GW - 1

WORK PLANS

1997

RIVER BANK INVESTIGATION

GIANT REFINING COMPANY

BLOOMFIELD REFINERY

PREPARED FOR

NEW MEXICO OIL CONSERVATION DIVISION
SANTA FE, NEW MEXICO

PREPARED BY

LYNN SHELTON
ENVIRONMENTAL MANAGER
GIANT REFINING COMPANY - BLOOMFIELD

June 12, 1997

RIVER BANK INVESTIGATION

GIANT REFINING COMPANY - BLOOMFIELD

MAY, 1997

GENERAL:

The Bloomfield refinery was originally built in the late 1950s and has been operated by Kimball Campbell, O. L. Garretson (Plateau), Suburban Propane, Inc. (Plateau), Bloomfield Refining Company and Giant Refining Company.

The facility is located approximately one mile south of Bloomfield, New Mexico on a precipice (bluff) overlooking the San Juan River. Several geological features come into play at the facility which will be discussed in another section.

Giant Refining Company (GRC) continues remediation activities at the refinery which were required of previous operators by a 3008 (h) Administrative Order on Consent that consists of interim measures of hydrocarbon recovery from the Jackson Lake Terrace and is now proceeding with the modification and submittal of a Corrective Measures Study.

On November 26, 1996, over three weeks into the low flow test of the San Juan River (≤250 cfs), maintenance personnel discovered a sheen of what appeared to be hydrocarbon in an eddy on the San Juan River (see site drawing, Figure 1). GRC immediately placed a floating boom around the sheen and placed absorbent pillows within the boomed area. All appropriate regulatory agencies were notified, including the National Response Center, the New Mexico Oil Conservation Division and the New Mexico Environment Department.

Mitigation activities were started immediately, including excavation to determine the source of the hydrocarbon, soil sampling, installation of a collection gallery to recover Separate Phase Hydrocarbon (SPH), laboratory analysis of the recovered product to determine the origin of the product and a geological assessment of the river bank (also referred to as the sand bar) and the precipice (bluff).

Recovery activities continue and a site assessment to determine the horizontal and vertical extent of the contamination on the river bank has been performed. The site assessment has included historical research of the geomorphology and hydrogeology of the prevalent geological features as well as drilling activity to determine the tops of pertinent formations. GRC has used Precision Engineering, Inc. of Las Cruces to develop a surface and subsurface model of the facility, portions of which are attached.

Through the aforementioned activities, GRC has determined the horizontal and vertical extent of the contamination below the river bank.

GEOLOGY:

The GRC facility is located on the Jackson Lake Terrace of the San Juan River (Pastuzak, 1968) about 120 feet above the present river level and about 500 feet from the river. The terrace was formed during the Pleistocene by downcutting of a former valley floor which had been aggraded with the cobble and gravel deposits during the last glacial advance. At the time, the San Juan River was swollen with meltwater and carried great quantities of glaciofluvial outwash.

During the last glacial retreat, wind blown sand and silt from the floodplains settled over the coarse clastics to form structureless loess deposits.

The Jackson Lake Terrace deposits on which the facility is situated are comprised of about 15 feet of cobbles and gravels overlying the Nacimiento Formation of Tertiary Age. The cobble bed is overlain by about 10-15 feet of fine-grained, windblown sand and silt. South of the facility, the cobble bed wedges out leaving only loess in overlying contact with the Nacimiento Formation. A substantial number of soil borings have demonstrated that the Pleistocene cobble bed occurs everywhere beneath the facility.

The Nacimiento Formation is described in the literature as a massively bedded, unctuous clay. The clay at the outcrop is a tight unfractured rock unit. As measured in nearby oil wells, the Nacimiento Formation is about 500 feet thick. At least 100 feet of this rock is exposed in the precipice (bluff) face north of the facility and adjacent to the San Juan River.

The morphology of the contact between the Quaternary cobble and silt of the Jackson Lake Terrace in the vicinity of the facility and the underlying Nacimiento Formation is important in that it influences control over the direction of groundwater flow. This morphology was evaluated in a Groundwater Discharge Plan renewal and submitted to the New Mexico Oil Conservation Division.

Recent drilling activities indicates a dip in the surface of the Nacimiento southward trending from the precipice at a rate of 2 to 4 vertical feet per 500 horizontal feet. This would explain the direct impact of water mounding and bank storage from the Hammond Ditch on the groundwater beneath the facility. The three dimensional model for the facility, will provide a visual representation of the depressions and characteristics of the formation beneath the facility. The three dimensional model will be available later in 1997.

The geology of the river bank area is composed of fluvials consisting of sand, silt, gravel and cobbles, generally 15 to 20 feet thick overlying and in direct contact with the Nacimiento Formation. As shown in the three dimensional drawings of the top of the

Nacimiento Formation in the river bank area (Figures 2 - 4) the surface of the Nacimiento, from the precipice to the river area, shows several depressions and some river channel scarring. In the area of the most prominent Jackson Lake Terrace seep, which is located north of the flare along the interface of the Jackson Lake Terrace cobble bed and the Nacimiento formation, there appears to be an erosional feature in the vertical face of the precipice that tends to channel groundwater seepage down to the river bank and then westward, within the bank, into a depression on the Nacimiento Formation. The western most, as well as northern most, boundary of the contamination that has flowed into this depression is the San Juan River, which acts as a hydraulic barrier during times of normal flow (500 + cfs).

Additional drawings (Figures 5-11) are included with this report to further illustrate the Nacimiento Formation and how the three dimensional drawings were created.

DRILLING ACTIVITY:

Since the discovery of the sheen on the river, numerous borings have been made to document the geology in the area of the seep and the river bank. Three soil borings were made near the outcrop of the precipice on December 10-13, 1996 (Figure 1) using a CME 75D drilling rig with 8.25 inch OD continuous hollow stem augers and a NWD4 core barrel system. Those borings were drilled to the river level to determine the integrity of the Nacimiento Formation. The Nacimiento Formation was continuously cored. No fracturing or faulting that could act as a hydraulic conduit was observed. This indicated that the SPH and water that had seeped down onto the river bank had migrated from the interface between the Jackson Lake Terrace and the Nacimiento Formation downward along the face of the precipice. Lithologic logs of those borings are included as Attachment 1.

Eight soil borings were made on March 13-20, 1997, again using the CME 75D drilling rig and 8.25 inch OD continuous hollow stem auger with a custom bit. Two of those borings were adjacent to or on the talus slope adjacent to the Nacimiento Formation outcrop and six borings were made on the river bank. The eight soil borings were made to characterize the vertical and horizontal extent of the contamination in the river terrace area as well as to document the surface of the Nacimiento Formation in the river area for the modeling activities that are ongoing. Lithologic logs of the seven borings are included as Attachment 2.

All drilling and logging activities were performed by Precision Engineering, Inc. of Las Cruces, NM. A copy of Mr. Bill Kingsley's report is included as Attachment 3. Sufficient information was obtained to define the extent of the contamination at the river bank.

EXTENT OF CONTAMINATION:

The horizontal and vertical extent of the contamination on the river bank was determined by using a combination of methods including visual observation, Photo-Ionization Detector (PID), soil sampling in conjunction with the characteristics of the Nacimiento Formation.

The vertical extent of the contamination under the river bank is to the top of the Nacimiento Formation. Historical data indicates that the Nacimiento Formation is an impermeable aquitard and observations made while drilling into the formation corroborated this. In every boring the Nacimiento Formation was found to be dry, with liquid infiltration limited generally to four to six inches, with a minimum of two inches and a maximum of 23 inches.

