MULRY AND CRESSWELL ENVIRONMENTAL, INC.

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FREE PRODUCT DELINEATION ALONG SHUNK ST. SEWER

BELMONT MARKETING TERMINAL
26TH STREET AND PASSYUNK AVENUE
PHILADELPHIA , PA

26 JANUARY 1998

Prepared for:

Mr. Steven Coladonato
Sun Philadelphia Refinery
3144 Passyunk Ave.
Philadelphia, PA 19145

Mr. Daniel Shine
Sun Twin Oaks Terminal
4041 Market Street
Aston, PA 19014

Prepared by: Mark Mattie and James Mulry, P.G.
Reviewed by: Marco Droese

Mark Mattie

James Mulry

Marco Droese

1691 Horseshoe Pike • Manor Professional Building • Suite 1 • Glenmoore, PA 19343 • Tel: (610) 942-9010 • Fax: (610) 942-9039
2 Kenley Court • Bear, DE 19701 • Tel: (302) 834-5310 • Fax: (302) 834-1616

Draft
Belmont Terminal, Shunk Street Sewer
Separate Phase Hydrocarbon Delineation / Remedial Testing Results
Revised 26 January, 1998

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FIGURES:

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Draft

Belmont Terminal, Shunk Street Sewer
Separate Phase Hydrocarbon Delineation / Remedial Testing Results
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I) Introduction

The Sun Company (R&M), Sun, Belmont Marketing Terminal is a truck petroleum loading facility adjacent to Sun's Philadelphia refinery located on the south side of Passyunk Avenue at the intersection of 26th Street in South Philadelphia (see Figure I). The Study Area of this report is the portion of the Terminal property through which the City of Philadelphia Shunk Street sewer passes, which is south of the Terminal office building and north of the facility's truck loading rack.

A City of Philadelphia combined storm and sanitary sewer line, the Shunk Street sewer, crosses the Terminal property in an approximately east - west direction and crosses under Passyunk Ave. in the vicinity of the Terminal main gate (see Figure II). The sewer was installed in the early 1900's and is reported thirteen feet in diameter constructed of brick. The top of the sewer is estimated to be approximately twenty feet below the current grade of the terminal parking lots and extends to approximately thirty three feet below this grade. The dimensions of the excavation in which the sewer was constructed, the methods of excavation employed and the nature and extent of fill used in restoring the sewer excavation are not known. In response to reports of hydrocarbon odors in the sewer and a visual inspection of the sewer line under the Terminal property conducted by the City of Philadelphia Water Department which reported hydrocarbon infiltration to the sewer line in this area, Sun contracted Mulry and Cresswell Environmental, Inc. (MCE) to conduct a subsurface investigation of the area.

Between 13 and 19 November 1997 MCE in conjunction with B.L. Myers Bros., Inc., a Pennsylvania certified and licensed drilling company installed seventeen borings on the Terminal property along the Shunk Street sewer, both north and south of the sewer line. Depending on whether or not a boring was to be completed as a temporary two inch diameter well or a permanent four or six inch diameter well, borings were drilled to either thirty five (temporary, 2" diameter) or fifty feet (4" and 6" diameter) below grade. The relative casing elevation of each well was surveyed by transit and rod, depth to water and or separate phase hydrocarbon (product) was measured and product bail-down and recovery tests were performed. Pumping tests were performed on three wells , RW 6, RW 15 and OW 17, and vacuum extraction tests via vacuum truck RW 6) and VR unit (OW 17) were performed on two wells.

This report describes the methods and results of the investigation along the Shunk Street sewer line on the Belmont Terminal property and contains

conclusions draw from these results and the results of remdiation feasibility testing conducted at the site.

II) Scope of Investigative Activities Conducted

To delineate the areal extent of separate phase hydrocarbon (free product) on the water table along the Shunk Street sewer, a grid was constructed with nodes spaced at alternating fifty foot intervals, north and south of the sewer along the length of the sewer in the study area. Prior to drilling, the Pennsylvania One Call, Inc. was notified to allow utility owners with potential conflicts to mark out subsurface utilities. All available drawings depicting subsurface features were reviewed and the borings were hand dug to at least four feet below grade prior to drilling with a rig. Fourteen borings were installed from east to west as determined by field monitoring during drilling. All borings were completed as two inch, four inch or six inch diameter wells, again based on field monitoring.

The relative casing elevations of the wells were surveyed by transit and rod and water table elevations in all wells determined. Wells were gauged frequently from 18 November through 19 December 1997 to allow determination of the areal extent of separate phase hydrocarbons and water table gradient. Pumping tests were conducted on RWs 6 and 15 and OW 17 to define aquifer characteristics in the study area and to gather data necessary for devising a remediation strategy. Soil vapor extraction testing, also to aid in formulating a remediation plan, was conducted on RW 6 utilizing a vacuum truck and on RW 15 utilizing a VR3 vapor extraction and thermal oxidizing unit.

The results of the execution of these work items are discussed below.

III) Boring and Well Installation

As depicted on Figure II, the Shunk Street Sewer crosses the Belmont Terminal property from east to west, passing between the Terminal offices and truck loading racks. As mentioned above, the sewer, constructed of brick sometime prior to 1904, is thirteen feet in diameter and extends from approximately twenty to thirty three feet below the grade of the terminal parking areas. A visual inspection of the sewer conducted by the City of Philadelphia Water Department reported separate phase hydrocarbons (product) entering the sewer line somewhere between the two manholes inside the study area. In order to determine if a product plume underlies the study area in the vicinity of or in contact with the sewer line, thirteen borings were installed both north and south

of the sewer along the length of the sewer on the Terminal property between 14 and 19 November 1997 and one additional well was drilled on 8 December 1997. Initially borings were installed to total depths of thirty five feet below grade and temporarily fitted with two inch diameter PVC well screen to determine the depth of the water table and allow liquid level gauging for the presence of free product. In areas where free product was encountered, borings were drilled to fifty feet below grade and completed with four inch or six inch schedule 40 PVC well screen (0.02" slot) and solid riser pipe to provide permanent wells. Figure III depicts the location and diameter of the wells installed. As presented on Figure III, a total of fourteen borings were installed and completed as temporary (TW) or permanent (RW or OW) wells: six four inch wells (OWs 2, 12, 13, 14, 16, and 17); two six inch wells (RW 6 and RW 15); and six two inch wells (TWs 3, 5, 8, 9, 10, and 11). The well designations as presented on Figure III are based on a combination of the original proposed boring locations, based on a one hundred foot grid overlying the area where the sewer crosses the terminal property, and the actual order in which borings were drilled which was field determined based on cumulative observations during drilling and well gauging.

All borings were installed by hollow stem augering and advanced with collection of split spoon samples at five foot intervals until the desired total depth was obtained. Collected split spoon samples were field screened with a Thermo Environmental Instruments model 580B Organic Vapor Monitor (OVM) which is an intrinsically safe photo ionization detector. Field headspace analysis consisted of transferring sample from the split spoon sample barrel to a "zip-lock" plastic bag, sealing the bag and allowing the sample to equilibrate with the headspace for an approximate duration of two to five minutes. After equilibration, the "zip-lock" was opened just enough to allow insertion of the probe tip of the OVM and the maximum OVM response for each sample was recorded for inclusion in the drilling log (see Appendix A). Well screen and solid pipe were lowered into the boring and for the permanent wells, clean quartz sand pack was poured into the augers to fill the annular space as the augers were retrieved. At least one foot of sand was placed above the screen/solid riser pipe joint. A minimum one foot hydrated bentonite pellet seal was placed over the sand pack and the remaining annular space was filled to grade with drill cuttings. For the temporary wells, the augers were pulled from the boring and the annular space was backfilled with drill cuttings. All permanent wells were capped with locking cap (gripper plug) although only RW 1 (formerly RW 15) outside the fence was fitted with a lock. The temporary wells were sealed with a two inch PVC slip cap. All well heads were finished to grade with a steel manhole. The manholes were not set in concrete as future work will probably require re-accessing many of the wells for plumbing installations.

Drilling logs for all borings and wells recording lithology, OVM responses, construction details and observations for each boring are contained in Appendix A.

IV) Geology

The study area is located in the lowland and intermediate upland section of the Atlantic Coastal Plain Physiographic Province. This Province is characterized by a flat upper terrace surface cut by narrow steep-sided valleys to open, shallow valleys, including the Delaware River floodplain. The underlying deposits are fluvial in origin including glacial meltwater and consist of unconsolidated to poorly consolidated sand and gravel.

From the presence of the sewer line beneath the investigated area it can be inferred that all the borings encountered the backfill of the sewer construction excavation, at least to the suspected depth of the bottom of the sewer line, e.g. approximately thirty three feet below grade. A generalized geologic cross section constructed from all boring logs is attached as Figure V. As depicted on the cross section, obvious anthropogenic fill was observed in most borings to depths of up to twenty feet below grade (RW 6). Sand and gravel was encountered below the fill as the predominant unit in all borings. Exceptions to the undifferentiated sand and gravel with varying amounts of silt and clay were:

- a clay unit of five foot maximum thickness was encountered from approximately fifteen to twenty feet below grade in the western portion of the investigation area in wells TW 8, TW 10, and OW 12;

- a gravel rich unit of a few foot thickness was encountered in all wells except OW 2 and TW 11, dipping to the east. It was encountered at approximately sixteen feet below grade at the western end of the investigation area (RW 15) to a depth of approximately twenty nine feet below grade in the eastern end of the investigation area (OW 14). A hard gravel layer of less than one foot thickness was encountered at approximately seventeen feet below grade in well TW 5 and approximately twenty seven feet below grade in well RW 6;
- a silt unit was encountered for the entire depth of well OW 2.

Although separated into distinct lithologic units on the drilling logs and cross section, it is probable that the entire area is comprised of undifferentiated native sediments utilized as fill. For the purposes of this investigation and subsequent remediation efforts, the entire area can be considered a mixture of

sand and gravel with varying silt and clay content. No continuous lithologic units were observed that would be expected to significantly influence the hydraulic characteristics of the subsurface in the area of the Shunk Street sewer line.

V) Hydrogeology

Groundwater at the study area is encountered under water table conditions at approximately twenty six to thirty feet below grade. Regional groundwater flow is expected to be towards the Schuylkill River to the west. From groundwater elevation data collected at another site in the area, the Sunoco Station at 28th and Passyunk, across Passyunk Avenue from the study area, local groundwater flow has been documented as to the south-southwest. Subsurface utilities also can influence local groundwater elevations to the point of creating local gradients that do not conform to the regional gradient. Water distribution and sewer lines often have minor leaks which can influence the local water table gradients. The City sewer systems are known to influence groundwater gradients along 26th Street and Packer Ave. In addition to leaks to or from these utilities, the presence of the backfilled trenches these utilities were constructed in are more permeable than and therefore preferential groundwater flow pathways over the undisturbed native geology. All of these factors could locally change the water table gradient compared to the anticipated regional gradient.

Plots of the groundwater elevation data collected from the wells installed at the Study area, along the Shunk Street sewer are displayed in Figures V through X. A general gradient to the west along the sewer line of approximately 3% to 4% was noted on the static water table plots constructed from data collected on 18 through 25 November. The addition of well OW 17 in December provided water table elevation data somewhat further from the sewer line. The additional data point indicates a gradient towards the sewer from the southwest in addition to the western gradient along the line. Also present with consistency is an area of higher groundwater elevation in the north east corner of the site, encompassing TW 5 and to a lesser extent, TW 9 and OW 2. This groundwater mound may be due to artificial recharge such as leaking water lines or catch basin drain pipes. In contrast to this mound, the water level in OW 14 was anomalously low on several gauging dates (20, 21 and 25 November and 17 December), it is possible the casing elevation of this well is incorrect or also possible that groundwater is infiltrating the sewer line in this location, lowering the water table elevation. This well was resurveyed on 15 January 1998 to eliminate the possibility of an incorrect casing elevation and the surveyed

elevation agreed with the previous elevation. The erratic water elevation in OW14 compared to surrounding wells is probable due to a non-groundwater influence, such as the sewer line or similar cultural phenomenon.

If local groundwater flow on the north side of Passyunk Avenue (Sunoco Station) is towards the southwest and groundwater flow on the south side of the sewer is towards the northwest, the sewer and/or the original excavation the sewer was constructed in is a groundwater discharge feature and local groundwater trough. In this case, any separate phase hydrocarbons in the vicinity of the sewer will migrate to this trough and follow the sewer to the west, providing an opportunity for product migration into the sewer in any areas where the sewer line integrity has been compromised.

VI) Pumping Tests

Three pumping tests were performed on different site wells. Subsequent to development by air lifting, a very brief (two hour) test was conducted on RW 15, a six inch diameter well, on 25 November 1997. A submersible pump with conductivity level controlling probes was deployed near the bottom of the well with the intake at approximately forty eight feet below the top of casing. This well was pumped at approximately 10 gallons per minute for two hours. During that time the product layer in the well increased to as much as 5.1 feet with 7.47 feet of draw down in water elevation. If corrected for the density of the product (assumed to be specific gravity of 0.68), actual draw down would be approximately 4.48 feet. See Figure IX for water and product measurements during the pumping test. The discharge from RW 15 was temporarily piped to a yard drain catch basin which in turn discharges to the refinery waste water collection system. In spite of a separation of approximately fourteen feet between the water/product interface and the pump intake, an oil/water emulsion was observed in the pump effluent and the pump test was terminated. As no exceptional turbulence was anticipated in this well under these pumping conditions, future groundwater pumping from RW 15 or nearby wells should account for the potential of an emulsified discharge.

A longer duration pumping test was conducted on RW 6, a six inch diameter well, also subsequent to development by air lifting on 25 November 1997. A submersible pump capable of producing six gallons per minute (gpm) was deployed near the bottom of the well (50 feet below top of casing (TOC)). Pumping at approximately 6 gpm was conducted for a duration of approximately four hours and forty minutes when the portable generator used to power the pump ran out of gas. Product accumulation, emulsion formation and discharge

overflow were not restricting factors in conducting this test. At the pumping rate of approximately 6 gpm, draw down in RW 6 after 285 minutes (four and three quarter hours) was 1.54 feet. Based on a Cooper-Jacob analysis of draw down in nearby observation wells over time, a transmissivity of 1.61×10^{0} ft^2/ min. and hydraulic conductivity of 10^{-2} ft./min. were calculated. While pumping RW 6, draw down was measured in OW 13 (0.17') and TW 3 (0.03') to the west but not OW 2 which actually rebounded by 0.02' during the test. To the east., no draw down was measured in OW 14 or TW 11. North of the sewer TW 5 remained at static and TW 9 fell 0.04'.

A third pumping test was conducted using a four inch well, OW 17, constructed approximately fifty feet south of the sewer, presumably outside the sewer construction excavation. Again the well was developed by air lifting and a submersible pump with conductivity controls was set near the bottom of the well, at approximately forty eight feet below TOC. The initial flow rate was set at six gallons per minute and the discharge was temporarily piped to the nearest yard drain. Pumping at 6 gpm was initiated at 2:59 PM on 17 December 1997 and continued at this rate until 10:08 AM on 18 December when the pump was found to be cycling and the flow rate was reduced to 4 gpm. As with the data from the pump test on RW 6, a Cooper-Jacob distance draw down analysis was conducted for data from observation wells influenced by pumping OW 17. Liquid level changes in response to pumping OW 17 are displayed on Table III. The transmissivity and hydraulic conductivity solutions calculated from the data collected while pumping OW 17 were in excellent agreement for those derived from earlier pump tests, e.g. $T \approx 1.5 \times 10^{0}$ ft$^{2/min.}$ and $k \approx 5 \times 10^{-2}$ ft./min. See Appendix B "Pumping Tests Analyses". From Table III, the decline in water table elevations in wells remote from the pumping well, wells TWs 5, 9, OW 11 and TW 5-73 was 0.06', 0.04', 0.05' and 0.04' respectively. These declines in water levels are considered to be background changes in static levels and not due to pumping effects. All changes of greater magnitude during the pumping test are considered to be in response to the pumping of OW 17. Observed draw down ranged from a maximum in RW 15, not corrected for product thickness increase of 0.88' with a coincidental increase in product thickness of 0.85', to 0.13' in OW 2, more than 260' to the east of the pumping well. If corrected for the increase in product thickness, these declines in water levels still equate to 0.30' in RW 15 and 0.12' in OW 2. While it is uncertain if the cone of depression formed around OW 17 during pumping was adequate to create a gradient away from the sewer line, it is clear that the pumping influence extended to the north side of the sewer line and hundreds of feet along the sewer line. See Figure VIII, the Water Table Elevation plot for 19 December 1997, after more than forty hours of pumping OW 17.

VII) Separate Phase Hydrocarbon (free product) and Bailing Tests

Of the fourteen wells installed, no separate phase hydrocarbons were measured on any of the gauging dates in wells TW 5, 8, 9, 11 and OW 14. Three of these wells, 5, 8 and 9, are on the north side of the Shunk Street Sewer. The other two wells, OW 14 and TW 11 are at the eastern end of the studt area. The product thickness in wells with separate phase hydrocarbons was at a maximum for all but RW 15 and OW 2 on 20 December 1997, at the conclusion of the pumping test on OW 17. Product thickness in RW 15 was greater during the short duration pumping test in RW 15 on 25 November 1997 when a separate phase thickness of over five feet was recorded. Product thickness was measured in RW 6 at a maximum of 0.66' on 18 November 1997, prior to over drilling the well to a six inch diameter.

Several product bailing and recovery tests were performed on wells with significant free product layers, particularly OW 3, RW 6 and OW 12. An attempt to quantify the rate of product accumulation in various wells is presented in Table IV. For the wells in the western portion of the study area, TW 10 and OW 12, product accumulation rates of up to 0.27 GPH (≈6.5 gpd) and 0.02 GPH (≈0.5 gpd) were recorded. Much lower rates were observed for the wells tested in the eastern portion of the site; rates for TWs 2, OW 3 and OW 13 were 0.05 GPH (≈1.2 gpd) for 2 and 3 and 0.08 GPH (≈ 1.9 gpd) for OW 13. The greatest observed rate of product accumulation was in RW 15 during the brief pumping test on this well on 25 November 1997. During the two hours of pumping, product thickness accumulated to a maximum of 5.10' at a maximum observed rate of 15.3 gallons per hour (GPH) at the start of the test. After one half hour of pumping, the product accumulation rate was 8.3 GPH. This rate of product accumulation was not maintained and the product thickness in the well actually declined subsequent to reaching the maximum at thirty minutes into the test. Due to the rapid draw down in the water level in the well, the product accumulation is not believed to be representative of a sustainable rate. It can be considered however as evidence that a separate phase plume that could be recovered in the liquid phase is present near RW 15.

The recovery data from product bailing tests on TW 3, OW 6 (twice before the well was over-drilled to six inch diameter) and OW 12 are presented in tables and graphs in Appendix C. The product thickness in a well is deemed to equal the "true" product thickness, that is the thickness of the hydrocarbon layer on the water table outside the well bore, at the inflection point of water table recharge subsequent to the well being bailed down. The inflection point is the point at which the water level in a recharging well ceases to rise and begins to fall as a

result of the weight of a floating product layer in the well. Several attempts were made to remove the product from OW 12 by bailing. All the product could not be removed by this method and the recovery tests conducted therefore started with a free product thickness of more than 0.1'. From the consistency of the post bailing product thickness and the recovery data, the true product thickness in the vicinity of this well is estimated to be 0.08' to 0.10'. Similar testing and analysis were applied to obtain estimated true product thicknesses of 0.04' for OW 3 and between 0.06' and 0.40' for RW 6.

VIII) Soil Vapor Extraction Testing

Prior to concluding the pumping test conducted on RW 6 on 25 November 1997, a vacuum truck was employed to withdraw soil vapors from RW 6. During the application of vacuum to the pumping well, vacuum readings (relative to atmospheric pressure) were conducted at surrounding wells. The vacuum applied to RW 6 was varied from a minimum of 5" Hg to a maximum of 16" Hg. Vacuum communication was consistently measured in OWs 2,13 and 14 and TW 5. The magnitude of measured vacuum communication for various wells is depicted on Figures X-XII.

From the field measurements, a vacuum radius of influence for different applied vacuums at the extraction well(s) can be extrapolated. Figure XIII depicts expected radii of vacuum influence for varied applied vacuums. The significance of this figure is the implication that to cover a one hundred foot length of the sewer with a 0.5 inch water vacuum, two vacuum extraction wells, one hundred feet apart would require an applied vacuum of approximately 72 inches of water gauge vacuum. Extraction wells placed on fifty foot centers would require an approximate vacuum of 30 inches of water gauge.

In addition to the "high vacuum" test conducted on RW 6, a VR3 vapor recovery unit (VR) was connected to RW 15 on 18 December 1997, during the second day of the pumping test on OW 17. The VR would run on well gas only but the controls for mixing auxiliary fuel (propane) would not function. The VR carburetor was manually adjusted to keep the unit running at 1700 RPM with no auxiliary fuel. For the unit to continue to operate the extracted well gas (soil gas) would have to contain hydrocarbon concentrations in the range of 1.4%-6.9%. The VR ran for two brief stints of 38 and 48 minutes, and again after some adjustments for a longer period of approximately 28.5 hours without any supplemental auxiliary fuel. As per the manufacturer's specification sheet, during the time of operation, the unit should have processed approximately 14.44 lbs. of hydrocarbon per hour or 411.5 lbs. during the 28.5 hours and

another 20 lbs. during the other brief periods of start-up operation. While operating, the VR applies whatever vacuum is necessary to the connected well(s) to satisfy its fuel needs. While drawing from RW15, minimal vacuum (1-4 inches of water gauge) was applied to the well and the corresponding withdrawal rate of soil gas ranged between seven and ten cubic feet per minute. VR operational data are contained in Appendix D.

