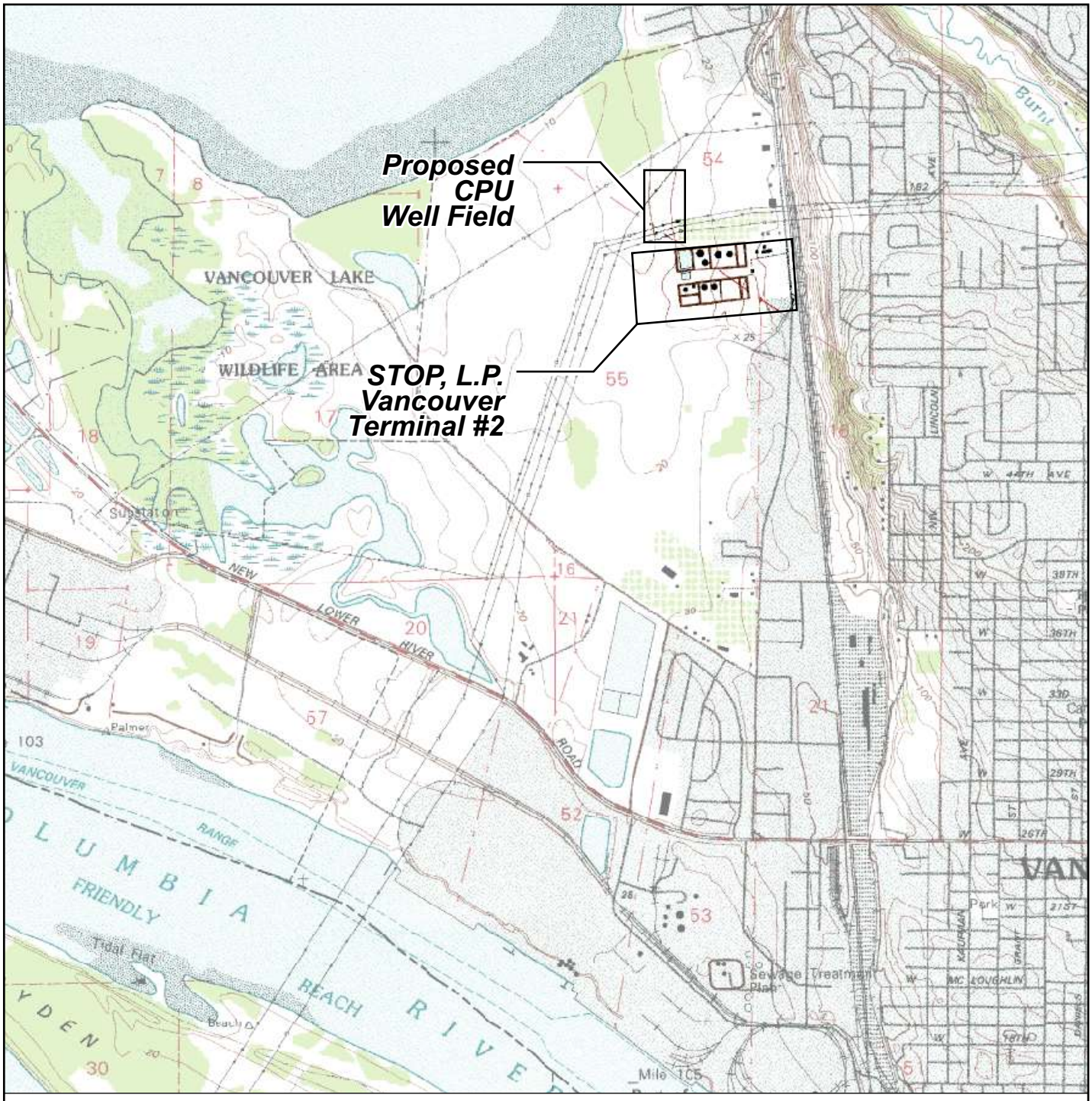
Freeze, R.A./Cherry J.A., 1979. *Groundwater*. Copyright by Prentice-Hall, Inc., 1979.

PGG, 2001. *Clark Public Utilities Lakeshore Wellfield Exploration and Testing Program*, February 2001.

