GW - 1

WORK PLANS

GIANT
REFINING COMPANY

CERTIFIED MAIL # 7099 3220 0010 2242 4825

January 31, 2005

Ms. Hope Monzeglio
State of New Mexico Environmental Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Re: Giant Bloomfield Refinery – NMED Conditional Approval of River Terrace Area Voluntary Corrective Measures Plan
RCRA Permit No. NMD 089416416
HWB-GRCB-04-006

Dear Ms. Monzeglio:

Giant Refining Company Bloomfield (GRCB) received the December 29, 2004 letter from the New Mexico Environmental Department (NMED) stating NMED's conditional approval of the November 24, 2004 *Voluntary Corrective Measure Plan* (VCM Plan) submitted by GRCB. The VCM Plan describes the voluntary corrective measures to be implemented by GRCB at the Bloomfield refinery at the River Terrace. The purpose of this letter is to respond to several of the conditions stated in NMED's letter.

Response to NMED Conditions of Approval

The following responses correspond to the conditions in NMED's December 29, 2004 approval letter.

1. We have provided the construction diagram and boring log for monitoring wells MW-48 and MW-49 (Attachment A).
2. Depth-to-water measurements were collected following the installation of the two monitoring wells and eight temporary well points in November 2004 (Attachment B). A survey of each River Terrace well location and top-of-casing elevation will be completed following the installation of the additional well points east of TP-3 (See Response #7). Once surveying of the River Terrace wells has been completed, groundwater elevation data will be compiled and submitted to NMED as requested.

PHONE
505-632-8013
FAX
505-632-3911

50 ROAD 4990
P.O. BOX 159
BLOOMFIELD
NEW MEXICO
87413

3. Each of the eight temporary well points (TP-1 through TP-8) was constructed using two-inch diameter five-foot hand-slotted PVC piping, extending approximately five feet below the water table. Groundwater has been detected approximately five feet below existing grade. We have provided a typical temporary well point construction drawing (Attachment C). The depth to water (bgs) in each of the locations is stated in the upper left header of the logs contained in the VCM plan.
4. Separate phase hydrocarbon (SPH) was not observed during the installation of the two monitoring wells (MW-48 and MW-49) and eight temporary well points (TP-1 through TP-8) in the River Terrace. Similarly, SPH was not observed during the two subsequent rounds of monthly sampling for December 2004 and January 2005.
5. The description of "black" in the boring logs refers to hydrocarbon staining.
6. In accordance with the agreed upon monthly sampling plan stated within the RTSPA Plan, groundwater samples were collected at monitoring wells MW-48 and MW-49 on December 27, 2004 and January 18, 2005. Samples from each well were analyzed for BTEX, TPH (GRO and DRO), and PAHs. We have provided the analytical report for the December 2004 sample results, and a table summarizing the groundwater analytical results for the River Terrace wells through December 2004 (Attachment D).

   The analytical results from the January 2005 monthly sample event will be provided to NMED upon receipt of the laboratory reports.
7. In order to delineate the extent of the contamination north and east of TP-3, we propose installing five additional temporary well points (TP-9 through TP-13). We have provided a revised River Terrace Well Location Map, which includes the location of the existing and proposed monitoring and temporary well points in the River Terrace (Attachment E). The well points will be constructed using machine-slotted screen. Weather and access conditions permitting, GRCB anticipates installing the additional well points by early March 2005.
8. The following responses correspond to comments of the proposed activities No. 1-6 outlined in the RTSPA Plan.

   1. The results and findings of the 24-hours aquifer test performed on MW-48 have been summarized in the Aquifer Test Summary Report (Attachment F).
   2. The results of the capture zone analysis are summarized as part of the Aquifer Test Summary Report (Attachment F).
   3. A revised Well Location Map has been provided, which includes the location of the existing and proposed monitoring and temporary well points in the River Terrace (Attachment E).
   4. Two subsequent monthly sampling events have been completed for December 2004 and January 2005. We have provided an analytical summary table and a copy of the laboratory report for the December 2004 sampling

event (Attachment F). The results of the January 2005 sampling event will be submitted to NMED once the results become available from the lab.

5. In the November 24, 2004 VCM Plan, GRCB's use of the term "feasibility study" was intended to mean the evaluation, selection, and implementation of appropriate voluntary corrective measures to reduce the concentrations of fuel hydrocarbons on the refinery side of the barrier, and further mitigate fuel hydrocarbon migration to the river.
6. Based on the results of the October 2004 site investigation, it appears that the dissolved-phase hydrocarbon plume is biologically active. Therefore, the January 2005 River Terrace sampling event included an expanded suite of parameters that will allow GRCB to further evaluate the subsurface biologic activity. These data, the aquifer test data presented in Attachment F, and sampling results from the additional monitoring points (see Response #7 above) will be used to assess voluntary corrective measures alternatives. The results of the alternatives assessment and a proposed Voluntary Corrective Measure will be included in a Voluntary Corrective Measures Work Plan (VCMWP). The VCMWP will be prepared and submitted to OCD and NMED for review in April 2005.

If you have any questions in this matter, please contact me at 505-632-4171.

Sincerely,

GIANT REFINING COMPANY

James R. Schmaltz
Environmental Manager

Cc: Denny Foust - NMED Aztec Office
Dave Cobrain – NMED Hazardous Waste Bureau
Hope Monzeglio – NMED Hazardous Waste Bureau
Bob Wilkinson – EPA
Ed Riege
Chad King

ATTACHMENT A

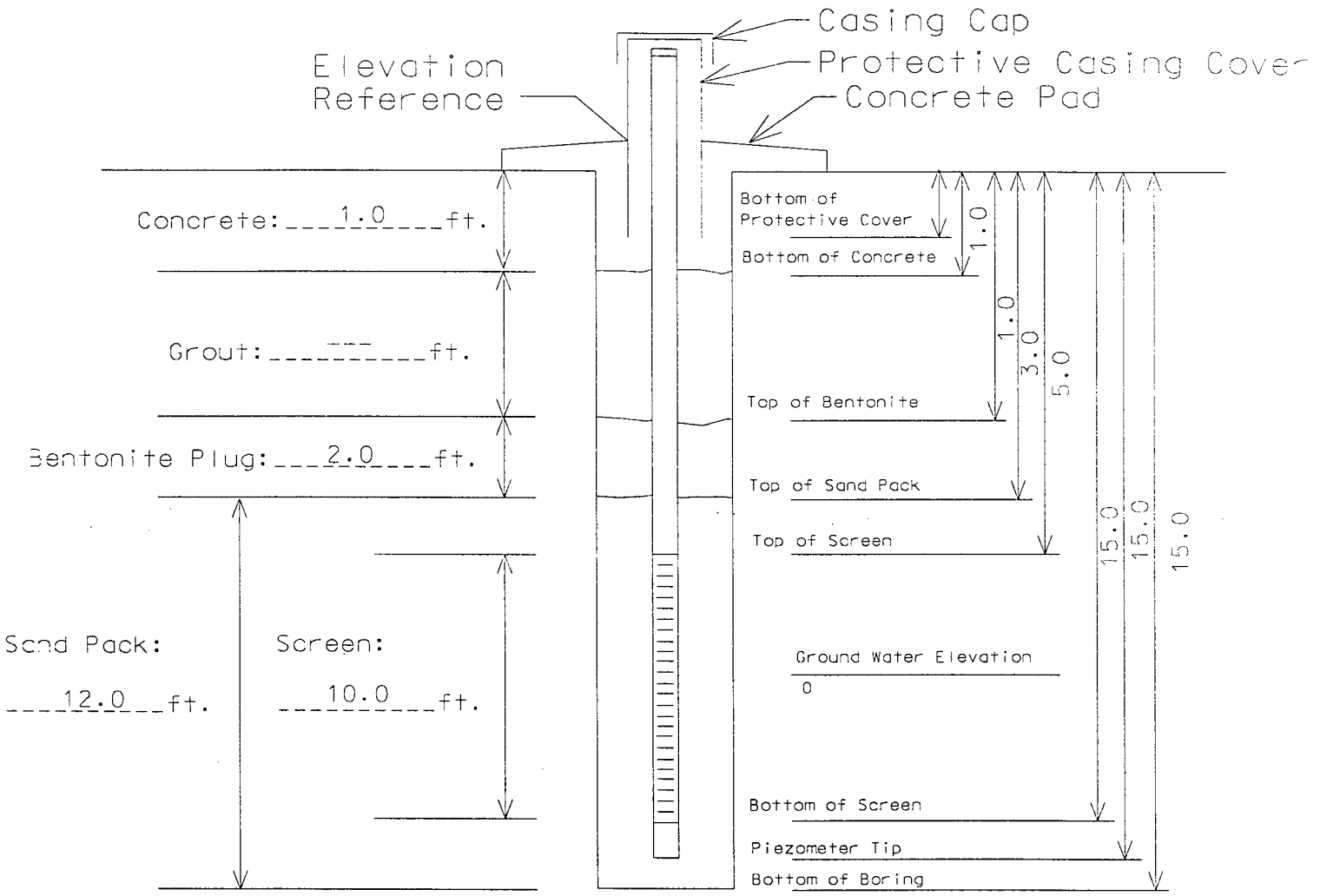
MW-48 and MW-49 Construction Diagram and Boring Log

PRECISION ENGINEERING, INC.

505-523-7674

Installation Diagram

Monitoring Well No. MW-48



Boring Diameter: 12 5/8"

Sand Type: 8-12 Silica

Bollards, Type/Size: Steel, 3"

Bentonite: 3/8" Chips

Screen Type/Size: 4" PVC Sch. 40, 0.020" Slotted

Cement/Grout: ---

Riser Type/Size: 4" PVC Sch. 40

Water: Potable

Locking Expandable Casing Plug? Yes

Site Northing: 6204.63

Other: N/A

Bottom Cap Used? Yes

Site Easting: 2700.70

Giant Refining Co.

Project #: 03-122

Project Name: Bloomfield Wells

Elevation: not surveyed

Sheet: 1 of 1
Bore Point: See plan
Water Elevation: 7.70
Boring No.: MW-48

Precision Engineering, Inc.
P.O. Box 422
Las Cruces, NM 88004
505-523-7674

File #: 03-122
Site: Bloomfield
Giant Refining
Elevation: Not Surveyed
Date: 10/28/2004

Log of Test Borings

LAB #	DEPTH	BLOW COUNT	PLOT	SCALE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR,ETC.)	%M	LL	PI	CLASS.
	0-1		*-**-*-* *-*O-*-*		**Silt**, sand, very fine to fine, brown, damp, a few cobbles				
	1-15.0		*-*o-*-* *-*o-*-*		**Sand**, silty, very fine to fine, brown, damp, gravelly				
	2.0		*-*o-*-*	2.5	Black with hydrocarbon odor				
			*-*o-*-* *-*o-*-* *-*o-*-* ********		medium to coarse sand				
			********	5.0					
			******** ******** ******** ******** ********						
			********	7.5					
			******** ******** ******** ******** ******** ***o****		water bearing				
			o*	10.0	some gravel				
			o* ***o**** ***o**** ***o**** ***o**** ***o**** ***o**** ***o**** ***o****						
				15.0					
					T.D. 15.0 Bottom of well 15' Placed 4" PVC, 10' factory slotted .020" screen Sanded with 8-12 Silica Sand to 3' bgs Bentonite Plug to 1' bgs				
				20.0					