IX) Conclusions

- The study area is underlain by predominantly sand and gravel with varying amounts of silt and clay. No continuos confining layers were encountered, nor were any units noted that would be expected to create preferential groundwater flow patterns;
- groundwater at the study location occurs under water table conditions at approximately twenty-six to thirty feet below grade;
- groundwater gradient along the Shunk Street Sewer is generally to the west in the study area;
- an area of elevated groundwater (mound) exists on the north side of the sewer line in the eastern portion of the area (TWs 5 and 9);
- the water elevation in OW 14, on the south side of the sewer in the eastern portion of the study area was much lower than surrounding wells on several gauging events;
- separate phase hydrocarbons were measured in all wells south of the sewer from RW 6 west to RW 15;
- pumping tests were conducted on three wells the results of which indicate:
- calculated aquifer characteristics were nearly identical for wells very close to the sewer line (RWs 6 and 15) and a well approximately twenty five feet south of the sewer line;
- Transmissivity was calculated as between 1.32×10^{0} and 4.99×10^{0} $ft^2/min.$;
- Hydraulic conductivity was calculated as between 1.33×10^{-1} and 5.39×10^{-2} ft/min.;
- separate phase hydrocarbon thickness increased in the pumping well and surrounding wells as the water table was drawn down;
- Vapor extraction testing conducted on wells RW 6 and RW 15 indicates a subsurface vacuum can be transmitted for tens of feet from an extraction well under a few inches of mercury vacuum;

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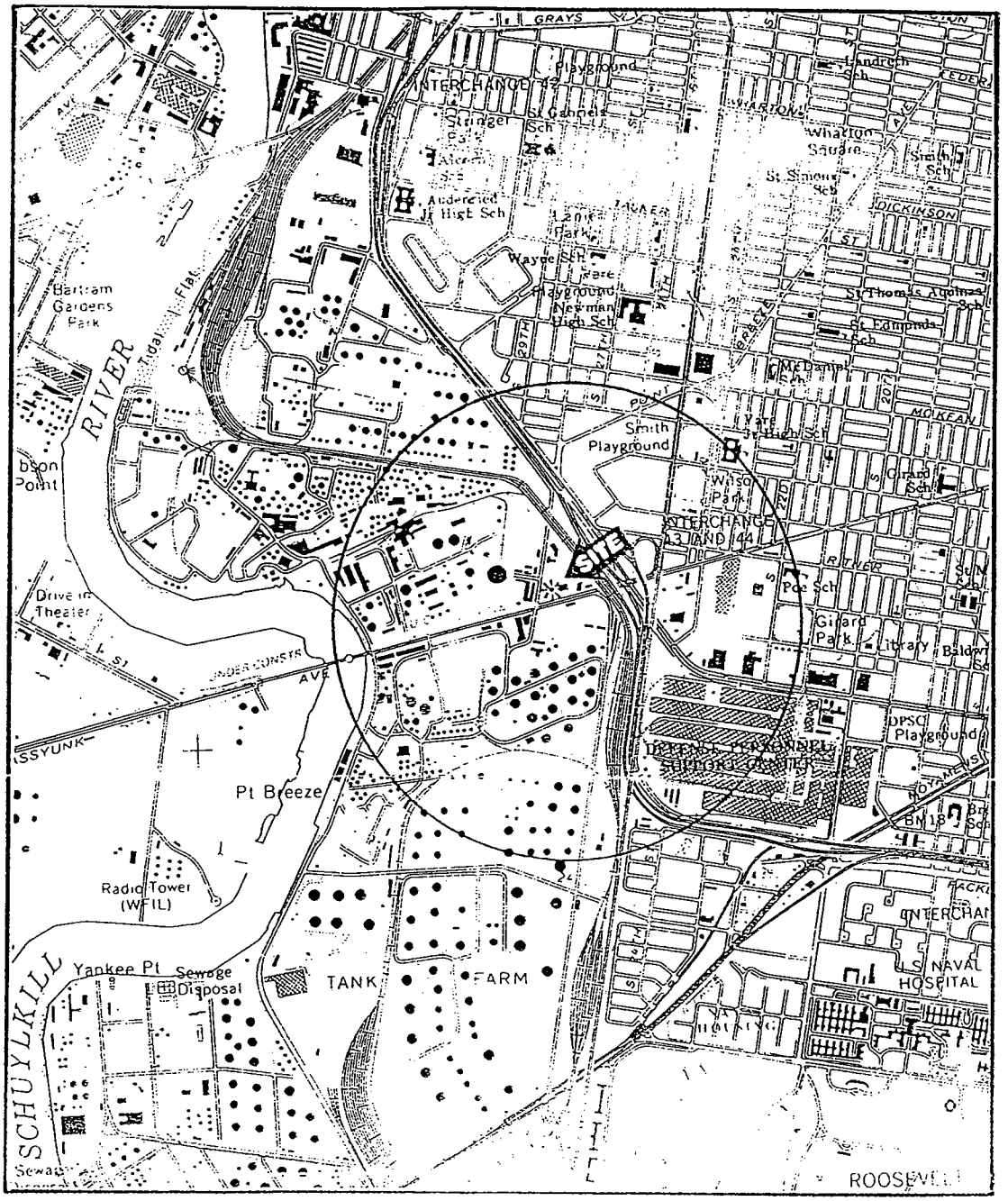


FIGURE I
SITE LOCATION
SUNOCO A- PLUS
2751 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

SCALE IN FEET
0 2000 4000

SOURCE : USGS. PHILADELPHIA, PA QUADRANGLE 1967
PHOTOREVISED 1985

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

PASSYUNK AVENUE

SIDEWALK

OFFICE BUILDING

BUILDING

GRASS AREA

SHUNK STREET SEWER MAIN 13'0

ELECTRICAL
SUB-STATION

PARKING

BRICK WALL

TW 5-73

APPROXIMATE
SCALE IN FEET
0 30

SOURCE: SUN FILE DRAWING

FIGURE II
STUDY AREA PLOT PLAN
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

PASSYUNK AVENUE

SIDEWALK

OFFICE BUILDING

BUILDING

GRASS AREA

RW 15

TW8

TW 10

SHUNK STREET SEWER MAIN 13'0

OW 12

OW 17

OW 16

ELECTRICAL SUB-STATION

TW 3

TW 5

OW 2

PARKING

OW 13

RW6

TW 9

OW 14

BRICK WALL

TW 11

TW 5-73

- OBSERVATION WELL
TW= 2" WELL
OW= 4" WELL
RW= 6" WELL

APPROXIMATE SCALE IN FEET

0 30

SOURCE: SUN FILE DRAWING

FIGURE III
BORING / WELL INSTALLATION LOCATIONS
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

RW 15 OW 17 TW 10 TW 11 OW 12 OW 16 TW 3 OW 2 OW 13 TW 5 RW 6 OW 14 TW 9 TW 11

TOP SOIL | ASPHALT AND BALLAST

FILL WITH CINDERS AND RUBBLE

FILL WITH CINDERS AND RUBBLE

GRAVEL WITH SAND, SILT AND CLAY

CLAY WITH SILT AND SAND

MEDIUM TO COARSE SAND WITH SILT, CLAY AND 10-20% GRAVEL

SILT WITH CLAY AND SAND

FILL

CLAY WITH SILT AND SAND, FEW PEBBLES

SANDY MEDIUM TO COARSE GRAVEL WITH SOME SILT AND CLAY

SAND WITH SILT, CLAY AND MINOR (<10%) GRAVEL

M-C GRAVEL

MEDIUM TO COARSE SAND WITH SILT, CLAY AND MINOR (<10%) GRAVEL

SHUNK STREET SEWER

5' 10' 15' 20' 25' 30' 35' 40' 45'

APPROXIMATE SCALE IN FEET
0 30
VERTICAL EXAGERATION 5

FIGURE IV
GENERALIZED GEOLOGIC CROSS SECTION
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

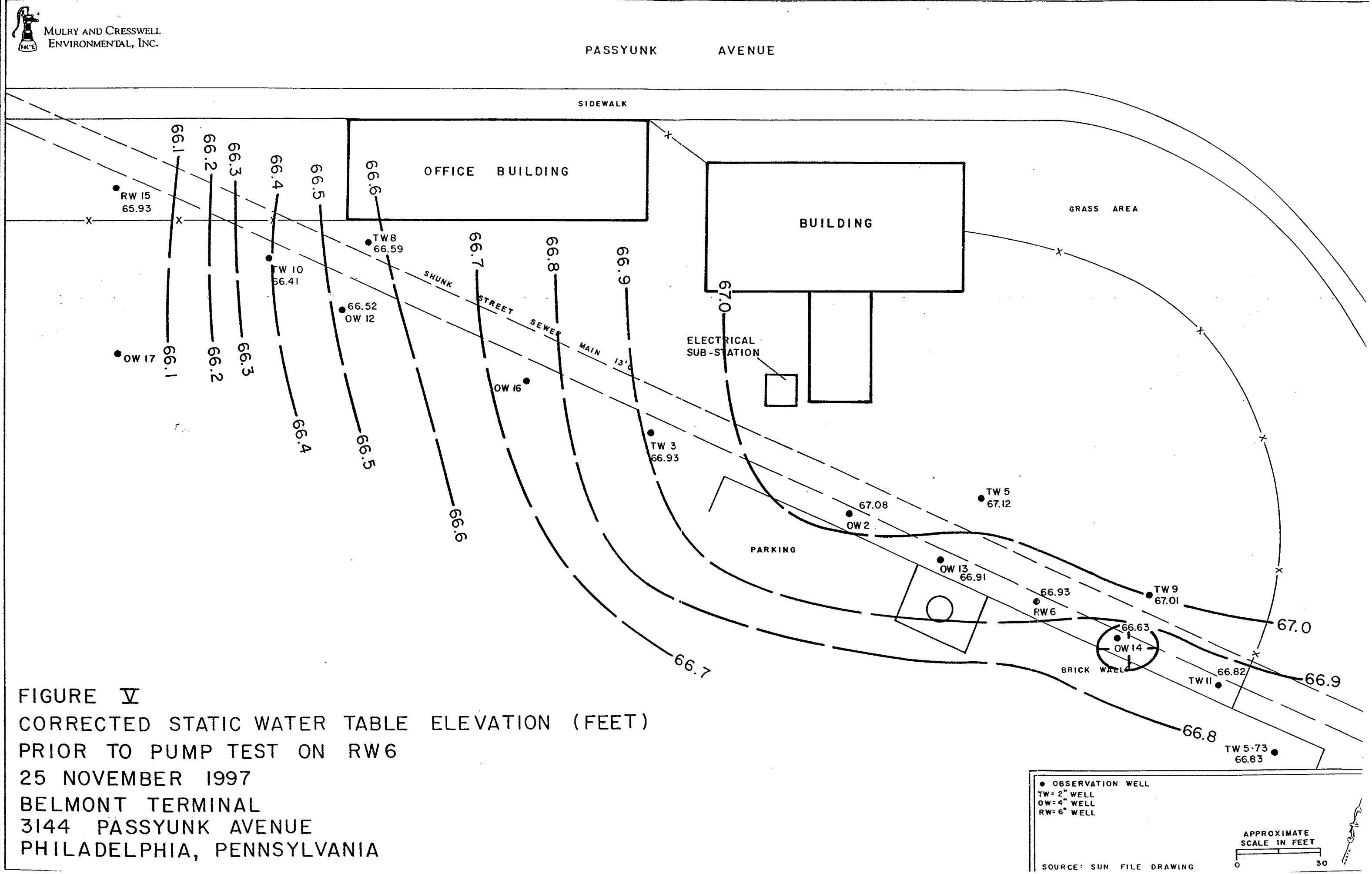


FIGURE V
CORRECTED STATIC WATER TABLE ELEVATION (FEET)
PRIOR TO PUMP TEST ON RW6
25 NOVEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

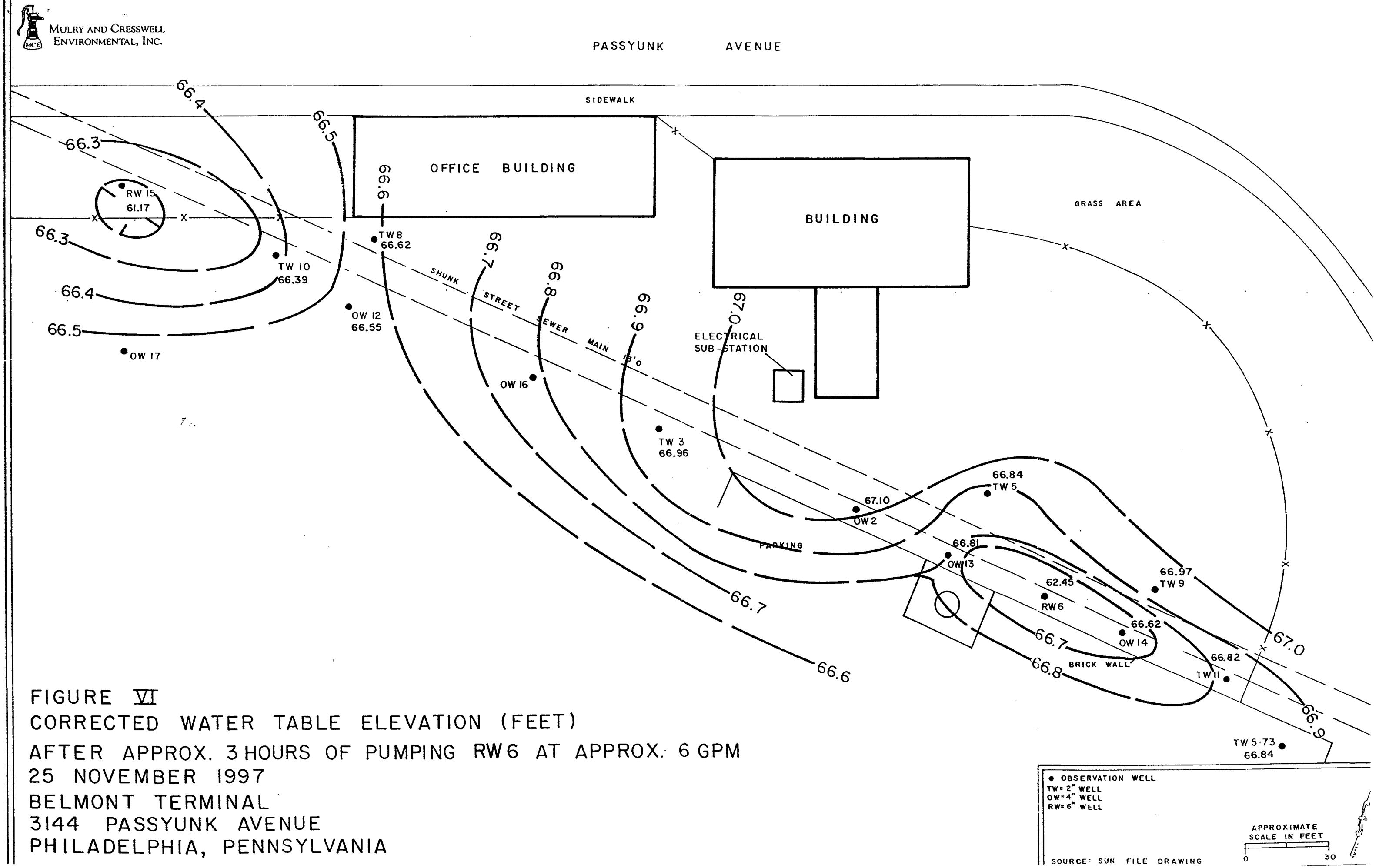


FIGURE VI
CORRECTED WATER TABLE ELEVATION (FEET)
AFTER APPROX. 3 HOURS OF PUMPING RW6 AT APPROX. 6 GPM
25 NOVEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

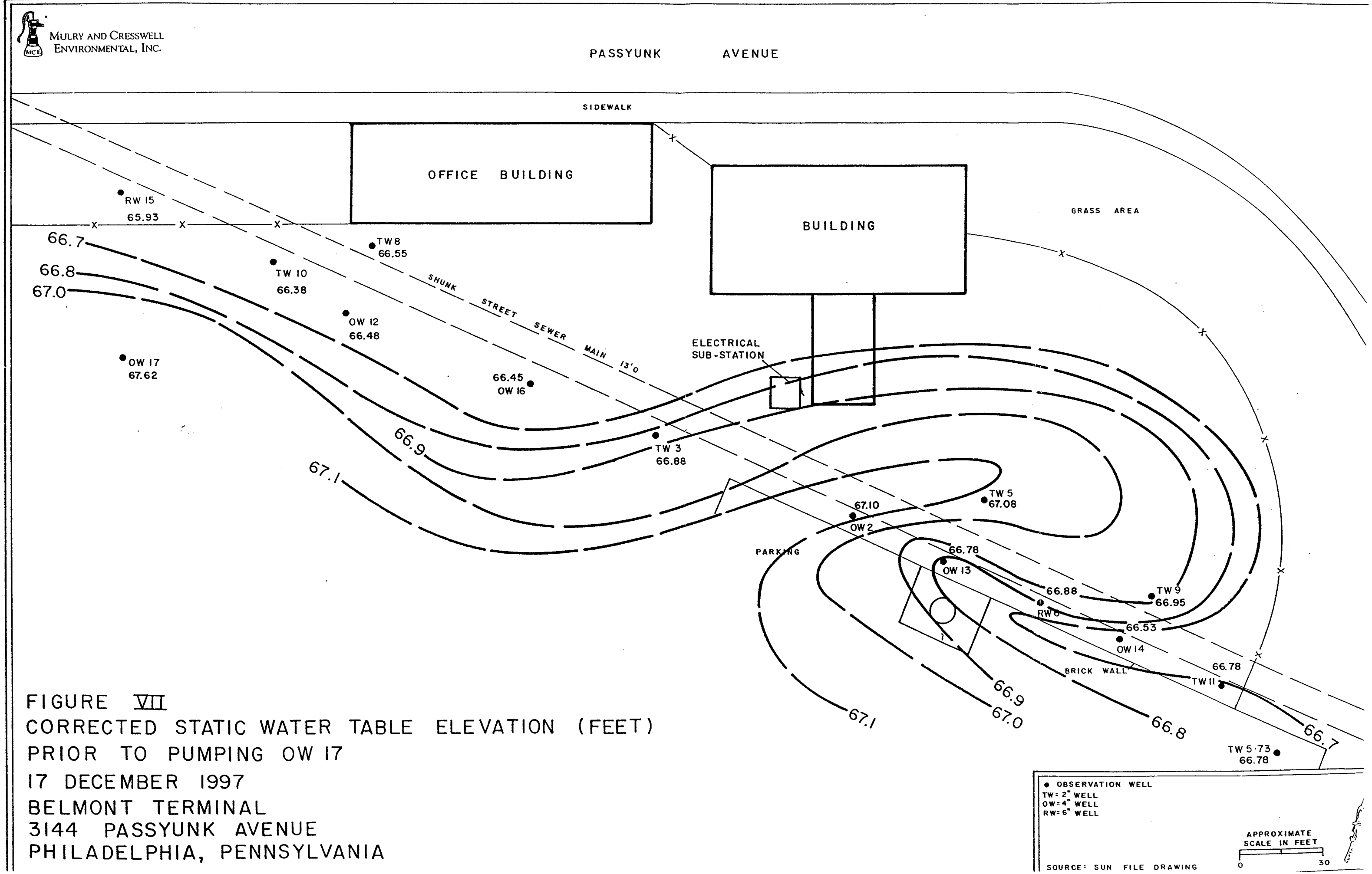


FIGURE VII
CORRECTED STATIC WATER TABLE ELEVATION (FEET)
PRIOR TO PUMPING OW 17
17 DECEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

PASSYUNK AVENUE

SIDEWALK

OFFICE BUILDING

BUILDING

GRASS AREA

RW 15
65.63

TW 10
66.20

TW8
66.44

SHUNK STREET SEWER MAIN 13'0

OW 12
66.32

55.93
OW 17

66.37
OW 16

ELECTRICAL
SUB-STATION

66.3

66.4

66.8

67.0

TW 3
66.78

TW 5
67.02

OW 2
66.98

PARKING

OW 13
66.70

RW6
66.86

TW 9
66.91

OW 14
66.44

BRICK WALL

TW 11
66.23

TW 5-73
66.74

● OBSERVATION WELL
TW= 2" WELL
OW=4" WELL
RW=6" WELL

APPROXIMATE
SCALE IN FEET
0 30

SOURCE: SUN FILE DRAWING

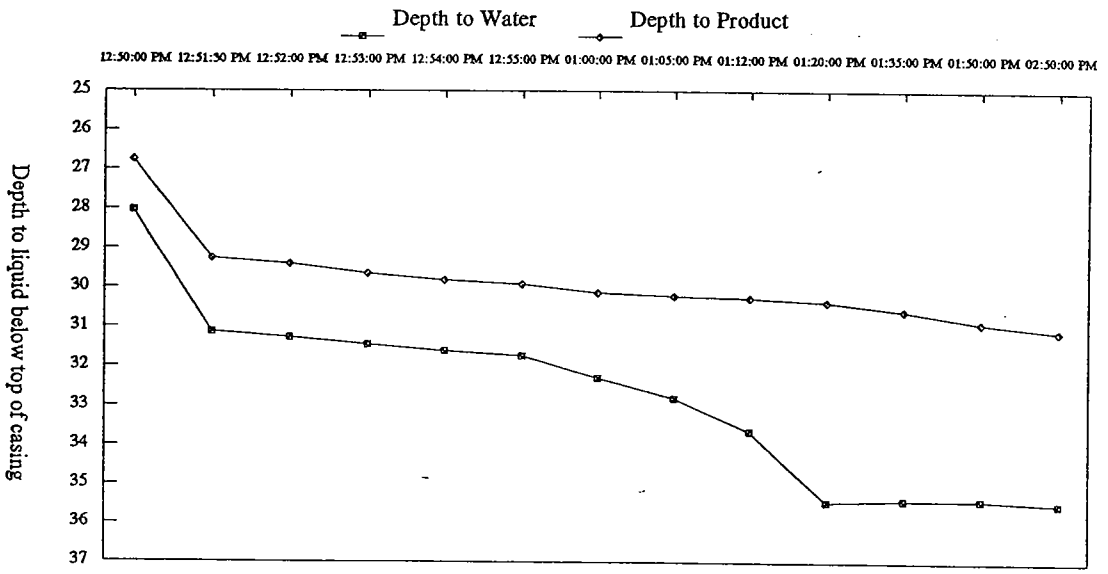
FIGURE VIII
CORRECTED WATER TABLE ELEVATION (FEET)
AFTER APPROXIMATELY 40 HOURS OF PUMPING OW 17
19 DECEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

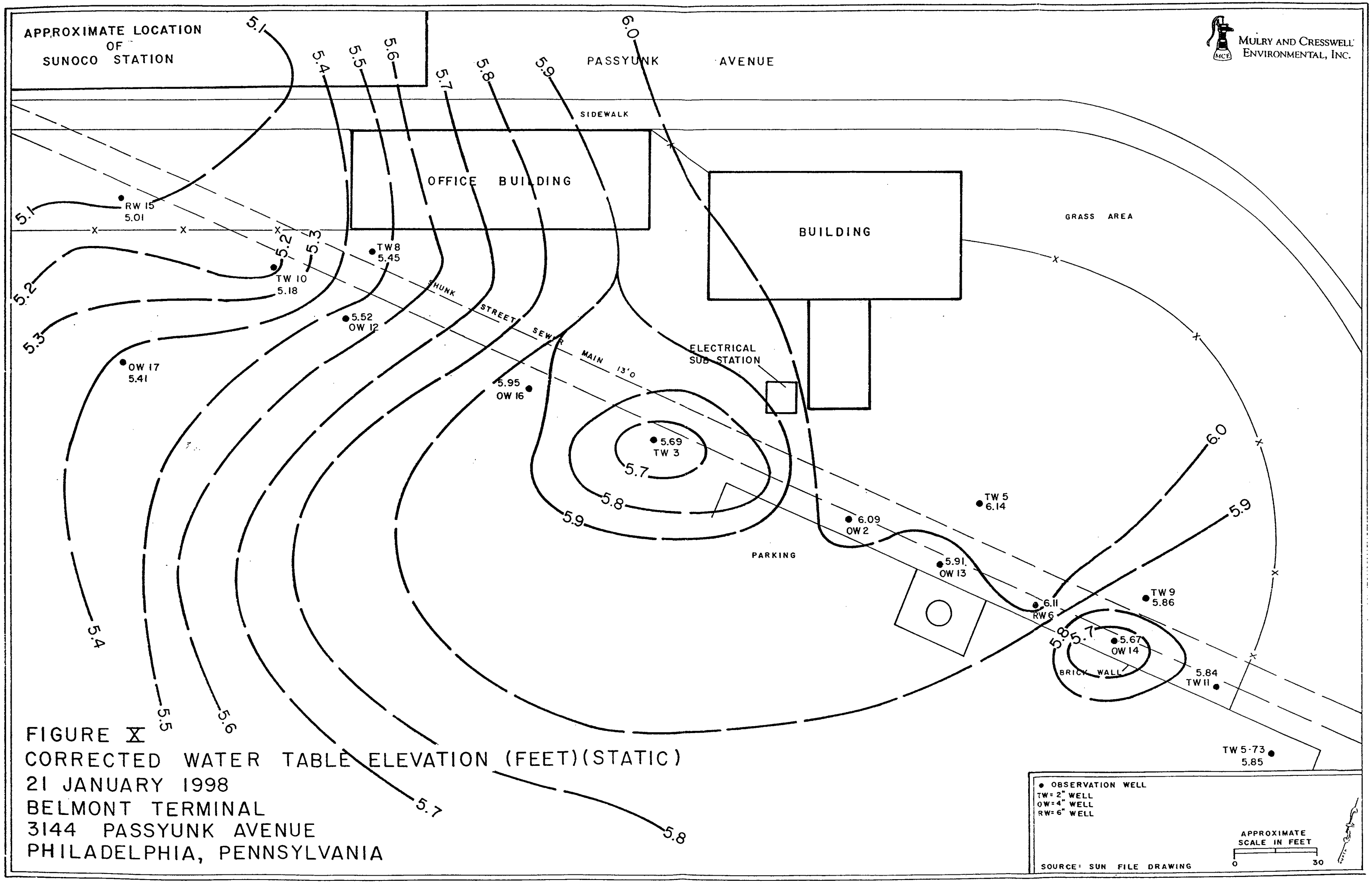
Figure IX: Belmont Terminal, Shunk Street Sewer Delineation

Pumping Test Rw 15, Q = 10 gpm, 25 Nov 97

Time	DTW	DTP	PT	Rate of Product Accumulation (gp
12:50:00 PM	28.03	26.74	1.29	
12:51:30 PM	31.13	29.25	1.88	15.60
12:52:00 PM	31.27	29.41	1.86	
12:53:00 PM	31.45	29.65	1.80	
12:54:00 PM	31.62	29.81	1.81	1.27
12:55:00 PM	31.73	29.92	1.81	3.33
01:00:00 PM	32.29	30.12	2.17	4.37
01:05:00 PM	32.81	30.21	2.60	8.40
01:12:00 PM	33.65	30.26	3.39	
01:20:00 PM	35.45	30.35	5.10	
01:35:00 PM	35.40	30.58	4.82	
01:50:00 PM	35.40	30.89	4.51	
02:50:00 PM	35.50	31.11	4.39	



Pump Test, RW 15, 25 November 1997



MULRY AND CRESSWELL ENVIRONMENTAL, INC.