Horizontal extent of the contamination was found to be from north of the primary seep out to the south edge of the water intake lagoon, then westerly to the west edge of the water intake lagoon and then northerly to the river bank, around the bank south southwest to the outcrop of the Nacimiento Formation along the precipice then easterly along the plane of the Nacimiento Formation beneath the talus slope back to the area of the seep. A line marking the extent of the contamination is included in Figures 2-4.

No SPH was observed during drilling of the borings. A sheen was thought to be observed in soil boring SB7-397, but PID readings were 0 and there was no hydrocarbon smell. PID readings generally indicated the presence of hydrocarbon, within the contaminated area, at the interface of the fluvials and the top of the Nacimiento Formation. Soil samples were taken at that interval and analyzed for BTEX constituents (EPA Method 8020) and Total Petroleum Hydrocarbons (EPA Method 418.1). Some additional sampling was performed, at depths other than the interface mentioned above, to determine concentrations when PID readings indicated the presence of hydrocarbons.

The absence of SPH in the soil borings within the contaminated area, when considered with the three dimensional drawings of the area, suggest that the SPH observed at the point where the original sheen was observed, that is, the point at which the San Juan River flows south-southwest into the exposed Nacimiento Formation at the bluff, is probably confined to a depression in the Nacimiento Formation at that point and is limited in volume.

SUMMARY:

GRC has performed substantial investigation of the contamination of the river bank and is performing ongoing mitigation activities to prevent additional releases into the San Juan River.

The sheen is felt to be directly attributable to the low flow test of the river. During the low flow test, the flow rate was at or below 250 cfs for a period of four months. After

three weeks of low flow, the hydraulic barrier formed by the San Juan River had diminished sufficiently to allow SPH that was trapped in the depression in the Nacimiento Formation (as bank storage) to migrate westward.

Additional data has been collected regarding the geology of the site and the vertical and horizontal delineation of the contamination has been made.

GRC determined when the sheen was discovered that the SPH appeared to be in the Naphtha - Kerosene range. Analysis for organic chlorides and olefins confirmed that the SPH was refined product. Interviews with various long term employees at the facility indicated that two leaded gasoline tanks (Tanks #6 & 7) were overfilled occasionally, allowing gasoline to enter the soil. GRC submits that this is, in all likelihood, the source of the SPH plume in the Jackson Lake Terrace formation beneath the facility and, subsequently, the river bank area.

GRC believes that SPH is not presently migrating from the facility to the river bank. Water samples taken from the seep at the interface of the Jackson Lake Terrace cobble bed and the Nacimiento Formation indicate that only a small quantity of dissolved BTEX is contained in the seep. GRC believes that the ongoing interim measures, in the form of product recovery from the Jackson Lake Terrace formation and maintaining a water level in the Hammond Ditch, are preventing migration of the SPH plume from beneath the facility to the northwest and down onto the river bank. GRC also believes that the removal of tanks 6 and 7 in 1987 removed the source of the hydrocarbon that is contained in the SPH plume.

GIANT REFINING COMPANY (as operator)

By: Lynn Shelton

Lynn Shelton
Environmental Manager

Date: 6/13/97

ATTACHMENT 1

PRECISION ENGINEERING, INC.

PROJECT: Bloomfield Refinery
uff Investigation

LOG OF TEST BORINGS

FILE #: 96-181
ELEVATION:
TOTAL DEPTH: 85'
LOGGED BY: Kingsley
DATE: 12/10/1996
STATIC WATER: 10.2'
BORING ID: MW24N Bore
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0-10.2				Cobbles, gravelly, sandy, very dense, rounded and disked, composed of chrystalline intrusives and high density metamorphic rocks, dry to 10.2 feet where the soil becomes water bearing. Generally light colored rocks and light brown fine grained soils.	
10.2-12.5				As above but water bearing. Materials coated black and have hydrocarbon odor.	
12.5				Odor is of older tetted hydrocarbon. Sheen on water, no free hydrocarbon observed	
12.5-39.0				Sandstone, fine, poorly cemented, argillaceous, hand sample crumbles, grey blue.	
				wet but not water bearing, weak hydrocarbon odor, mod. dense, massive (no jointing)	
				Yellow brown color at 13.0', no hydrocarbon odor, slightly less moisture.	
		20		Blue grey at 15.0', no hydrocarbon odor. Sandstone dries white to light grey.	
				Sample recovery 100%. Cores are high quality. Core rate using carbide NWD4 bit	
				approx. 1'/min	
				Thin (<1cm) carbonaceous shale seams, appears coaly, random orientation but	
				typically near flat lying. No free water, samples moist.	
39.0					
39.0-42.0		40		Shale, damp to moist, no water at interface of sandstone above and shale, blue grey	
42.0				to steel grey, crumbles easily in hand samples but dense in situ. Core rate 3"/min	
42.0-85.0				No jointing observed in cores. Recovery 100%. Occasional sandstone stringer	
				6" or less in thickness (rare). Cores are high quality. Some carbonaceous zones.	
				Sandstone, fine, weakly cemented, argillaceous, sample crumbles with difficulty,	
				grey to light brown, some calcite filling along flat lying bedding planes, moist	
				dense, more cemented than sandstone above. Core rate 7"/min.	
				Some shale in very thin lenses >60'.	
		60			
		80			
85.0					
TD					

LOGGED BY: Kingsley

SIZE AND TYPE OF BORING: 8-5/8 od HSA to 12.5', NWD4 core to 85'

PRECISION ENGINEERING, INC.

PROJECT: Bloomfield Refinery
luff Investigation

LOG OF TEST BORINGS

FILE #: 96-181
ELEVATION:
TOTAL DEPTH: 80
LOGGED BY: Kingsley
DATE: 12/11-12/1996
STATIC WATER: 11.7
BORING ID: N Point Bore
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0-11.7			▼	Cobbles, gravelly, sandy, very dense, rounded and disked, composed of chrystalline intrusives and high density metamorphic rocks, dry to 11.7 feet where the soil becomes water bearing. Generally light colored rocks and light brown fine grained soils.	
11.7-12.0				As above but water bearing. Materials coated black and have hydrocarbon odor.	
12.0			▼	Odor is of older fetted hydrocarbon. No sheen observed, no free hydrocarbon.	
12.0-34.7			▼	Sandstone, fine, poorly cemented, argillaceous, hand sample crumbles, grey blue, wet but not water bearing, weak hydrocarbon odor to 13.0, >13.0 no odor, mod. dense	
				Yellow brown color at 13.0', no hydrocarbon odor, slightly less moisture.	
		20	▼	Auger drill to 20.0'. Rotary drill using NWD4 core with carbide bit to TD.	
			▼	21'-23' carbonaceous shale laminae in the sandstone <5mm. >25' sandstone is yellow streaked (limonitic banding).	
34.7			▼		
34.7-52.0			▼	Shale, damp to moist, no water at interface of sandstone above and shale, blue grey to steel grey, crumbles easily in hand samples but dense in situ. Core rate 2"/min	
		40	▼	No jointing observed in cores. Recovery 100%. Cores are high quality.	
52.0			▼		
52.0-80.0			▼	Sandstone, fine, moderately cemented, argillaceous, sample difficult to crumble,	
			▼	grey to light brown, some calcite filling along flat lying bedding planes, moist	
			▼	dense, more cemented than sandstone above. Core rate 5"/min.	
		60	▼		
			▼	mud volume virtually unchanged during the coring.	
			▼	significantly more dense at 73'. Core rate 3"/min.	
80.0		80	▼		
TD					

LOGGED BY: Kingsley

SIZE AND TYPE OF BORING: 8-5/8 od HSA to 20', NWD4 core to 80'

PRECISION ENGINEERING, INC.