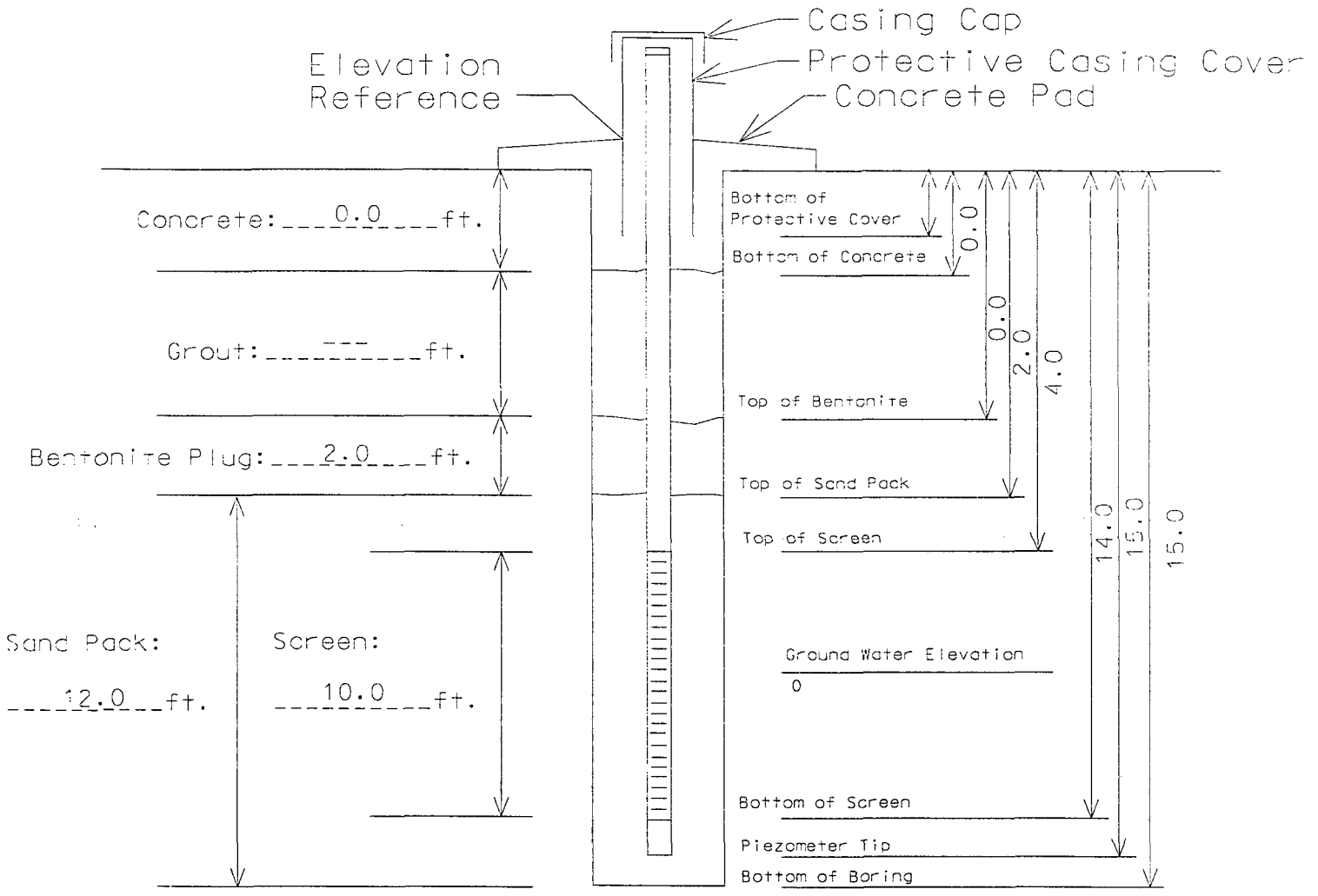
SIZE & TYPE OF BORING: 4 1/4" ID HOLLOW STEMMED AUGER — LOGGED BY: KM

C:\bill\Projects\2004\hammond ditch correspondence\ditchlogsasof11105\[M\

PRECISION ENGINEERING, INC.
505-523-7674

Installation Diagram

Monitoring Well No. MW-49



Boring Diameter: $12\frac{5}{8}$"

Sand Type: 8-12 Silica

Bollards, Type/Size: Steel, 3"

Bentonite: $\frac{3}{8}$" Chips

Screen Type/Size: 4" PVC Sch. 40, 0.020" Slotted

Cement/Grout: ---

Riser Type/Size: 4" PVC Sch. 40

Water: Potable

Locking Expandable Casing Plug? Yes

Site Northing: 6196.16

Other: N/A

Bottom Cap Used? Yes

Site Easting: 2653.14

Giant Refining Co.

Project #: 03-122

Project Name: Bloomfield Wells

Elevation: Not Surveyed

Sheet: 1 of 1
Bore Point: See plan
Water Elevation: 9.00
Boring No.: MW49

Precision Engineering, Inc.
P.O. Box 422
Las Cruces, NM 88004
505-523-7674

File #: 03-122
Site: Bloomfield
Giant Refining
Elevation: Not Surveyed
Date: 10/28/2004

Log of Test Borings

LAB #	DEPTH	BLOW COUNT	PLOT	SCALE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR,ETC.)	%M	LL	PI	CLASS.
	0-3		*O*-*-O *O*-*-O *O*-*-O *O*-*-O *O*-*-O *O*-*-O	2.5	**Cobbles**, sand, very fine to fine, gravel, brown, damp, cobbles				
	3-15.0		*-*o-*-* *-*o-*-* ******** ******** ******** ******** ******** **O**O* **O**O* **O**O* ******** ******** ******** ******** ******** ******** ******** ******** ******** ******** ******** ******** ********	5.0 7.5 10.0 15.0	**Sand**, silty, very fine to fine, brown, moist, fine to medium sand Black with hydrocarbon odor, wet some cobbles water bearing medium to coarse sand, grey				
				20.0	T.D. 15.0 Bottom of well 14' Placed 4" PVC, 10' factory slotted .020" screen Sanded with 8-12 Silica Sand to 2' bgs Bentonite Plug to gs				

SIZE & TYPE OF BORING: 4 1/4" ID HOLLOW STEMMED AUGER LOGGED BY: KM

C:\bill\Projects\2004\hammond ditch correspondence\ditchlogsasof11105\[M\

ATTACHMENT B

River Terrace Water Level Data – December 2004

Giant Bloomfield Refinery
River Terrace - Water Level Data
December 2004

Well #	Date Collected	Depth to Water[1] (ft)	SPH [2] (ft)	Well Depth[3] (ft)	Well Casing Height [4] (ft)	Observations
TP #1	10/28/04	5.44	0		0.9	No SPH - But have a visible sheen
TP #2	10/28/04	7.01	0		0.59	No SPH - But have a visible sheen
TP #3	10/28/04	7.02	0		1.22	No SPH - No odor or sheen
TP #4	10/28/04	6.28	0		0.9	No SPH - But have a visible sheen
TP #5	10/28/04	6.18	0		0.83	No SPH - But have a visible sheen
TP #6	10/28/04	5.96	0		1.16	No SPH - No sheen
TP #7	10/28/04	6.79	0		1.1	No SPH - Barely any water in it
TP #8	10/28/04	5.96	0		1.39	No SPH - But have a visible sheen
MW #48	11/01/04	7.73	0	17.22	2.89	
MW #49	11/01/04	9	0	16.48	3.15	

Notes:

(1) = Depth-to-water measurements are recorded from the top of casing.
(2) = SPH refers to separate phase hydrocarbons.
(3) = Well depth readings are reflective of field measurements at the time of data collection.
(4) = Well casing height refers to high of casing stick-up above existing grade.

ATTACHMENT C

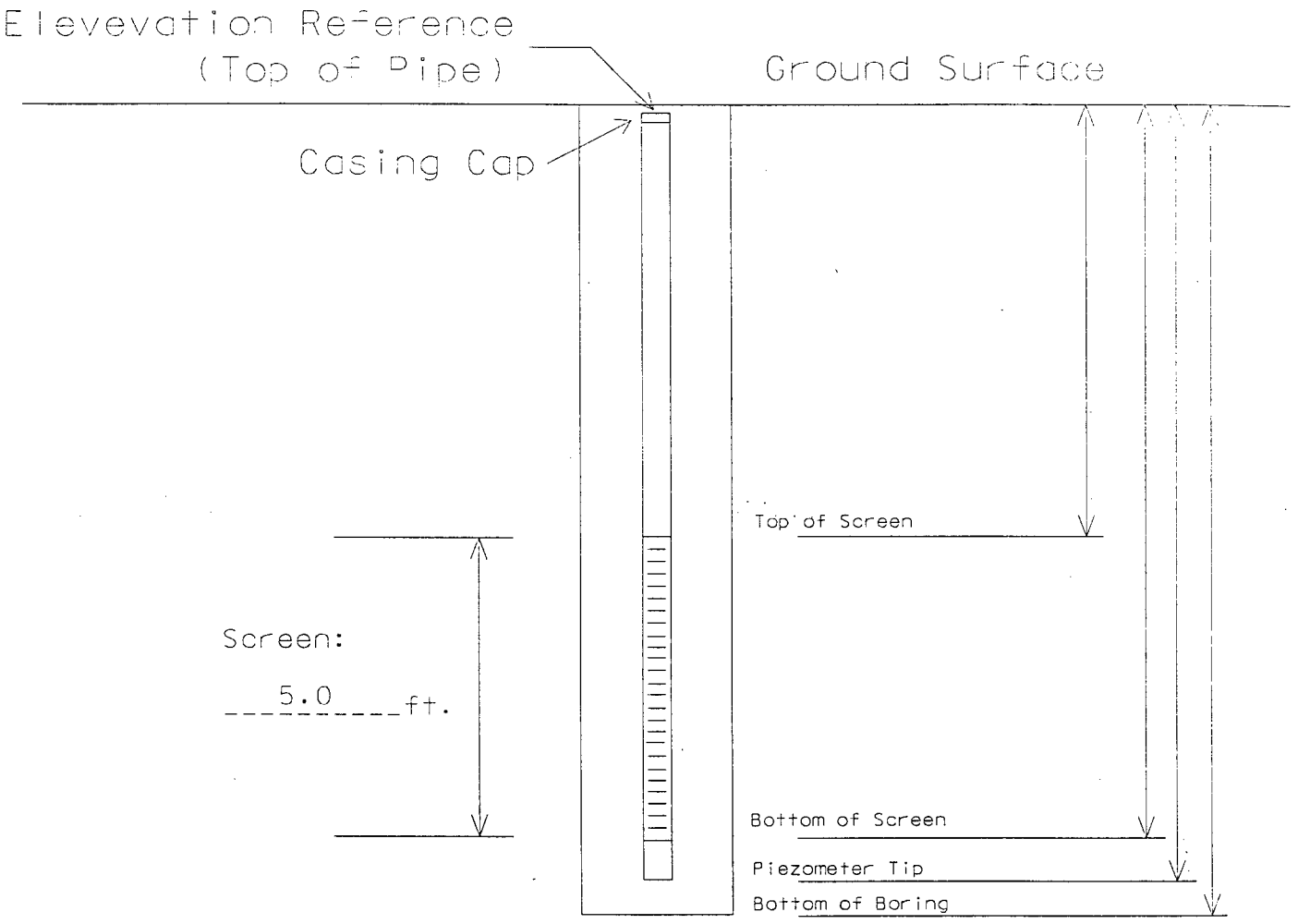
Typical Temporary Well Point Construction Drawing

PRECISION ENGINEERING, INC.

505-523-7674

Temporary Piezometer Installation - Typical

See Logs for Depth Details



Boring Diameter: 8 5/8"

Sand Type: Native Backfill

Bollards, Type/Size: None

Bentonite: None

Screen Type/Size: 2" PVC Sch. 40, 0.060" Hand Slotted @ 3" Intervals

Cement/Grout: None

Riser Type/Size: 2" PVC Sch. 40

Water: Potable

Locking Expandable Casing Plug? No (Slip Cap)

Site Northing: _____

Other: N/A

Bottom Cap Used? Yes

Site Easting: _____

Giant Refining Co.

Project #: 03-122

Project Name: Bloomfield Wells

Elevation: _____

ATTACHMENT D

River Terrace Groundwater Analytical Results Summary

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

COVER LETTER

January 13, 2005

Cindy Hurtado
San Juan Refining
#50 CR 4990
Bloomfield, NM 87413
TEL: (505) 632-4161
FAX (505) 632-3911

RE: River Terrace - MW #48 & MW #49 Order No.: 0412237

Dear Cindy Hurtado:

Hall Environmental Analysis Laboratory received 2 samples on 12/28/2004 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent.

Reporting limits are determined by EPA methodology. No determination of compounds below these (denoted by the ND or < sign) has been made.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman, Business Manager
Nancy McDuffie, Laboratory Manager

4901 Hawkins NE ■ Suite D ■ Albuquerque, NM 87109
505.345.3975 ■ Fax 505.345.4107
www.hallenvironmental.com

Hall Environmental Analysis Laboratory

Date: *13-Jan-05*

CLIENT:	San Juan Refining	Client Sample ID:	MW #48
Lab Order:	0412237	Collection Date:	12/27/2004 1:50:00 PM
Project:	River Terrace - MW #48 & MW #49		
Lab ID:	0412237-01	Matrix:	AQUEOUS