FIGURE X
CORRECTED WATER TABLE ELEVATION (FEET)(STATIC)
21 JANUARY 1998
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

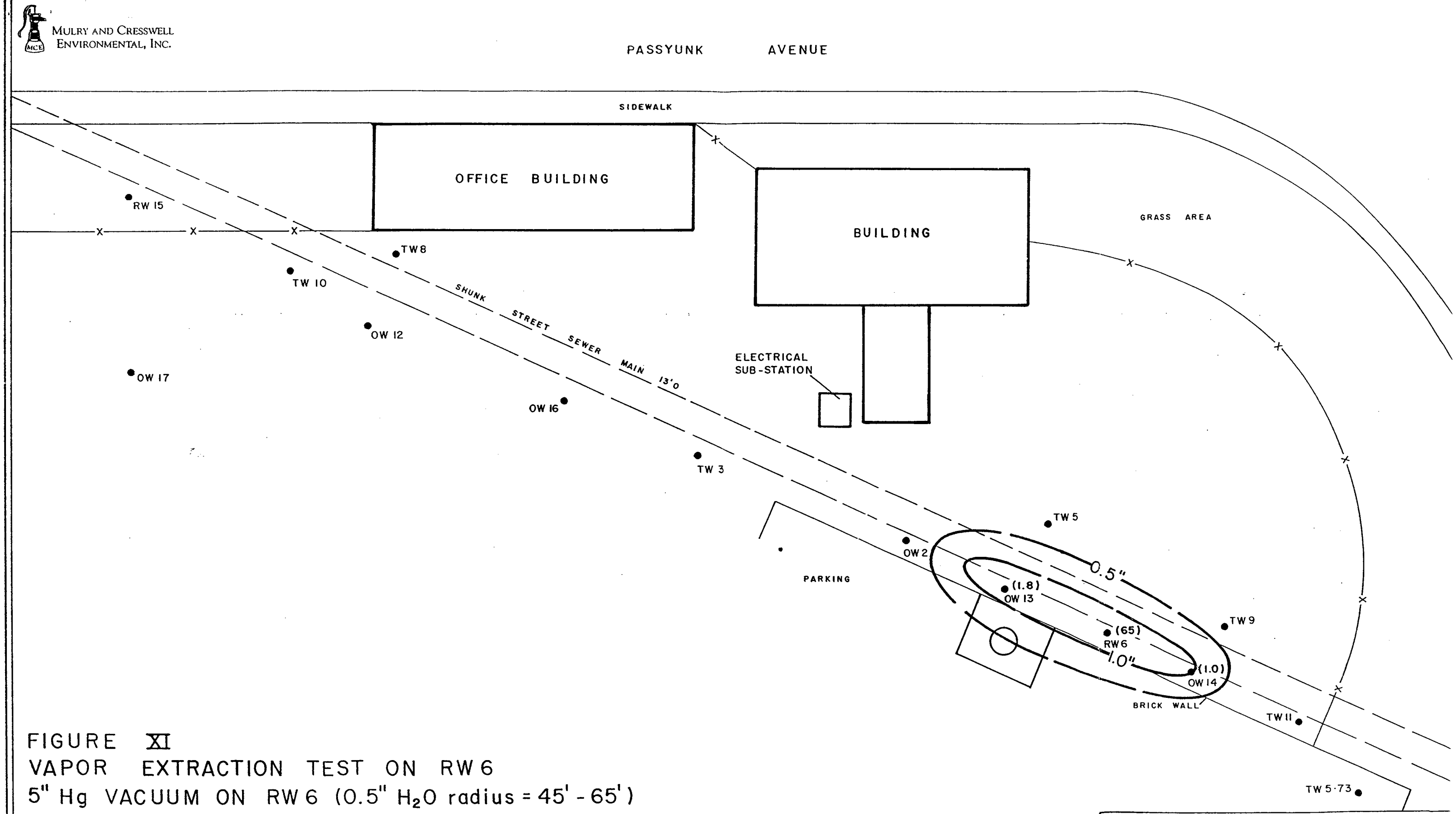


FIGURE XI
VAPOR EXTRACTION TEST ON RW 6
5" Hg VACUUM ON RW 6 (0.5" H_2O radius = 45' - 65')
25 NOVEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

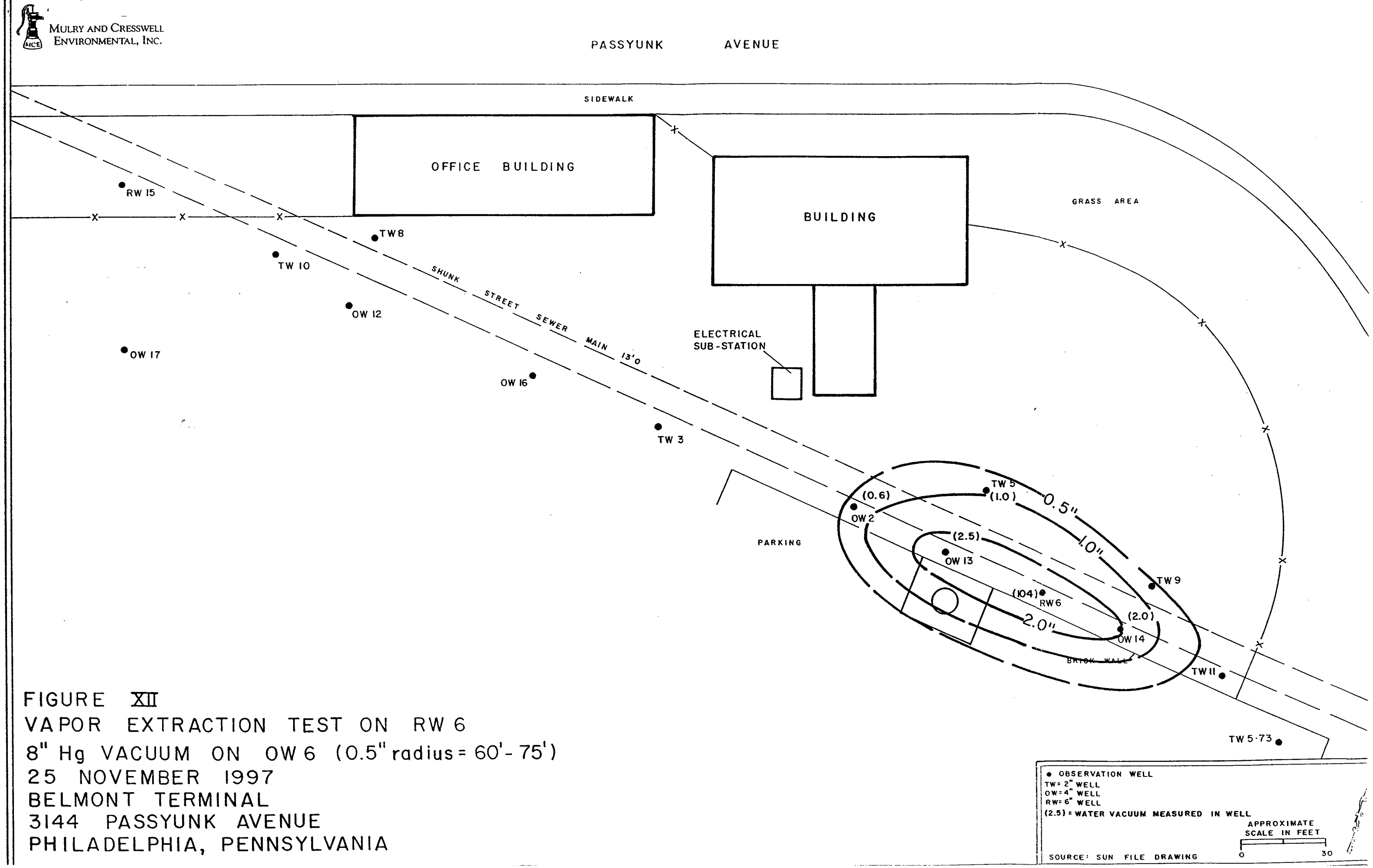


FIGURE XII
VAPOR EXTRACTION TEST ON RW 6
8" Hg VACUUM ON OW 6 (0.5" radius = 60'- 75')
25 NOVEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

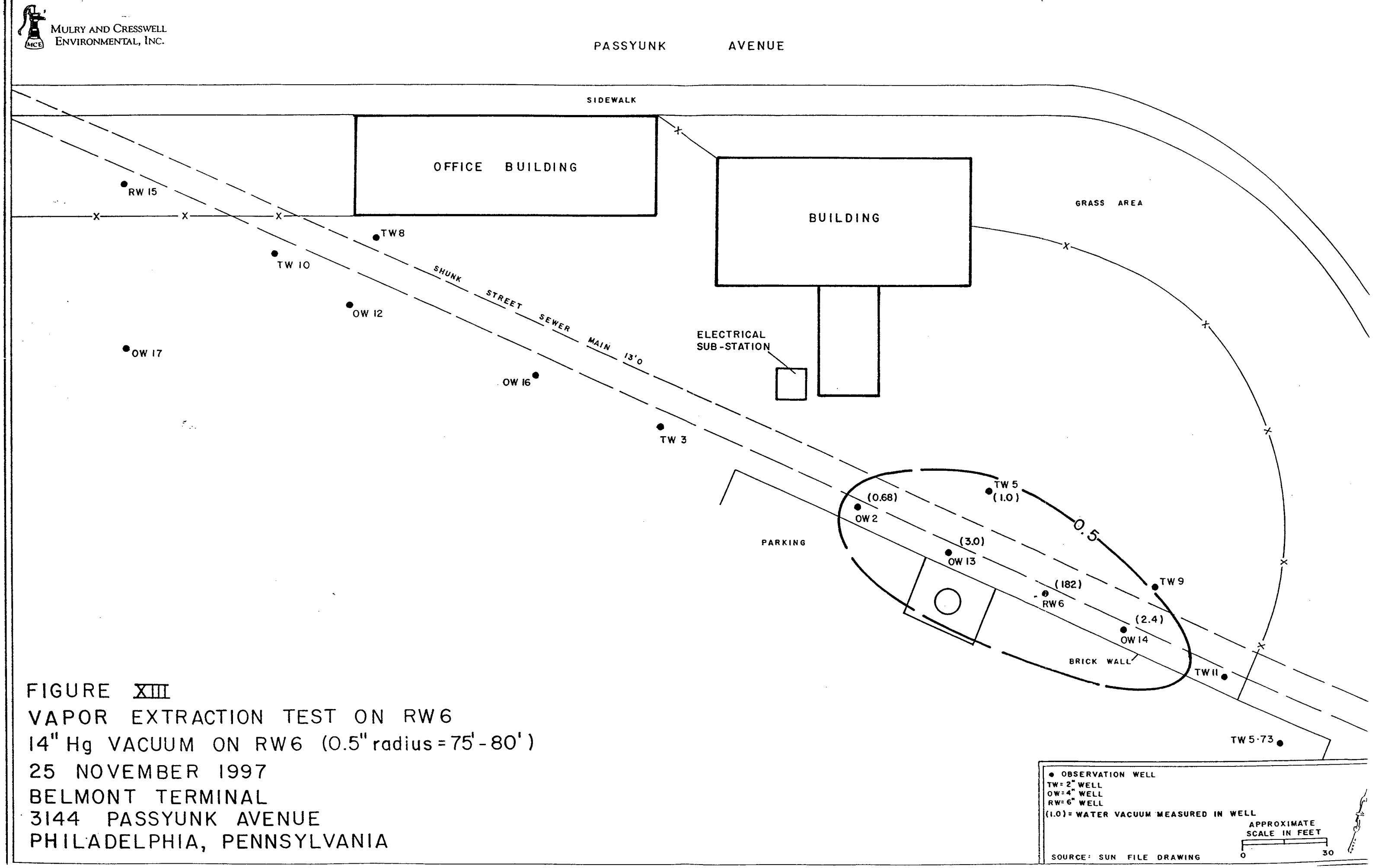


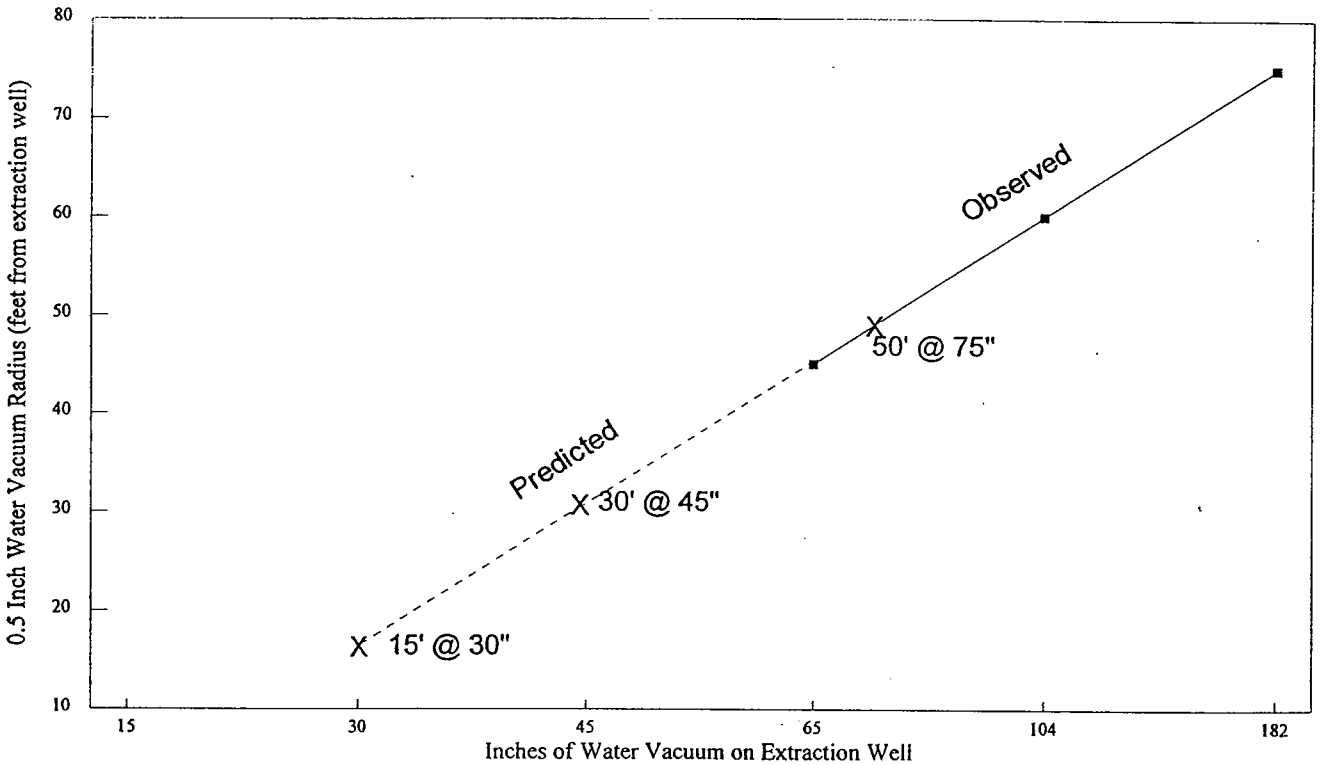
FIGURE XIII
VAPOR EXTRACTION TEST ON RW6
14" Hg VACUUM ON RW6 (0.5" radius = 75'-80')
25 NOVEMBER 1997
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

Figure XIV: Belmont Terminal, Shunk Street Sewer Delineation, Vacuum Test on RW 6

Observed and Predicted Radius Of 0.5" H2O Vacuum Influence

Hg Vac	H2O Vac	0.5" Radius
	15	
	30	
	45	
5	65	45
8	104	60
14	182	75



MULRY AND CRESSWELL ENVIRONMENTAL, INC.

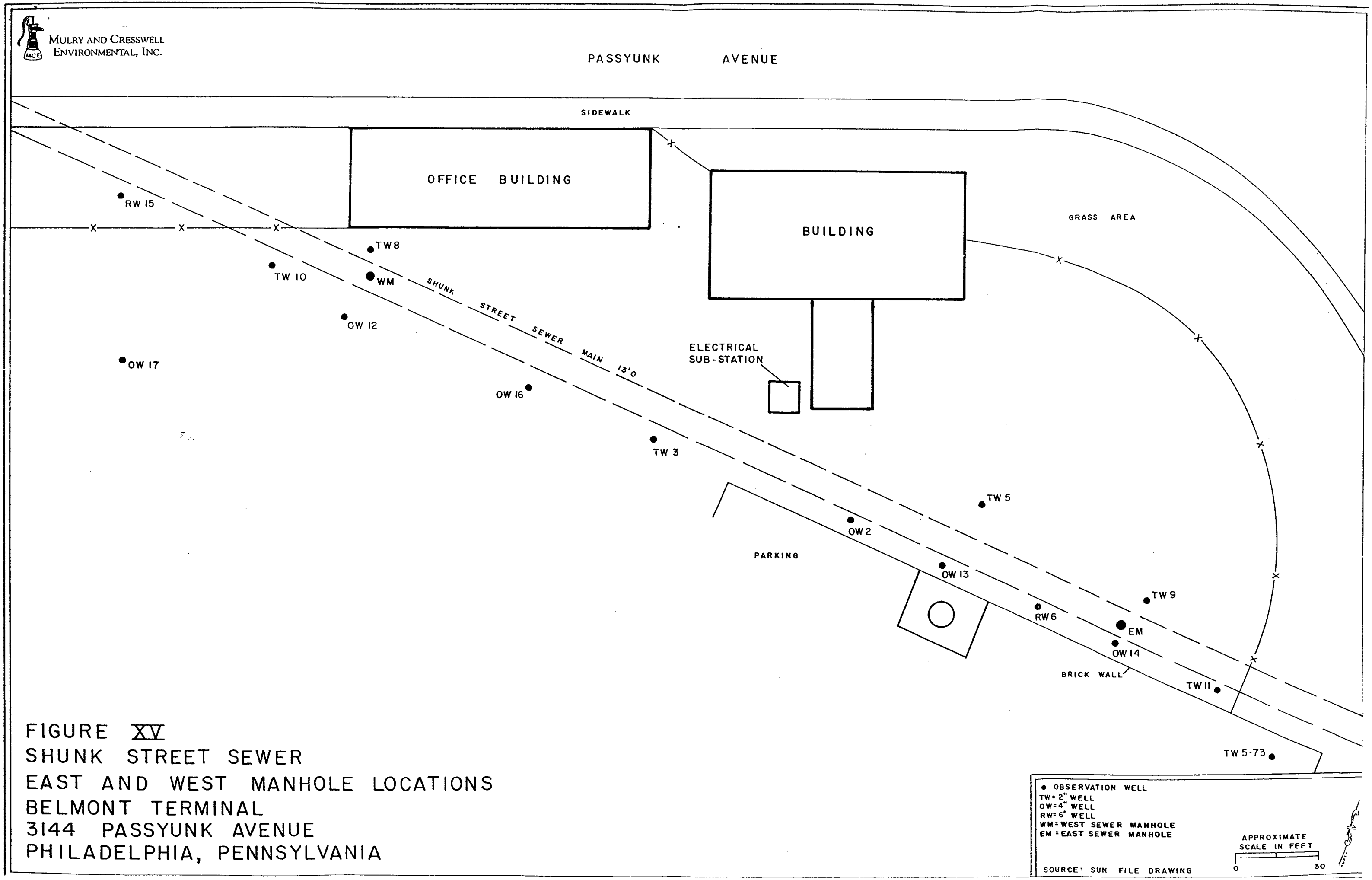


FIGURE XV
SHUNK STREET SEWER
EAST AND WEST MANHOLE LOCATIONS
BELMONT TERMINAL
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Table I: Belmont Terminal, Shunk Street Sewer Delineation

Liquid Level Data 25 Nov 97 (static)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.37	27.30	0.07	94.40	67.03	67.08
3	28.56	28.40	0.16	95.38	66.82	66.93
5	31.13		0.00	98.25	67.12	67.12
6	26.88		0.00	93.81	66.93	66.93
8	26.95		0.00	93.54	66.59	66.59
9	28.69		0.00	95.70	67.01	67.01
10	26.97	26.89	0.08	93.33	66.36	66.41
11	28.36		0.00	95.18	66.82	66.82
12	26.86	25.81	1.05	92.67	65.81	66.52
13	27.93	27.74	0.19	94.71	66.78	66.91
14	28.35		0.00	94.98	66.63	66.63
15	28.10	26.81	1.29	93.15	65.05	65.93
TW 5-73	26.00		0.00	92.83	66.83	66.83

Liquid Level Data 25 Nov 97
(RW 6 pumping at 6 gpm for 4 hours and RW 15 for 0.5 hours at 10 gpm)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.35	27.28	0.07	94.40	67.05	67.10
3	28.59	28.34	0.25	95.38	66.79	66.96
5	31.13		0.00	98.25	67.12	67.12
6	31.36		0.00	93.81	62.45	62.45
8	26.92		0.00	93.54	66.62	66.62
9	28.73		0.00	95.70	66.97	66.97
10	26.99	26.91	0.08	93.33	66.34	66.39
11	28.36		0.00	95.18	66.82	66.82
12	26.83	25.79	1.04	92.67	65.84	66.55
13	28.10	27.79	0.31	94.71	66.61	66.82
14	28.35		0.00	94.98	66.63	66.63
15	35.45	30.35	5.10	93.15	57.70	61.17
TW 5-73	25.99		0.00	92.83	66.84	66.84

Depth to Water (DTW) and Depth to Product (DTP) in feet below top of casing.