PGG, 2003a. *Work Plan for Drilling and Testing Test Well TW-7, Clark Public Utilities Fruit Valley Test Well Site*, April 2003.

PGG, 2003b. *Comments Submitted to Ecology Regarding Preliminary Permit and Work Plan for Drilling and Testing Fruit Valley Test Well*, Letter to Clark Public Utilities dated May 20, 2003.

SECOR, 2003. *Results of Phase II Environmental Site Assessment*, June 6, 2003.



Base map prepared from USGS 7.5-minute quadrangle of Vancouver, WA, dated 1990, as provided by Topozone.

0 2000 4000

Scale in Feet

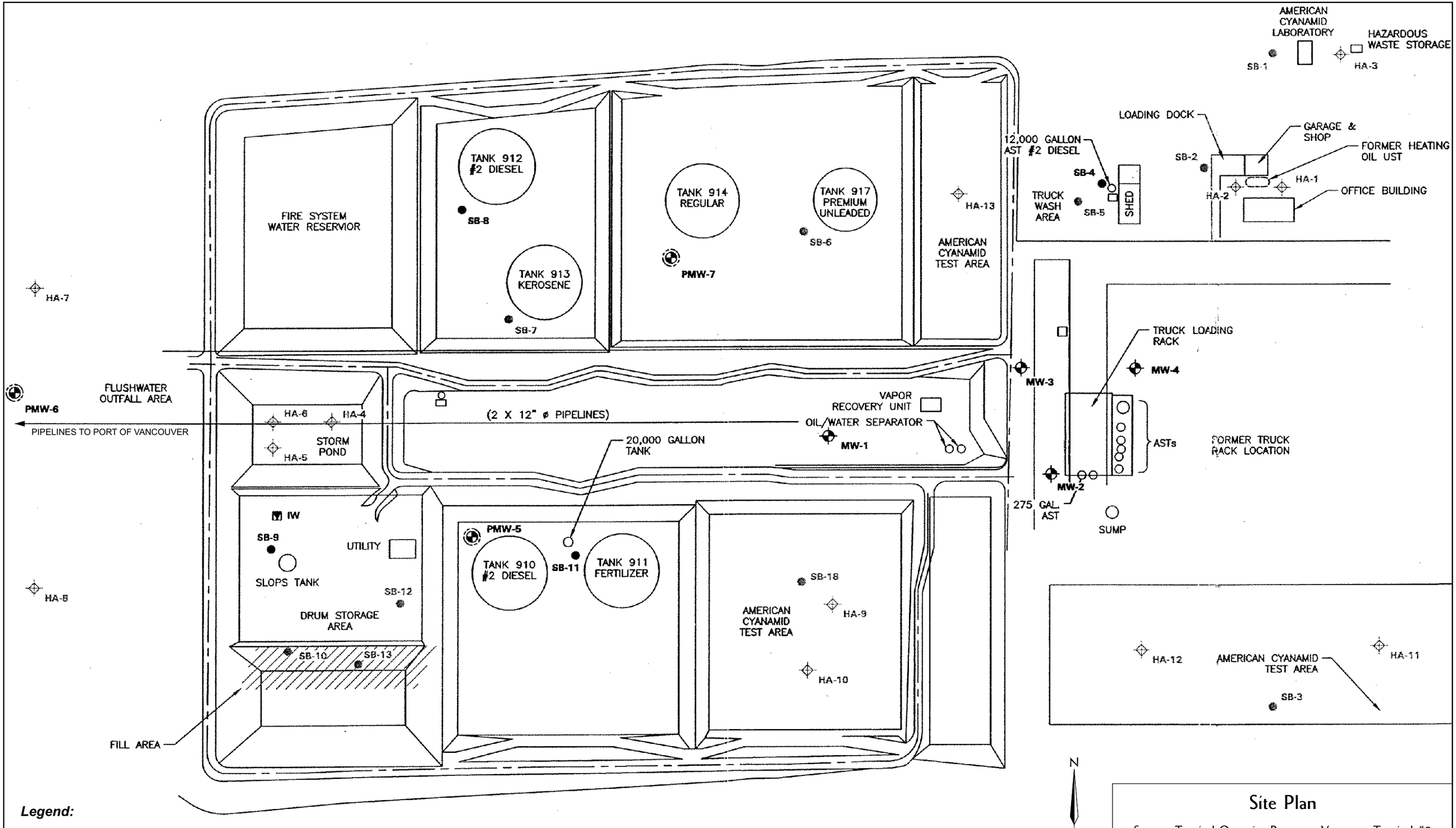
N

Site Location Map

Support Terminal Operating Partners - Vancouver Terminal #2
Vancouver, Washington