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 8015B: DIESEL RANGE						Analyst: JMP
Diesel Range Organics (DRO)	ND	1.0		mg/L	1	1/3/2005 5:09:41 PM
Motor Oil Range Organics (MRO)	ND	5.0		mg/L	1	1/3/2005 5:09:41 PM
Surr: DNOP	112	58-140		%REC	1	1/3/2005 5:09:41 PM
EPA METHOD 8015B: GASOLINE RANGE						Analyst: NSB
Gasoline Range Organics (GRO)	28	5.0		mg/L	100	1/3/2005 5:34:00 PM
Surr: BFB	111	78.3-120		%REC	100	1/3/2005 5:34:00 PM
EPA METHOD 8021B: VOLATILES						Analyst: NSB
Methyl tert-butyl ether (MTBE)	ND	250		µg/L	100	1/3/2005 5:34:00 PM
Benzene	690	50		µg/L	100	1/3/2005 5:34:00 PM
Toluene	ND	50		µg/L	100	1/3/2005 5:34:00 PM
Ethylbenzene	1900	50		µg/L	100	1/3/2005 5:34:00 PM
Xylenes, Total	8200	50		µg/L	100	1/3/2005 5:34:00 PM
Surr: 4-Bromofluorobenzene	110	83.3-121		%REC	100	1/3/2005 5:34:00 PM
EPA METHOD 8310: PAHS						Analyst: BL
Naphthalene	190	13		µg/L	5	1/10/2005 12:51:57 PM
1-Methylnaphthalene	69	2.5		µg/L	1	1/7/2005 3:18:32 PM
2-Methylnaphthalene	76	2.5		µg/L	1	1/7/2005 3:18:32 PM
Acenaphthylene	ND	2.5		µg/L	1	1/7/2005 3:18:32 PM
Acenaphthene	ND	2.5		µg/L	1	1/7/2005 3:18:32 PM
Fluorene	1.1	0.80		µg/L	1	1/7/2005 3:18:32 PM
Phenanthrene	2.2	0.60		µg/L	1	1/7/2005 3:18:32 PM
Anthracene	ND	0.60		µg/L	1	1/7/2005 3:18:32 PM
Fluoranthene	ND	0.30		µg/L	1	1/7/2005 3:18:32 PM
Pyrene	ND	0.30		µg/L	1	1/7/2005 3:18:32 PM
Benz(a)anthracene	ND	0.020		µg/L	1	1/7/2005 3:18:32 PM
Chrysene	ND	0.20		µg/L	1	1/7/2005 3:18:32 PM
Benzo(b)fluoranthene	ND	0.050		µg/L	1	1/7/2005 3:18:32 PM
Benzo(k)fluoranthene	ND	0.020		µg/L	1	1/7/2005 3:18:32 PM
Benzo(a)pyrene	ND	0.020		µg/L	1	1/7/2005 3:18:32 PM
Dibenz(a,h)anthracene	ND	0.040		µg/L	1	1/7/2005 3:18:32 PM
Benzo(g,h,i)perylene	ND	0.030		µg/L	1	1/7/2005 3:18:32 PM
Indeno(1,2,3-cd)pyrene	ND	0.080		µg/L	1	1/7/2005 3:18:32 PM
Surr: Benzo(e)pyrene	81.8	54-102		%REC	1	1/7/2005 3:18:32 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *13-Jan-05*

CLIENT:	San Juan Refining	**Client Sample ID:**	MW #49
Lab Order:	0412237	**Collection Date:**	12/27/2004 1:00:00 PM
Project:	River Terrace - MW #48 & MW #49		
Lab ID:	0412237-02	**Matrix:**	AQUEOUS

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 8015B: DIESEL RANGE						Analyst: JMP
Diesel Range Organics (DRO)	ND	1.0		mg/L	1	1/4/2005 10:11:04 AM
Motor Oil Range Organics (MRO)	ND	5.0		mg/L	1	1/4/2005 10:11:04 AM
Surr: DNOP	98.2	58-140		%REC	1	1/4/2005 10:11:04 AM
EPA METHOD 8015B: GASOLINE RANGE						Analyst: NSB
Gasoline Range Organics (GRO)	0.23	0.050		mg/L	1	1/4/2005 10:13:32 AM
Surr: BFB	108	78.3-120		%REC	1	1/4/2005 10:13:32 AM
EPA METHOD 8021B: VOLATILES						Analyst: NSB
Methyl tert-butyl ether (MTBE)	ND	2.5		µg/L	1	1/4/2005 10:13:32 AM
Benzene	9.7	0.50		µg/L	1	1/4/2005 10:13:32 AM
Toluene	ND	0.50		µg/L	1	1/4/2005 10:13:32 AM
Ethylbenzene	1.9	0.50		µg/L	1	1/4/2005 10:13:32 AM
Xylenes, Total	0.52	0.50		µg/L	1	1/4/2005 10:13:32 AM
Surr: 4-Bromofluorobenzene	105	83.3-121		%REC	1	1/4/2005 10:13:32 AM
EPA METHOD 8310: PAHS						Analyst: BL
Naphthalene	ND	2.5		µg/L	1	1/7/2005 4:06:32 PM
1-Methylnaphthalene	ND	2.5		µg/L	1	1/7/2005 4:06:32 PM
2-Methylnaphthalene	ND	2.5		µg/L	1	1/7/2005 4:06:32 PM
Acenaphthylene	ND	2.5		µg/L	1	1/7/2005 4:06:32 PM
Acenaphthene	ND	2.5		µg/L	1	1/7/2005 4:06:32 PM
Fluorene	ND	0.80		µg/L	1	1/7/2005 4:06:32 PM
Phenanthrene	ND	0.60		µg/L	1	1/7/2005 4:06:32 PM
Anthracene	ND	0.60		µg/L	1	1/7/2005 4:06:32 PM
Fluoranthene	ND	0.30		µg/L	1	1/7/2005 4:06:32 PM
Pyrene	ND	0.30		µg/L	1	1/7/2005 4:06:32 PM
Benz(a)anthracene	ND	0.020		µg/L	1	1/7/2005 4:06:32 PM
Chrysene	ND	0.20		µg/L	1	1/7/2005 4:06:32 PM
Benzo(b)fluoranthene	ND	0.050		µg/L	1	1/7/2005 4:06:32 PM
Benzo(k)fluoranthene	ND	0.020		µg/L	1	1/7/2005 4:06:32 PM
Benzo(a)pyrene	ND	0.020		µg/L	1	1/7/2005 4:06:32 PM
Dibenz(a,h)anthracene	ND	0.040		µg/L	1	1/7/2005 4:06:32 PM
Benzo(g,h,i)perylene	ND	0.030		µg/L	1	1/7/2005 4:06:32 PM
Indeno(1,2,3-cd)pyrene	ND	0.080		µg/L	1	1/7/2005 4:06:32 PM
Surr: Benzo(e)pyrene	88.0	54-102		%REC	1	1/7/2005 4:06:32 PM

Qualifiers:

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *13-Jan-05*

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7169** Batch ID: **7169** Test Code: **SW8015** Units: **mg/L** Analysis Date **1/3/2005 3:39:14 PM** Prep Date **12/30/2004**
Client ID: Run ID: **FID(17A) 2_041230A** SeqNo: **330395**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics (DRO)	ND	1									
Motor Oil Range Organics (MRO)	ND	5									
Surr: DNOP	1.194	0	1	0	119	58	140	0			

Sample ID **Reagent Blank 5m** Batch ID: **R14198** Test Code: **SW8015** Units: **mg/L** Analysis Date **1/3/2005 9:35:16 AM** Prep Date
Client ID: Run ID: **PIDFID_050103A** SeqNo: **330242**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	ND	0.05									
Surr: BFB	19.09	0	20	0	95.5	78.3	120	0			

Sample ID **Reagent Blank 5m** Batch ID: **R14206** Test Code: **SW8015** Units: **mg/L** Analysis Date **1/4/2005 8:43:42 AM** Prep Date
Client ID: Run ID: **PIDFID_050104A** SeqNo: **330471**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	ND	0.05									
Surr: BFB	19.24	0	20	0	96.2	78.3	120	0			

3 / 10

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

J

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT
Method Blank

Sample ID **Reagent Blank 5m** Batch ID: **R14198** Test Code: **SW8021** Units: **µg/L** Analysis Date **1/3/2005 9:35:16 AM** Prep Date

Client ID: Run ID: **PIDFID_050103A** SeqNo: **330238**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	2.5									
Benzene	ND	0.5									
Toluene	ND	0.5									
Ethylbenzene	ND	0.5									
Xylenes, Total	ND	0.5									
Surr: 4-Bromofluorobenzene	19.22	0	20	0	96.1	83.3	121	0			

Sample ID **Reagent Blank 5m** Batch ID: **R14206** Test Code: **SW8021** Units: **µg/L** Analysis Date **1/4/2005 8:43:42 AM** Prep Date

Client ID: Run ID: **PIDFID_050104A** SeqNo: **330470**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	2.5									
Benzene	ND	0.5									
Toluene	ND	0.5									
Ethylbenzene	ND	0.5									
Xylenes, Total	ND	0.5									
Surr: 4-Bromofluorobenzene	19.97	0	20	0	99.9	83.3	121	0			

4 / 10

Qualifiers: ND - Not Detected at the Reporting Limit; J - Analyte detected below quantitation limits; S - Spike Recovery outside accepted recovery limits; R - RPD outside accepted recovery limits; B - Analyte detected in the associated Method Blank

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT
Method Blank

Sample ID **MB-7179** Batch ID: **7179** Test Code: **SW8310** Units: **µg/L** Analysis Date **1/7/2005 12:54:33 PM** Prep Date **1/3/2005**
Client ID: Run ID: **HUGO_050107A** SeqNo: **331224**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Naphthalene	ND	2.5									
1-Methylnaphthalene	ND	2.5									
2-Methylnaphthalene	ND	2.5									
Acenaphthylene	ND	2.5									
Acenaphthene	ND	2.5									
Fluorene	ND	0.8									
Phenanthrene	ND	0.6									
Anthracene	ND	0.6									
Fluoranthene	ND	0.3									
Pyrene	ND	0.3									
Benz(a)anthracene	ND	0.02									
Chrysene	ND	0.2									
Benzo(b)fluoranthene	ND	0.05									
Benzo(k)fluoranthene	ND	0.02									
Benzo(a)pyrene	ND	0.02									
Dibenz(a,h)anthracene	ND	0.04									
Benzo(g,h,i)perylene	ND	0.03									
Indeno(1,2,3-cd)pyrene	ND	0.08									
Surr: Benzo(e)pyrene	8.55	0	10	0	85.5	54	102	0			

5/10

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits

Hall Environmental Analysis Laboratory

Date: *13-Jan-05*

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT

Laboratory Control Spike - generic

Sample ID LCS-7169	Batch ID: 7169	Test Code: SW8015	Units: mg/L	Analysis Date 1/3/2005 4:09:07 PM	Prep Date 12/30/2004
Client ID:		Run ID: FID(17A) 2_041230A		SeqNo: 330396	

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics (DRO)	5.595	1	5	0	112	81.2	149	0			

Sample ID LCSD-7169	Batch ID: 7169	Test Code: SW8015	Units: mg/L	Analysis Date 1/3/2005 4:39:01 PM	Prep Date 12/30/2004
Client ID:		Run ID: FID(17A) 2_041230A		SeqNo: 330397	

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics (DRO)	5.657	1	5	0	113	81.2	149	5.595	1.10	23	

Sample ID GRO std 2.5ug	Batch ID: R14198	Test Code: SW8015	Units: mg/L	Analysis Date 1/3/2005 10:05:01 AM	Prep Date
Client ID:		Run ID: PIDFID_050103A		SeqNo: 330248	

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	0.5244	0.05	0.5	0	105	82.6	114	0			

Sample ID GRO std 2.5ug	Batch ID: R14198	Test Code: SW8015	Units: mg/L	Analysis Date 1/3/2005 6:33:51 PM	Prep Date
Client ID:		Run ID: PIDFID_050103A		SeqNo: 330252	

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	0.4968	0.05	0.5	0	99.4	82.6	114	0.5244	5.41	8.39	

Sample ID GRO std 2.5ug	Batch ID: R14206	Test Code: SW8015	Units: mg/L	Analysis Date 1/4/2005 11:13:21 AM	Prep Date
Client ID:		Run ID: PIDFID_050104A		SeqNo: 330473	

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline Range Organics (GRO)	0.5016	0.05	0.5	0	100	82.6	114	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT
Laboratory Control Spike - generic

Sample ID **BTEX lcs 100ng** Batch ID: **R14198** Test Code: **SW8021** Units: **µg/L** Analysis Date **1/3/2005 5:04:03 PM** Prep Date
Client ID: Run ID: **PIDFID_050103A** SeqNo: **330336**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	43.46	2.5	40	0	109	64.5	133	0			
Benzene	20.36	0.5	20	0	102	88.7	114	0			
Toluene	20.01	0.5	20	0	100	89.3	112	0			
Ethylbenzene	20.64	0.5	20	0	103	88.6	113	0			
Xylenes, Total	60.06	0.5	60	0	100	89.4	112	0			

Sample ID **BTEX std 100ng** Batch ID: **R14206** Test Code: **SW8021** Units: **µg/L** Analysis Date **1/4/2005 7:42:37 PM** Prep Date
Client ID: Run ID: **PIDFID_050104A** SeqNo: **330511**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	38.09	2.5	40	0	95.2	64.5	133	0			
Benzene	20.16	0.5	20	0	101	88.7	114	0			
Toluene	19.44	0.5	20	0	97.2	89.3	112	0			
Ethylbenzene	20.19	0.5	20	0	101	88.6	113	0			
Xylenes, Total	59.17	0.5	60	0	98.6	89.4	112	0			

7 / 10

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT
Laboratory Control Spike - generic

Sample ID LCS-7179 Batch ID: 7179 Test Code: SW8310 Units: µg/L Analysis Date 1/7/2005 1:42:33 PM Prep Date 1/3/2005
Client ID: Run ID: HUGO_050107A SeqNo: 331225