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Table II: Belmont Terminal, Shunk Street Sewer Delineation

Change in DTW and Product Thickness During Pump Test on RW 6

Well #	Change in Water El.	Change in PT
2	0.02	-0.00
3	-0.03	0.09
5	0.00	0.00
6	-4.48	0.00
8	0.03	0.00
9	-0.04	0.00
10	-0.02	0.00
11	0.00	0.00
12	0.03	-0.01
13	-0.17	0.12
14	0.00	0.00
15	-7.35	3.81
TW 5-73	0.01	0.00

Depth to Water (DTW) and Depth to Product (DTP) in feet below top of casing.

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

Table III: Belmont Terminal, Shunk Street Sewer Delineation

Liquid Level Data 17 Dec (static, prior to pump test on OW 17)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.31	27.30	0.01	94.40	67.09	67.10
3	28.91	28.31	0.60	95.38	66.47	66.88
5	31.17		0.00	98.25	67.08	67.08
6	26.95	26.92	0.03	93.81	66.86	66.88
8	26.99		0.00	93.54	66.55	66.55
9	28.75		0.00	95.70	66.95	66.95
10	27.08	26.89	0.19	93.33	66.25	66.38
11	28.40		0.00	95.18	66.78	66.78
12	26.94	25.84	1.10	92.67	65.73	66.48
13	28.80	27.52	1.28	94.71	65.91	66.78
14	28.45		0.00	94.98	66.53	66.53
15	27.99	26.86	1.13	93.15	65.16	65.93
16	28.25	27.78	0.47	94.38	66.13	66.45
17	27.04	27.01	0.03	94.64	67.60	67.62
TW 5-73	26.05		0.00	92.83	66.78	66.78

Liquid Level Data 20 Dec 97 (after approx. 42 hours of pumping OW 17)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.56	27.36	0.20	94.40	66.84	66.98
3	29.04	28.39	0.65	95.38	66.34	66.78
5	31.23		0.00	98.25	67.02	67.02
6	26.96	26.95	0.01	93.81	66.85	66.86
8	27.10		0.00	93.54	66.44	66.44
9	28.79		0.00	95.70	66.91	66.91
10	27.29	27.06	0.23	93.33	66.04	66.20
11	28.45		0.00	95.18	66.73	66.73
12	27.27	25.92	1.35	92.67	65.40	66.32
13	28.96	27.56	1.40	94.71	65.75	66.70
14	28.54		0.00	94.98	66.44	66.44
15	28.87	26.89	1.98	93.15	64.28	65.63
16	28.49	27.78	0.71	94.38	65.89	66.37
17	38.74	38.69	0.05	94.64	55.90	55.93
TW 5-73	26.09		0.00	92.83	66.74	66.74

Change in DTW and Product Thickness During Pump Test on RW 17
From 17 to 19 December 1997

Well #	Change in Water El.	Change in PT
2	-0.25	0.19
3	-0.13	0.05
5	-0.06	0.00
6	-0.01	-0.02
8	-0.11	0.00
9	-0.04	0.00
10	-0.21	0.04
11	-0.05	0.00
12	-0.33	0.25
13	-0.16	0.12
14	-0.09	0.00
15	-0.88	0.85
16	-0.24	0.24
17	-11.70	0.02
TW 5-73	-0.04	0.00

Depth to Water (DTW) and Depth to Product (DTP) in feet below top of casing.

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

Table IV: Belmont Terminal, Shunk Street Sewer Delineation

Product Recovery by Bailing (gal.) Prior to Recovery Tests

Date	TW 3	OW 6	OW 12	RW 15
17-Nov-97		0.75		
18-Nov-97	0.50	0.75		
19-Nov-97			2.00	
19-Nov-97			0.50	
20-Nov-97				2.50

Approximate Rate Of Product Accumulation (galllons per hour)
Post Bailing

TW 3	OW 6	OW 12	RW 15
0.01			
0.10	> 0.01		
		0.60	
		0.40	
			0.40

Product Accumulation Rate During Pumping Test On OW 17
17 - 19 December 1997

RW 15

Time	DTW	DTP	PT	Vol.	Rate
0.00	27.99	26.86	1.13	0.73	
33.00	28.30	26.94	1.36	0.88	0.27
66.00	28.47	26.94	1.53	0.99	0.20
112.00	28.62	26.93	1.69	1.10	0.14
1149.00	28.91	26.91	2.00	1.30	0.01
1215.00	28.87	26.89	1.98	1.29	-0.01

TW 10

Time	DTW	DTP	PT	Vol.	Rate
0.00	27.08	26.89	0.19	0.03	
17.00	27.10	26.90	0.20	0.03	0.01
59.00	27.12	26.94	0.18	0.03	-0.00
107.00	27.24	26.97	0.27	0.04	0.02
1136.00	27.36	27.06	0.30	0.05	0.00

OW 12

Time	DTW	DTP	PT	Vol.	Rate
0.00	26.94	25.84	1.10	0.72	
23.00	27.00	25.85	1.15	0.75	0.08
57.00	27.04	25.87	1.17	0.76	0.02
102.00	27.11	25.89	1.22	0.79	0.04
1144.00	27.33	25.94	1.39	0.90	0.01

Product Accumulation Rate During Pumping Test On OW 17

OW 2

Time	DTW	DTP	PT	Vol.	Rate
0.00	27.37	27.30	0.07	0.05	
45.00	27.35	27.28	0.07	0.05	-0.00
60.00	27.36	27.27	0.09	0.06	0.05
90.00	27.36	27.28	0.08	0.05	-0.01
180.00	27.35	27.28	0.07	0.05	-0.00

OW 13

Time	DTW	DTP	PT	Vol.	Rate
0.00	27.93	27.74	0.19	0.12	
45.00	28.03	27.77	0.26	0.17	0.06
60.00	28.07	27.78	0.29	0.19	0.08
90.00	28.09	27.81	0.28	0.18	-0.01
120.00	28.10	27.79	0.31	0.20	0.04
180.00	28.10	27.80	0.30	0.20	-0.01

OW 3

Time	DTW	DTP	PT	Vol.	Rate
0.00	28.56	28.40	0.16	0.10	
45.00	28.55	28.36	0.19	0.12	0.03
60.00	28.56	28.35	0.21	0.14	0.05
180.00	28.59	28.34	0.25	0.16	0.01

RW 15 Pump Test in RW 15, 25 Nov. 97

Time	DTW	DTP	PT	Vol.	Rate
0.00	28.03	26.74	1.29	0.84	
1.50	31.13	29.25	1.88	1.22	15.34
2.00	31.27	29.41	1.86	1.21	-1.56
3.00	31.45	29.65	1.80	1.17	-2.34
4.00	31.62	29.81	1.81	1.18	0.39
5.00	31.73	29.92	1.81	1.18	-0.00
10.00	32.29	30.12	2.17	1.41	2.81
15.00	32.81	30.21	2.60	1.69	3.35
22.00	33.65	30.26	3.39	2.20	4.40
30.00	35.45	30.35	5.10	3.32	8.34
45.00	35.40	30.58	4.82	3.13	-0.73
60.00	35.40	30.89	4.51	2.93	-0.81
120.00	35.50	31.11	4.39	2.85	-0.08

Time in minutes elapsed since pumping began or bailing ceased.
DTW (depth to water) and DTP (depth to product) in feet below top of casing.
PT (product thickness) in feet.
Vol. (volume) of product in well (gallons).
Rate (of product accumulation) in gallons per hour.

APPENDIX A

Drilling Logs

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13, 17 and 18 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: OW 2

CONSTRUCTION: 4" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 5.5'	black sand and brown clay with brick rubble, wood debris and white cinder			
5.5' - 25'	grey silt			
25' - 30'	clayey brown silt	wet	967 (25') 2157 (30')	60 (25') 230 (30')
30' - 35'	clayey brown sand with some gravel	moist		

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13 and 17 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 3

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 4.5'	black sand with gravel and rubble	petroleum odor		
4.5' - 20'	grey to black silty sand	moist	61 (10') 2200 (15') 5800 (20')	90 (10') 380 (15') 7% LEL (20')
20' - 35'	brown sandy, silty, clayey gravel		3200+ (30')	68% LEL (30')

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13 and 14 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 5

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 3'	black and brown sand with brown to grey clay with cinder and brick rubble			
3' - 5'	brown sand with red clay and rubble			
5' - 10'	brown clayey sand with gravel	moist		630 (10')
10'-17'	grey sandy clay with some gravel	moist		780 (15')
17'	gravel layer			
17' - 35'	brown to grey sandy clay with gravel	moist		760 (20') 920 (25') 1340 (30')

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13, 14 and 19 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: RW 6

CONSTRUCTION: 6" Schedule 40 PVC; 25' Blank Pipe; 25' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 3'	brown sand with red brick and some white cinder	petroleum odor		
3' - 5'	white ash and timber fragments with some brown sand			50 (5')
5' - 20'	clayey, silty grey sand with brick rubble	slight petroleum odor, wet		190 (15')
20'-27'	brown clayey sand with gravel	petroleum odor, not as wet		20 (20')
27'	gravel layer			
27' - 35'	brown clayey sand with gravel	water at approximately 28', product residue apparent in wet soil		110 (30') 130% LEL (35')
35' - 50'	clayey, silty, medium to coarse black sand		1800+ (45') 1700+ (50')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 14 and 18 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 8

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 5.5'	brown sand and brown to grey clay with gravel	slight petroleum odor		
5.5' - 15'	sandy gravel fill			
15' - 20'	silty fine sandy grey clay			
20' - 24'	silty clayey sand and gravel			
24' - 35'	gravel with some sand			

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13 and 17 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 9

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 2'	black sand with brick rubble, white cinder and some brown clay			
2' - 15'	brown sand with heavy red clay and rubble		0 (10')	
15' - 35'	clayey, silty grey sand	wet		

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 14 and 17 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 10

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 2'	brown sand and rubble			
2' - 5'	brown sand with some clay and rubble	petroleum odor		
5' - 15'	sandy gravel with rubble fill		187 (10')	160 (10')
15' - 20'	silty, fine sandy grey clay		164 (15')	140 (15')
20' - 24'	silty, clayey sand and gravel		275 (20')	270 (20')
15' - 35'	clayey, silty grey sand	wet	272 (25') 2000+ (30')	300 (25') 50% LEL (30')

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 14 and 17 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 35')

IDENTIFICATION: TW 11

CONSTRUCTION: 2" Schedule 40 PVC; 15' Blank Pipe; 20' 0.020" Slot Screen

TOTAL DEPTH: 35 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 15'	silty clay and gravel with brick rubble and white cinder	wet @ 10', moist @ 15'	109 (10')	90 (10')
15' - 25'	silty clayey brown sand	perched water @ 14'	153 (15') 112 (20')	30 (15') 40 (20')
25' - 35'	brown sandy silt	slightly moist @ 28'	146 (25') 20 (30')	80 (25') 90 (30')
14' - 35'	silty, clayey grey sand			

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 18 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: OW 12

CONSTRUCTION: 4" Schedule 40 PVC; 15' Blank Pipe; 35' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
5' - 15'	silty black clay and med to coarse sand with 10-20% pebbles		101 (10')	
15' - 20'	sandy, silty grey clay		849 (15')	
20' - 50'	silty, clayey medium to coarse grey to brown sand and gravel		607 (20') 1480 (25') 1500+ (30') 1121 (35') 1900+ (40') 1700+ (45') 1399 (50')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 18 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: OW 13

CONSTRUCTION: 4" Schedule 40 PVC; 15' Blank Pipe; 35' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 5'	black sand and brown clay with brick rubble, timber fragments and white cinder			
5' - 22'	silty, clayey, medium to coarse and grey to black sand with pebbles		61 (10') 75 (15') 161 (20')	
22' - 29'	silty, clayey, sandy, medium to coarse and gray to black gravel with timber fragments		3000+ (25')	
29' - 50'	silty, clayey, medium to coarse brown sand with few pebbles		4000+ (30') 5200+ (35')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 18 and 19 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: OW 14

CONSTRUCTION: 4" Schedule 40 PVC; 15' Blank Pipe; 35' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 1.25'	black tar			
1.25' - 2'	layer of bricks			
2' - 5'	black sand and white cinder			
5' - 15'	silty, sandy clay with pebbles		127 (10')	
15' - 29'	silty, clayey sand with gravel		127 (15') 53 (20') 12 (25')	
29' - 34'	silty, sandy medium to coarse gravel		175 (30')	
34' - 50'	silty, clayey, medium to coarse brown sand with few pebbles		68 (35') 316 (40') 6400+ (45')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 19 November 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: RW 15

CONSTRUCTION: 6" Schedule 40 PVC; 15' Blank Pipe; 35' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	topsoil			
1' - 16'	sandy, silty brown clay		0 (10') 0 (15')	
16' - 29'	silty, sandy gravel		54 (20') 95 (25')	
29' - 50'	silty, medium to coarse sand		106 (30') 1032 (35')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 13 November and 8 December 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: OW 16

CONSTRUCTION: 4" Schedule 40 PVC; 20' Blank Pipe; 30' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 5'	black sand and rubble	strong petroleum odor		
5' - 14'	clayey, silty, sandy gravel with pebbles and timber fragments		573 (10')	
14' - 23'	clayey, silty medium to coarse black sand changing to sandy, silty, grey to black clay with <10% pebbles @ 23'		588 (15') 593 (20')	
23' - 50'	clayey, silty, medium to coarse brown sand		1500+ (25') 2800+ (30') 2800+ (35') 2500+ (40') 2300+ (45') 2000+ (50')	

OBSERVATION WELL DRILLING LOG

LOCATION: Sunoco Belmont Terminal
26th Street and Passyunk Avenue
Philadelphia, PA

DATE: 8 December 1997

GEOLOGIST: James H. Mulry, P.G.

DRILLER: B. L. Myers Bros., Inc., Glenmoore, Pa.

METHOD: Hand Dig (1' - 5'), 10" Auger (5' - 50')

IDENTIFICATION: OW 17

CONSTRUCTION: 4" Schedule 40 PVC; 20' Blank Pipe; 30' 0.020" Slot Screen

TOTAL DEPTH: 50 feet

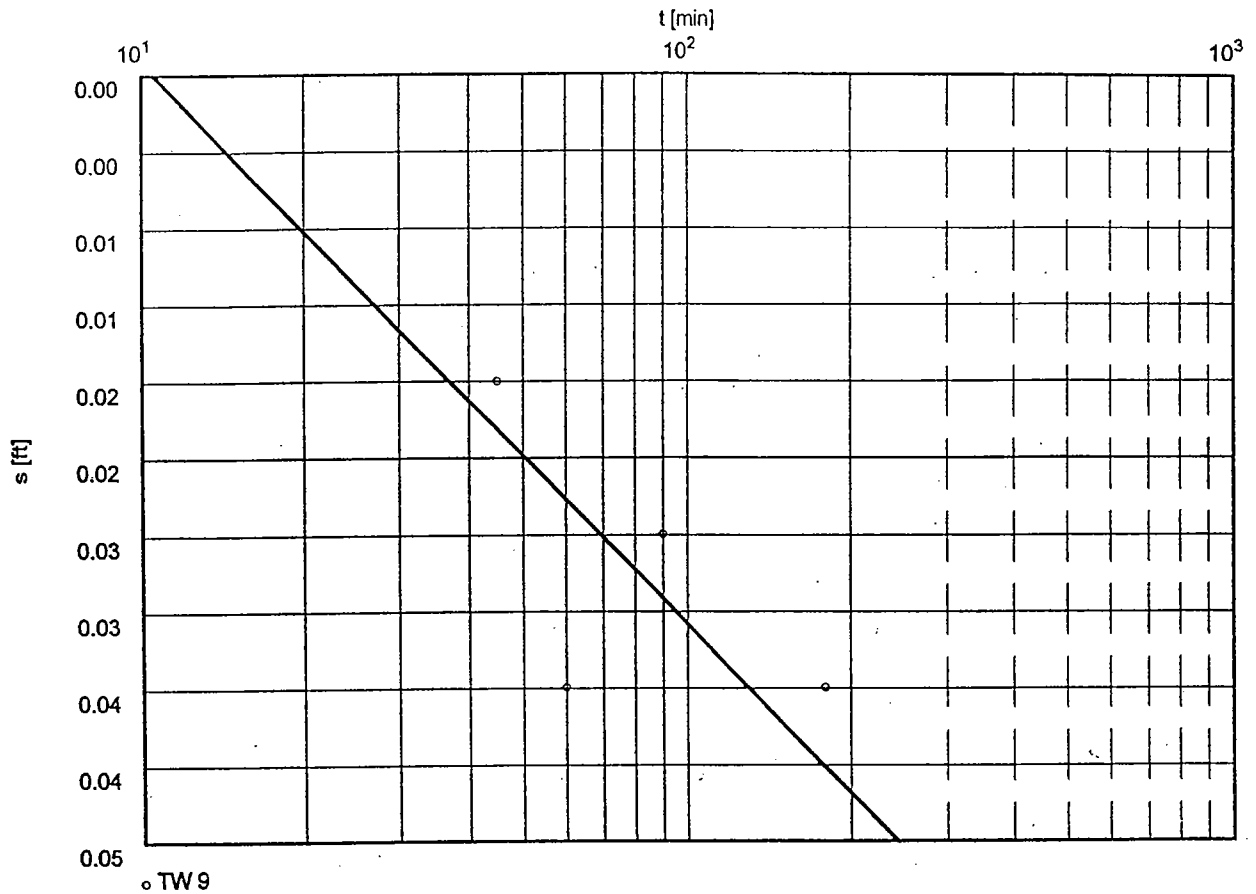
DEPTH	DESCRIPTION	COMMENTS	OVM (ppm)	GasTech (ppm)
0 - 1'	asphalt and ballast			
1' - 5'	cinder fill			
5' - 27'	clayey, silty medium to coarse black sand with gravel and 20% pebbles changing to silty, clayey sandy gravel	perched water @ 11'	203 (10') 138 (15') 170 (20') 183 (25')	
27' - 38'	sandy, silty, clayey sandy gravel		388+ (30') 856+ (35')	
38' - 50'	sandy, silty brown clay	saturated @ 42'	514 (40') 322 (45')	

APPENDIX B

Pumping Tests Analyses

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 1 Project: Belmont Terminal Evaluated by: MM | Date: 15.01.1998

Pumping Test No.	Test conducted on: 25 November 1997
TW 9	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 4.00×10^{0}

Hydraulic conductivity [ft/min]: 1.33×10^{-1}

Aquifer thickness [ft]: 30.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 2 Project: Belmont Terminal Evaluated by: MM | Date: 15.01.1998

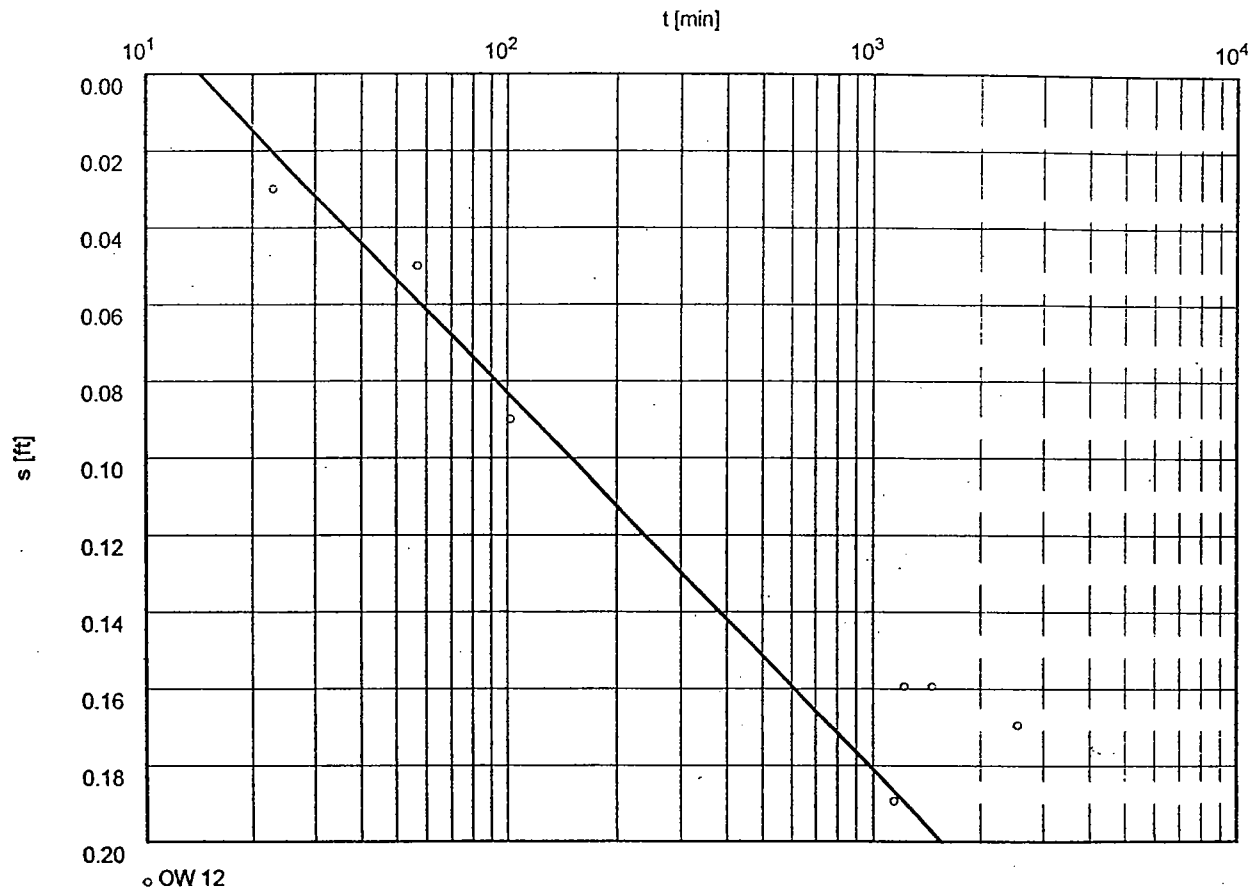
Pumping Test No.	Test conducted on: 25 November 1997
TW 9	TW 9
Discharge 6.00 U.S.gal/min	Distance from the pumping well 40.00 ft

Static water level: 28.69 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	Corrected drawdown [ft]
1	45.00	28.71	0.02	0.02
2	60.00	28.73	0.04	0.04
3	90.00	28.72	0.03	0.03
4	180.00	28.73	0.04	0.04

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 1 Project: Belmont Terminal Evaluated by: MM | Date: 06.01.1998

Pumping Test No.	Test conducted on: 17-19 December 1997
OW 12	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 1.49×10^{0}

Hydraulic conductivity [ft/min]: 4.99×10^{-2}

Aquifer thickness [ft]: 30.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 2 Project: Belmont Terminal Evaluated by: MM | Date: 06.01.1998

Pumping Test No.	Test conducted on: 17-19 December 1997
OW 12	OW 12
Discharge 6.00 U.S.gal/min	Distance from the pumping well 80.00 ft

Static water level: 26.19 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	Corrected drawdown [ft]
1	23.00	26.22	0.03	0.03
2	57.00	26.24	0.05	0.05
3	102.00	26.28	0.09	0.09
4	1144.00	26.38	0.19	0.19
5	1226.00	26.35	0.16	0.16
6	1466.00	26.35	0.16	0.16
7	2557.00	26.36	0.17	0.17

Waterloo Hydrogeologic
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Unconfined aquifer

Project: Belmont Terminal

Evaluated by: MM | Date: 06.01.1998

Pumping Test No.