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number	1126-02	Figure
March 2007		1



Legend:

- PMW-1 — TEMPORARY MONITORING WELL LOCATION
- MW-5 — GROUNDWATER MONITORING WELL LOCATION
- SB-1 — AREA OF KNOWN RELEASES SOIL BORING/GROUNDWATER SAMPLE LOCATION
- SB-1 — AREA OF CONCERN SOIL BORING/GROUNDWATER SAMPLE LOCATION
- HA-1 — AREA OF KNOWN RELEASES HAND AUGER SAMPLE LOCATION
- HA-1 — AREA OF CONCERN HAND AUGER SAMPLE LOCATION
- IW — IRRIGATION WELL LOCATION

NOTE: Base map from a by SECOR International, Inc. (06/02/03)

Site Plan

Support Terminal Operating Partners - Vancouver Terminal #2
Vancouver, Washington

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number 1126-02

March 2007

Figure 2

Attachment A

Concentration Maps from SECOR and AMEC Reports

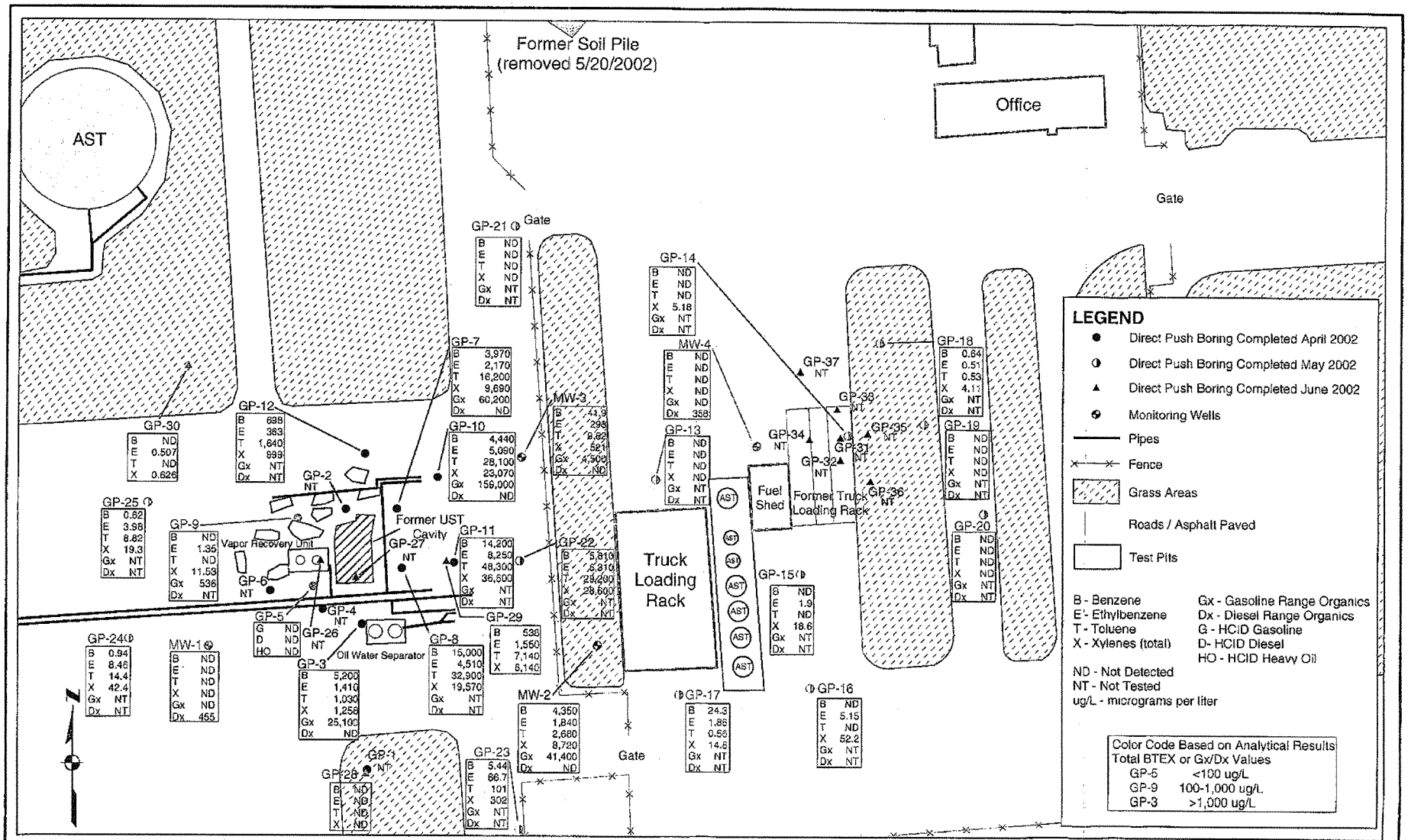


FIGURE 5

amec

7376 SW Durham Road
Portland, OR, U.S.A. 97224

W.O. 1-61M-11061-0 T2
DESIGN BEL
DRAWN BRJ
DATE SEPTEMBER 2002

CENEX HARVEST STATES COOPERATIVES
5420 N.W. FRUIT VALLEY ROAD
VANCOUVER, WASHINGTON

BTEX, TPH-Gx, TPH-Dx, RESULTS FOR GROUNDWATER FROM DIRECT PUSH & MONITORING WELL BORINGS

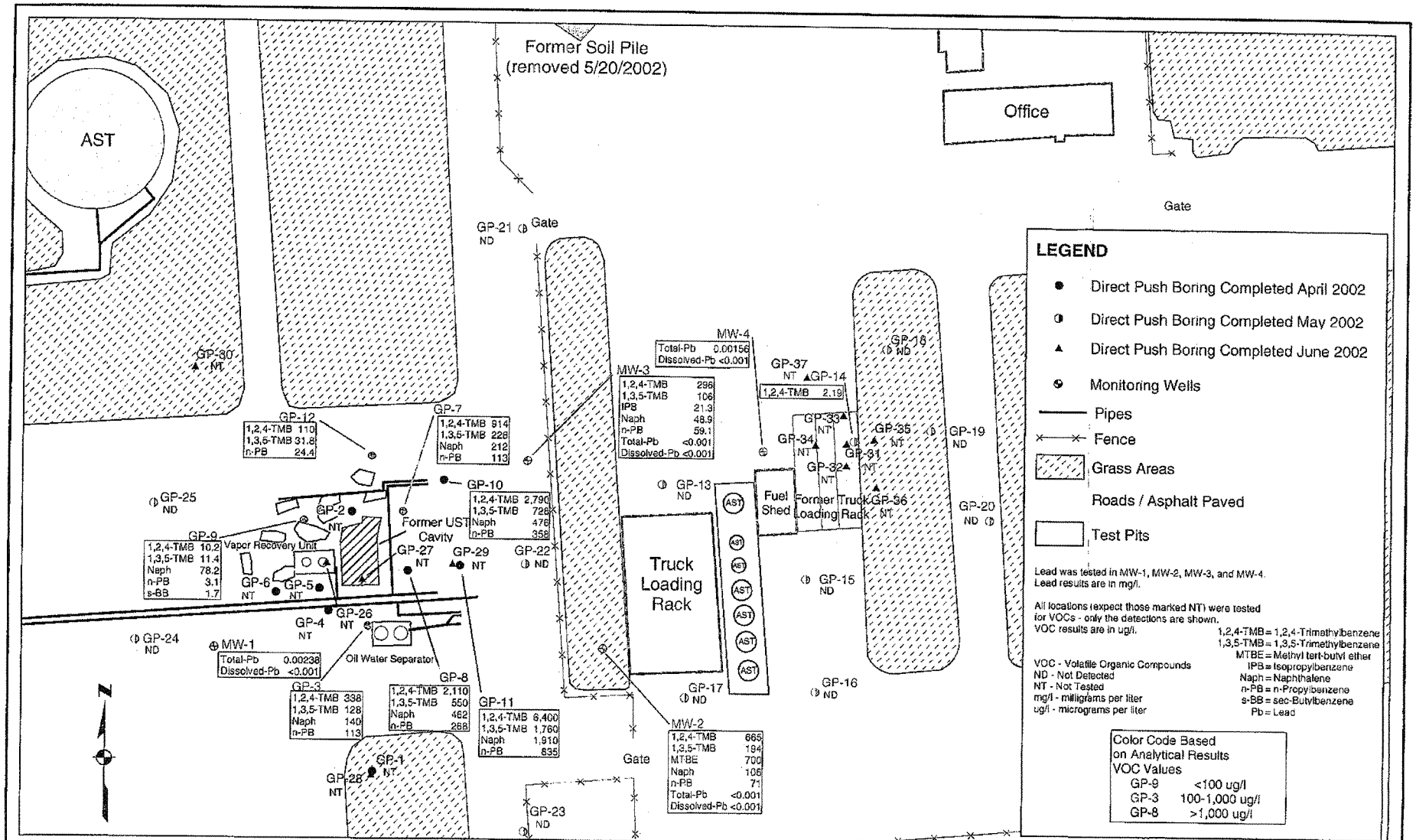


FIGURE 6

amec
7376 SW Durham Road
Portland, OR, U.S.A. 97224

W.O. 1-61M-11061-0 T2
DESIGN BEL
DRAWN BRJ
DATE SEPTEMBER 2002

CENEX HARVEST STATES COOPERATIVES
5420 N.W. FRUIT VALLEY ROAD
VANCOUVER, WASHINGTON

VOC and Pb RESULTS FOR GROUNDWATER FROM DIRECT PUSH & MONITORING WELL BORINGS