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Naphthalene	32.35	2.5	40	0	80.9	20.939	111.211	0			
1-Methylnaphthalene	32.39	2.5	40.1	0	80.8	22.016	110.385	0			
2-Methylnaphthalene	31.65	2.5	40	0	79.1	21.098	111.261	0			
Acenaphthylene	30.78	2.5	40.1	0	76.8	23.852	116.857	0			
Acenaphthene	31.39	2.5	40	0	78.5	27.524	111.73	0			
Fluorene	3.02	0.8	4.01	0	75.3	31.046	113.32	0			
Phenanthrene	1.75	0.6	2.01	0	87.1	42.279	115.749	0			
Anthracene	1.66	0.6	2.01	0	82.6	43.767	118.693	0			
Fluoranthene	3.46	0.3	4.01	0	86.3	55.334	117.461	0			
Pyrene	3.49	0.3	4.01	0	87.0	57.722	120.832	0			
Benz(a)anthracene	0.34	0.02	0.401	0	84.8	70.18	113.452	0			
Chrysene	1.69	0.2	2.01	0	84.1	43.942	141.404	0			
Benzo(b)fluoranthene	0.42	0.05	0.501	0	83.8	71.192	103.368	0			
Benzo(k)fluoranthene	0.22	0.02	0.25	0	88.0	75.336	107.209	0			
Benzo(a)pyrene	0.22	0.02	0.251	0	87.6	74.556	100.742	0			
Dibenz(a,h)anthracene	0.46	0.04	0.501	0	91.8	80.693	106.931	0			
Benzo(g,h,i)perylene	0.44	0.03	0.5	0	88.0	55.168	135.014	0			
Indeno(1,2,3-cd)pyrene	0.91	0.08	1.002	0	90.8	79.328	104.794	0			

8 / 10

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: San Juan Refining
Work Order: 0412237
Project: River Terrace - MW #48 & MW #49

QC SUMMARY REPORT
Laboratory Control Spike Duplicate

Sample ID LCSD-7179 Batch ID: 7179 Test Code: SW8310 Units: µg/L Analysis Date 1/7/2005 2:30:33 PM Prep Date 1/3/2005
Client ID: Run ID: HUGO_050107A SeqNo: 331226

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Naphthalene	27.72	2.5	40	0	69.3	20.939	111.211	32.35	15.4	32.1	
1-Methylnaphthalene	29.52	2.5	40.1	0	73.6	22.016	110.385	32.39	9.27	32.7	
2-Methylnaphthalene	28.91	2.5	40	0	72.3	21.098	111.261	31.65	9.05	34	
Acenaphthylene	29.32	2.5	40.1	0	73.1	23.852	116.857	30.78	4.86	38.8	
Acenaphthene	30.78	2.5	40	0	77.0	27.524	111.73	31.39	1.96	38.6	
Fluorene	3.01	0.8	4.01	0	75.1	31.046	113.32	3.02	0.332	39.3	
Phenanthrene	1.77	0.6	2.01	0	88.1	42.279	115.749	1.75	1.14	25	
Anthracene	1.7	0.6	2.01	0	84.6	43.767	118.693	1.66	2.38	23.9	
Fluoranthene	3.66	0.3	4.01	0	91.3	55.334	117.461	3.46	5.62	15.7	
Pyrene	3.48	0.3	4.01	0	86.8	57.722	120.832	3.49	0.287	15.3	
Benz(a)anthracene	0.35	0.02	0.401	0	87.3	70.18	113.452	0.34	2.90	119	
Chrysene	1.72	0.2	2.01	0	85.6	43.942	141.404	1.69	1.76	16.6	
Benzo(b)fluoranthene	0.42	0.05	0.501	0	83.8	71.192	103.368	0.42	0	21.7	
Benzo(k)fluoranthene	0.23	0.02	0.25	0	92.0	75.336	107.209	0.22	4.44	19.4	
Benzo(a)pyrene	0.22	0.02	0.251	0	87.6	74.556	100.742	0.22	0	16.7	
Dibenz(a,h)anthracene	0.46	0.04	0.501	0	91.8	80.693	106.931	0.46	0	17.3	
Benzo(g,h,i)perylene	0.43	0.03	0.5	0	86.0	55.168	135.014	0.44	2.30	118	
Indeno(1,2,3-cd)pyrene	0.91	0.08	1.002	0	90.8	79.328	104.794	0.91	0	17.7	

9/10

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

Hall Environmental Analysis Laboratory

Sample Receipt Checklist

Client Name SJR | Date and Time Received:

Work Order Number 0412237 | Received by AMG

Checklist completed by _____ 12/29/04
Signature | Date

Matrix | Carrier name UPS

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐		
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑	Not Shipped ☐	
Custody seals intact on sample bottles?	Yes ☐	No ☐	N/A ☑		
Chain of custody present?	Yes ☑	No ☐			
Chain of custody signed when relinquished and received?	Yes ☑	No ☐			
Chain of custody agrees with sample labels?	Yes ☑	No ☐			
Samples in proper container/bottle?	Yes ☑	No ☐			
Sample containers intact?	Yes ☑	No ☐			
Sufficient sample volume for indicated test?	Yes ☑	No ☐			
All samples received within holding time?	Yes ☑	No ☐			
Water - VOA vials have zero headspace?	No VOA vials submitted ☐	Yes ☑	No ☐		
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑		

Container/Temp Blank temperature? 5° *4° C ± 2 Acceptable* If given sufficient time to cool.

COMMENTS:

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding _____

Comments: _____

Corrective Action _____

CHAIN-OF-CUSTODY RECORD

QA / QC Package:
Std ☐ Level 4 ☐
Other:

HALL ENVIRONMENTAL ANALYSIS LABORATORY
4901 Hawkins NE, Suite D
Albuquerque, New Mexico 87109
Tel. 505.345.3975 Fax 505.345.4107
www.hallenvironmental.com

Client: San Juan Refining
Address: #50 Rd 4990, Bloomfield, NM 87413
Phone #: 505-632-4161
Fax #: 505-632-3911

Project Name: River Terrace MW #48 & MW #49
Project #:
Project Manager:
Sampler: Cindy Hurtado
Sample Temperature: 5°C

ANALYSIS REQUEST

Date	Time	Matrix	Sample I.D. No.	Number/Volume	Preservative: $HgCl_2$	Preservative: HNO_3	Preservative:	HEAL No.
12/27/04	150pm	H2O	MW #48	2-VOA	X			041237 1
/	/	/	/	2-VOA	X			1
/	/	/	/	1-liter			Amber	1
12/27/04	1pm	H2O	MW #49	2-VOA	X			2
/	/	/	/	2-VOA	X			2
/	/	/	/	1-liter			Amber	2

BTEX + MTBE + ~~TMB's~~ (8021)	BTEX + MTBE + TPH (Gasoline Only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	EDC (Method 8021)	8310 ~~PNA's~~ (PAH)	RCRA 8 Metals	Anions (F, Cl, NO_3, NO_2, PO_4, SO_4)	8081 Pesticides / PCB's (8082)	8260B (VOA)	8270 (Semi-VOA)	Air Bubbles or Headspace (Y or N)
+												
		+										
						X						
+												
		+										
						X						

Date	Time	Relinquished By: (Signature)	Received By: (Signature)	
12/27/04	3pm	Cindy Hurtado		12/28/04 1:10
Date:	Time:	Relinquished By: (Signature)	Received By: (Signature)	

Remarks:

River Terrace Groundwater Analytical Results Summary
Giant Refinery - Bloomfield, NM

	MW-49 (River Side)				MW-48 (Plant Side)				TP#1		TP#2		TP#2		TP#3		TP#3		TP#4		TP#4		TP#5		TP#5		TP#6		TP#6		TP#7		TP#7		TP#8		TP#8	
	Collected 11/1/04	DF	Collected 12/27/04	DF	Collected 11/1/04	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10 28/2004	DF	Collected 12 27 04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28 2004	DF	Collected 12/27 04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF
Lead	<0.0050 mg/L	(1)	NS ---	---	0.014 mg/L	(1)	NS ---	---																														
Manganese	2.1 mg/L	(1)	NS ---	---	0.55 mg/L	(1)	NS ---	---																														
Selenium	<0.05 mg/L	(1)	NS ---	---	<0.05 mg/L	(1)	NS ---	---																														
Silver	<0.005 mg/L	(1)	NS ---	---	<0.005 mg/L	(1)	NS ---	---																														
Uranium	<0.10 mg/L	(1)	NS ---	---	<0.10 mg/L	(1)	NS ---	---																														
Zinc	0.0089 mg/L	(1)	NS ---	---	0.026 mg/L	(1)	NS ---	---																														
EPA METHOD 6010C: TOTAL RECOVERABLE METALS																																						
Arsenic	<0.02 mg/L	(1)	NS ---	---	<0.02 mg/L	(1)	NS ---	---																														
Barrium	0.48 mg/L	(1)	NS ---	---	0.32 mg/L	(1)	NS ---	---																														
Cadmium	<0.002 mg/L	(1)	NS ---	---	<0.002 mg/L	(1)	NS ---	---																														
Calcium	160 mg/L	(1)	NS ---	---	130 mg/L	(1)	NS ---	---																														
Chromium	<0.006 mg/L	(1)	NS ---	---	<0.006 mg/L	(1)	NS ---	---																														
Iron	19 mg/L	(10)	NS ---	---	19 mg/L	(10)	NS ---	---																														
Lead	0.014 mg/L	(1)	NS ---	---	0.023 mg/L	(1)	NS ---	---																														
Magnesium	31 mg/L	(1)	NS ---	---	22 mg/L	(1)	NS ---	---																														
Manganese	4.4 mg/L	(1)	NS ---	---	2.4 mg/L	(1)	NS ---	---																														
Potassium	7.9 mg/L	(1)	NS ---	---	6.9 mg/L	(1)	NS ---	---																														
Selenium	<0.05 mg/L	(1)	NS ---	---	<0.05 mg/L	(1)	NS ---	---																														
Silver	<0.005 mg/L	(1)	NS ---	---	<0.005 mg/L	(1)	NS ---	---																														
Sodium	330 mg/L	(10)	NS ---	---	400 mg/L	(10)	NS ---	---																														
Uranium	<0.10 mg/L	(1)	NS ---	---	<0.10 mg/L	(1)	NS ---	---																														
Zinc	0.061 mg/L	(1)	NS ---	---	0.056 mg/L	(1)	NS ---	---																														
EPA METHOD 150.1: pH																																						
pH	7.73 pH units	(1)	NS ---	---	7.88 pH units		NS ---	---																														
EPA METHOD 160.1: TDS																																						
Total Dissolved Solids	1400 mg/L	(1)	NS ---	---	1500 mg/L		NS ---	---																														

NOTE:

(1) The below list includes analytes detected within at least one of the collected samples.

River Terrace Groundwater Analytical Results Summary
Giant Refinery - Bloomfield, NM