PROJECT: Bloomfield Refinery
ff Investigation

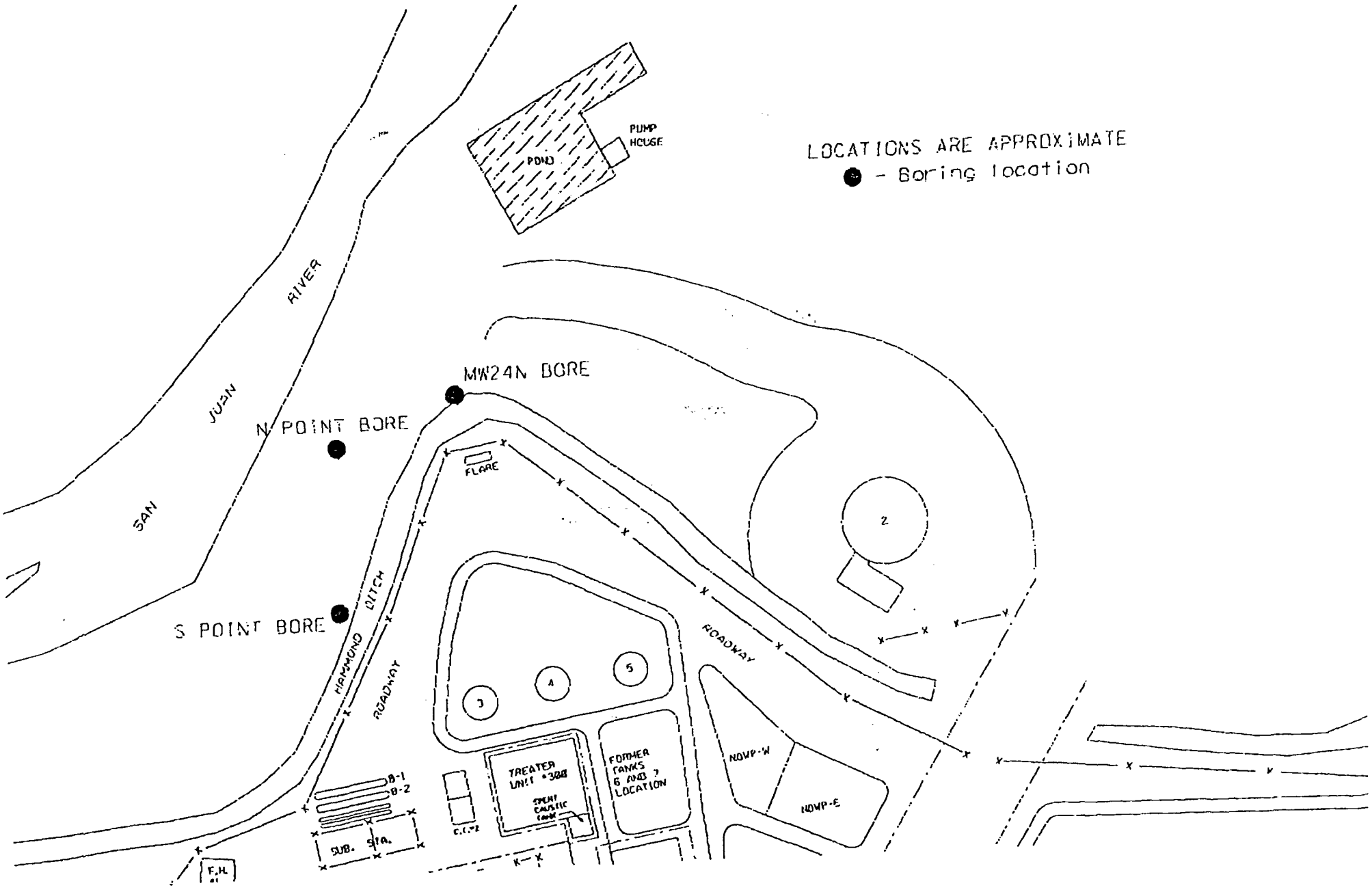
LOG OF TEST BORINGS

FILE #: 96-101
ELEVATION:
TOTAL DEPTH: 85
LOGGED BY: Kingsley
DATE: 12/13/1996
STATIC WATER: 19.5
BORING ID: S Point Bore
PAGE: 1

DEPTH	PLOT	SAMPLE	SAMPLE TYPE	MATERIAL CHARACTERISTICS (MOISTURE CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0-19.5	00o0o00o0		▼	Cobbles, gravelly, sandy, very dense, rounded and disked, composed of chrystalline	
	o00o0o00o			intrusives and high density metamorphic rocks, dry to 19.5 feet where the soil	
	00o0o00o0			becomes water bearing. Generally light colored rocks and light brown fine grained	
	o00o0o00o		▼	soils.	
	00o0o00o0				
	o00o0o00o		▼		
	00o0o00o0		▼		
	o00o0o00o				
19.5-22.0	00o0o00o0			As above but water bearing. Materials coated black and have hydrocarbon odor.	
	o00o0o00o	20	▼	Odor is of older fetted hydrocarbon. Slight sheen observed, no free hydrocarbon.	
22.0	00o0o00o0		▼		
22.0-36.0	*********		▼	Sandstone, fine, poorly cemented, argillaceous, hand sample crumbles, grey blue,	
	*********		▼	wet but not water bearing, weak hydrocarbon odor to 22.6, >22.6 no odor, mod, dense	
	*********		▼		
	*********		▼	Auger drill to 25.0'. Rotary drill using NWD4 core with carbide bit to TD.	
	*********		▼		
	*********		▼	Some limonitic banding >30'.	
36.0	*********		▼		
0-50.5	---------		▼	Shale, damp to moist, no water at interface of sandstone above and shale, blue grey	
	---------	40	▼	to steel grey, crumbles easily in hand samples but dense in situ. Core rate 2"/min	
	---------		▼	No jointing observed in cores. Recovery 100%. Cores are high quality.	
	---------		▼		
	---------		▼		
	---------		▼		
50.5	---------		▼		
50.5-85.0	*********		▼	Sandstone, fine, moderately cemented, argillaceous, sample difficult to crumble,	
	*********		▼	grey to light brown, some calcite filling along flat lying bedding planes, moist	
	*********		▼	dense, more cemented than sandstone above. Core rate 4.5"/min.	
	*********		▼		
	*********	60	▼		
	*********		▼		
	*********		▼		
	*********		▼		
	*********		▼		
	*********		▼	mud volume virtually unchanged during the coring.	
	*********		▼	more dense at 75'. Core rate 3.5"/min.	
	*********		▼		
	*********		▼		
	*********		▼		
	*********	80	▼		
	*********		▼		
85.0	*********		▼		
TD					

LOGGED BY: Kingsley

SIZE AND TYPE OF BORING: 8-5/8 od HSA to 25.0' NWD4 core to 85'


LOCATIONS ARE APPROXIMATE
● - Boring location
POND
PUMP HOUSE
SAN JUAN RIVER
MW24N BORE
N POINT BORE
S POINT BORE
FLARE
HAMMOND DITCH
ROADWAY
ROADWAY
2
3
4
5
TREATER UNIT #388
SPENT CAUSTIC TANK
FORMER TANKS 6 AND 7 LOCATION
NDWP-W
NDWP-E
B-1
B-2
SUB. STA.
F.H.

ATTACHMENT 2

PRECISION ENGINEERING, INC.