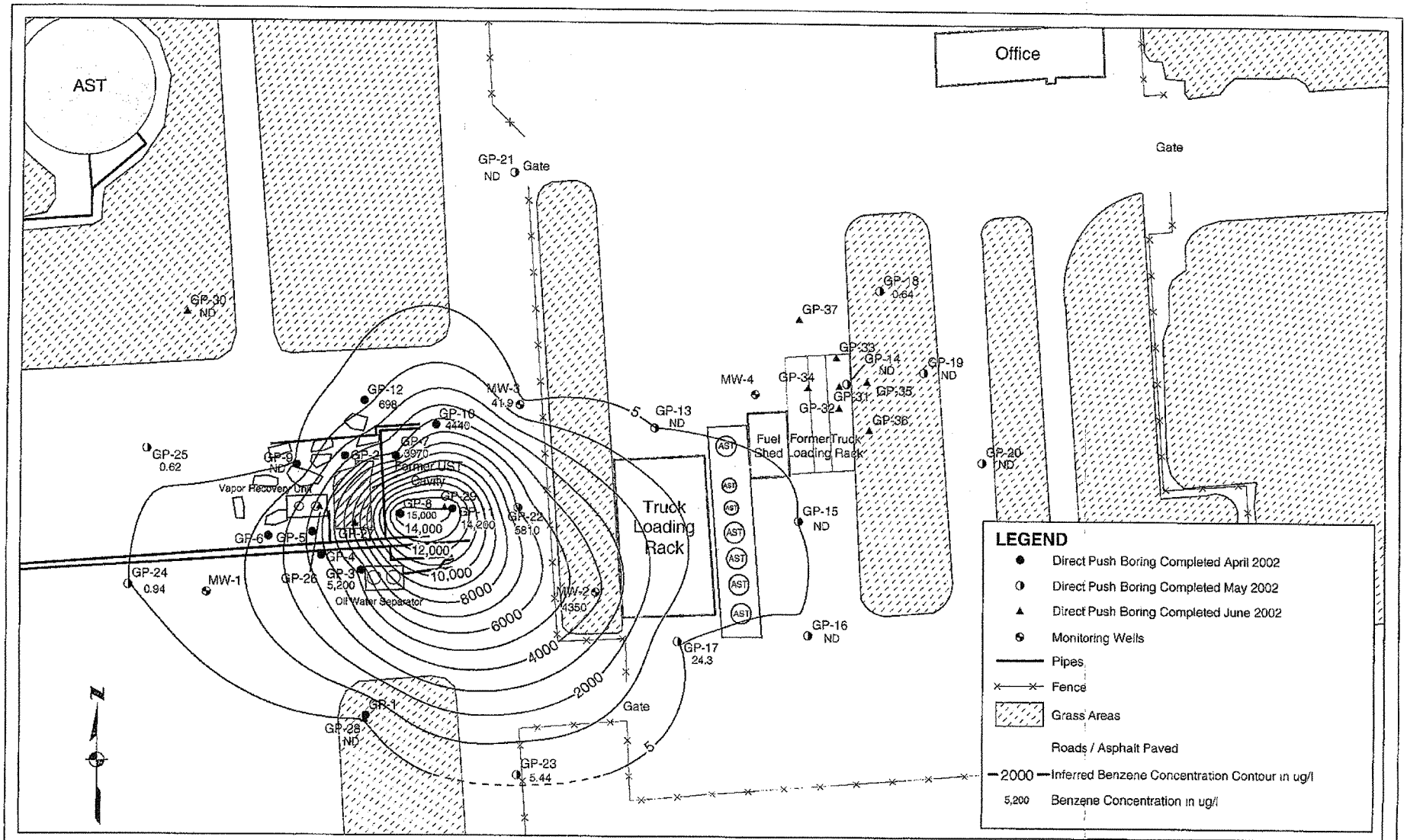


FIGURE 7

amec

7376 SW Durham Road
Portland, OR, U.S.A. 97224

W.O.	1-61M-11081-0 T2
DESIGN	BEL
DRAWN	BRJ
DATE	SEPTEMBER 2002

CENEX HARVEST STATES COOPERATIVES
5420 N.W. FRUIT VALLEY ROAD
VANCOUVER, WASHINGTON

BENZENE CONCENTRATIONS AND INFERRED CONTOUR FOR APRIL - JUNE 2002

ANALYTE	
TPH-HCID	HYDROCARBON IDENTIFICATION
TPH-G	TOTAL PETROLEUM HYDROCARBONS AS GASOLINE
TPH-D	TOTAL PETROLEUM HYDROCARBONS AS DIESEL
OCP	ORGANO-CHLORINE PESTICIDES
OPP	ORGANO-PHOSPHORUS PESTICIDES
CH	CHLORINATED HERBICIDES
TZ	TRIAZINES
VOCs	VOLATILE ORGANIC COMPOUNDS
B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENES
MTBE	METHYL-TERTIARY-BUTYL-ETHER
N	NAPHTHALENE