	MW-49 (River Side)				MW-48 (Plant Side)				TP#1		TP#2		TP#2		TP#3		TP#3		TP#4		TP#4		TP#5		TP#5		TP#6		TP#6		TP#7		TP#7		TP#8		TP#8	
	Collected 11/1/04	DF	Collected 12/27/04	DF	Collected 11/1/04	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF	Collected 10/28/2004	DF	Collected 12/27/04	DF
EPA METHOD 300.0: ANIONS																																				
Fluoride	0.48 mg/L	(1)	NS ---	---	0.54 mg/L	(1)	NS ---	---																												
Chloride	130 mg/L	(10)	NS ---	---	120 mg/L	(10)	NS ---	---																												
Nitrogen, Nitrite (As N)	<0.10 mg/L	(1)	NS ---	---	<0.10 mg/L	(1)	NS ---	---																												
Nitrogen, Nitrate (As N)	<0.10 mg/L	(1)	NS ---	---	<0.10 mg/L	(1)	NS ---	---																												
Phosphorus, Orthophosphate (As P)	<0.50 mg/L	(1)	NS ---	---	<0.50 mg/L	(1)	NS ---	---																												
Sulfate	280 mg/L	(10)	NS ---	---	250 mg/L	(10)	NS ---	---																												
EPA METHOD 8015B: DIESEL RANGE																																				
Diesel Range Organics	<1.0 mg/L	(1)	<1.0 mg/L	(1)	1.5 mg/L	(1)	<1.0 mg/L	(1)	6.1 mg/L	(1)	NS ---	---	1.3 mg/L	(1)	NS ---	---	<1.0 mg/L	(1)	NS ---	---	1.3 mg/L	(1)	NS ---	---	<1.0 mg/L	(1)	NS ---	---	<1.0 mg/L	(1)	NS ---	---	4.4 mg/L	(1)	NS ---	---
Motor Oil Range Organics	<5.0 mg/L	(1)	<5.0 mg/L	(1)	<5.0 mg/L	(1)	<5.0 mg/L	(1)	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---	<5.0 mg/L	(1)	NS ---	---
EPA METHOD 8015B: GASOLINE RANGE																																				
Gasoline Range Organics	1.8 mg/L	(10)	0.23 mg/L	(1)	51 mg/L	(200)	28 mg/L	(100)	140 mg/L	(500)	NS ---	---	92 mg/L	(100)	NS ---	---	1.8 mg/L	(1)	NS ---	---	22 mg/L	(20)	NS ---	---	67 mg/L	(100)	NS ---	---	13 mg/L	(20)	NS ---	---	1.7 mg/L	(1)	NS ---	---
EPA METHOD 8021B: VOLATILES																																				
Methyl tert-butyl ether (MTBE)	NS ---	---	<2.5 ug/L	(1)	NS ---	---	<250 ug/L	(100)	<250 ug/L	(100)	NS ---	---	<250 ug/L	(100)	NS ---	---	<2.5 ug/L	(1)	NS ---	---	<50 ug/L	(10)	NS ---	---	<250 ug/L	(100)	NS ---	---	<50 ug/L	(20)	NS ---	---	<2.5 ug/L	(1)	NS ---	---
Benzene	NS ---	---	9.7 ug/L	(1)	NS ---	---	690 ug/L	(100)	1200 ug/L	(100)	NS ---	---	3100 ug/L	(100)	NS ---	---	3.5 ug/L	(1)	NS ---	---	<10 ug/L	(10)	NS ---	---	280 ug/L	(200)	NS ---	---	98 ug/L	(20)	NS ---	---	5.5 ug/L	(1)	NS ---	---
Toluene	NS ---	---	<0.5 ug/L	(1)	NS ---	---	<50 ug/L	(100)	340 ug/L	(100)	NS ---	---	8200 ug/L	(100)	NS ---	---	23 ug/L	(1)	NS ---	---	<10 ug/L	(10)	NS ---	---	<100 ug/L	(200)	NS ---	---	<10 ug/L	(20)	NS ---	---	<0.50 ug/L	(1)	NS ---	---
Ethlbenzene	NS ---	---	1.9 ug/L	(1)	NS ---	---	1900 ug/L	(100)	5200 ug/L	(500)	NS ---	---	4200 ug/L	(100)	NS ---	---	51 ug/L	(10)	NS ---	---	810 ug/L	(10)	NS ---	---	2200 ug/L	(200)	NS ---	---	1100 ug/L	(20)	NS ---	---	15 ug/L	(5)	NS ---	---
Xylenes, Total	NS ---	---	0.52 ug/L	(1)	NS ---	---	8200 ug/L	(100)	39000 ug/L	(500)	NS ---	---	27000 ug/L	(500)	NS ---	---	310 ug/L	(10)	NS ---	---	1600 ug/L	(10)	NS ---	---	21000 ug/L	(200)	NS ---	---	3900 ug/L	(20)	NS ---	---	220 ug/L	(1)	NS ---	---
EPA METHOD 8260B: VOLATILES																																				
Benzene	<10 ug/L	(10)	NS ---	---	890 ug/L	(100)	NS ---	---																												
Toluene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Ethylbenzene	15 ug/L	(10)	NS ---	---	3700 ug/L	(100)	NS ---	---																												
Methyl tert-butyl ether (MTBE)	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2,4-Trimethylbenzene	370 ug/L	(10)	NS ---	---	7300 ug/L	(100)	NS ---	---																												
1,3,5-Trimethylbenzene	72 ug/L	(10)	NS ---	---	2000 ug/L	(100)	NS ---	---																												
1,2-Dichloroethande (EDC)	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2-Dibromoethane (EDB)	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Naphthalene	39 ug/L	(10)	NS ---	---	1300 ug/L	(100)	NS ---	---																												
1-Methylnaphthalene	<40 ug/L	(10)	NS ---	---	<400 ug/L	(100)	NS ---	---																												
2-Methylnaphalene	<40 ug/L	(10)	NS ---	---	560 ug/L	(100)	NS ---	---																												
Acetone	<100 ug/L	(10)	NS ---	---	<1000 ug/L	(100)	NS ---	---																												
Bromobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Bromochlormethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Bromodichloromethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Bromoform	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Bromomethane	<20 ug/L	(10)	NS ---	---	<200 ug/L	(100)	NS ---	---																												
2-Butanone	<100 ug/L	(10)	NS ---	---	<1000 ug/L	(100)	NS ---	---																												
Carbon disulfide	<100 ug/L	(10)	NS ---	---	<1000 ug/L	(100)	NS ---	---																												
Carbon Tetrachloride	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Chlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Chloroethane	<20 ug/L	(10)	NS ---	---	<200 ug/L	(100)	NS ---	---																												
Chloroform	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Chloromethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
2-Chlorotoluene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
4-Chlorotoluene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
cis-1,2-DCE	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
cis-1,3-Dichloropropene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2-Dibromo 3-chloropropane	<20 ug/L	(10)	NS ---	---	<200 ug/L	(100)	NS ---	---																												
Dibromochloromethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Dibromomethane	<20 ug/L	(10)	NS ---	---	<200 ug/L	(100)	NS ---	---																												
1,2-Dichlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,3-Dichlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,4-Dichlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Dichlorodifluoromethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1-Dichloroethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1-Dichloroethene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2-Dichloropropane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,3-Dichloropropane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
2,2-Dichloropropane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1-Dichloropropene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Hexachlorobutadiene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
2-Hexanone	<100 ug/L	(10)	NS ---	---	<1000 ug/L	(100)	NS ---	---																												
Isopropylbenzene	31 ug/L	(10)	NS ---	---	270 ug/L	(100)	NS ---	---																												
4-Isopropyltoluene	47 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
4-Methyl-2-pentanone	<100 ug/L	(10)	NS ---	---	<1000 ug/L	(100)	NS ---	---																												
Methylene Chloride	<30 ug/L	(10)	NS ---	---	<300 ug/L	(100)	NS ---	---																												
n-Butylbenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
n-Propylbenzene	65 ug/L	(10)	NS ---	---	700 ug/L	(100)	NS ---	---																												
sec-Butylbenzene	13 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Styrene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
tert-Butylbenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1,1,2-Tetrachloroethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1,2,2-Tetrachloroethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Tetrachloroethene (PCE)	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
trans-1,2-DCE	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
trans-1,3-Dichloropropene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2,3-Trichlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2,4-Trichlorobenzene	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1,1-Trichloroethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,1,2-Trichloroethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Trichloroethene (TCE)	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Trichlorofluoromethane	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
1,2,3-Trichloropropane	<20 ug/L	(10)	NS ---	---	<200 ug/L	(100)	NS ---	---																												
Vinyl chloride	<10 ug/L	(10)	NS ---	---	<100 ug/L	(100)	NS ---	---																												
Xylenes, Total	320 ug/L	(10)	NS ---	---	24000 ug/L	(250)	NS ---	---																												
EPA METHOD 8310: PAHS																																				
Naphthalene	6.7 ug/L	(1)	<2.5 ug/L	(1)	560 ug/L	(1)	190 ug/L	(5)																												
1-Methylnaphthalene	10 ug/L	(1)	<2.5 ug/L	(1)	160 ug/L	(1)	69 ug/L	(1)																												
2-Methylnaphthalene	6 ug/L	(1)	<2.5 ug/L	(1)	250 ug/L	(1)	76 ug/L	(1)																												
Acenaphthylene	<2.5 ug/L	(1)	<2.5 ug/L	(1)	<2.5 ug/L	(1)	<2.5 ug/L	(1)																												
Acenaphthene	<2.5 ug/L	(1)	<2.5 ug/L	(1)	<2.5 ug/L	(1)	<2.5 ug/L	(1)																												
Fluorene	<0.8 ug/L	(1)	<0.8 ug/L	(1)	1.0 ug/L	(1)	1.1 ug/L	(1)																												
Phenanthrene	<0.6 ug/L	(1)	<0.6 ug/L	(1)	5.9 ug/L	(1)	2.2 ug/L	(1)																												
Anthracene	<0.06 ug/L	(1)	<0.6 ug/L	(1)	<0.60 ug/L	(1)	<0.60 ug/L	(1)																												
Fluoranthene	<0.3 ug/L	(1)	<0.3 ug/L	(1)	<0.3 ug/L	(1)	<0.3 ug/L	(1)																												
Pyrene	<0.3 ug/L	(1)	<0.3 ug/L	(1)	<0.3 ug/L	(1)	<0.3 ug/L	(1)																												
Benz(a)anthracene	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)																												
Chrysene	<0.2 ug/L	(1)	<0.2 ug/L	(1)	<0.2 ug/L	(1)	<0.2 ug/L	(1)																												
Benzo(b)fluoranthene	<0.05 ug/L	(1)	<0.05 ug/L	(1)	<0.05 ug/L	(1)	<0.05 ug/L	(1)																												
Benzo(k)fluoranthene	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)																												
Benzo(a)pyrene	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)	<0.02 ug/L	(1)																												
Dibenz(a,h)anthracene	<0.04 ug/L	(1)	<0.04 ug/L	(1)	<0.04 ug/L	(1)	<0.04 ug/L	(1)																												
Benzo(g,h,i)perylene	<0.03 ug/L	(1)	<0.03 ug/L	(1)	<0.03 ug/L	(1)	<0.03 ug/L	(1)																												
Indeno(1,2,3-cd)pyrene	<0.08 ug/L	(1)	<0.08 ug/L	(1)	<0.08 ug/L	(1)	<0.08 ug/L	(1)																												
EPA 120.1 SPECIFIC CONDUCTANCE																																				
Specific Conductance	1900 umhos/cm	(1)	NS ---	---	2700 umhos/cm	(1)	NS ---	---																												
EPA METHOD 7470: MERCURY																																				
Mercury	0.0003 mg/L	(1)	NS ---	---	<0.00020 mg/L	(1)	NS ---	---																												
EPA METHOD 6010C: DISSOLVED METALS																																				
Arsenic	<0.02 mg/L	(1)	NS ---	---	<0.02 mg/L	(1)	NS ---	---																												
Barium	0.3 mg/L	(1)	NS ---	---	0.21 mg/L	(1)	NS ---	---																												
Cadmium	<0.002 mg/L	(1)	NS ---	---	<0.002 mg/L	(1)	NS ---	---																												
Chromium	<0.006 mg/L	(1)	NS ---	---	<0.006 mg/L	(1)	NS ---	---																												
Copper	<0.006 mg/L	(1)	NS ---	---	<0.006 mg/L	(1)	NS ---	---																												
Iron	0.18 mg/L	(1)	NS ---	---	0.16 mg/L	(1)	NS ---	---																												

ATTACHMENT E

River Terrace Well Location Map (Revised)

Giant Bloomfield Refinery
River Terrace Well Location Map

Notes: ■ = Proposed location of additional temporary wells.

ATTACHMENT F

Aquifer Test Results Summary Report

AQUIFER TEST RESULTS SUMMARY REPORT
San Juan River Terrace Site
Giant Refinery, Bloomfield, NM

GENERAL

This report describes the aquifer (pump) test that was performed in December 2004 on well MW-48 at the Giant Refinery Facility located in Bloomfield, New Mexico. The purpose of the pump test was to obtain aquifer hydraulic properties of the river terrace alluvial aquifer below the refinery. Monitoring well MW-48 was pump tested at a constant pumping rate of 4.7 gallons per minute for a period of over 17 hours. Water levels were monitored in the test well, well MW-49, and six piezometers throughout the test. A temporary staff gage was placed in the San Juan River located adjacent to well MW-49 and hourly stage river level readings were recorded. Once the pump test was terminated, water level recovery measurements were recorded in the test well and 2 piezometers for a period of approximately 5 hours. The locations of the wells and piezometers are shown on Figure 1.

The test well and piezometers are located on the San Juan River floodplain located at the Giant refinery. Well MW-48 was drilled and installed in October 28, 2004. The well consists of a 4-inch diameter, schedule 40 well casing and 0.020–inch slotted screen. The well extends to a depth of 15-feet and is gravel packed with Colorado Silica 8 -12 sand. The screen length is 10 feet and is positioned 5 to 15-feet below ground surface. The lithologic materials encountered during drilling and installation of the well ranged from fine sands to gravel and cobbles. Observation of nearby bluff exposures along the river suggests that bedrock is present at a depth of about 15 to 20 feet below ground surface at the terrace.

Well MW-48 is located approximately 65 feet east and 100 feet south of the San Juan River. An exposed bedrock (Nacimiento Formation) bluff face is located about 65 feet to the south. The barrier wall was installed in the early 1990s, and is located approximately 15 to 20 feet east of the San Juan River. The barrier wall is approximately 150 to 180 feet in length, beginning near the bedrock bluff to the south, running north and parallel to the San Juan River. Well MW-48 is located approximately 40 feet east of the barrier wall, 100 feet south from the San Juan River, and approximately 70 feet north of the bedrock bluff.

A pre-pump test "kick off" meeting was held prior to the pump test with Malcolm Pirnie (MPI), Giant, and Envirotech, Inc. personnel. Pump test procedures, personnel duties, individual assignments, equipment checks, and other requirements for the test were

finalized at that time. A geologist was assigned to manage the test and that person was responsible for the operation of the pumping test.

EQUIPMENT

Envirotech Inc. provided the pump, discharge equipment, generator, piping and related accessories to perform the test. Envirotech personnel operated the pump throughout the testing activities. A 4-inch, 3/4 horsepower pump capable of pumping 25 gallons per minute was installed in well MW-48. The discharge water was piped to and contained in a temporary 16,000 gallon tank provided by Giant. The tank was located approximately 25 feet from well MW-48. The outlet for the discharge pipe entered the tank from the top.