LOCATION:

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5464.8
TOTAL DEPTH: 31.5'
LOGGED BY: WHK
DATE: 3-13-97
STATIC WATER: 6.0'/16 HRS
BORING ID: SB1-397
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-6.1	***000***		C	SAND, GRAVELLY, SOME GREY SANDSTONE, LOOSE, (SLOPE TALUS)	0.0-10.0
	000		C		0
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000	5.0	C		
	000		C		
6.1	***000***		C		
6.1-30.3	===**====		C	SHALE, SLIGHTLY SANDY, DARK GREY, WET (NOT WATER BEARING), DENSE	
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====	10	C		
	===**====		C	OLD HYDROCARBON ODOR (DEGRADED)	302
	===**====		C	SLIGHTLY MORE FISSLE AT 12 FEET, DRY GREATER THAN 11 FEET	11.0-31.5
	===**====		C		0
	===**====		C	12.0-13.0 FEET-BROWNER AND SANDY, DRY	
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====	15	C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====	20	C	SHALE, DARK GREY, HARD, DRY FISSLE, SLIGHTLY SANDY	
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

LOCATION:

FILE #:	97-028
ELEVATION:	5464.80
TOTAL DEPTH:	31.5'
LOGGED BY:	WHK
DATE:	3-13-97
STATIC WATER:	6.0'/16 HRS
BORING ID:	SB1-397
PAGE:	2

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
	===**====		C		23.0-31.5
	===**====		C		0
	===**====		C		
	===**====		C		
	===**====	25	C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====		C		
	===**====	30	C	SHALE-HARD FISSLE. SOME SANDY STRINGERS APPROXIMATELY 3 FOOT THICK AT 22'-25'	
30.3	===**====		C		
30.3-31.5	SSSSSSSSS		C	SANDSTONE, WHITE, DENSE, DRY, FINE	
TOTAL DEPTH			C	SOME CUTTINGS OBSERVED AT 20'-25' THAT WERE SATURATED, THEN DRIES OUT.	
			C	SAME OBSERVED WHEN DRILLING 25'-30'.	
			C	SUSPECT WATER AT 10.5'-11.0' RUNNING DOWN BORE HOLE. ANNULUS IS SATURATING	
			C	CUTTINGS.	
			C		
			C		
			C		
			C		
			C		
			C		
			C		
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			C		
			C		
			C		
			C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION:

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5446.64
TOTAL DEPTH: 37.0'
LOGGED BY: WHK
DATE: 3-13-97
STATIC WATER: 28.0'/16 HRS
BORING ID: SB2-397
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-6.0	***000***		C	NOTE: SEEP AT SURFACE OF PAD	0.0-2.0
	000		C	SAND, GRAVELLY, WET/MOIST, LOOSE, BROWN, BLACK IN ZONES, HAS (POOR) HYDROCARBON	0
	000		C	ODOR-OLD SMELL	
	000		C		2.0-5.0
	000		C		5
	000		C		
	000		C		
	000		C		
	000		C		
	000	5.0	C		
	000		C		
6.0	***000***		C		
6.0-17.0	***000***		C	SAND, FINE, GRAVELLY, FLUID BEARING, JET BLACK, STRONG HYDROCARBON ODOR-OLD FETTED.	
	000		C	LOOSE	
	000		C	NOT WATER BEARING GREATER THAN 15.0'	
	000		C	MORE CLAY GREATER THAN 15.0'	
	000		C		
	000		C		
	000		C		
	000	10	C		
	000		C		537
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000	15	C		
	000		C		975
	000		C		
	000		C		
17.0	***000***		C		
17.0-23.5	SSSSSSSSS		C	SANDSTONE, LIGHT GREY/WHITE, HARD, WET, LAMINATED, SHOWS SOME ANGULAR DISCONTINUITY	
	SSSSSSSSS		C	(NOT WATER BEARING)	
	SSSSSSSSS		C		
	SSSSSSSSS		C		
	SSSSSSSSS		C		
	SSSSSSSSS	20	C		
	=S=S=S=S=		C	SHALE AND SANDSTONE IN RANDOM DISCONTINUOUS LAYERS AND DIPS-SUSPECT TOPPLED BLOCK	
	=S=S=S=S=		C	FROM ADJACENT CLIFF FACE	1331
	=S=S=S=S=		C		
	=S=S=S=S=		C		
	=S=S=S=S=		C		67
	=S=S=S=S=		C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION:

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5446.64
TOTAL DEPTH: 37.0'
LOGGED BY: WHK
DATE: 3-13-97
STATIC WATER: 28.0'/16 HRS
BORING ID: SB2-397
PAGE: 2

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
23.5	=S=S=S=S=		C		
23.5-29.0	*********		C	SAND, MEDIUM, WET, LOOSE, DARK GREY, OLD HYDROCARBON ODOR FETTED, NOT WATER BEARING	
	*********		C		
	*********	25	C		
	*********		C		571
	*********		C		
	*********		C		1037
	*********		C		
	*********		C		
	*********		C		
	*********		C	WATER BEARING AT 28.0', BLACK, HYDROCARBON ODOR (OLD)	449
29.0	*********		C		
29.0-32.5	SSSSSSSSS		C	NACIMIENTO FORMATION	773
	SSSSSSSSS	30	C	SANDSTONE, HARD, MOIST, ARGILLACEOUS, LIGHT BROWN	
	SSSSSSSSS		C		155
	SSSSSSSSS		C		40
	SSSSSSSSS		C		48
	SSSSSSSSS		C		
32.5	SSSSSSSSS		C		22
32.5-37.0	=========		C	SHALE, GREY-GREEN, HARD, DRY/DAMP, FISSLE	32.0-37.0
	=========		C		0
	=========		C		
	=========		C		
	=========	35	C		
	=========		C		
	=========		C		
	=========		C		
37.0	=========		C		
TOTAL DEPTH				WATER AT 28.0' IN AUGER AFTER 16 HOURS	

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION:

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5419.09
TOTAL DEPTH: 10.0'
LOGGED BY: WHK
DATE: 3-14-97
STATIC WATER: 4.0'
BORING ID: SB3-397
PAGE: I

DEPTH	SAMPLE TOT	SAMPLE SCALE	SAMPLE LE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-1.0	****0****		C	SAND. LOOSE. BROWM. MOIST. (FILL) GRAVELLY	
1.0	****0****		C		
1.0-2.2	///**-///		C	CLAY. SANDY. SILT. BLACK-GREY. OLD HYDROCARBON ODOR. WET. NEARLY WATER BEARING	109
2.2	///**-///		C		
2.2-6.0	*********		C	SAND. FINE-MEDIUM. WELL SORTED. BLACK. WET. WATER BEARING GREATER THAN 4.0 FEET	
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********	5.0	C		
	*********		C		1068
6.0	*********		C		
6.0-10.0	SSSSSSSSS		C	NACIMIENTO FORMATION	16.5
	SSSSSSSSS		C	SANDSTONE. ARGILLACEOUS. FINE. DENSE. GREENGREY. WET. NO ODOR	
	SSSSSSSSS		C		
	SSSSSSSSS		C		0
	SSSSSSSSS		C		
	SSSSSSSSS		C		
	SSSSSSSSS		C		
	SSSSSSSSS	10	C	MOIST AT 10.0 FEET	0
TOTAL DEPTH					