1,2,3-TMB	1,2,4-TRIMETHYL BENZENE
1,3,5-TMB	1,3,5-TRIMETHYL BENZENE
IPB	ISOPROPYL BENZENE
N-PB	N-PROPYL BENZENE
CF	CHLOROFORM
OTHER VOCs	OTHER VOLATILE ORGANIC COMPOUNDS
PAHs	POLYAROMATIC COMPOUNDS
AN	ACENAPHTHENE
AT	ANTHRACENE
CHRYS	CHRYSENE
F	FLUORENE
N	NAPHTHALENE
PHEN	PHENANTHRENE
PY	PYRENE
Pb	TOTAL LEAD

SB-8	ug/L
TPH-D	20,900
PAHs	
AN	11.2
F	17.9
N	642
PHEN	32.3

SB-1	ug/L
TPH-HCID	ND
OCP	ND
OPP	ND
CH	ND
TZ	ND

SB-2	ug/L
TPH-HCID	ND

SB-4	ug/L
TPH-HCID	ND
PAHs	ND

SB-7	ug/L
TPH-HCID	ND

PMW-7	ug/L
TPH-HCID	ND

SB-6	ug/L
TPH-HCID	ND

SB-5	ug/L
TPH-HCID	ND

PMW-6	ug/L
TPH-HCID	ND

MW-3	ug/L
VOCs	
B	90.8
T	9.65
E	338
X	538.2
MTBE	3.7
N	30.8
1,2,3-TMB	315
1,3,5-TMB	89.5
IPB	19.4
N-PB	62.3
OTHER VOCs	ND
OTHER PAHs	ND