OW 12

Discharge 6.00 U.S.gal/min

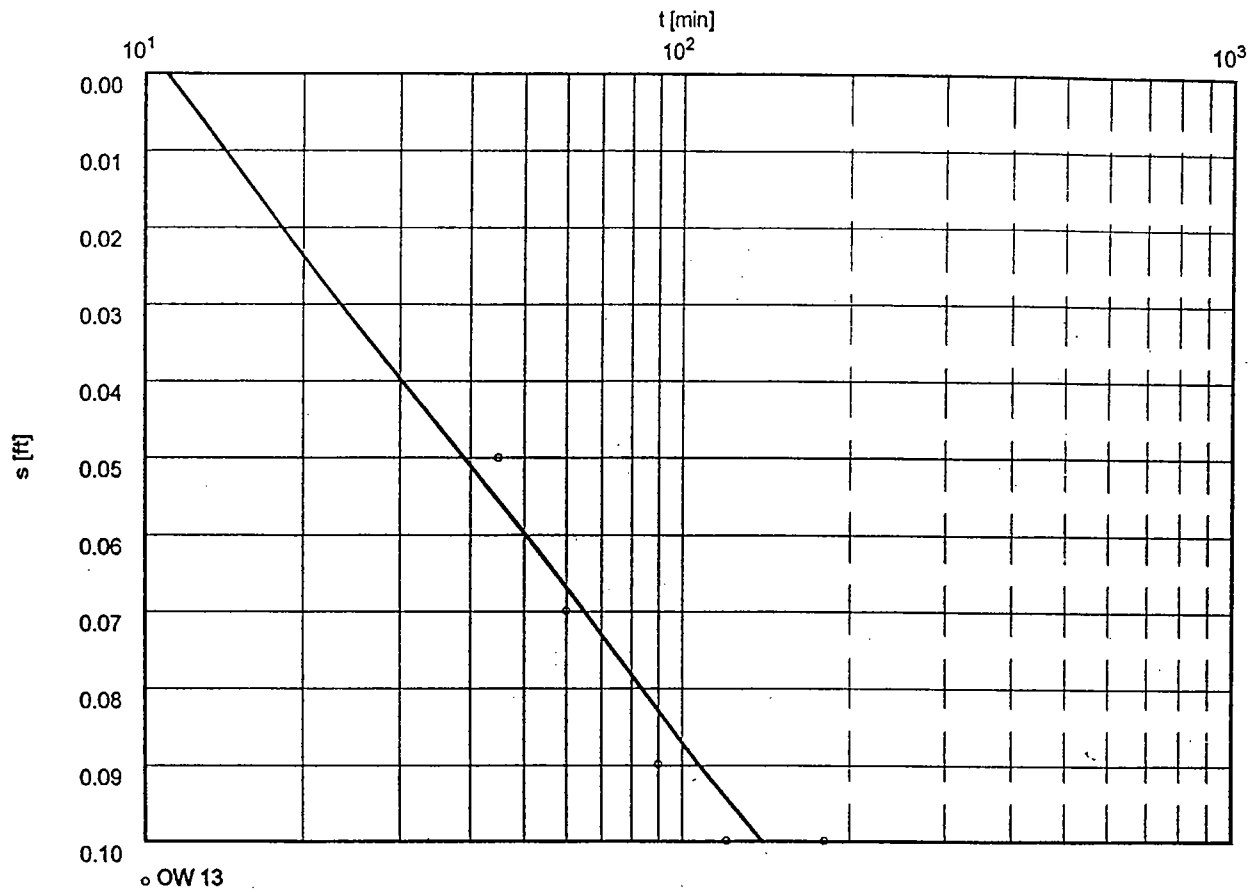
Test conducted on: 17-19 December 1997

Measured at Pump (in OW 17)

	Pumping test duration [min]	Discharge [U.S.gal/min]
1	0.00	6.00
2	1160.00	6.00
3	1161.00	4.00
4	2672.00	4.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	**Pumping test analysis** Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	**Page 1** Project: Belmont Terminal Evaluated by: MM | Date: 15.01.1998

Pumping Test No.	Test conducted on: 25 November 1997
OW 13	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 1.61×10^{0}

Hydraulic conductivity [ft/min]: 5.39×10^{-2}

Aquifer thickness-[ft]: 30.00

Waterloo Hydrogeologic
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Time-Drawdown-method after
COOPER & JACOB
Unconfined aquifer

Project: Belmont Terminal

Evaluated by: MM | Date: 15.01.1998

Pumping Test No. OW 13

Test conducted on: 25 November 1997

OW 13

Discharge 6.00 U.S.gal/min

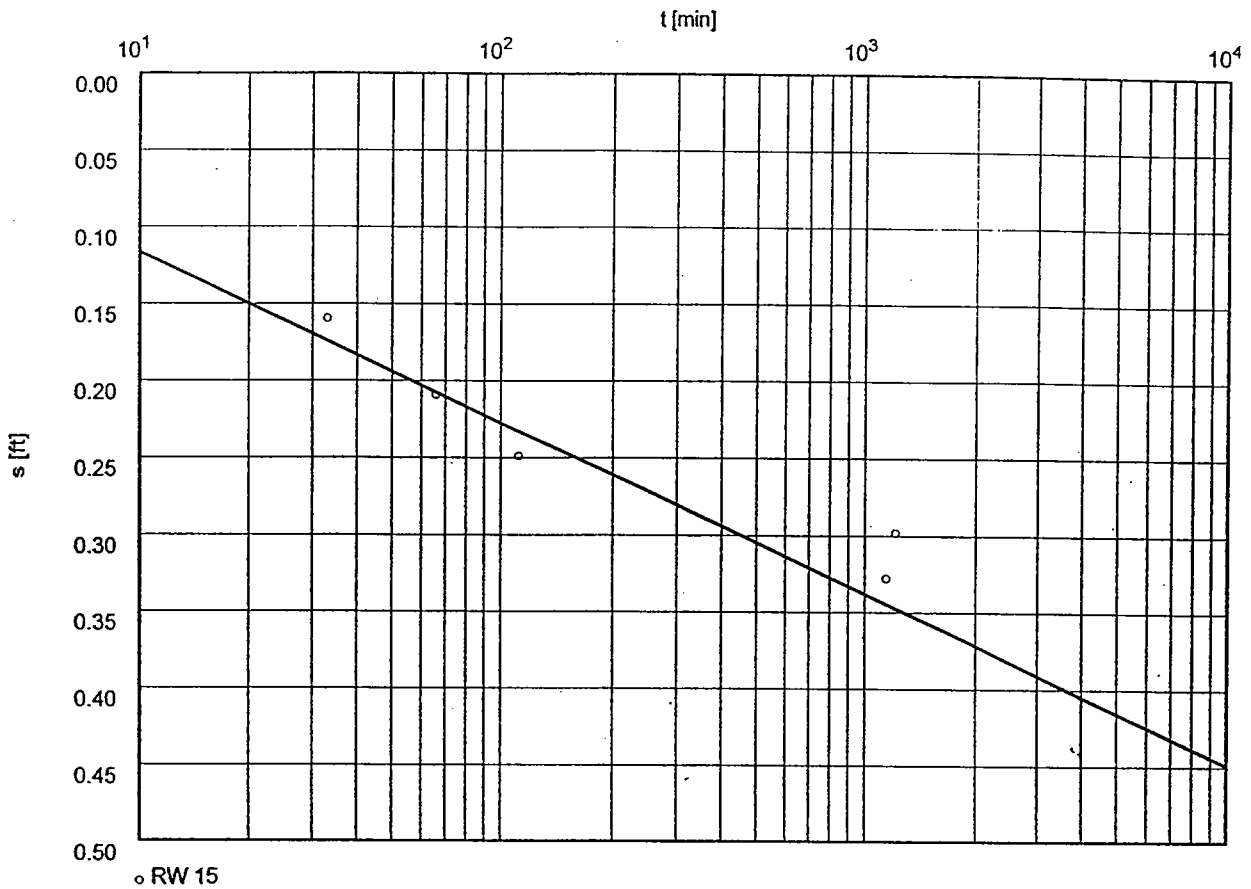
Distance from the pumping well 40.00 ft

Static water level: 27.80 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	Corrected drawdown [ft]
1	45.00	27.85	0.05	0.05
2	60.00	27.87	0.07	0.07
3	90.00	27.89	0.09	0.09
4	120.00	27.90	0.10	0.10
5	180.00	27.90	0.10	0.10

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	**Pumping test analysis** Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 1 Project: Belmont Terminal Evaluated by: MM | Date: 05.01.1998

Pumping Test No.	Test conducted on: 17-19 December 1997
RW 15	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 1.32×10^{0}

Hydraulic conductivity [ft/min]: 4.40×10^{-2}

Aquifer thickness [ft]: 30.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 2 Project: Belmont Terminal Evaluated by: MM | Date: 05.01.1998

Pumping Test No.	Test conducted on: 17-19 December 1997
RW 15	RW 15
Discharge 6.00 U.S.gal/min	Distance from the pumping well 60.00 ft

Static water level: 27.22 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	Corrected drawdown [ft]
1	33.00	27.38	0.16	0.16
2	66.00	27.43	0.21	0.21
3	112.00	27.47	0.25	0.25
4	1149.00	27.55	0.33	0.33
5	1215.00	27.52	0.30	0.30

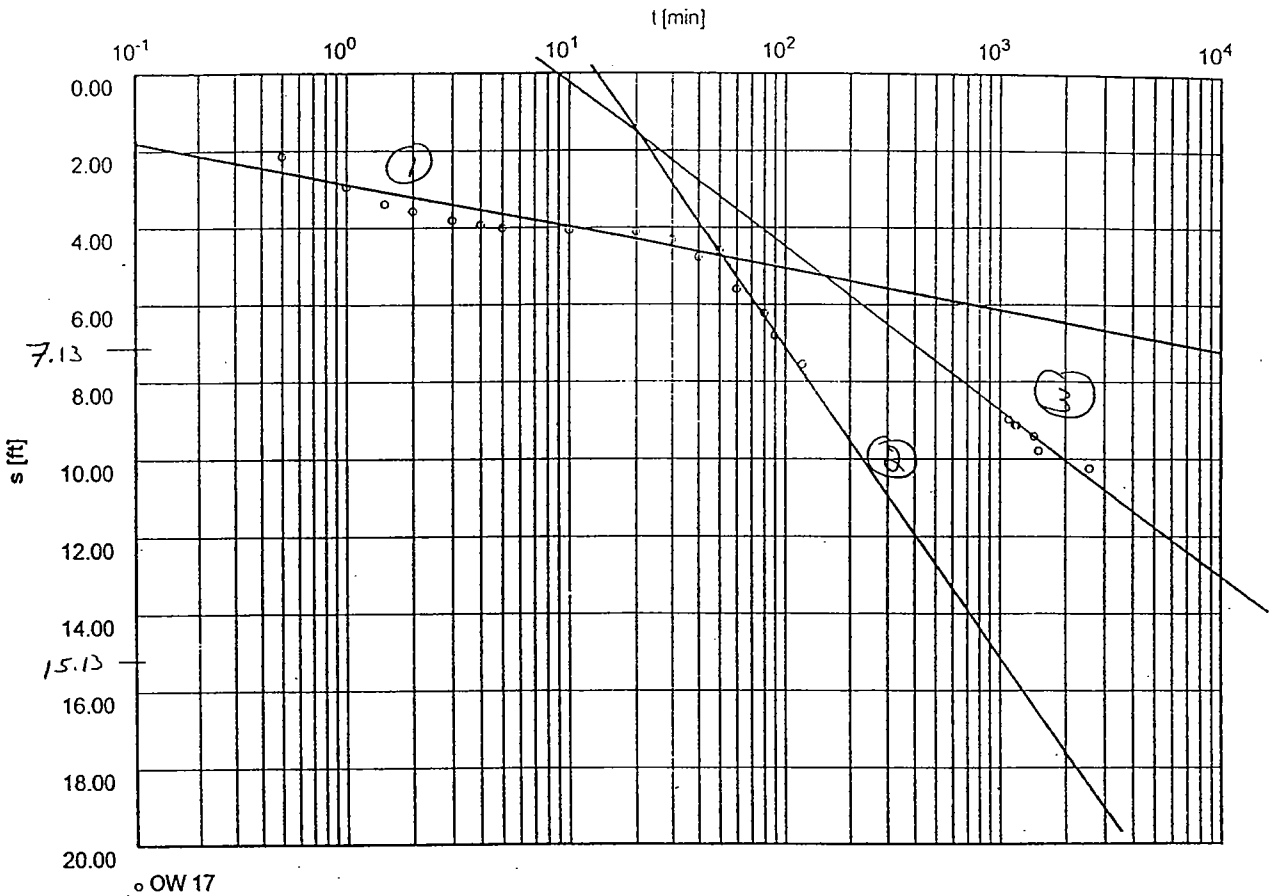
Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 3 Project: Belmont Terminal Evaluated by: MM | Date: 05.01.1998

Pumping Test No.	Test conducted on: 17-19 December 1997
RW 15	Measured at Pump (in OW 17)
Discharge 6.00 U.S.gal/min	

	Pumping test duration [min]	Discharge [U.S.gal/min]
1	0.00	6.00
2	1160.00	6.00
3	1161.00	4.00
4	2672.00	4.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 1 Project: Belmont Terminal Evaluated by: MM | Date: 31.12.1997

Pumping Test No.	Test conducted on: 17-19 December
OW 17	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 1.35×10^{-1}

Hydraulic conductivity [ft/min]: 4.50×10^{-3}

Aquifer thickness [ft]: 30.00

$$T = \frac{264\,Q}{\Delta S}$$

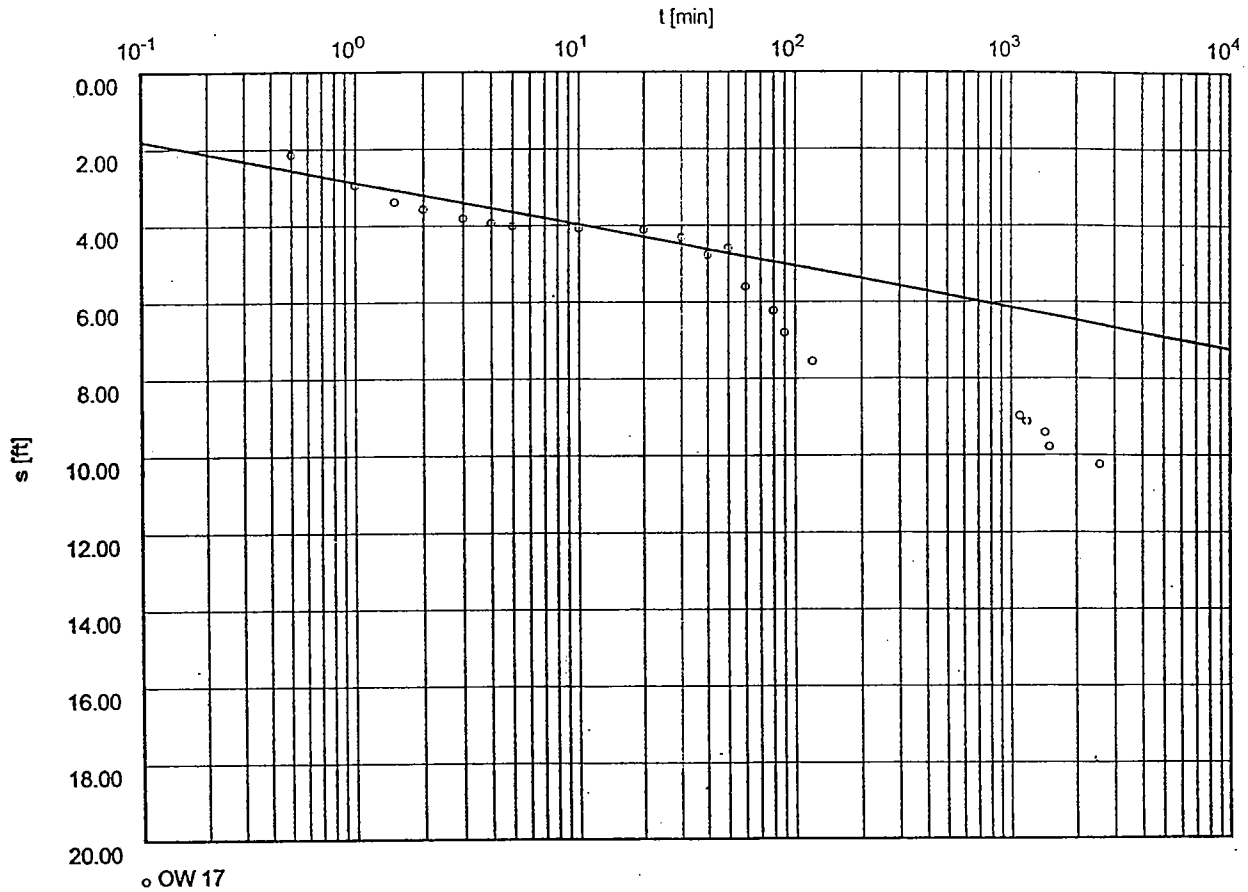
second curve $\Delta S = 15.13 - 7.13 = 8.00$

5×10^1 (50 min) $\quad T = \dfrac{264 \left| \frac{6\ g}{min} \right|}{8} = 198 = 1.98 \times 10^2$

Third Curve

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 1 Project: Belmont Terminal Evaluated by: MM | Date: 31.12.1997

Pumping Test No.	Test conducted on: 17-19 December
OW 17	
Discharge 6.00 U.S.gal/min	



Transmissivity [ft²/min]: 1.35×10^{-1}

Hydraulic conductivity [ft/min]: 4.50×10^{-3}

Aquifer thickness [ft]: 30.00

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 2 Project: Belmont Terminal Evaluated by: MM | Date: 31.12.1997

Pumping Test No.	Test conducted on: 17-19 December
OW 17	OW 17
Discharge 6.00 U.S.gal/min	Distance from the pumping well 1.00 ft

Static water level: 27.02 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]	Corrected drawdown [ft]
1	0.50	29.25	2.23	2.15
2	1.00	30.13	3.11	2.95
3	1.50	30.62	3.60	3.38
4	2.00	30.83	3.81	3.57
5	3.00	31.11	4.09	3.81
6	4.00	31.24	4.22	3.92
7	5.00	31.35	4.33	4.02
8	10.00	31.42	4.40	4.08
9	20.00	31.47	4.45	4.12
10	30.00	31.71	4.69	4.32
11	40.00	32.25	5.23	4.77
12	50.00	32.02	5.00	4.58
13	60.00	33.28	6.26	5.61
14	80.00	34.09	7.07	6.24
15	90.00	34.85	7.83	6.81
16	120.00	35.88	8.86	7.55
17	1100.00	38.00	10.98	8.97
18	1175.00	38.25	11.23	9.13
19	1201.00	38.24	11.22	9.12
20	1443.00	38.71	11.69	9.41
21	1508.00	39.33	12.31	9.78
22	2566.00	40.12	13.10	10.24

Waterloo Hydrogeologic 180 Columbia St. W. Waterloo,Ontario,Canada ph.(519)746-1798	Pumping test analysis Time-Drawdown-method after COOPER & JACOB Unconfined aquifer	Page 3 Project: Belmont Terminal Evaluated by: MM | Date: 31.12.1997

Pumping Test No.	Test conducted on: 17-19 December
OW 17	Measured at Pump
Discharge 6.00 U.S.gal/min	

	Pumping test duration [min]	Discharge [U.S.gal/min]
1	0.00	6.00
2	1160.00	6.00
3	1161.00	4.00
4	2566.00	4.00

APPENDIX C

Liquid Level Gauging Data, Hydrographs and Bailing /Recovery Tests Data

MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

Belmont Terminal, Shunk Street Sewer Delineation

Liquid Level Data 18 Nov 97

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	28.41		0.00	95.50	67.09	67.09
3	28.55	28.26	0.29	95.38	66.83	67.03
5	31.11		0.00	98.25	67.14	67.14
6	30.60	29.94	0.66	97.09	66.49	66.94
9	28.69		0.00	95.70	67.01	67.01
10	26.91	26.87	0.04	93.33	66.42	66.45
11	28.34		0.00	95.18	66.84	66.84

Liquid Level Data 19 Nov 97

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	Being re-drilled		0.00	95.50	95.50	95.50
3	28.38	28.33	0.05	95.38	67.00	67.03
5	31.06		0.00	98.25	67.19	67.19
6	Being re-drilled		0.00	97.09	97.09	97.09
8	26.87		0.00	93.54	66.67	66.67
9	28.63		0.00	95.70	67.07	67.07
10	26.84	26.82	0.02	93.33	66.49	66.50
11	28.30		0.00	95.18	66.88	66.88
12	26.39	25.82	0.57	92.67	66.28	66.67

Liquid Level Data 20 Nov 97

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.28		0.00	94.40	67.12	67.12
3	28.43	28.38	0.05	95.38	66.95	66.98
5	31.08		0.00	98.25	67.17	67.17
6	26.86		0.00	93.81	66.95	66.95
8	26.91		0.00	93.54	66.63	66.63
9	28.67		0.00	95.70	67.03	67.03
10	26.92	26.85	0.07	93.33	66.41	66.46
11	28.34		0.00	95.18	66.84	66.84
12	26.56	25.84	0.72	92.67	66.11	66.60
13	27.80	27.78	0.02	94.71	66.91	66.92
14	27.41		0.00	94.98	67.57	67.57
15	28.07	26.96	1.11	93.15	65.08	65.83
TW 5-73	25.97		0.00	92.83	66.86	66.86