Refer to Table 1 for the list of equipment used during the pre-pumping and final pump tests. In addition to the equipment listed, a micro processor-based data acquisition system (In-Situ) was utilized to collect water level information during the pumping periods in piezometers TP-6 and TP-8. In all observation wells identified for monitoring, water levels were measured using battery-powered water level sensing devices.

TABLE 1
Equipment List

- Pump test forms (Write-in-Rain™ paper)
- Ruler – Engineer Scale
- Water Level Measuring Devices (with assigned number on each device)
- Extra batteries with each device
- Calculator
- Pencils and Erasers
- Table and Chair
- Log Paper – 3-cycle semi-log graph
- Flashlights (with extra batteries)
- Metal Clipboard (with cover)
- Stop Watches
- Base Map of pumping well & observation wells
- Boring logs and Piezometer Construction Details

MONITORING LOCATIONS

Water levels were monitored in the pumping well and seven observation wells (six piezometers and one monitoring well) throughout the pumping test. The piezometers included TP-1, TP-2, TP- 5, TP-6, TP-7, and TP-8. Monitoring well MW-49, located on the river side of the existing barrier wall, was also monitored. A temporary staff gage was placed in the river adjacent to well MW-49 and was monitored hourly throughout the test. The locations of all observation wells are shown on Figure 1.

Pre-pumping Test

One day prior to the pump test, a 10- to 30-minute pre-pumping test was run in the pumping well. The objectives of the pre-pumping test were as follows:

- Select a pumping rate for the optional final pumping test.
- Determine the expected drawdown in the test well at various pumping rates.
- Calibrate and verify the operational capacity of all equipment being used in pump test.

These trial runs were needed to make final adjustments to the pump test plan, which included making final decisions on equipment changes and measurement of water levels. The pre-pump test procedures were as follows:

- Coordinate installation of the test pump, power supply, discharge line, and flow meter with Envirotech.
- Install battery-powered electrical depth gages in all observation wells to measure groundwater levels during the test.
- Install In-Situ data acquisition system and transducers (mini trolls) in piezometers TP-6 and TP-8 to monitor groundwater levels during the test.
- Start the pre-test, measuring pump discharge during the test. At least three pumping rates were run to determine the optimum pumping rate for the long-term pump test.
- Collect water level readings at 5-minute levels to the nearest 0.01 foot. The depth to water was referenced from the top of the monitoring well casing.

CONSTANT-RATE PUMP TEST

A 17-hour Constant-Rate Pump Test was performed in well MW-48. The constant rate aquifer test began at 1:15 PM on December 9, 2004. All of the equipment, including pumping, discharge piping, water flow, and water depth measuring equipment, was assembled, proven operational, and inspected the day before initiation of the constant rate drawdown test.

Scheduling, Planning, and Coordination

A meeting of all pump test field personnel was held at the test well site one hour prior to commencing the pump test. The data acquisition and transducer systems were checked and proven operational. Personnel were given a final brief on their individual duties and responsibilities and a final equipment check was conducted at that time, including synchronization of stop watches.

Rest Period

Static non-pumping water level readings were recorded at least one hour prior to the start of pumping. The last readings were recorded immediately before starting the pump.

Data Collection

The pumping test was started at 1:15 PM on December 9, 2004. Any adjustments of the pumping rate required to maintain a nearly constant pumping rate throughout the test were noted on the field forms. The exact time of each recorded measurement was documented on the pumping well and observation well forms. As discussed above, the depth-to-water level measurements were referenced from the top of the monitoring well or top of the steel casing. Measurements were made to the nearest 0.01 foot. MPI, Giant, and Envirotech personnel assisted in recording water level measurement readings. In addition, river stage readings were recorded on an hourly basis.

Pumping Rate

The well was pumped at a constant pumping rate of 4.7 gpm determined from the pre-test pumping. The pumping rate remained constant for the duration of the pumping test. The pumping rate was measured by using both a totalizing flow meter and using the "bucket test".

Recovery Period

After completion of the pump test, we recorded the exact time of pump shutdown, and the rate of recovery of the water levels in wells being monitored and recorded these levels for a 5-hour period.

FIELD REDUCTION OF DATA

During the pump test, the field data was compiled and reduced to estimate drawdown and calculated recovery in the pumping well. Drawdown and recovery measurements for the pumping well and piezometers are presented in Appendix A.

The distances from test well MW-48 to well MW-49 and all the peizometers were measured in the field using a 100-foot tape measure. Table 2 shows a summary of the distances from MW-48 to each respective well or piezometer.

TABLE 2 Summary of Well / Piezometer Distances from MW-48		
Well / Piezometer ID	**Distance from MW-48 (ft)**	**Location**
MW-49	53	Outside Barrier Wall
TP-1	66	Inside Barrier Wall
TP-2	52	Adjacent to Bluff
TP-5	99	East of Well MW-48
TP-6	44	East of Well MW-48
TP-7	96	North End of Barrier Wall
TP-8	42	Inside Barrier Wall

AQUIFER TEST RESULTS

Drawdown was measured in pumping well MW-48 and piezometers TP-1, TP-2, TP-5, TP-6, TP-7, and TP-8 (Appendix A). The pumping test ran for approximately 1,050 minutes until the generator failed. Recovery measurements began shortly there after.

The following is a summary of the results observed after 1,000 minutes of pumping:

- The drawdown observed in MW-48 showed a water level decline of approximately 2.5 feet.
- The maximum drawdown observed in all piezometers was 0.45 feet measured in TP-8.
- A minimum drawdown observed in the piezometers was 0.10 feet in TP-6.
- The staff gage showed no significant change in river stage height (>0.10 foot of decline) during the test.
- No drawdown was observed in well MW-49, except for a slight decline measured near the end of the test. The water level declined <0.05 feet. The water level fully recovered prior to terminating the pumping test, suggesting the decline was caused by a variation in river stage height.

Recovery water levels were taken in well MW-48 and piezometers TP-6 and TP-8 for approximately 5 hours after the pump test was terminated. The water level in the test well MW-48 recovered 2.24 feet, or 88% of recovery to static level after 5 hours. Water levels in TP-6, located east of pumping well MW-48, did not recover during that period. Water levels in piezometer in TP-8 recovered 0.16 feet, or 36 % of recovery from static water level.

AQUIFER TEST INTERPRETATION

Data from the aquifer test was utilized from both the pumping and recovery phases. The aquifer test data was used to estimate hydraulic conductivity of the aquifer. The drawdown data was plotted on a semi-log cycle graph and analyzed over a single time log cycle. The transmissivity was determined from the Cooper and Jacob (1946) equation, $T = 264\ Q/\ \Delta s$, and the hydraulic conductivity was calculated using a 10-foot aquifer thickness.

Analysis of the drawdown data revealed two distinct types of curves. These curves indicate the presence of distinct hydraulic boundaries in the vicinity of each well. At TP-8, the slope of the drawdown curve increases sharply as the test progresses, while TP-6 remains relatively flat. The response at TP-8 is characteristic of an impermeable boundary (i.e. barrier wall and/or bedrock face). The results from TP-6 are more characteristic of a recharging boundary (i.e. San Juan River).

For piezometers TP-1 and TP-2, the slopes of the drawdown curves "steepen" or increase throughout the test. These piezometers are located adjacent to either the barrier wall or to the bedrock face. The increased drawdown observed is typically encountered when the cone of depression reaches an impermeable boundary, causing the rate of drawdown to increase in that direction.

The drawdown curves for piezometer TP-5 and well MW-49, like TP-6, indicate an opposite effect. The drawdown response is relatively flat, which reflects recharge effects from the San Juan River. Piezometers TP-5 and TP-6 are located upgradient of the pumping well, between well MW-48 and the river. Very little drawdown was observed at these two locations and at MW-49 until the later portion of the aquifer test. The observed drawdown in MW-49 was likely due to a slight change in river stage near the end of the pumping test.

Distribution of Drawdown

The semi-log drawdown curves for piezometers located near the barrier wall and the bluff face (TP-1,-2 and -8) show continuous drawdown when pumping at 4.7 gpm. As the cone of depression from the pumping well spreads laterally and intercepts the barrier wall and bedrock face, drawdown increases in these areas due to their impermeable characteristics (lack of available water for the well to draw in). In contrast, the water levels east or upgradient of well MW-48 only slightly declined during the test.

Impermeable Boundary Effects

The semi-log drawdown curves for the three piezometers by the barrier wall and the bluff face show nearly 0.5 feet of drawdown after 17 hours of pumping. The drawdown data

suggests the barrier wall and bluff face (impermeable boundary) have a large affect on water level declines in TP-1, TP-2, TP-6 and TP-7. After several hundred minutes of pumping, the drawdown curves show an increasing rate of drawdown. The drawdown curves, if extrapolated out to several days and weeks, suggest drawdown would likely accelerate due to the effects of the impermeable boundaries.

River Recharge Effects

The semi-log drawdown curves for the two piezometers (TP-5 and TP-6) and well MW-49 show little to effect from pumping well MW-48. A slight drawdown was observed after several hours of pumping in all three observation points. However, when recovery levels measured in TP-6 were reviewed, no recovery was evident as the water level had stabilized for 5 hours, suggesting the San Juan River stage had decreased about 0.10 foot. This drop likely caused aquifer levels to drop in response to the change. It appears that the area east of pumping well MW-48 is affected by recharge from the river.

Parameter Estimation Results

Transmissivity (T) and hydraulic conductivity (K) were calculated for well MW-48 and piezometers TP-1, TP-2, and TP-8 using the Jacob method (semi-log straight line method). Drawdown and recovery curves were analyzed. Each curve yielded a different hydraulic conductivity. An aquifer thickness of 10 feet (bedrock is shallow below the alluvial aquifer) was assumed. T and K values calculated for each well or piezometer decreased significantly from early time to late time analyses. Average T and K values were calculated as follows:

- Early Time : T=1,200 ft2/day; K= 120 ft/d
  Boundary effects are absent in the early time response.
- Mid-Late Time: T =500 ft2/day; K-50 ft/d
  Boundary effects are significant during late time response.

CAPTURE ZONE ANALYSIS

The hydraulic conductivities determined from the pump test analysis were used to estimate the capture zone for a pumping well located on the river terrace. A groundwater spreadsheet (D.K. Todd. Groundwater Hydrology. *John Wiley and Sons, Inc., New York, 1990, 2nd Edition.)* was used to calculate and model the area of capture. The formulas in the spreadsheet assume an aquifer of uniform thickness that is homogeneous, isotropic and infinite in aerial extent.

The hydraulic conductivity input was evaluated based on the proximity of the pumping well to a hydraulic boundary. As the boundary conditions were observed to drive the

hydraulic response of the aquifer during the pump test, similarly the capture zone of a pumping well will be affected by the boundaries.

In addition to the hydraulic conductivity, a pumping rate, aquifer thickness and hydraulic gradient were input parameters for the capture model. A sensitivity analysis of each parameter revealed various capture zone shapes and sizes. The hydraulic gradient was determined from a topographic map of the San Juan river basin, and ranged from 0.0005 foot per foot (ft/ft) to 0.001 ft/ft. The aquifer thickness was varied between 10 feet and 15 feet, and the pumping rate was varied between 1 gpm and 5 gpm. In this range of inputs, the area of capture for a pumping well located on the river terrace extended as far as 500 feet downgradient, 1600 feet upgradient and 3000 feet wide.

After running multiple iterations of the capture zone model, Malcolm Pirnie determined that an adequate capture zone can be obtained at a pumping rate of 2 to 5 gpm.