MW-4	ug/L
VOCs	ND
PAHs	ND

SB-9	ug/L
TPH-D	66,200
Pb	1,780
PAHs	
AT	4.04
F	20.9
N	728
PHEN	38.9
PY	2.35
OTHER PAHs	ND

PMW-5	ug/L
TPH-D	1,880
N	0.34
OTHER PAHs	ND

SB-11	ug/L
TPH-HCID	ND
N	0.266
OTHER PAHs	ND

MW-1	ug/L
VOCs	ND
PAHs	ND

SB-18	ug/L
TPH-HCID	ND

SB-12	ug/L
TPH-HCID	ND

IW/W-2	ug/L
VOCs	
B	534
T	9.75
E	194
X	876
MTBE	77.6
N	15.0
1,2,3-TMB	160
1,3,5-TMB	62.4
IPB	19.4
N-PB	15.8
OTHER VOCs	ND
OTHER PAHs	ND

SB-3	ug/L
OCP	ND
OPP	ND
CH	ND
TZ	ND

12,000 GALLON AST #2 DIESEL
HAZARDOUS WASTE STORAGE
AMERICAN CYANAMID LABORATORY
LOADING DOCK
GARAGE & SHOP
FORMER HEATING OIL UST
OFFICE BUILDING
SHED
TRUCK WASH AREA
TANK 912 #2 DIESEL
TANK 914 REGULAR
TANK 917 PREMIUM UNLEADED
TANK 913 KEROSENE
FIRE SYSTEM WATER RESERVOIR
AMERICAN CYANAMID TEST AREA
HA-13
HA-7
FLUSHWATER OUTFALL AREA
PIPELINES TO PORT OF VANCOUVER
(2 X 12" ø PIPELINES)
VAPOR RECOVERY UNIT
OIL/WATER SEPARATOR
STORM POND
HA-6
HA-4
HA-5
20,000 GALLON TANK
TRUCK LOADING RACK
ASTs
FORMER TRUCK RACK LOCATION
275 GAL. ASTs
SUMP
UTILITY
SLOPS TANK
DRUM STORAGE AREA
FILL AREA
HA-8
TANK 910 #2 DIESEL
TANK 911 FERTILIZER
AMERICAN CYANAMID TEST AREA
HA-10
HA-9
HA-12
HA-11
AMERICAN CYANAMID TEST AREA
NOT TO SCALE

LEGEND

- PMW-1 — TEMPORARY MONITORING WELL LOCATION
- MW-5 — GROUNDWATER MONITORING WELL LOCATION
- SB-1 — AREA OF KNOWN RELEASES SOIL BORING/GROUNDWATER SAMPLE LOCATION
- SB-1 — AREA OF CONCERN SOIL BORING/GROUNDWATER SAMPLE LOCATION
- HA-1 — AREA OF KNOWN RELEASES HAND AUGER SAMPLE LOCATION
- HA-1 — AREA OF CONCERN HAND AUGER SAMPLE LOCATION
- IW — IRRIGATION WELL LOCATION

SECOR
International Incorporated
7730 SW MOHAWK STREET
TUALATIN, OREGON 97062
(503) 691-2030/692-7074 (FAX)