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION: SEE SITE PLAN

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5428.88
TOTAL DEPTH: 20.0'
LOGGED BY: WHK
DATE: 3-14-97
STATIC WATER: 11.5'
BORING ID: SB4-397
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-6.0	///--*0//		C	CLAY, SILTY, SANDY, SOME LARGE COBBLES, BOULDER INFILL	0.0-20.0
	///--*0//		C	LARGE COBBLE (BOULDER) 4.5-6.0, BROWN	0
	///--*0//		C		
	///--*0//		C		
	///--*0//		C		
	///--*0//		C		
	///--*0//		C		
	///--*0//		C		
	///--*0//		C		
	///--*0//	5.0	C		
	///--*0//		C		
6.0	///--*0//		C		
6.0-9.5	*********		C	SAND, FINE, LIGHT BROWN, LOOSE, MOIST	
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
9.5	*********		C		
9.5-17.0	***000***	10	S	SAND, GRAVELLY, DENSE, BROWN, MOIST, WATER BEARING AT 11.5 FEET	
	000		S		
	000		S		
	000		S		
	000		S		
	000		S		
	000		S		
	000		S		
	000		S		
	000		S		
	000	15	S		
	000		S		
	000		S	GLASS FRAGMENT, HIGHLY WEATHERED FOUND AT 16.0 FEET	
	000		S		
17.0	***000***		S		
17.0-20.0	=========		S	NACIMIENTO FORMATION	
	=========		S	SHALE, BLACK/GREY, MOIST, HARD, FISSLE, LITTLE TO NO SAND	
	=========		S		
	=========		S		
	=========		S		
	=========	20	S		
TOTAL DEPTH					

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION: SEE SITE PLAN

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5423.26
TOTAL DEPTH: 17.5'
LOGGED BY: WHK
DATE: 3-20-97
STATIC WATER: 4.0'
BORING ID: SB5-397
PAGE: 1

DEPTH	POLT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-11.5	*********		C	SAND, FINE, LOOSE, MOIST, BROWN	
	*********		C		
	*********		C		
	*********		C		
	*********		C		60
	*********		C		
	*********		C		
	*********		C	BLACK, WATER BEARING AT 4.0'	
	*********		C		603
	*********	5.0	C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********	10	C		
	*********		C	SOME SHEEN	1056
	*********		C		
11.5	*********		C		
11.5-13.5	***00****		C	SAND, MEDIUM GRAINED, SOME COBBLES, DENSE, FLOWS, BLACK	
	00*		C		
	00*		C		231
13.5	***00****		C		
13.5-15.0	***00****		C	SAND, MEDIUM, GRAVELLY, GREY (DARK), NO ODOR, LOOSE	
	00*		C		
15.0	***00****	15	C		0
15.0-17.5	=========		C	SHALE, GREY, HARD, DAMP, FISSLE, (APPEARS DRY), LITTLE SAND	
	=========		C		
	=========		C		
	=========		C		0
17.5	=========		C		
TOTAL DEPTH				NO SHEEN-ANY DEPTH	

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION: SEE SITE PLAN

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5422.69
TOTAL DEPTH: 17.5'
LOGGED BY: WHK
DATE: 3-20-97
STATIC WATER: 4.67'
BORING ID: SB6-397
PAGE: 1

DEPTH	SOIL TYPE	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-14.5	*********		C	SAND, FINE, DAMP, BROWN, MODERATELY DENSE, BLACK, FINE AND COARSE GRAVEL	
	*********		C		
	*********		C		0
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C	BLACK AT 4.0 FEET	
	*********	5.0	C	WATER BEARING AT 4.67 FEET-NO SHEEN (NO SEPARATE PHASE)	
	*********		C	GRAVELLY AT 5.0 FEET, GRAVEL UP TO 2 INCHES IN SIZE	981
	*********		C	LITTLE TO NO SILT	
	*********		C		
	*********		C		
	*********		C		
	*********		C		511
	*********		C		
	*********		C		970
	*********		C		
	*********	10	C		
	*********		C		13
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		50
	*********		C		
	*********		C		
14.5	*********		C		
14.5-17.5	$$$$$$$$$	15	C	NACIMIENTO FORMATION	
	$$$$$$$$$		C	SANDSTONE, FINE, GREY-BLUE, DENSE, MOIST-WET, NOT WATER BEARING, FRESH SAMPLE LOOKS	3
	$$$$$$$$$		C	DRY	
	$$$$$$$$$		C		
	$$$$$$$$$		C		0
17.5	$$$$$$$$$		C		
TOTAL DEPTH					

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION: SEE SITE PLAN

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5423.17
TOTAL DEPTH: 17.5'
LOGGED BY: WHK
DATE: 3-20-97
STATIC WATER: 5.0'
BORING ID: SB7-397
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-1.0	///000///		C	CLAY, GRAVELLY, DRY-DAMP, SOFT, BROWN, NO ODOR	0.0-17.5
1.0	///000///		C		0
1.0-5.0	*********		C	SAND, FINE, LOOSE, MOIST, BROWN, NO ODOR	
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
	*********		C		
5.0	*********	5.0	C		
5.0-16.3	***000***		C	SLIGHTLY GRAVELLY GREATER THAN 4.0'	
	000		C	SAND, FINE-MEDIUM, WATER BEARING, GRAVELLY, LOOSE, BROWN, NO ODOR	
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000	10	C		
	000		C		
	000		C		
	000		C		
	000		C	BOULDER AT 11.5'-12.9'	
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000	15	C		
	000		C		
	000		C		
16.3	***000***		C		
16.3-17.5	=========		C	SHALE, GREY-BLUE, HARD, FISSLE, MOIST, APPEARS DRY	
17.5	=========		C		
TOTAL DEPTH					

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

PRECISION ENGINEERING, INC.

LOCATION: SEE SITE PLAN

LOG OF TEST BORINGS

FILE #: 97-028
ELEVATION: 5421.52
TOTAL DEPTH: 17.5'
LOGGED BY: WHK
DATE: 3-20-97
STATIC WATER: 4.0'
BORING ID: SB8-397
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE, CONDITION, COLOR, GRAINSIZE, ETC.)	PID (ppm)
0.0-4.5	**0000***		C	SAND, FINE, LOOSE, BROWN, VERY COBBLEY, MOIST	0.0-17.5
	0000*		C		0
	0000*		C		
	0000*		C		
	0000*		C		
	0000*		C		
	0000*		C		
	0000*		C		
4.5	**0000***		C		
4.5-9.0	***///***	5.0	C	SAND, CLAYEY, WATER BEARING, LIGHT GREY, VERY LOOSE, NO ODOR	
	///		C	WATER BEARING GREATER THAN 4.0 FEET	
	///		C		
	///		C		
	///		C		
	///		C		
	///		C		
	///		C		
9.0	***///***		C		
9.0-13.5	***000***		C	SAND, COBBLEY, WATER BEARING, NO ODOR, MODERATELY DENSE, GREY-BROWN	
	000	10	C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
	000		C		
13.5	***000***		C		
13.5-16.5	***00****		C	SAND, FINE, SLIGHTLY GRAVELLY, WATER BEARING, GREY, NO ODOR	
	00*		C		
	00*	15	C		
	00*		C		
	00*		C		
16.5	***00****		C		
16.5-17.5	=========		C	NACIMIENTO FORMATION	
17.5	=========		C	SHALE, BLACK, FISSLE, DENSE, MOIST, NOT WATER BEARING	
TOTAL DEPTH					

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID CONTINUOUS FLIGHT HSA

ATTACHMENT 3

PRECISION ENGINEERING, INC.
P.O. BOX 422 • LAS CRUCES, NM 88004
Ph: (505) 523-7674
FAX: (505) 523-7248 • E-mail: werpei@aol.com

May 23, 1997

Mr. Lynn Shelton, CET
Environmental Manager
Giant Refining Company
Bloomfield Refinery
#50 County Road 4990
P.O. Box 159
Bloomfield, New Mexico 87413-0159

Re: Geologic Conditions at the Sandbar Site, Bloomfield Refinery

Dear Lynn,

Attached is our report on findings at the "Sandbar" site. The report contains our subsurface information and interpretation of the data obtained during the investigation. The information outlines the vertical and horizontal extent of the contamination identified at the Sandbar site.