FIGURE 1

River Terrace Well Location Map

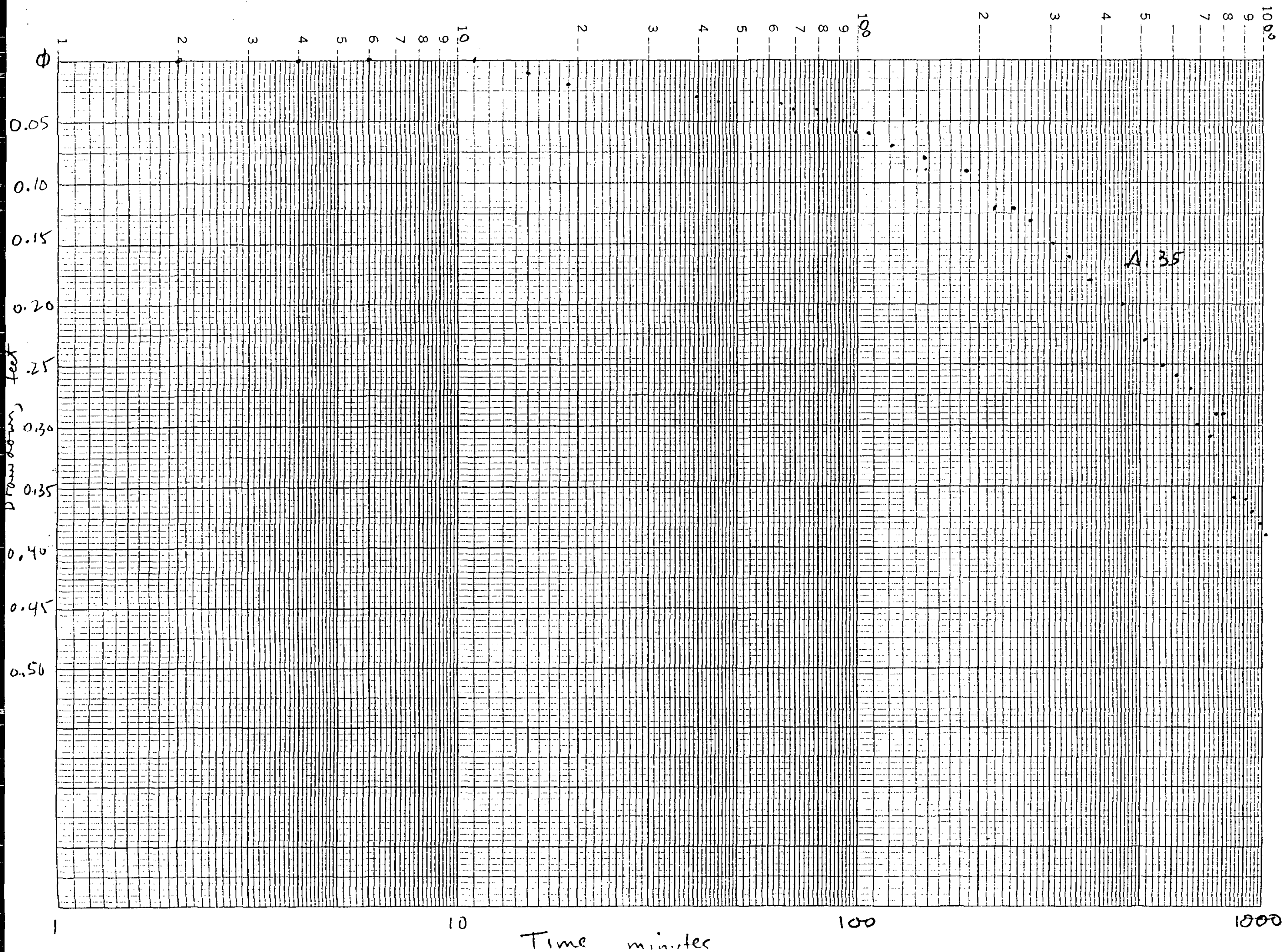
Giant Bloomfield Refinery
River Terrace Well Location Map
Figure 1

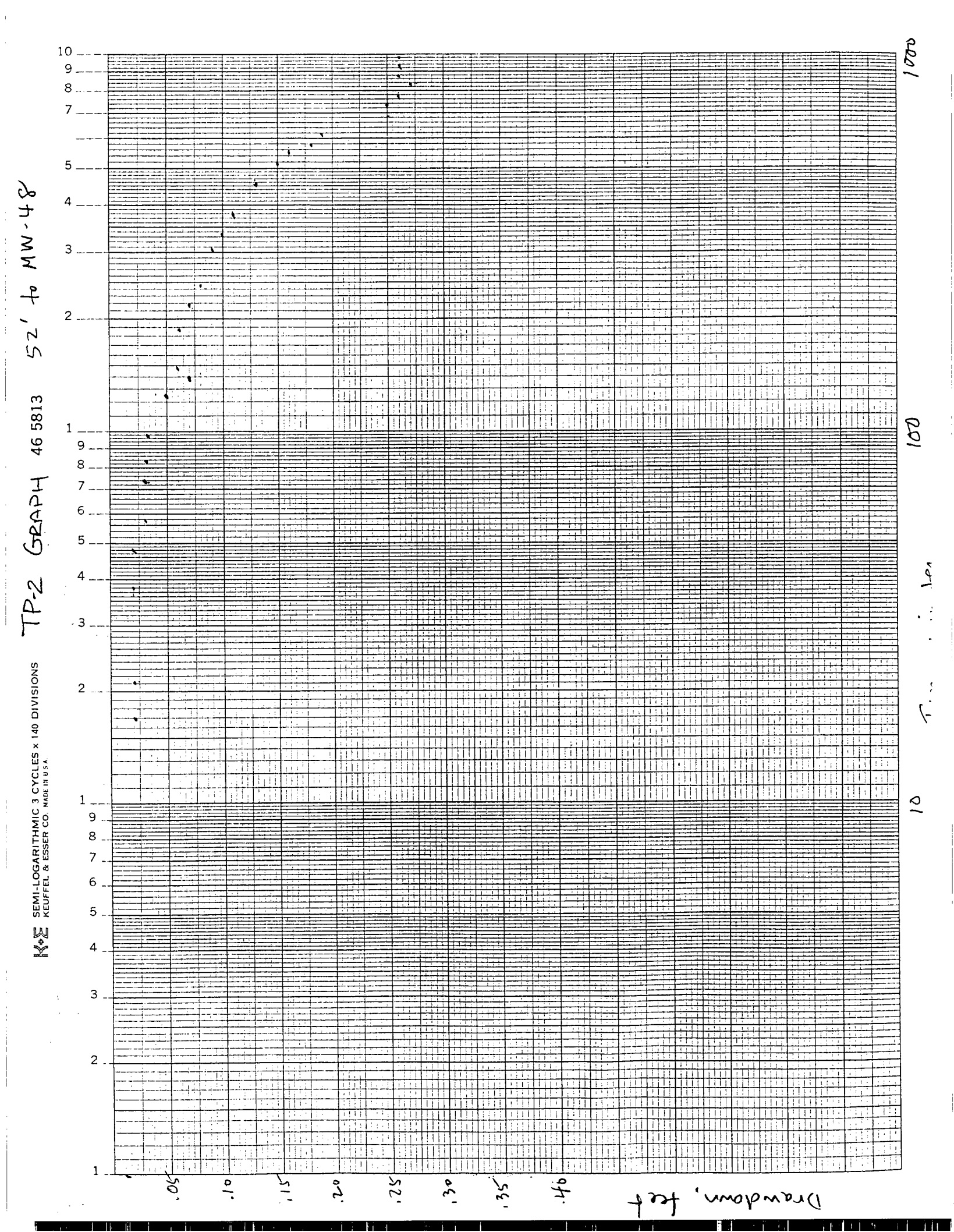
APPENDIX A

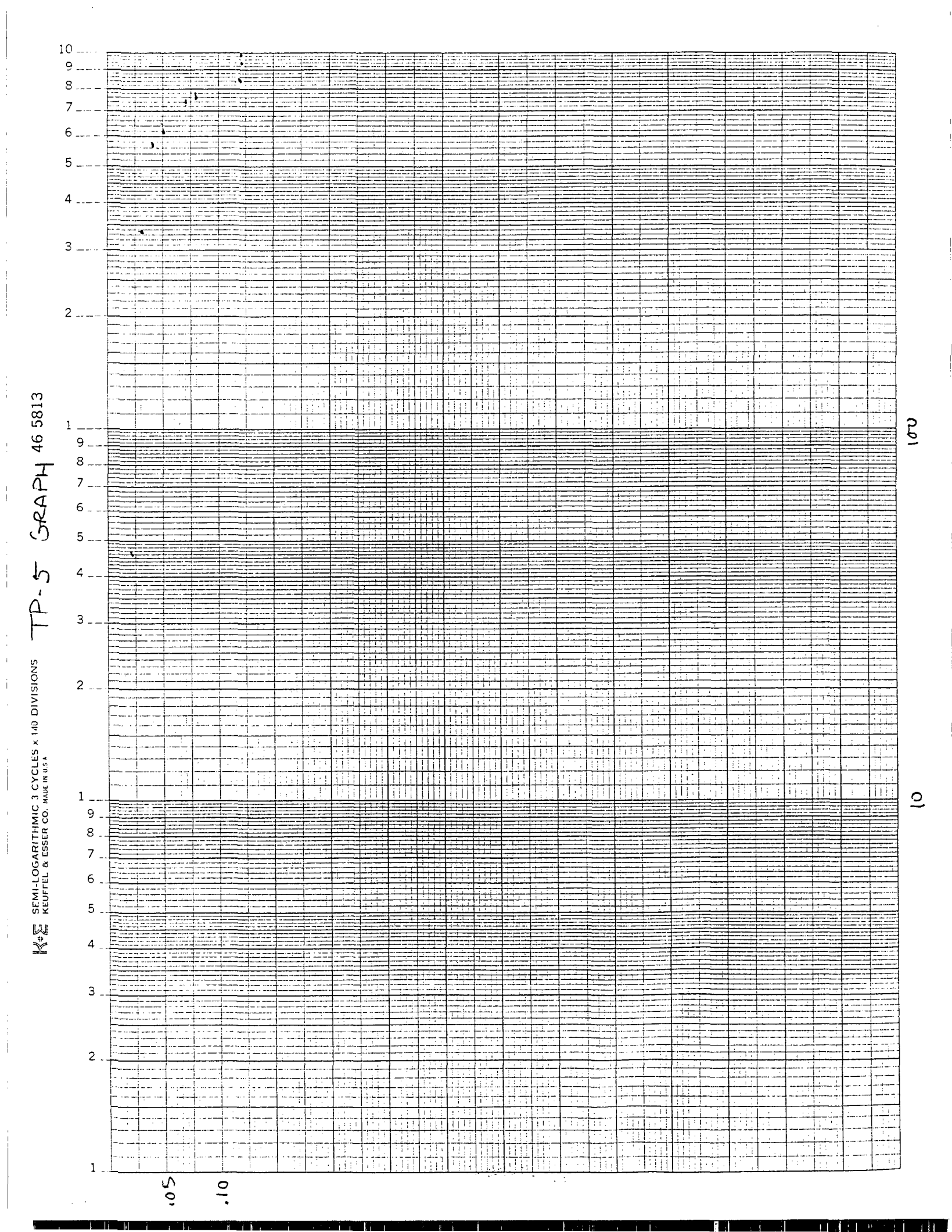
Drawdown and Recovery Graphs

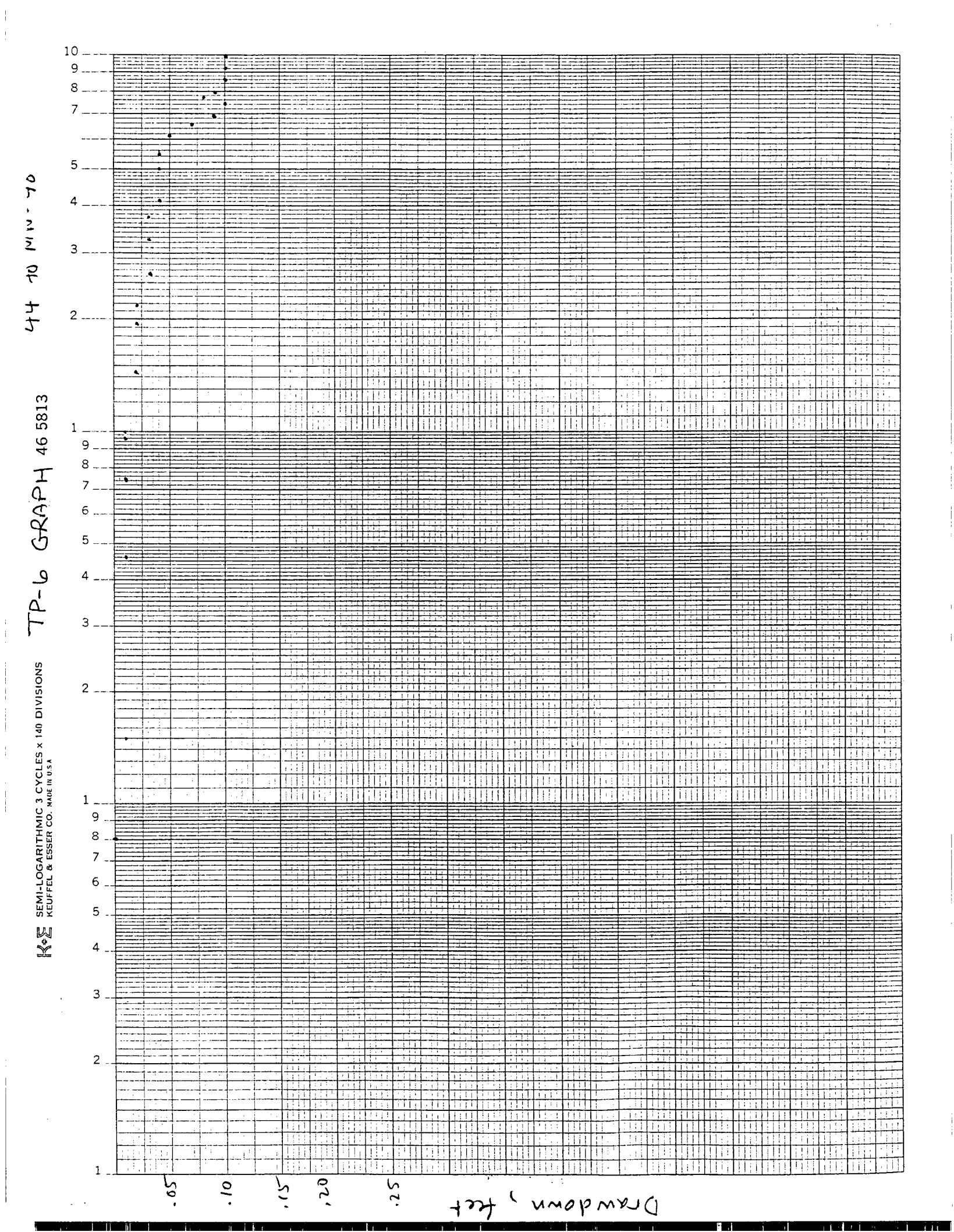
K&E SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