GROUNDWATER ANALYTICAL RESULTS MAP (APRIL 2003)
CENEX TERMINAL
5420 FRUIT VALLEY ROAD
VANCOUVER, WASHINGTON

FIGURE: 5

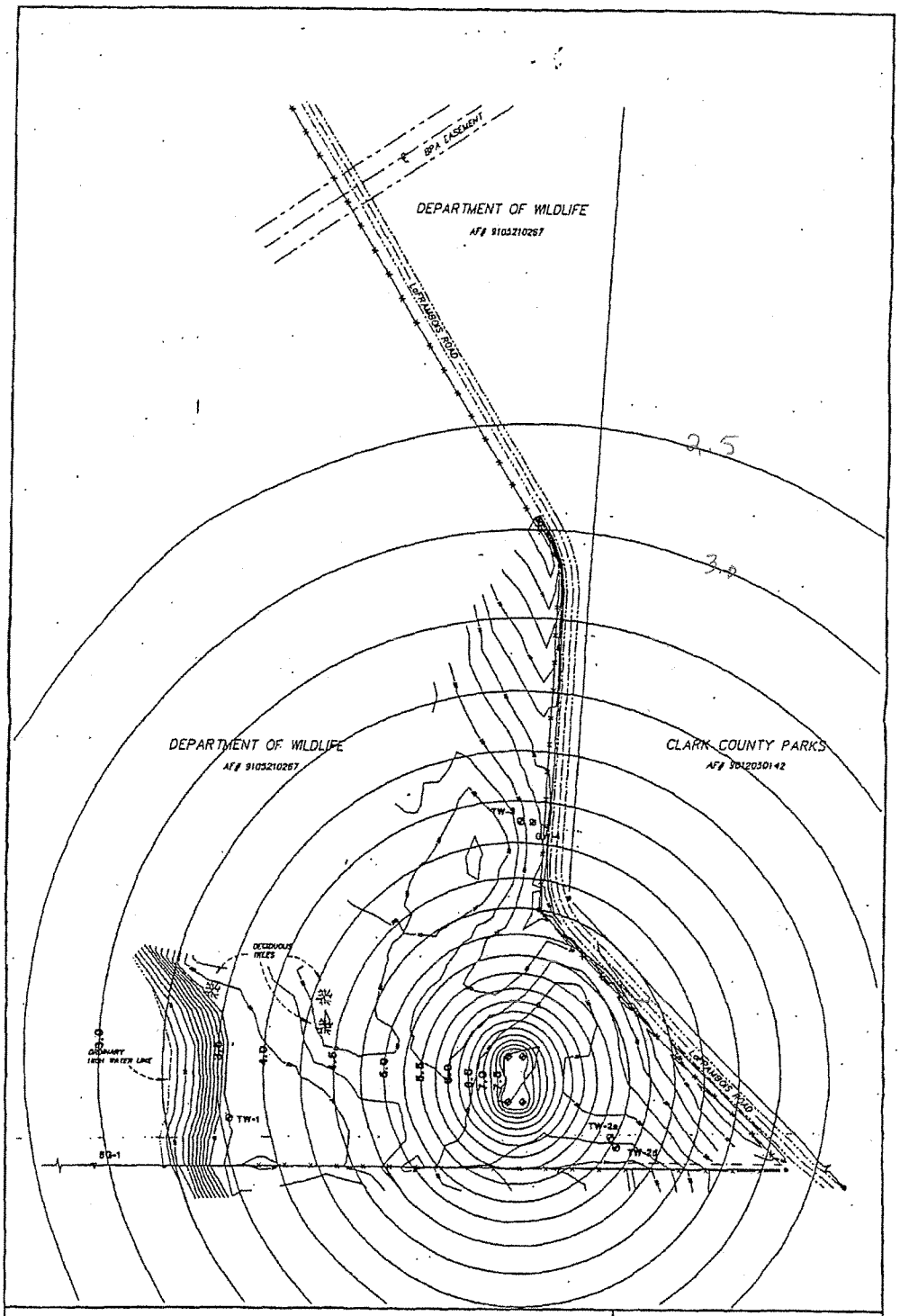
JOB#: 150T.0413.00.0004 APPR: DWN: KPM DATE: 06/02/03

N:/CENEX

DWG: 150T-9413-45A-0403.dwg

Attachment B

Figure 15 from PGG (2001)


BPA EASEMENT
DEPARTMENT OF WILDLIFE
AF# 9105210267
LOFTUS ROAD
2.5
3.0
DEPARTMENT OF WILDLIFE
AF# 9105210267
CLARK COUNTY PARKS
AF# 9012030142
TW-3
DECIDUOUS TREES
ORDINARY HIGH WATER LINE
TW-1
BG-1
TW-2a
TW-2b
LOFTUS ROAD
LEGEND
Proposed 20-inch Production Well
6-inch Test Well
2-inch Monitoring Well
Staff Gage
Survey Monument
Drawdown Contour (ft)
0
100
200
Scale in Feet
FIGURE 15
Distribution of Drawdown
for 20 MGD Pumping Scenario
CPU Lakeshore
Wellfield Development Project
Pacific Groundwater Group

PMX 009585