Liquid Level Data 21 Nov 97

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.28		0.00	94.40	67.12	67.12
3	28.48	28.37	0.11	95.38	66.90	66.97
5	31.10		0.00	98.25	67.15	67.15
6	26.85		0.00	93.81	66.96	66.96
8	26.92		0.00	93.54	66.62	66.62
9	28.68		0.00	95.70	67.02	67.02
10	26.93	26.86	0.07	93.33	66.40	66.45
11	28.34		0.00	95.18	66.84	66.84
12	26.75	25.78	0.97	92.67	65.92	66.58
13	27.78	27.74	0.04	94.71	66.93	66.96
14	28.35		0.00	94.98	66.63	66.63
15	27.57	27.56	0.01	93.15	65.58	65.59
TW 5-73	25.99		0.00	92.83	66.84	66.84

Liquid Level Gauging, Depths in feet below top of casing

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Belmont Terminal, Shunk Street Sewer Delineation

Liquid Level Data 25 Nov 97 (static)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.37	27.30	0.07	94.40	67.03	67.08
3	28.56	28.40	0.16	95.38	66.82	66.93
5	31.13		0.00	98.25	67.12	67.12
6	26.88		0.00	93.81	66.93	66.93
8	26.95		0.00	93.54	66.59	66.59
9	28.69		0.00	95.70	67.01	67.01
10	26.97	26.89	0.08	93.33	66.36	66.41
11	28.36		0.00	95.18	66.82	66.82
12	26.86	25.81	1.05	92.67	65.81	66.52
13	27.93	27.74	0.19	94.71	66.78	66.91
14	28.35		0.00	94.98	66.63	66.63
15	28.10	26.81	1.29	93.15	65.05	65.93
TW 5-73	26.00		0.00	92.83	66.83	66.83

Liquid Level Data 25 Nov 97

(RW 6 pumping at 6 gpm for 4 hours and RW 15 for 0.5 hours at 10 gpm)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.35	27.28	0.07	94.40	67.05	67.10
3	28.59	28.34	0.25	95.38	66.79	66.96
5	31.13		0.00	98.25	67.12	67.12
6	31.36		0.00	93.81	62.45	62.45
8	26.92		0.00	93.54	66.62	66.62
9	28.73		0.00	95.70	66.97	66.97
10	26.99	26.91	0.08	93.33	66.34	66.39
11	28.36		0.00	95.18	66.82	66.82
12	26.83	25.79	1.04	92.67	65.84	66.55
13	28.10	27.79	0.31	94.71	66.61	66.82
14	28.35		0.00	94.98	66.63	66.63
15	35.45	30.35	5.10	93.15	57.70	61.17
TW 5-73	25.99		0.00	92.83	66.84	66.84

Liquid Level Gauging, Depths in feet below top of casing

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Belmont Terminal, Shunk Street Sewer Delineation

Liquid Level Data 17 Dec (static, prior to pump test on OW 17)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.31	27.30	0.01	94.40	67.09	67.10
3	28.91	28.31	0.60	95.38	66.47	66.88
5	31.17		0.00	98.25	67.08	67.08
6	26.95	26.92	0.03	93.81	66.86	66.88
8	26.99		0.00	93.54	66.55	66.55
9	28.75		0.00	95.70	66.95	66.95
10	27.08	26.89	0.19	93.33	66.25	66.38
11	28.40		0.00	95.18	66.78	66.78
12	26.94	25.84	1.10	92.67	65.73	66.48
13	28.80	27.52	1.28	94.71	65.91	66.78
14	28.45		0.00	94.98	66.53	66.53
15	27.99	26.86	1.13	93.15	65.16	65.93
16	28.25	27.78	0.47	94.38	66.13	66.45
17	27.04	27.01	0.03	94.64	67.60	67.62
TW 5-73	26.05		0.00	92.83	66.78	66.78

Liquid Level Data 20 Dec 97 (after approx. 42 hours of pumping OW 17)

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.56	27.36	0.20	94.40	66.84	66.98
3	29.04	28.39	0.65	95.38	66.34	66.78
5	31.23		0.00	98.25	67.02	67.02
6	26.96	26.95	0.01	93.81	66.85	66.86
8	27.10		0.00	93.54	66.44	66.44
9	28.79		0.00	95.70	66.91	66.91
10	27.29	27.06	0.23	93.33	66.04	66.20
11	28.45		0.00	95.18	66.73	66.73
12	27.27	25.92	1.35	92.67	65.40	66.32
13	28.96	27.56	1.40	94.71	65.75	66.70
14	28.54		0.00	94.98	66.44	66.44
15	28.87	26.89	1.98	93.15	64.28	65.63
16	28.49	27.78	0.71	94.38	65.89	66.37
17	38.74	38.69	0.05	94.64	55.90	55.93
TW 5-73	26.09		0.00	92.83	66.74	66.74

Liquid Level Gauging, Depths in feet below top of casing

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Belmont Terminal, Shunk Street Sewer Delineation

Arbitrary datum at Belmont Terminal was 60.72' higher than Arco datum.

Static 21 January 1998

Terminal Wells

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
2	27.74	27.52	0.22	33.68	5.94	6.09
3	28.84	27.88	0.96	33.88	5.04	5.69
5	27.95		0.00	34.09	6.14	6.14
6	27.11	26.92	0.19	33.09	5.98	6.11
8	26.38		0.00	31.83	5.45	5.45
9	28.13		0.00	33.99	5.86	5.86
10	27.93	26.30	1.63	32.00	4.07	5.18
11	28.62		0.00	34.46	5.84	5.84
12	27.40	25.98	1.42	31.95	4.55	5.52
13	28.80	27.74	1.06	33.99	5.19	5.91
14	28.59		0.00	34.26	5.67	5.67
15	28.30	27.00	1.30	32.43	4.13	5.01
16	28.02	27.20	0.82	33.41	5.39	5.95
17	27.49	26.25	1.24	32.06	4.57	5.41
TW 5-73	26.26		0.00	32.11	5.85	5.85

Sunoco Station Wells, 28th and Passyunk

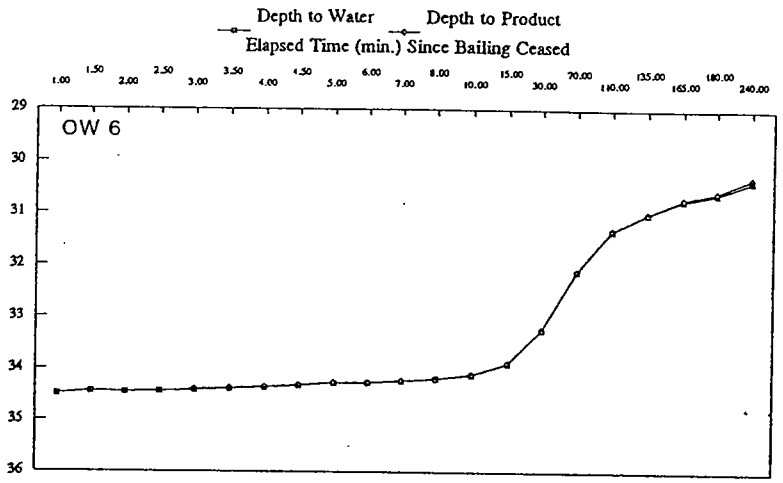
Well #	DTW	DTP	PT	Casing El	Water El	Corrected
OW 1	27.62		0.00	32.57	4.95	4.95
OW 2	27.34		0.00	32.75	5.41	5.41
OW 3	27.80		0.00	33.42	5.62	5.62

Proximal Refinery Wells

Well #	DTW	DTP	PT	Casing El	Water El	Corrected
S-74	26.26		0.00	32.11	5.85	5.85
S-76	28.16	26.98	1.18	33.05	4.89	5.69
S-77	29.03	29.03	0.00	34.08	5.05	5.05

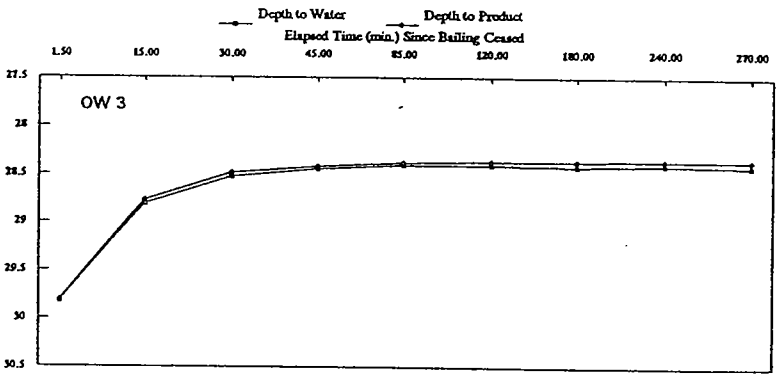
OW 6 17-Nov-97

Time	DTW	DTP
0.00	30.81	29.92
1.00	34.50	
1.50	34.44	
2.00	34.46	
2.50	34.44	
3.00	34.42	34.41
3.50	34.39	34.38
4.00	34.37	34.36
4.50	34.33	34.32
5.00	34.28	34.27
6.00	34.28	34.27
7.00	34.24	34.23
8.00	34.20	34.19
10.00	34.12	34.11
15.00	33.91	33.90
30.00	33.25	33.24
70.00	32.12	32.11
110.00	31.33	31.31
135.00	31.00	30.98
165.00	30.73	30.69
180.00	30.61	30.57
240.00	30.37	30.31



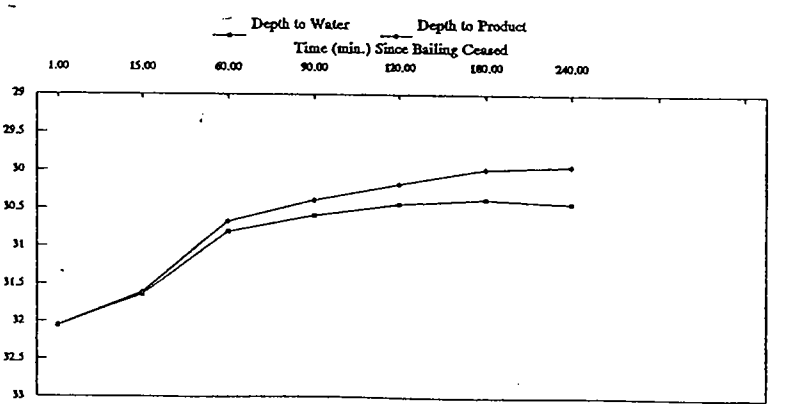
OW 3

Time	DTW	DTP
0.00	28.56	28.25
1.50	29.82	29.81
15.00	28.81	28.77
30.00	28.53	28.49
45.00	28.45	28.42
85.00	28.41	28.38
120.00	28.41	28.37
180.00	28.42	28.37
240.00	28.41	28.36
270.00	28.42	28.36

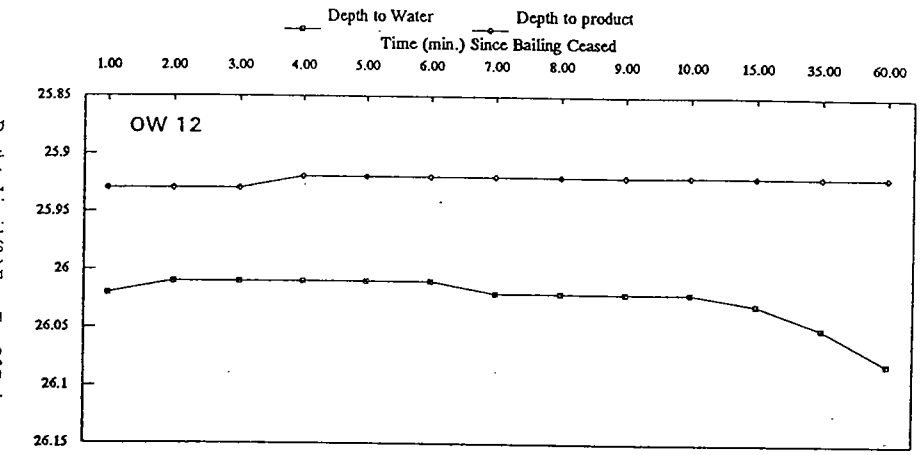


OW 6 18-Nov-97

Time	DTW	DTP
0.00	30.63	29.90
1.00	32.07	32.05
15.00	31.64	31.61
60.00	30.81	30.68
90.00	30.59	30.39
120.00	30.44	30.18
180.00	30.38	29.98
240.00	30.43	29.94



OW 12	19-Nov-97	
Time	DTW	DTP
0.00	26.09	25.94
1.00	26.02	25.93
2.00	26.01	25.93
3.00	26.01	25.93
4.00	26.01	25.92
5.00	26.01	25.92
6.00	26.01	25.92
7.00	26.02	25.92
8.00	26.02	25.92
9.00	26.02	25.92
10.00	26.02	25.92
15.00	26.03	25.92
35.00	26.05	25.92
60.00	26.08	25.92

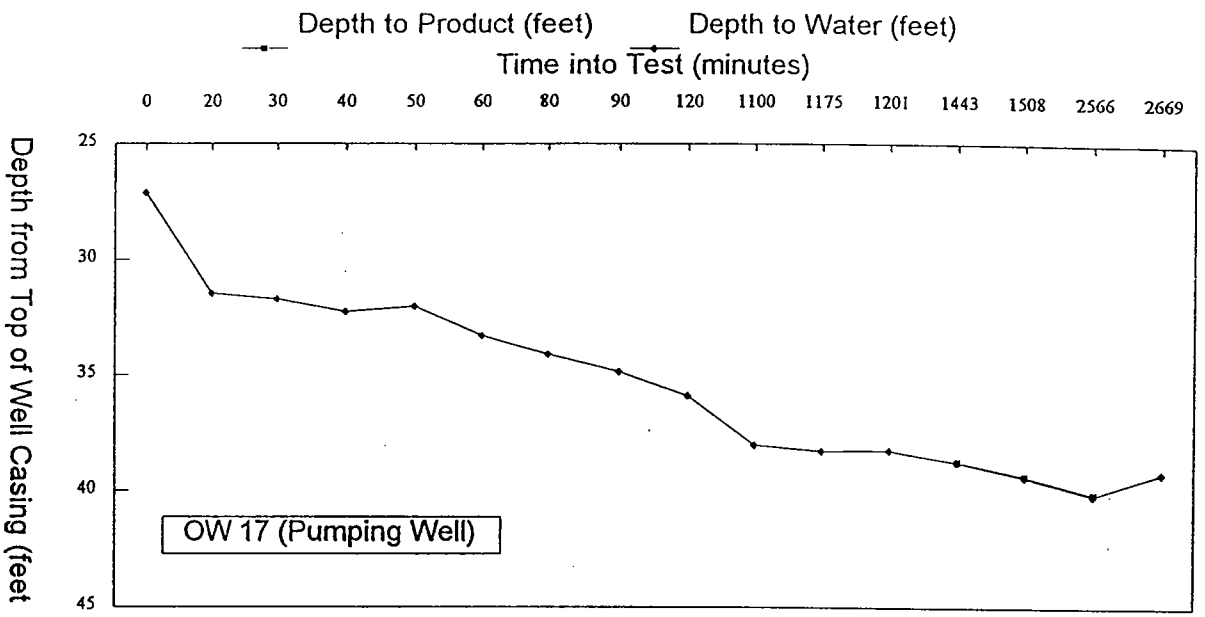


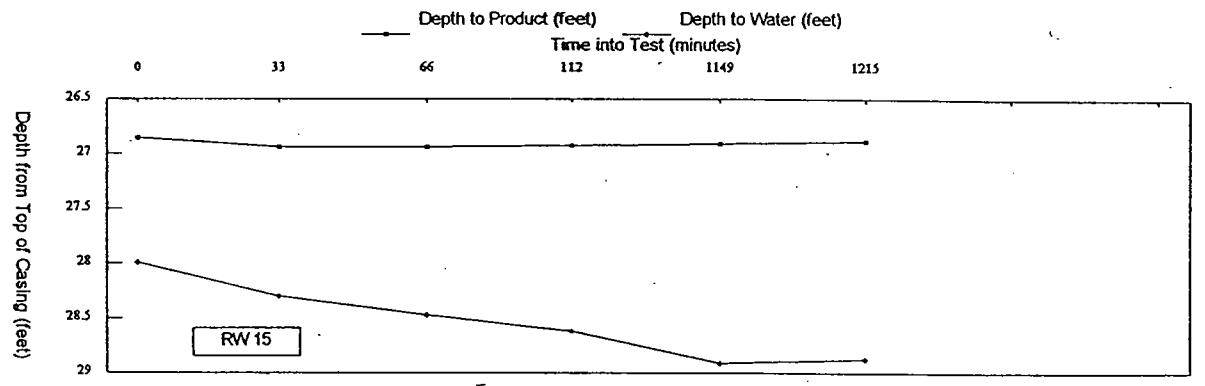
MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

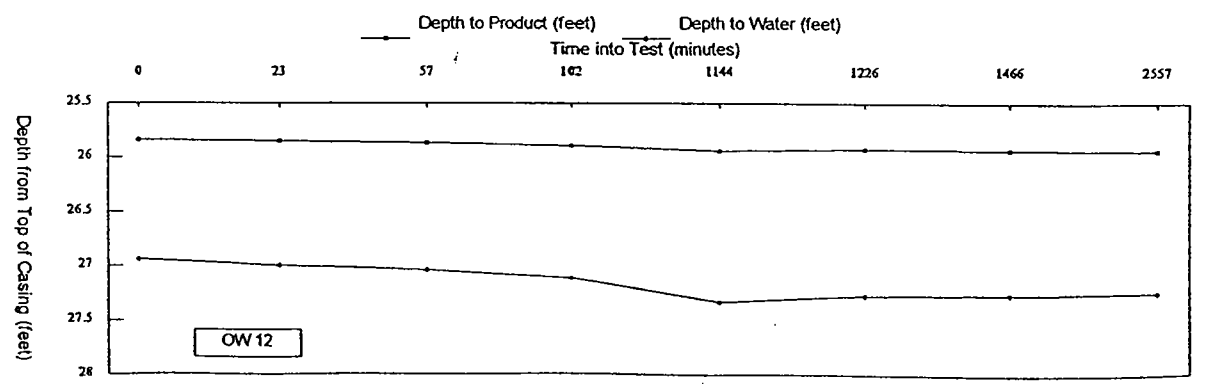
Pumping Test on Well OW 17, 17-19 December 1997

Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA





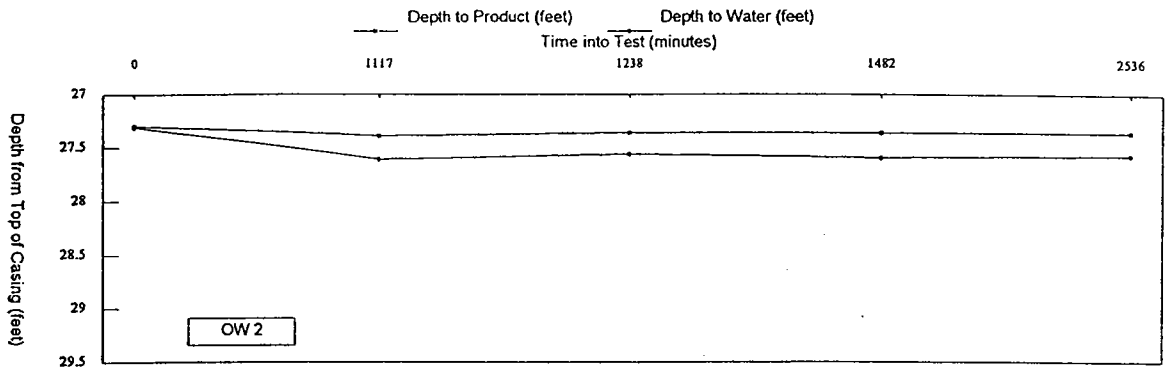


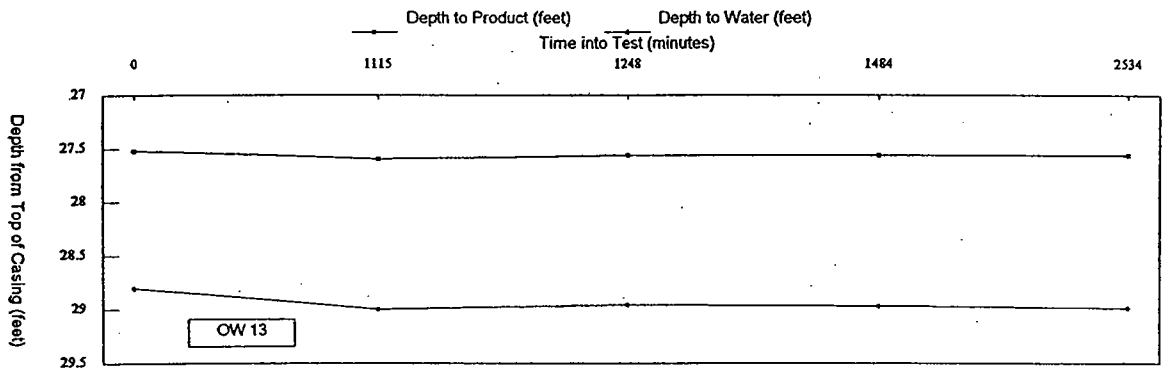
MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

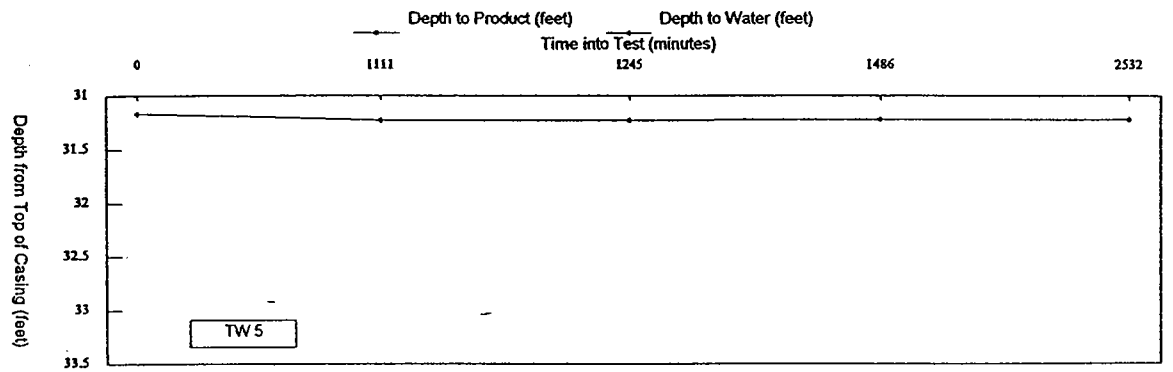
Pumping Test on Well OW 17, 17-19 December 1997