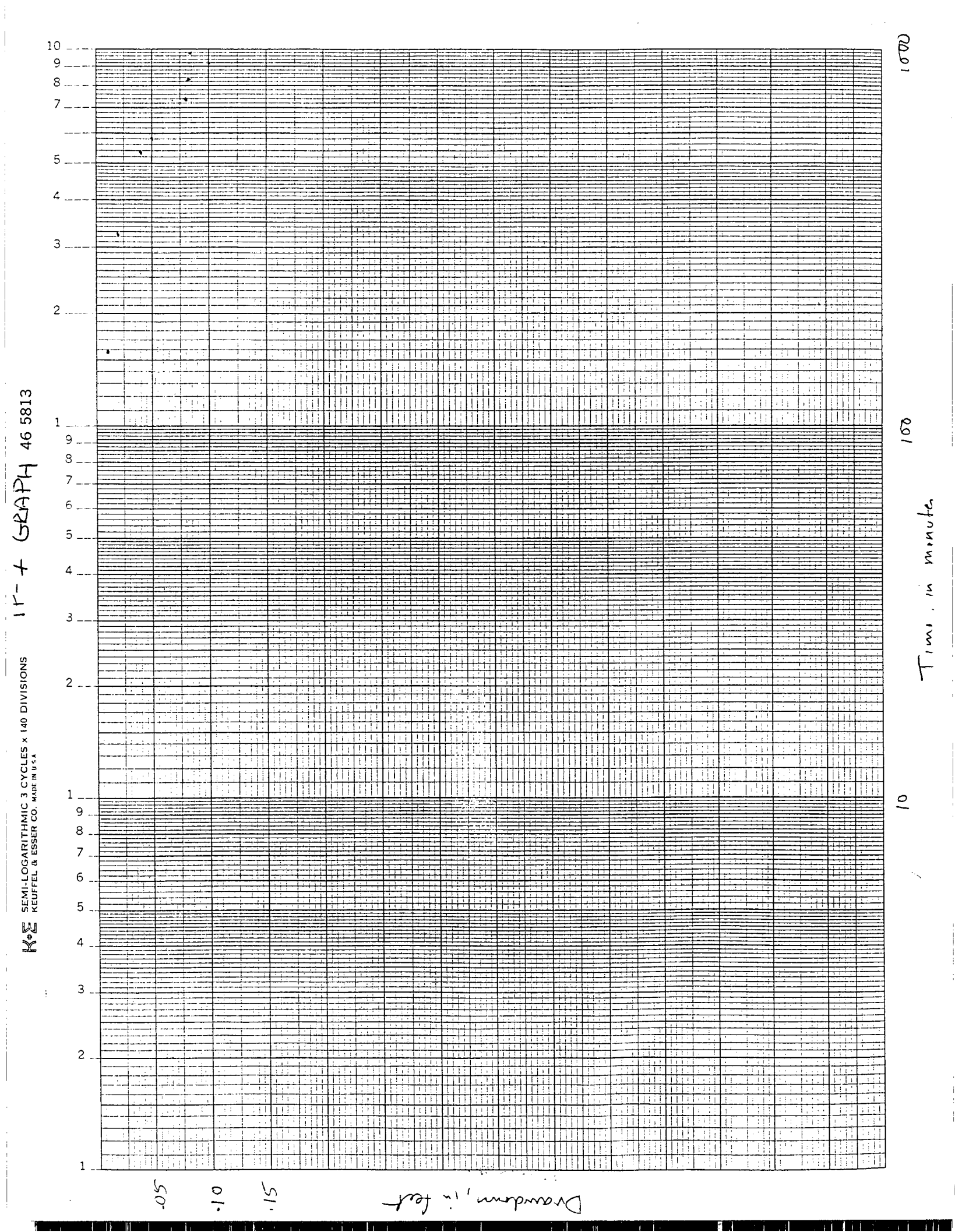
TP-1 GRAPH 46 5813

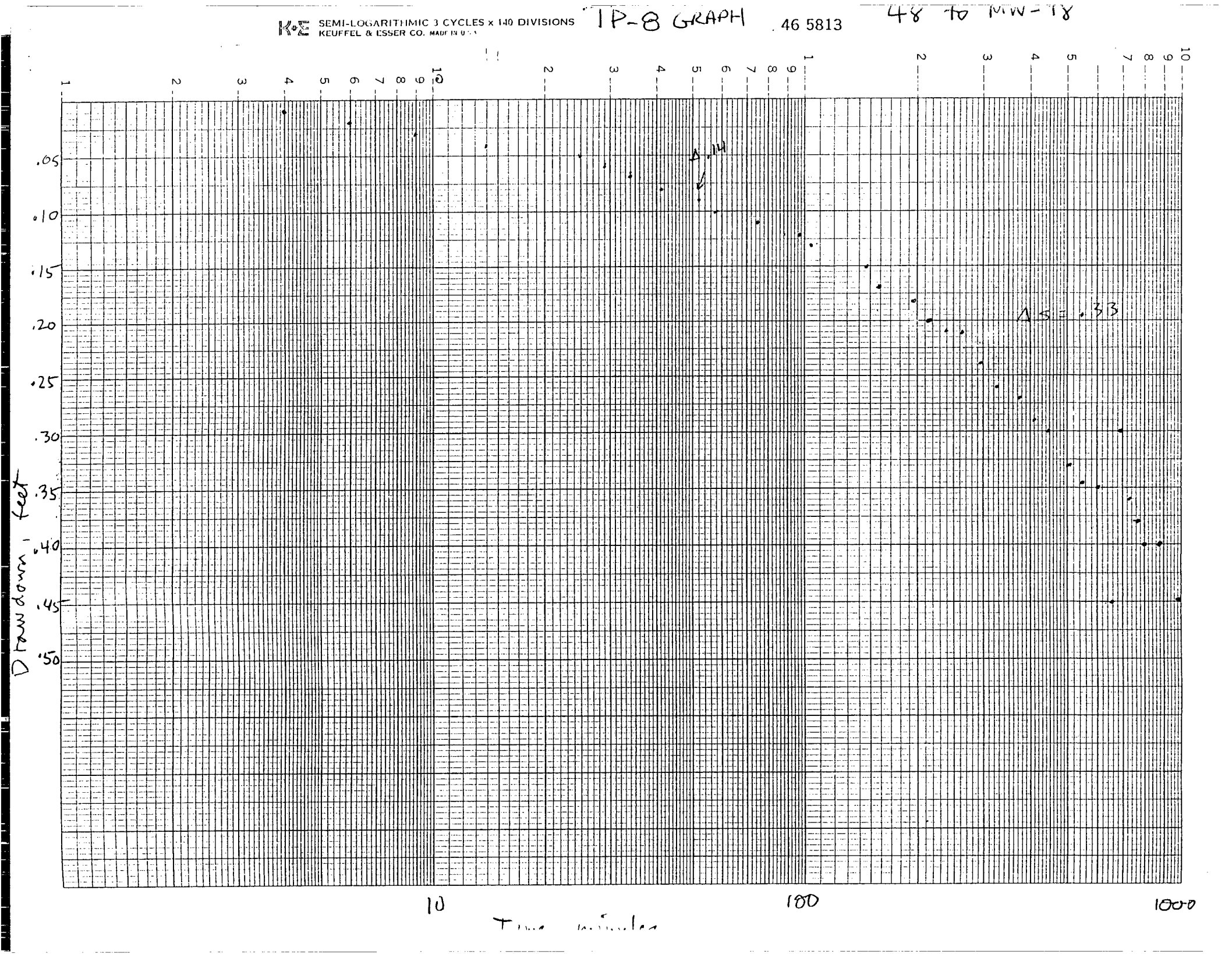



TP-2 GRAPH 46 5813 52' to MW-48
SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
10
9
8
7
5
4
3
2
1
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
1
1000
100
10
.05
.10
.15
.20
.25
.30
.35
.40
Drawdown, feet


TP-5 GRAPH 46 5813
K&E SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
1
.05
.10
100
10

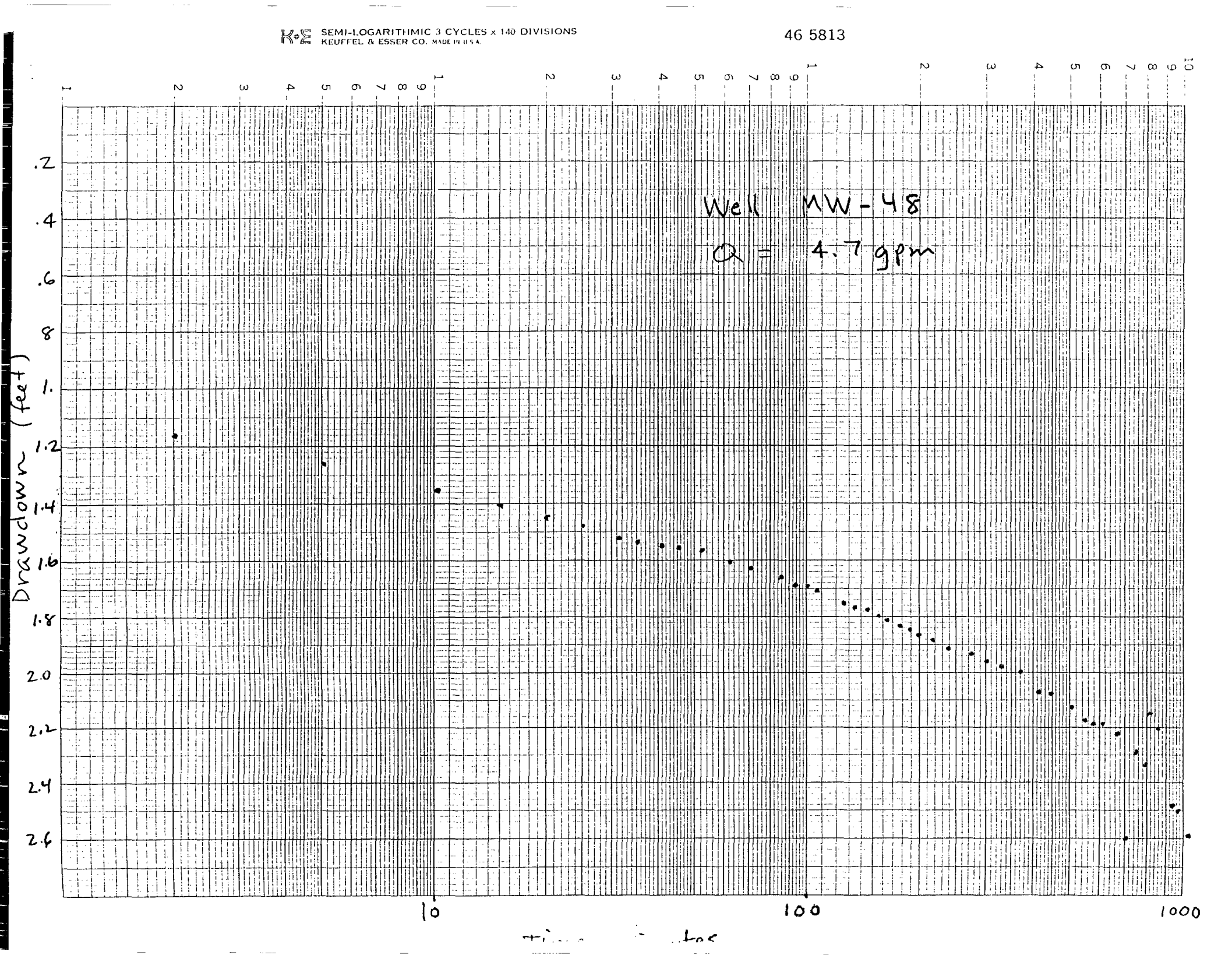

TP-6 GRAPH 46 5813
44 TO NW-70
SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
10
9
8
7
5
4
3
2
1
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
1
.05
.10
.15
.20
.25
Drawdown, feet


SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 5813
1r-4 GRAPH
Time, in minutes
Drawdown, in feet
.05
.01
.15


K&E SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
TP-8 GRAPH
46 5813
48 to MW-18
Δ .14
Δ s = .33
.05
.10
.15
.20
.25
.30
.35
.40
.45
.50
Drawdown, feet
10
100
1000
Time, minutes

K+E SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 5813



TP- 8 Pump Test

TP- 8 Recovery Test