As you are aware the interpretation of the extent of the impacted area is based on borings performed at the site, an evaluation of the surface geologic features, as well as previous drilling information provided by Giant Refining Company. If you have any questions concerning the information provided please contact our office.

Sincerely,
Precision Engineering, Inc.

William H. Kingsley, P.E.

Bloomfield Refinery Sandbar Area
File # 97-031

Introduction

In late November of 1996 an apparent hydrocarbon release was noted in an area of the refinery property locally termed as the "Sandbar". The hyrdocarbon was noted as a sheen on the San Juan River surface at a point where the river bends and flows adjacent to a bluff approximately eighty (80) to ninety (90) feet in height. The release was noted at the beginning of a low flow period for the river which was intended to assist in the propagation of certain fish species native to the river. Recovery operations were initiated and quickly controlled the release. It is the intent of this report to discuss the horizontal and vertical extent of the impacted area as it relates to the river area.

Site Geology

Generally, the refinery site is located on a bluff that has been developed as a result of the incision of the San Juan River into the Nacimiento Formation. There are three distinct stratigraphic units that underlay the refinery site. From oldest to youngest these units are: the Nacimiento Formation, the Jackson Lake Terrace, and an unnamed structureless loess unit composed of silts and fine sand that have been deposited as the result of eolian deposition during the last glacial retreat.

The uppermost loess deposit is essentially absent from the river terrace area above the sandbar site. Deflation caused by wind and precipitation erosion has all but eliminated the layer within approximately one hundred (100) feet of the bluff crest. Only a thin veneer of the deposit remains at isolated protected locations along the bluff crest.

The Jackson Lake Terrace is composed of well rounded cobble and boulder sized rocks placed as the result of high energy deposition during melting of the last glacial advance. The rock is often disk shaped as a result of grinding and polishing of slabby rock debris. The rock is predominantly comprised of metamorphic and intrusive volcanic fragments imported by the swollen San Juan River system. Because of the disk shaped nature of the materials, when confined the rock is very dense. The smooth, well rounded surfaces, however, cause the material to be relatively unstable when exposed and unconfined. As a result, most of the material eroded out of an exposed section of Jackson Lake Terrace accumulates at the toe of sloping faces. Substantial amounts of the rocky material litters the base of the eroded slopes of cuts through the Jackson Lake Terrace material. The terrace material caps the bluff throughout the sandbar area.

The Nacimiento Formation directly underlies the Jackson Lake Terrace material and is composed of a highly argillaceous, very fine, soft, sand or siltstone with interbeds of dense black shale. The clay-sandstone is massively bedded at the sandbar site and in the continuous cores and in outcrops shows little evidence of vertical jointing. Some outcrops show blocks separating from the main unit to form toppling blocks, however, continuous deep seated jointing is not observed.

The material that composes the sand bar area itself consists of relatively loose sands and cobbles deposited by the San Juan River. The lower two to three feet of this debris where

near the face of the bluff is fine sand. The sand is placed in laminar layers and likely represents older flood plain deposits of the river. This sand represents the bulk of the affected material along the south edge of the sandbar.

In the past the river channel flowed along the bluff face at the sand bar location but was aggraded when the river was forced to the north by naturally occurring upstream channel changes. These changes pushed the point of contact between the river and the Nacimiento Formation to the west, forming the sandbar area.

All but twenty (20) to thirty (30) feet of the Nacimiento bluff is covered by talus debris. The talus consists mainly of sandy clays deposited as a result of the erosion of the cliff face. Some large blocks of the formation have toppled onto the talus slope and have been subsequently buried by additional soil. Occasional cobbles or boulders are encountered in the talus debris, but, because the slope is steep and the rock of the Jackson Lake Terrace is well rounded these materials tend to collect at the base of the talus pile.

Free water was encountered at all drilling locations, however, it varied in thickness substantially. The water encountered at the sandbar is essentially at the same elevation as the river. Observations in stand pipes placed in the sandbar area indicate fluctuation of the river level directly affects the depth of the groundwater in the sandbar area.

Free water on the bluff directly over looking the sandbar appears to be generated by the Hammond ditch and flows along the top of the Nacimiento Formation surface. Drilling along the bluff crest indicated that no free water was encountered below the Nacimiento Formation surface. The findings support earlier studies that indicate the Nacimiento is an aquitard.

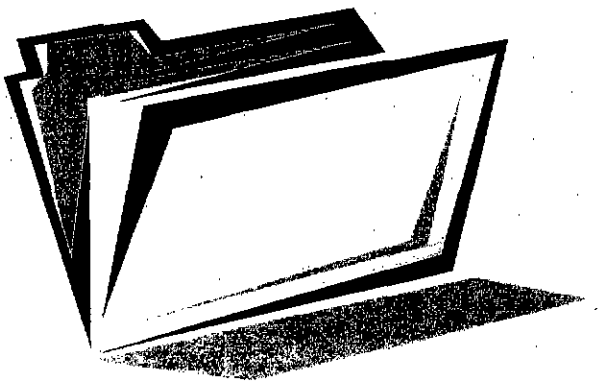
The impacted area consists of a portion of the site extending from the Hammond ditch on the south to the San Juan River on the north. Ponds in the sandbar area used to provide water to the refinery facility also appear to be a northern boundary. Drilling north of the pond outline showed no affected material. The east extent of the affected area at the sand bar is a point approximately parallel to the east edge of the pump station. The west edge is essentially defined by the river edge as it sweeps southward and contacts the Nacimiento Formation outcrop at the bluff face. Hand excavations and hand augering showed no evidence of the impacted material west of the westerly most edge of the sand bar along the bluff face.

The thickness of the affected material varies from approximately three feet at the westerly edge of the sand bar to approximately nine feet of material in the central portion of the sandbar area. The upper surface of the affected material is typically within five feet of the existing ground surface at any location within the affected area. The lower boundary can be is defined by the top of the Nacimiento Formation. In the sandbar area the Nacimiento Formation is typically a black, dense, fissle shale. Hydrocarbon within the shale drops to nondetectable levels as measured using photoionization techniques within one to two feet of the shale surface. Samples of the shale show decreasing moisture content with depth and are nonwater bearing.

During the drilling no free product was identified during the drilling in the sandbar area.

Evaluation of the drill logs indicate that there is an incised area that cuts into the Nacimiento surface at the sand bar location. Water flowing over the top of the Nacimiento surface follows the dished out zone and migrates onto the flatter Nacimiento surface below, which represents the present day bed level of the river. The river apparently looped through what is now the raised sandbar surface cutting out the Nacimiento surface. The Nacimiento surface below the sandbar is slightly lower toward the south central portion of the sandbar than at the edges suggesting that the river scoured the Nacimiento surface somewhat as it flowed adjacent to the bluff at that location. This may account for some "pooling" of contaminants and hydraulic trapping during high flow periods.

Logs of the drilling, boring location diagrams, and cross sections used for the evaluation of the site are included as attachments. Information used for the interpretation of the site conditions was derived from our observations of drilling, previous drill logs, an evaluation of site outcrops, and a review of previous studies performed near the plant site.