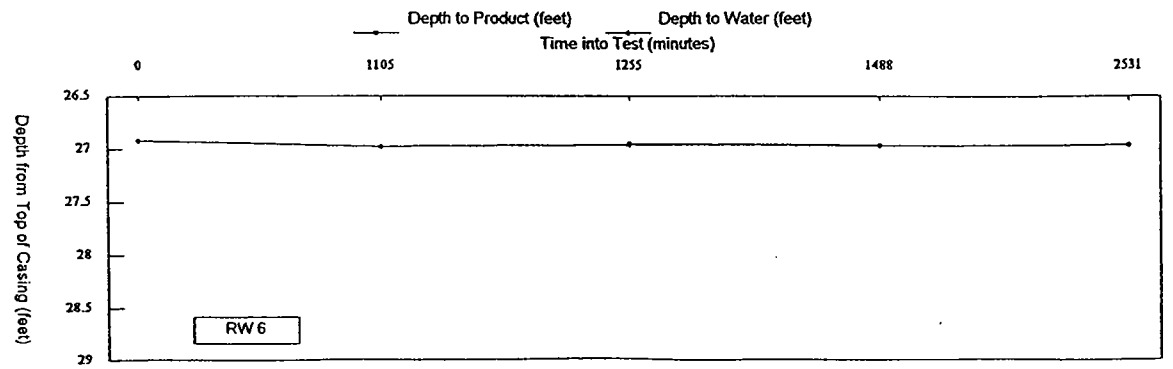
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA







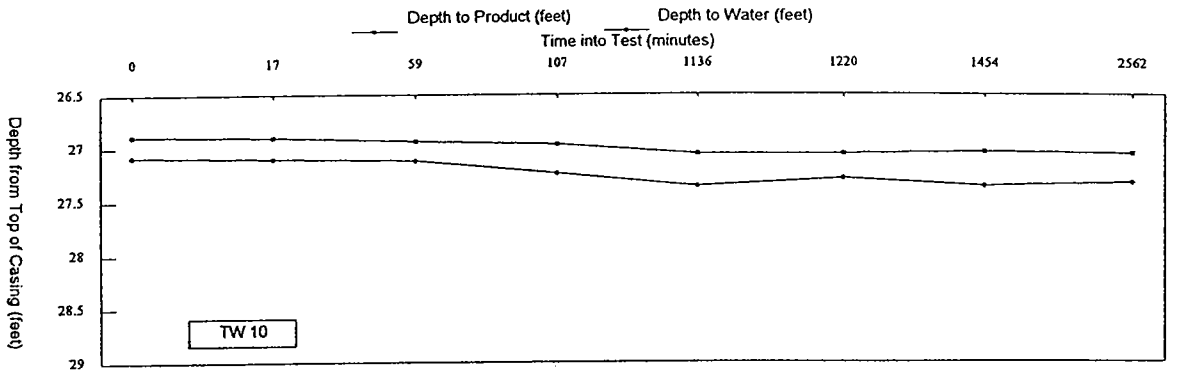


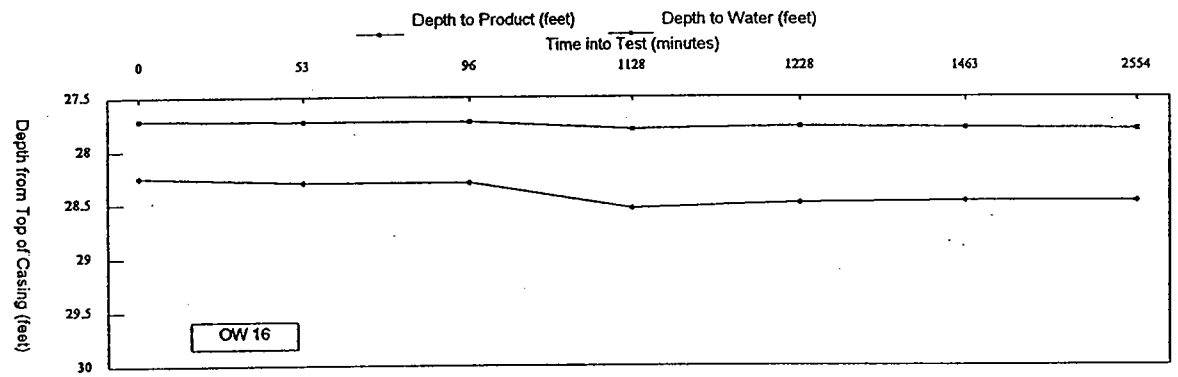
MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

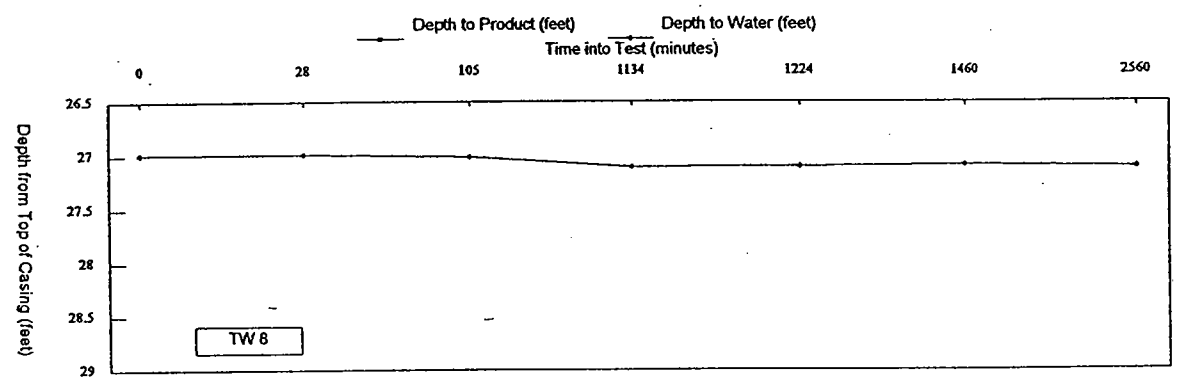
Pumping Test on Well OW 17, 17-19 December 1997

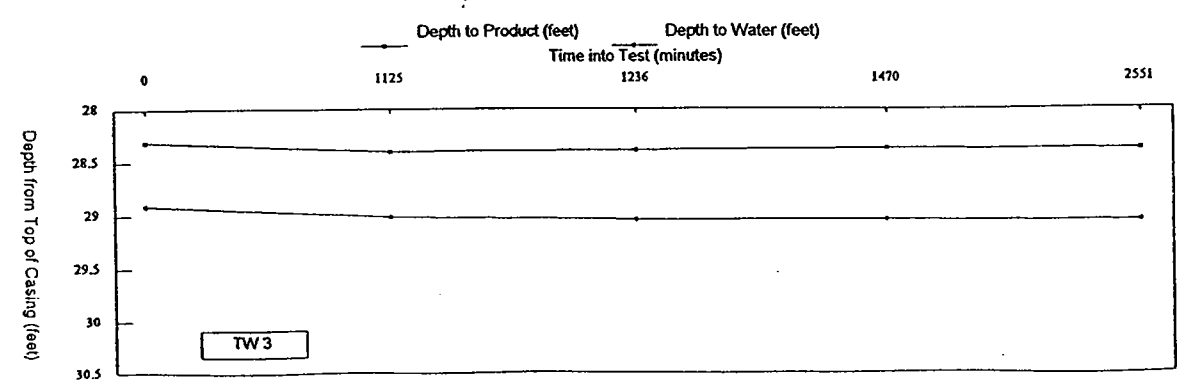
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA







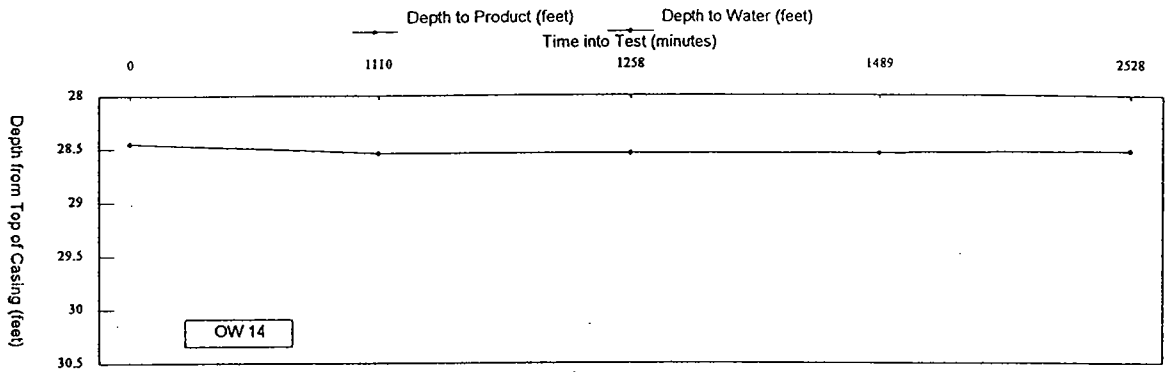


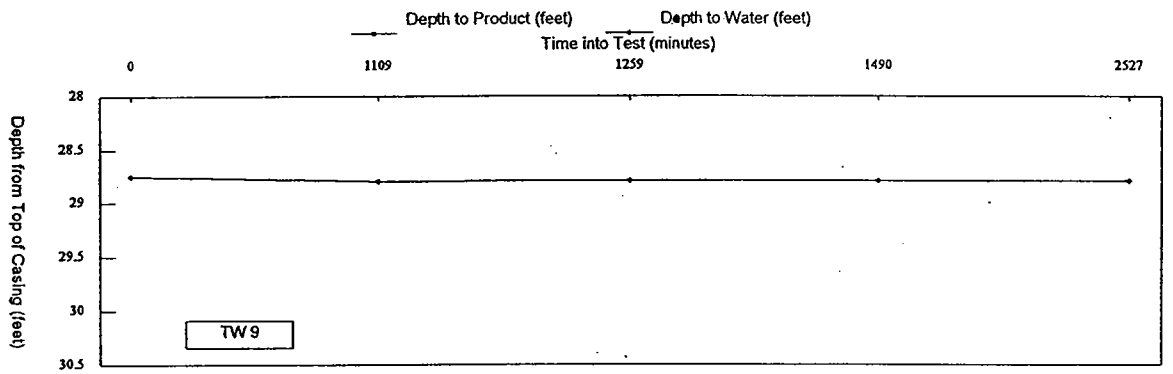
MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

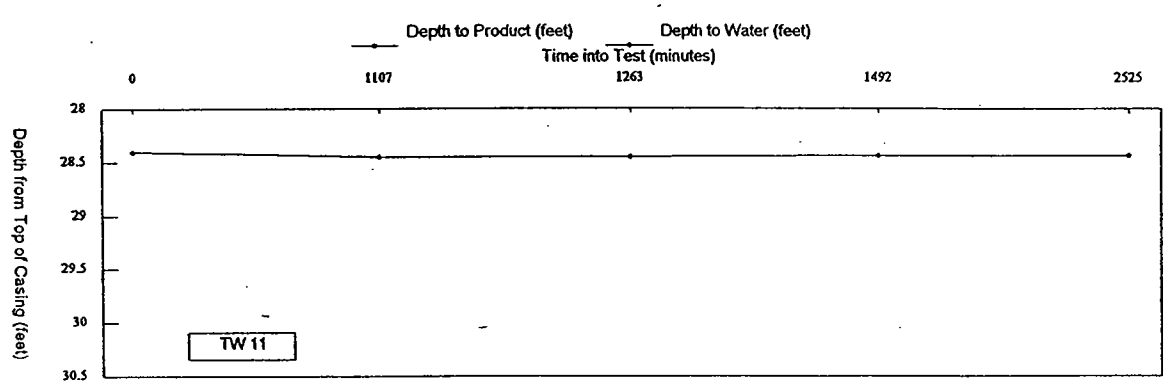
Pumping Test on Well OW 17, 17-19 December 1997

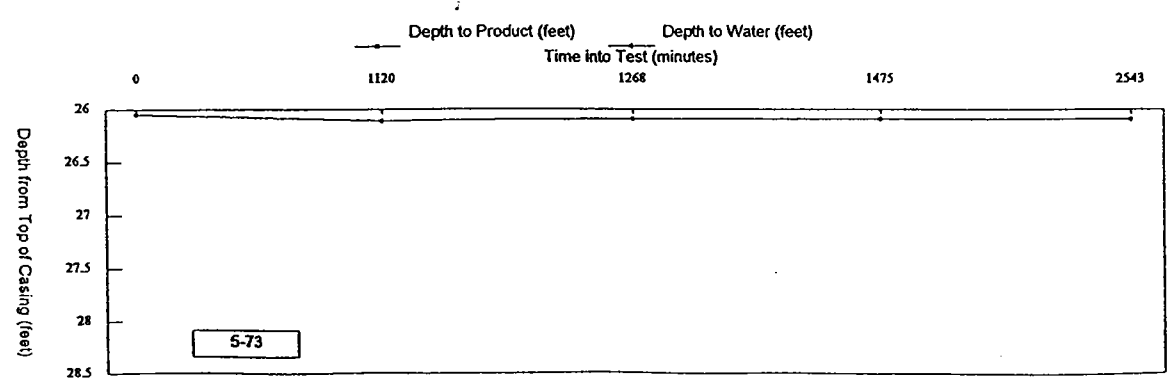
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA



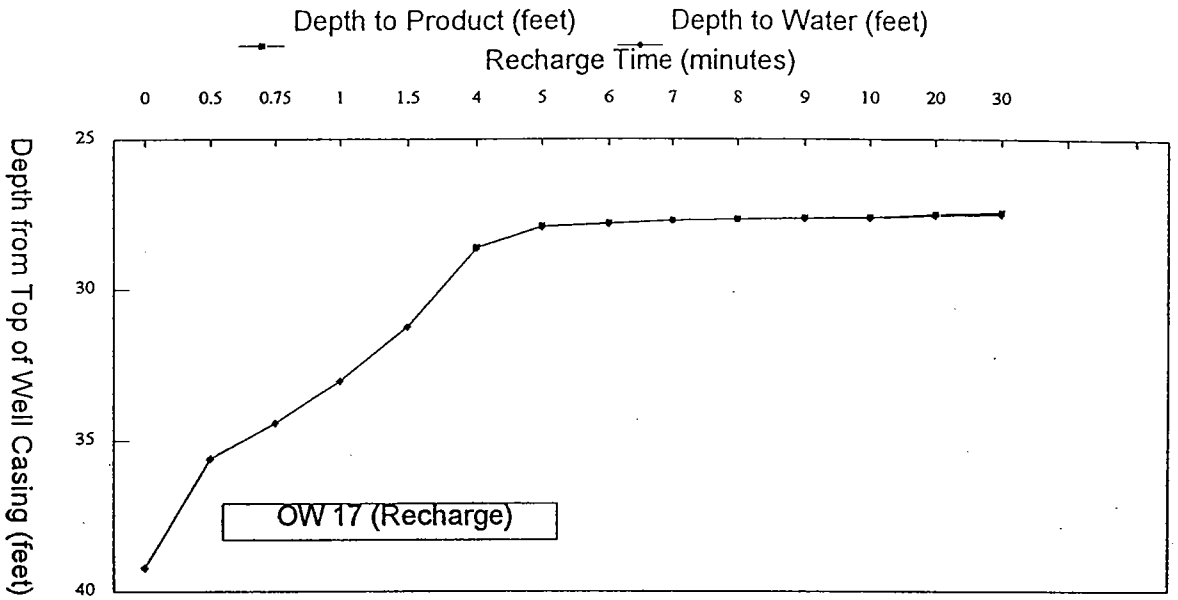






MULRY AND CRESSWELL
ENVIRONMENTAL, INC.

Recharge of Well OW 17 Subsequent to Pump Test, 19 December 1997
Change in Water Table Elevation
Sunoco Belmont Terminal, Philadelphia, PA



MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Pumping Test on Well #6 with Vacuum Extraction During Final 25 Minutes , 25 November 1997
Change in Water Table Elevation in Pumping and Observation Wells and Vacuum Measurements
Sunoco Belmont Terminal, Philadelphia, PA

Start test @ 11:06

Time into Pumptest (T0 + min)	Flow Rate (gpm)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)								
		Well #6	Well #14	Well #13	Well #5	Well #9	Well #11	Well #2	Well #3	Well #5-73
0 (static)	0	29.93	28.35	(27.74) 27.93	31.13	28.69	28.36	(27.30) 27.37	(28.40) 28.56	26.00
1	6	30.23	-	-	-	-	-	-	-	-
1.5	6	30.38	-	-	-	-	-	-	-	-
2	6	30.47	-	-	-	-	-	-	-	-
3	6	30.62	-	-	-	-	-	-	-	-
4	6	30.70	-	-	-	-	-	-	-	-
5	6	30.75	-	-	-	-	-	-	-	-
10	6	30.89	-	-	-	-	-	-	-	-
15	6	30.97	-	-	-	-	-	-	-	-
20	6	31.05	-	-	-	-	-	-	-	-
30	6	31.12	-	-	-	-	-	-	-	-
45 (11:51)	6	31.18	28.34	(27.77) 28.03	31.13	28.71	28.35	(27.28) 27.35	(28.36) 28.55	25.98
60 (12:06)	6	31.23	28.34	(27.78) 28.07	-	28.73	28.36	(27.27) 27.36	(28.35) 28.56	25.99
90 (12:06)	6	31.27	28.35	(27.81) 28.09	-	28.72	28.36	(27.28) 27.36	-	-
120 (13:06)	6	31.32	28.35	(27.79) 28.10	-	-	-	-	-	-
180 (14:06)	6	31.36	28.36	(27.80) 28.10	31.13	28.73	28.36	(27.28) 27.35	(28.34) 28.59	25.99
240 (15:06)	6	31.44	-	-	-	-	-	-	-	-
285 (15:46)	6	31.47	-	-	-	-	-	-	-	-
Connected Vacuum Truck @ 16:20	Truck Vacuum (" of Hg)	Vacuum in Inches of Water Column as Measured at Well Heads								
16:24	5	-	1.00	1.80	-	-	-	-	-	-
16:25	8	-	2.00	2.50	-	-	-	-	-	-
16:32	8	-	2.40	3.10	1.00	-	-	0.60	-	-
16:40	14	-	-	3.00	1.00	-	-	-	-	-

Vapor extraction and pumping ceased @ 16:45

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Pumping Test on Well #15, 25 November 1997

Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA

Start test @ 12:50

Time into Pumptest (T0 + min)	Flow Rate (gpm)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)					
		Well #15	SPH Thicness - Well #15	Well #10	Well #12	Well #8	Well #3
0 (static)	0	(26.74) 28.03	1.29	(26.89) 26.97	(25.81) 26.86	26.95	(28.40) 28.56
1.5	10	(29.25) 31.13	1.88	-	-	-	-
2	10	(29.41) 31.27	1.86	-	-	-	-
3	10	(29.65) 31.45	1.80	-	-	-	-
4	10	(29.81) 31.62	1.81	-	-	-	-
5	10	(29.92) 31.73	1.81	-	-	-	-
10	10	(30.12) 32.29	2.17	-	-	-	-
15	10	(30.21) 32.81	2.60	-	-	-	-
22	10	(30.26) 33.65	3.39	-	-	-	-
30	10	(30.35) 35.45	5.10	-	-	-	-
45 (13:35)	10	(30.58) 35.40	4.82	-	-	-	-
60 (13:50)	10	(30.89) 35.40	4.51	-	-	-	-
70 (14:00)	10	(31.11) 35.50	4.39	(26.91) 26.99	(25.79) 26.83	26.92	(28.34) 28.59

Pumping ceased @ approximately 15:00

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Pumping Test on Well OW 17, with vapor extraction on RW 15 for final 21 hours, 17-19 December 1997
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA

est started @ 14:59, 17 December 1997

Time into Pumptest (T0 + min)	Flow Rate (gpm)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)														
		OW 17	RW 15	TW 10	OW 12	OW 16	TW 8	TW 3	OW 2	OW 13	TW 5	RW 6	OW 14	TW 9	TW 11	Well #5-73
(static) Totalizer: 844,215	0	27.12	(26.86) 27.99	(26.89) 27.06	(25.84) 26.94	(27.72) 28.25	26.99	(28.31) 28.91	(27.30) 27.31	(27.52) 28.80	31.17	26.92	28.45	28.75	28.40	28.05
.5	6	29.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	30.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.5	6	30.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	30.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	31.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	31.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	31.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0	6	31.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	6	-	-	(26.90) 27.10	-	-	-	-	-	-	-	-	-	-	-	-
0	6	31.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	6	-			(25.85) 27.00				-	-		-	-	-	-	
8	6	-	-	-	-	-	26.99	-	-	-	-	-	-	-	-	-
0	6	31.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	6	-	(26.94) 28.30	-	-	-	-	-	-	-	-	-	-	-	-	-
0	6	32.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0	6	32.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	6	-	-	-	-	(27.73) 28.30	-	-	-	-	-	-	-	-	-	-
7	6	-	-	-	(25.87) 27.04	-	-	-	-	-	-	-	-	-	-	-
8	6	-	-	-	-	-	26.99	-	-	-	-	-	-	-	-	-
9	6	-	-	(26.94) 27.12	-	-	-	-	-	-	-	-	-	-	-	-
0	6	33.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	6	-	(26.94) 28.47	-	-	-	-	-	-	-	-	-	-	-	-	-
0	6	34.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0	6	34.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	6	-	-	-	-	(27.73) 28.30	-	-	-	-	-	-	-	-	-	-
02	6	-	-	-	(25.89) 27.11	-	-	-	-	-	-	-	-	-	-	-
05	6	-	-	-	-	-	27.01	-	-	-	-	-	-	-	-	-
07	6	-	-	(26.97) 27.24	-	-	-	-	-	-	-	-	-	-	-	-
12	6	-	(26.93) 28.62	-	-	-	-	-	-	-	-	-	-	-	-	-
20	6	35.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100 (09:19, 18 Dec. 1997)	6	~36.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
105	6	-	-	-	-	-	-	-	-	-	-	26.98	-	-	-	-
107	6	-	-	-	-	-	-	-	-	-	-	-	-	-	28.45	-
109	6	-	-	-	-	-	-	-	-	-	-	-	-	28.80	-	-
110	6	-	-	-	-	-	-	-	-	-	-	-	28.54	-	-	-
111	6	-	-	-	-	-	-	-	-	-	31.23	-	-	-	-	-
115	6	-	-	-	-	-	-	-	-	(27.60) 29.00	-	-	-	-	-	-
117	6	-	-	-	-	-	-	-	(27.39) 27.61	-	-	-	-	-	-	-
120	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.11
125	6	-	-	-	-	-	-	(28.40) 29.02	-	-	-	-	-	-	-	-
128	6	-	-	-	-	(27.60) 28.54	-	-	-	-	-	-	-	-	-	-
134	6	-	-	-	-	-	27.11	-	-	-	-	-	-	-	-	-
136	6	-	-	(27.06) 27.36	-	-	-	-	-	-	-	-	-	-	-	-
144	6	-	-	-	(25.94) 27.33	-	-	-	-	-	-	-	-	-	-	-

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Pumping Test on Well OW 17, with vapor extraction on RW 15 for final 21 hours, 17-19 December 1997
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA

Time into Pumptest (T0 + min)	Flow Rate (gpm)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)														
		OW 17	RW 15	TW 10	OW 12	OW 16	TW 8	TW 3	OW 2	OW 13	TW 5	RW 6	OW 14	TW 9	TW 11	Well #5-73
1149 (10:08, 18 Dec. 1997)	6	-	(26.91) 26.91	-	-	-	-	-	-	-	-	-	-	-	-	-
1161 Pump rate stepped-down	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1175 Totalizer: 849,807	4	38.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1201	4	38.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1215	4	-	(26.89) 26.87	-	-	-	-	-	-	-	-	-	-	-	-	-
1220	4	-	-	(27.06) 27.29	-	-	-	-	-	-	-	-	-	-	-	-
1224	4	-	-	-	-	-	27.10	-	-	-	-	-	-	-	-	-
1226	4	-	-	-	(25.92) 27.27	-	-	-	-	-	-	-	-	-	-	-
1228	4	-	-	-	-	(27.78) 28.49	-	-	-	-	-	-	-	-	-	-
1236	4	-	-	-	-	-	-	(28.39) 29.04	-	-	-	-	-	-	-	-
1238	4	-	-	-	-	-	-	-	(27.36) 27.56	-	-	-	-	-	-	-
1245	4	-	-	-	-	-	-	-	-	-	31.23	-	-	-	-	-
1248	4	-	-	-	-	-	-	-	-	(27.56) 28.96	-	-	-	-	-	-
1255	4	-	-	-	-	-	-	-	-	-	-	(26.95) 26.96	-	-	-	-
1258	4	-	-	-	-	-	-	-	-	-	-	-	28.54	-	-	-
1259	4	-	-	-	-	-	-	-	-	-	-	-	-	28.79	-	-
1263	4	-	-	-	-	-	-	-	-	-	-	-	-	-	28.45	-
1268	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.09
1412 (14:31, 18 Dec. 1997) Vapor extraction started on RW 15	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1443	4	(38.69) 38.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1454	4	-	-	(27.04) 27.36	-	-	-	-	-	-	-	-	-	-	-	-
1460	4	-	-	-	-	-	27.09	-	-	-	-	-	-	-	-	-
1463	4	-	-	-	-	(27.79) 28.47	-	-	-	-	-	-	-	-	-	-
1466	4	-	-	-	(25.93) 27.26	-	-	-	-	-	-	-	-	-	-	-
1470	4	-	-	-	-	-	-	(28.37) 29.04	-	-	-	-	-	-	-	-
1475	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.09
1482	4	-	-	-	-	-	-	-	(27.36) 27.59	-	-	-	-	-	-	-
1484	4	-	-	-	-	-	-	-	-	(27.56) 28.97	-	-	-	-	-	-
1486	4	-	-	-	-	-	-	-	-	-	31.22	-	-	-	-	-
1488	4	-	-	-	-	-	-	-	-	-	-	(26.96) 26.97	-	-	-	-
1489	4	-	-	-	-	-	-	-	-	-	-	-	28.54	-	-	-
1490	4	-	-	-	-	-	-	-	-	-	-	-	-	28.79	-	-
1492	4	-	-	-	-	-	-	-	-	-	-	-	-	-	28.44	-
1508	4	(39.31) 39.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MULRY AND CRESSWELL ENVIRONMENTAL, INC.

Pumping Test on Well OW 17, with vapor extraction on RW 15 for final 21 hours, 17-19 December 1997
Change in Water Table Elevation in Pumping and Observation Wells

Sunoco Belmont Terminal, Philadelphia, PA

Time into Pumptest (T0 + min)	Flow Rate (gpm)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)														
		OW 17	RW 15	TW 10	OW 12	OW 16	TW 8	TW 3	OW 2	OW 13	TW 5	RW 6	OW 14	TW 9	TW 11	Well #5-73
501 (08:40, 19 Dec. 1997) Totalizer: 854775	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
525	4	-	-	-	-	-	-	-	-	-	-	-	-	-	28.44	-
527	4	-	-	-	-	-	-	-	-	-	-	-	-	28.79	-	-
528	4	-	-	-	-	-	-	-	-	-	-	-	28.52	-	-	-
531	4	-	-	-	-	-	-	-	-	-	-	26.96	-	-	-	-
532	4	-	-	-	-	-	-	-	-	-	31.22	-	-	-	-	-
534	4	-	-	-	-	-	-	-	-	(27.56) 28.99	-	-	-	-	-	-
536	4	-	-	-	-	-	-	-	(27.36) 27.57	-	-	-	-	-	-	-
543	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.09
551	4	-	-	-	-	-	-	(28.38) 29.06	-	-	-	-	-	-	-	-
554	4	-	-	-	-	(27.80) 28.47	-	-	-	-	-	-	-	-	-	-
557	4	-	-	-	(25.94) 27.25	-	-	-	-	-	-	-	-	-	-	-
560	4	-	-	-	-	-	27.11	-	-	-	-	-	-	-	-	-
562	4	-	-	(27.06) 27.33	-	-	-	-	-	-	-	-	-	-	-	-
566	4	(40.10) 40.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
669	4	39..20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
672 (11:31, 19 Dec. 1997) Totalizer: 855368 Pumping from OW 15 ceased, Vapor extraction on RW 15 continued	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Recharge of Well OW 17 subsequent to Pumping Test, 19 December 1997

Time into Recharge (T0 + min)	Flow Rate (N/A)	Depth to Water and Separate Phase Hydrocarbons (SPH) in Feet (Depth to SPH in parentheses)														
		OW 17	RW 15	TW 10	OW 12	OW 16	TW 8	TW 3	OW 2	OW 13	TW 5	RW 6	OW 14	TW 9	TW 11	Well #5-73
0 (11:27, 19 Dec. 1997)	-	39..20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.5	-	35.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.75	-	34.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	33.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.5	-	31.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	(28.61) 28.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	(27.91) 27.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	(27.80) 27.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	(27.71) 27.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	(27.66) 27.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	(27.63) 27.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	(27.60) 27.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	(27.50) 27.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	(27.45) 27.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX D

VR 3 Operational Data

BR - MONT

(1)

RESTART AT: 12/14/97 [illegible]7 (12/08/97 21:02:44) S5245 V2.21 .
12/14/97 19:05:20 LIMIT 414 ENG TMR 11577. ENGINE FAILED ALARM UNIT 150

12/14/97 19:05:20 150
100 4. 50.F 54.F 59.F 46. -1.3 9.6 0. -6. 12.2 99.9 0.500 1.00 30 757 278.

12/14/97 19:06:11 150
100 5. 48.F 54.F 59.F 0. -1.3 9.6 0. -6. 11.5 13.4 0.673 0.00 30 757 278.

RESTART AT: 12/14/97 19:08:58 (12/14/97 19:06:46) S5245 V2.21 .
12/14/97 19:09:01 150
100 4. 50.F 56.F 58.F 12. -1.3 9.6 0. -6. 12.3 99.9 0.500 0.00 30 757 278.

RESTART AT: 12/14/97 19:10:51 (12/14/97 19:09:17) S5245 V2.21 .
12/14/97 19:10:54 150
100 4. 50.F 56.F 58.F 13. -1.2 9.6 0. -7. 12.2 99.9 0.500 0.00 30 757 278.

12/14/97 19:11:34 150
100 5. 50.F 57.F 58.F 0. -1.3 9.6 0. -6. 11.6 42.5 0.615 0.00 30 757 278.

RESTART AT: 12/14/97 19:55:23 (12/14/97 19:14:14) S5245 V2.21 .
12/14/97 19:55:26 150
100 4. 54.F 70.F 59.F 0. -1.2 9.4 0. -6. 12.2 99.9 0.500 0.00 30 757 278.

RESTART AT: 12/14/97 20:06:54 (12/14/97 19:55:57) S5245 V2.21 .
12/14/97 20:06:57 150
100 4. 55.F 70.F 60.F 0. 8.8 9.8 0. -6. 12.3 99.9 0.500 0.00 30 757 278.

RESTART AT: 12/14/97 20:16:48 (12/14/97 20:08:24) S5245 V2.21 .

12/14/97 20:16:51 150

100 4. 56.F 71.F 60.F 0. 50.1 9.8 0. -6. 12.3 99.9 0.500 0.00 30 757 278.

12/14/97 20:17:01 150

100 5. 56.F 71.F 60.F 0. 50.1 9.8 0. -6. 12.2 99.9 0.500 0.00 30 757 278.

12/14/97 20:17:34 150

100 5. 56.F 70.F 61.F 0. 29.3 9.8 0. -6. 12.2 99.9 0.500 0.00 30 757 278.

RESTART AT: 12/14/97 20:18:20 (12/14/97 20:18:48) S5245 V2.21 .

(2)

(3)

V.R.SYSTEMS INC. MODEL V3 S/N 150
OWNER V.R.SYSTEMS INC PERMIT NO.

ENGINE RPM	TEMPERATURE COOLANT	OIL	EXHAUST	OIL PSI	POSITIONS CARB.	BYPASS	WELL FLOW CFM-VAC.H2O	BATTERY VOLTS	DUTY CYCLE	PERCENT OXYGEN	AUXILIARY FUEL CFM THOUSANDS-UNITS		ENGINE HOURS
12/14/97 20:21:23 150													
100 [illegible]	[illegible]	56.F	71.F	51.F	[illegible]	2.[illegible]	9.6	0.	-5.	13.3	99.9	0.500	0.00	30	757	278.
12/14/97 20:22:[illegible] 150																
100 1479.	72.F	62.F	351.F	49.	26.5	9.6	0.	-5.	14.3	13.6	0.673	0.00	30	757	278.
12/14/97 20:36:01 150																
100 2442.	168.F	129.F	935.F	53.	24.8	8.5	0.	-2.	13.5	13.4	0.673	0.00	30	758	278.
12/14/97 20:37:40 150																
100 2524.	169.F	129.F	953.F	54.	24.8	9.5	0.	-3.	13.4	56.0	0.588	0.00	30	759	278.
12/14/97 20:42:32 150																
100 1463.	166.F	119.F	1207.F	54.	24.9	9.4	18.	-7.	13.3	99.5	0.501	0.00	30	760	278.
12/14/97 20:44:18 150																
100 1593.	164.F	117.F	1507.F	54.	24.4	9.4	18.	-7.	13.4	99.5	0.501	0.00	30	760	278.
12/14/97 20:47:03 150																
100 1504.	164.F	119.F	1354.F	54.	25.0	9.3	18.	-6.	13.4	99.5	0.501	0.00	30	760	278.
12/14/97 20:47:42 150																
100 1513.	164.F	120.F	1367.F	54.	24.9	9.3	18.	-6.	13.3	99.6	0.501	0.00	30	760	278.
12/14/97 20:49:12 150																
100 1324.	165.F	116.F	988.F	54.	18.2	0.1	12.	-4.	13.4	99.6	0.501	0.00	30	760	278.
12/14/97 20:51:50 150																
100 1685.	165.F	120.F	979.F	54.	20.5	0.0	14.	-5.	13.3	99.5	0.501	0.00	30	760	278.
12/14/97 20:53:08 150																
100 1658.	167.F	122.F	985.F	54.	20.4	0.0	14.	-4.	13.3	99.5	0.501	0.00			
12/14/97 20:54:57 150																
100 1484.	164.F	117.F	1017.F	54.	20.0	0.1	13.							760	278.
12/14/97 20:57:14 150																
100 1474.	166.F	121.F	97[illegible]							[illegible]	[illegible]	0.00	30	760	278.
12/14/97 21:[illegible] 150																
100 [illegible]	[illegible]	167.F	[illegible]	54.	20.0	0.1	13.	-4.	13.3	99.6	0.501	0.00	30	760	278.

12/14/97 21:01:15 LIMIT 414 ENG TMR 2378. ENGINE FAILED ALARM UNIT 150

38 min = 0.63hr
@ Avg RPM = 1684
916s

RESTART AT: 12/14/97 21:15:37 12/14/97 [illegible] 19) 55245 V2.21
12/14/97 21:15:36 150

100	2012.	167.F	111.F	586.F	54.	19.3	-0.4	0.	-5.	13.6	98.2	0.504	0.00	30	761	278.

12/14/97 21:19:25 150

100	1997.	170.F	118.F	703.F	54.	19.3	-0.5	0.	-4.	13.8	54.6	0.591	0.00	30	761	278.

12/14/97 21:21:35 150

100	2325.	171.F	119.F	894.F	54.	23.6	-0.6	12.	-5.	13.6	88.9	0.522	0.00	30	762	278.

	RPM	COOLANT	OIL	EXHAUST	PSI	CARB.	BYPASS	CFM-VAC.H2O		VOLTS	CYCLE	OXYGEN	CFM THOUSANDS-UNITS		HOURS
12/14/97 21:23:40 150															
100	1692.	166.F	125.F	870.F	54.	16.9	-0.6	8.	-4.	13.5	93.5	0.513	0.00	30	762	278.
12/14/97 21:26:16 150															
100	1665.	166.F	127.F	799.F	54.	15.3	-0.6	7.	-4.	13.4	92.9	0.514	0.00	30	762	279.
12/14/97 21:29:28 150															
100	1649.	164.F	129.F	787.F	54.	16.3	-0.6	9.	-3.	13.3	93.5	0.513	0.00	30	762	279.
12/14/97 21:32:45 150															
100	1651.	164.F	131.F	782.F	54.	15.8	-0.2	8.	-2.	13.3	93.3	0.513	0.00	30	762	279.
12/14/97 21:54:09 150															
100	1642.	166.F	141.F	779.F	54.	15.8	-0.1	7.	-0.	13.4	95.2	0.510	0.00	30	762	279.
12/14/97 22:05:00 150															
100	1643.	166.F	143.F	778.F	54.	16.3	-0.0	7.	-0.	13.3	94.8	0.510	0.00	30	762	279.
12/14/97 22:07:15 150															
100	1640.	166.F	141.F	780.F	54.	16.3	-0.0	8.	0.	13.4	95.4	0.509	0.00	30	762	279.
12/14/97 22:11:17 LIMIT 302 OIL PSI 24. LOW OIL PSI SD UNIT 150															
12/14/97 22:11:17 LIMIT 414 ENG TMR 3329. ENGINE FAILED ALARM UNIT 150															
RESTART AT: 12/14/97 22:11:47 (12/14/97 22:11:26) S5245 V2.21 .															
12/14/97 22:11:50 150															
100	5.	171.F	127.F	711.F	0.	18.3	0.1	0.	1.	12.8	99.9	0.500	0.00	30	762	279.
12/14/97 22:12:22 150															
100	6.	185.F	127.F	683.F	0.	18.8	-0.5	0.	1.	12.1	13.1	0.674	0.00	30	762	279.
RESTART AT: 12/14/97 22:13:27 (12/14/97 22:12:41) S5245 V2.21 .															
12/14/97 22:13:30 150															
100	5.	177.F	127.F	631.F	0.	28.0	-0.4	0.	0.	12.7	99.9	0.500	0.00	30	763	279.
RESTART AT: 12/14/97 22:14:05 (12/14/97 22:13:37) S5245 V2.21 .															
12/14/97 22:14:08 150															
100	5.	181.F	123.F	620.F	0.	26.4	-0.4	0.	-0.	12.6	99.9	0.500	0.89	30	763	279.
12/14/97 22:16:44 150															
100	1907.	167.F	122.F	827.F	54.	19.4	-0.2	10.	-1.	13.3	91.8	0.516	0.00	30	764	279.
12/14/97 22:17:43 150															
100	1914.	169.F	123.F	848.F	54.	19.7	1.0	9.	-1.	13.4	92.9	0.514	0.00	30	764	279.
12/14/97 22:18:16 150															
100	1913.	167.F	123.F	860.F	54.	19.6	1.1	9.	-1.	13.3	92.2	0.516	0.00	30	764	279.
12/14/97 22:18:54 LIMIT 414 ENG TMR 293. ENGINE FAILED ALARM UNIT 150															
12/14/97 22:19:01 150															
100	6.	168.F	107.F	854.F	0.	19.5	-0.2	0.	-0.	12.6	74.6	0.551	0.00	30	764	279.
12/14/97 22:19:17 LIMIT 302 OIL PSI 28. LOW OIL PSI SD UNIT 150															

BG MOUNT (5)

20 min @ 1655 RPM
@ 13.9 Hz = 11 lbs.

BELMONT

V.R.SYSTEMS INC. MODEL V3 S/N 150
OWNER V.R.SYSTEMS INC PERMIT NO.

ENGINE RPM	TEMPERATURE COOLANT	TEMPERATURE OIL	TEMPERATURE EXHAUST	OIL PSI	POSITIONS CARB.	POSITIONS BYPASS	WELL FLOW CFM-VAC.H2O	BATTERY VOLTS	DUTY CYCLE	PERCENT OXYGEN	AUXILIARY FUEL CFM THOUSANDS-UNITS	ENGINE HOURS
12/18/97												
12/14/97 22:19:24 150												
1000	5.	172.F	110.F	945.F	3.	13.5	-0.2	0.	-0.	13.0	96.1	0.500	0.00	30	765	279.
12/14/97 22:20:16 LIMIT 414 ENG TMR 50. ENGINE FAILED ALARM UNIT 150												
12/14/97 22:20:19 150												
1000	0.	175.F	112.F	920.F	28.	-25.0	-25.0	0.	-378.	0.0	0.0	0.700	0.00	30	765	279.
12/14/97 22:22:00 LIMIT 414 ENG TMR 98. ENGINE FAILED ALARM UNIT 150												
12/14/97 22:22:07 150												
1000	6.	175.F	109.F	912.F	1.	-25.0	-25.0	0.	-378.	0.1	0.0	0.700	0.00	30	767	279.
12/18/97 15:33												
RESTART AT: 12/14/97 22:22:39 (12/14/97 22:22:15) S5245 V2.21												
12/14/97 22:22:42 150												
1000	5.	185.F	109.F	846.F	0.	24.3	-0.1	0.	-1.	12.7	97.5	0.505	1.18	30	768	279.
12/14/97 22:24:39 150												
1000	1205	171.F	125.F	848.F	54.	17.6	-0.2	0.	-1.	12.7	98.3	0.510	0.00	30	768	279.

100	1692.	170.F	128.F	866.F	54.	17.9	0.2	9.	-1.	13.4	90.1	0.520	0.00	30	769	279.
12/14/97 22:26:35 150																
100	1717.	169.F	128.F	840.F	54.	18.2	0.3	8.	-1.	13.5	90.3	0.519	0.00	30	769	279.
12/14/97 22:27:42 150																
100	1703.	170.F	134.F	843.F	54.	18.1	0.0	9.	-1.	13.7	90.9	0.518	0.00	30	769	279.
12/15/97 00:00:00 150																
100	1707.	167.F	151.F	827.F	54.	18.0	-0.1	7.	-0.	13.4	92.8	0.514	0.00	30	769	281.
12/15/97 04:00:00 150																
100	1705.	168.F	151.F	813.F	53.	18.0	-0.1	9.	0.	13.4	93.5	0.513	0.00	30	769	285.
12/15/97 08:00:00 150																
100	1703.	168.F	152.F	812.F	54.	18.0	-0.1	7.	-1.	13.4	92.9	0.514	0.00	30	769	289.
12/15/97 12:00:00 150																
100	1695.	167.F	151.F	809.F	54.	18.0	-0.1	7.	-1.	13.4	92.1	0.516	0.00	30	769	293.
12/15/97 15:12:05 150																
100	1708.	168.F	150.F	806.F	53.	18.0	-0.1	7.	-1.	13.4	92.8	0.514	0.00	30	769	296.
12/15/97 16:00:00 150																
100	1719.	168.F	149.F	805.F	53.	18.0	-0.2	10.	-1.	13.4	93.0	0.514	0.00	30	769	297.
12/15/97 17:48:50 150																
100	1707.	168.F	155.F	803.F	53.	18.0	-0.1	7.	-1.	13.6	93.0	0.514	0.00	30	769	299.
12/15/97 20:00:00 150																
100	1732.	168.F	159.F	794.F	53.	18.0	-0.4	8.	-1.	13.5	94.1	0.512	0.00	30	769	301.

7

VE Systems inc.

Technology In Support of the Environment.

TO CALCULATE ESTIMATED DESTRUCTION RATE (Lb/Hr) OF SOIL GAS WITH VR V3 SERIES (PROPANE)

1) Enter Propone Consumption (SCFM) from Computer Printout: (Note 1) 0 SCFM

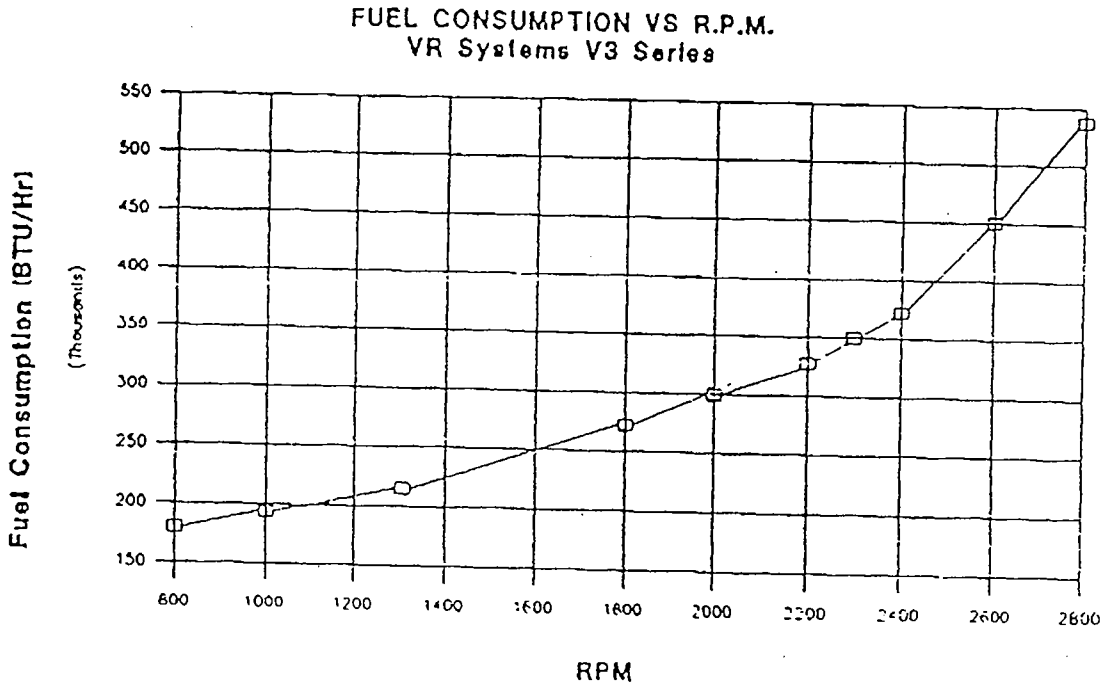
2) Enter Engine RPM from Computer Printout: 1700 RPM

3) Enter Corresponding Total Fuel Consumption in BTU/Hr from Graph Below: 260 BTU/Hr

4) Calculate BTU/Hr Contributed by Propone (#1 X 2380 BTU/CF X 60 Min/Hr): 0 BTU/Hr

5) Subtract Propone BTU/Hr (#4) from Total BTU/Hr (#3) to Determine Soil Gas BTU/Hr: 260,000 BTU/Hr

6) Divide #5 by Caloric Content (BTU/Lb) of Soil Gas: (Note 2) 14.44 Lb/Hr



Notes:

1) The cumulative amount over time is more accurate than the instantaneous CFM reading.

2) A typical caloric content for soil gas is approximately 18,000 BTU/Lb.

3) Results obtained using the above method are estimated and not guaranteed.

FM0026 4-21-94

1338 KNOLLWOOD CIRCLE • ANAHEIM, CALIFORNIA 92801 • TELEPHONE: (714) 826-0483