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IMPROVED DUE TO CONDITION

OF ORIGINALS

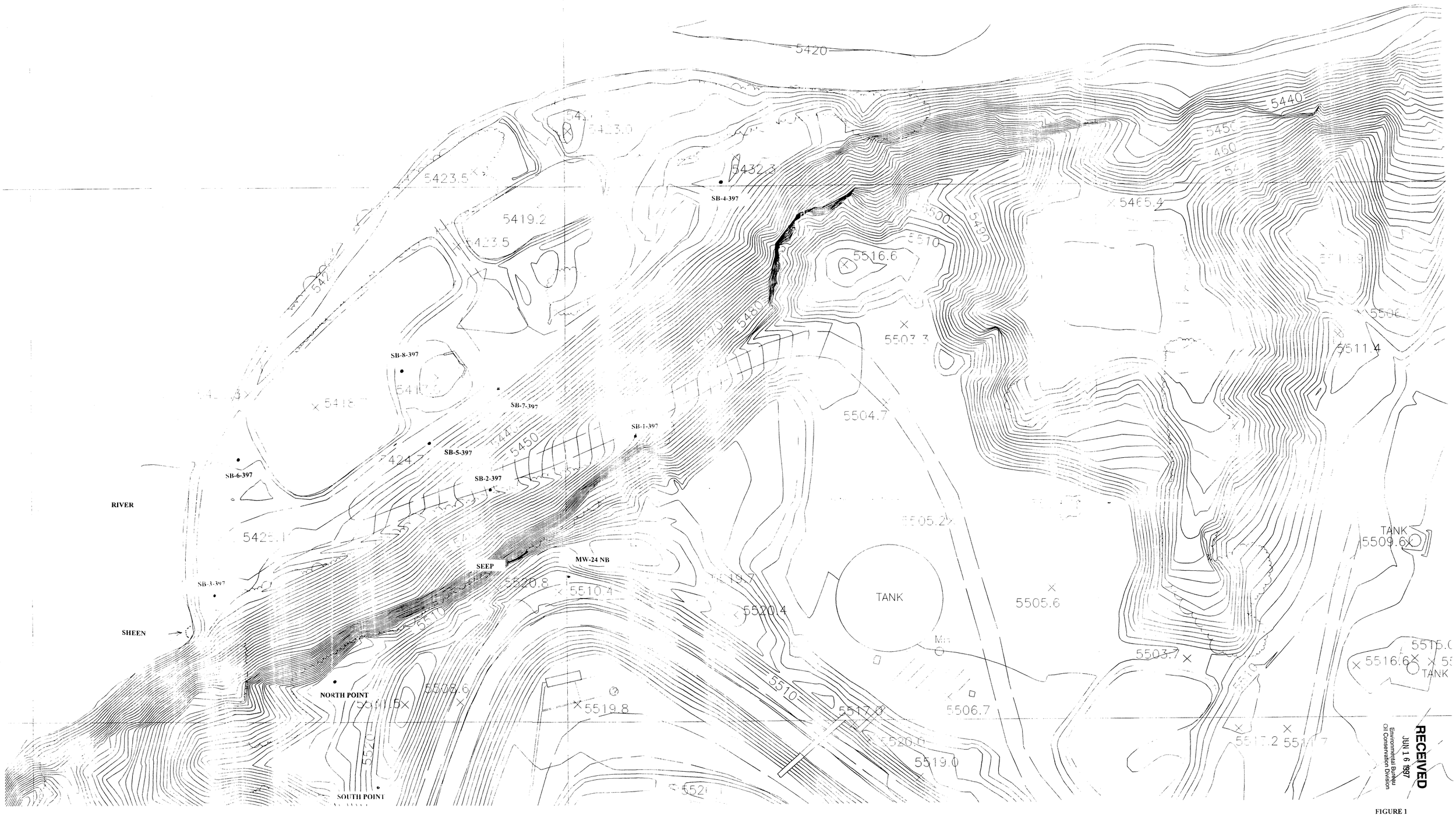


FIGURE 1

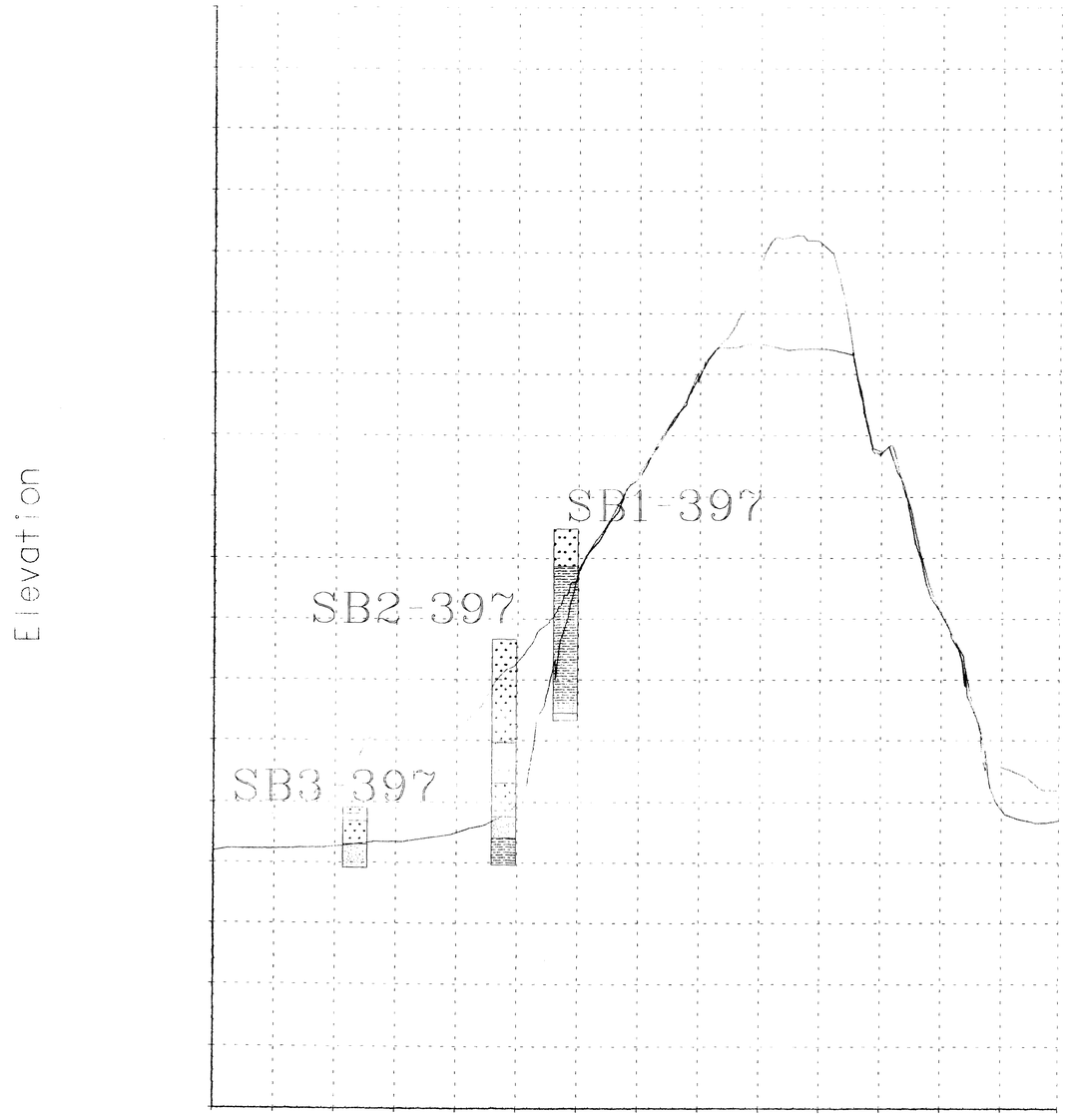
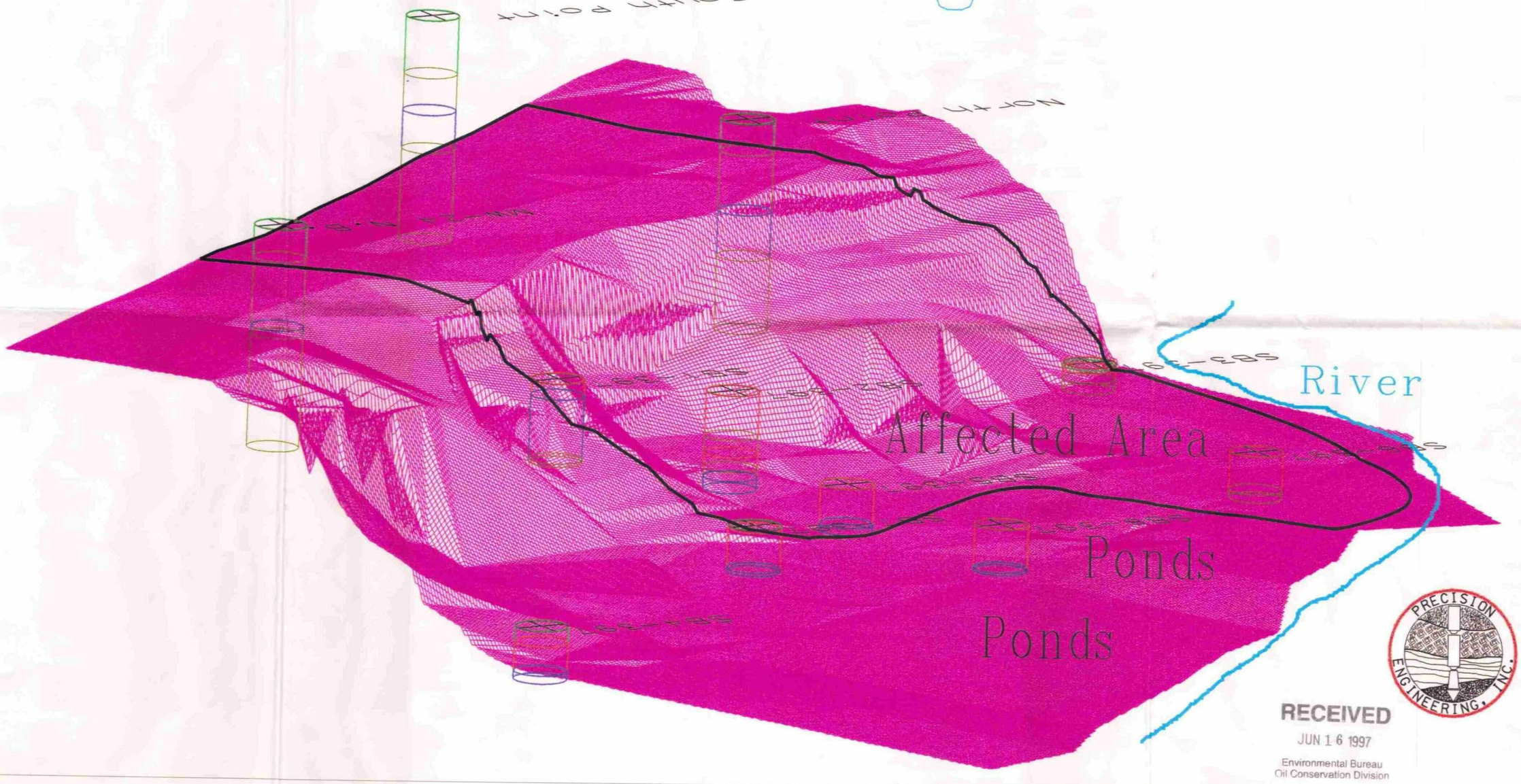


FIGURE 11

FIGURE 13

View Looking SW



PRECISION ENGINEERING, INC.

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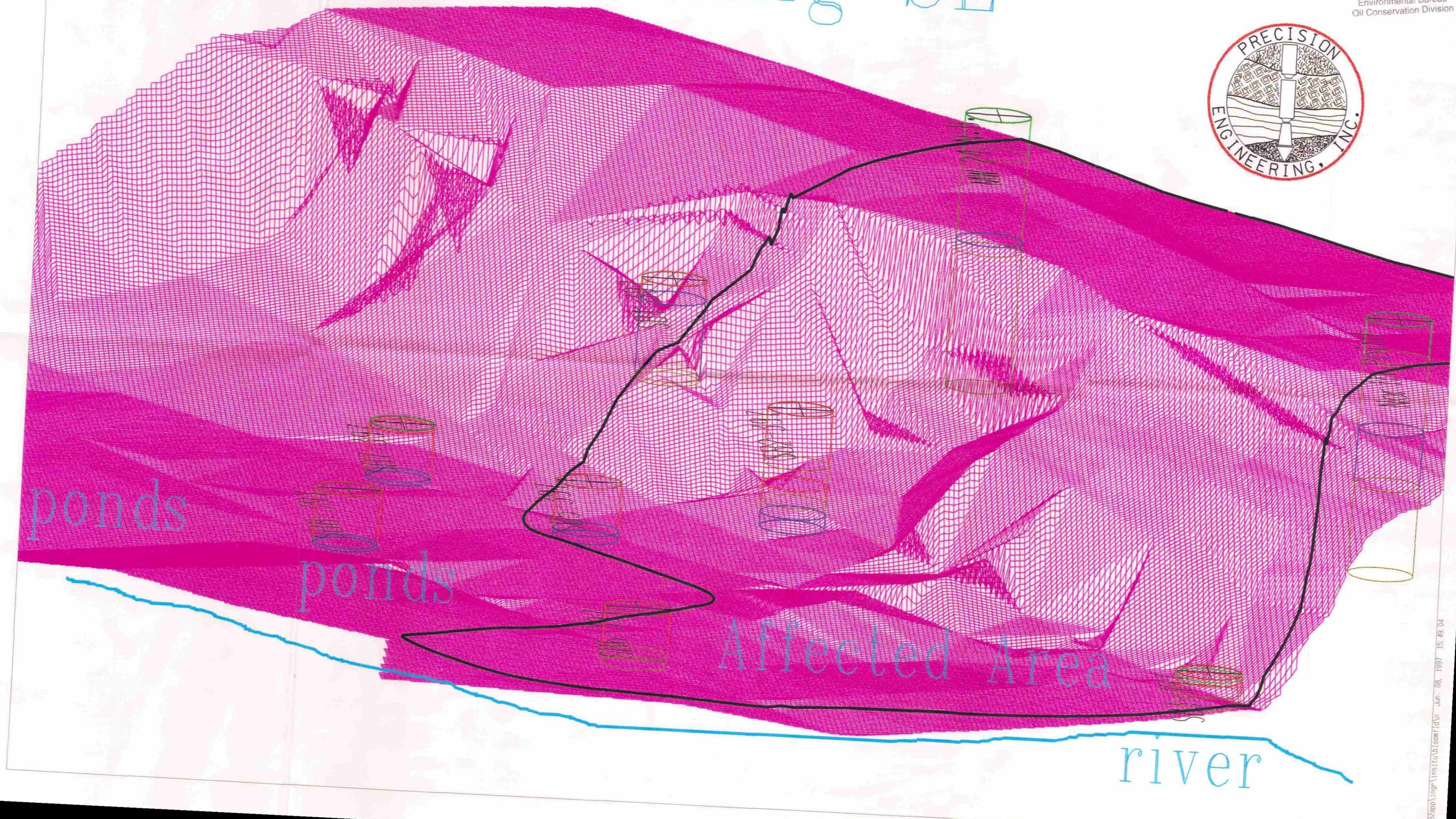
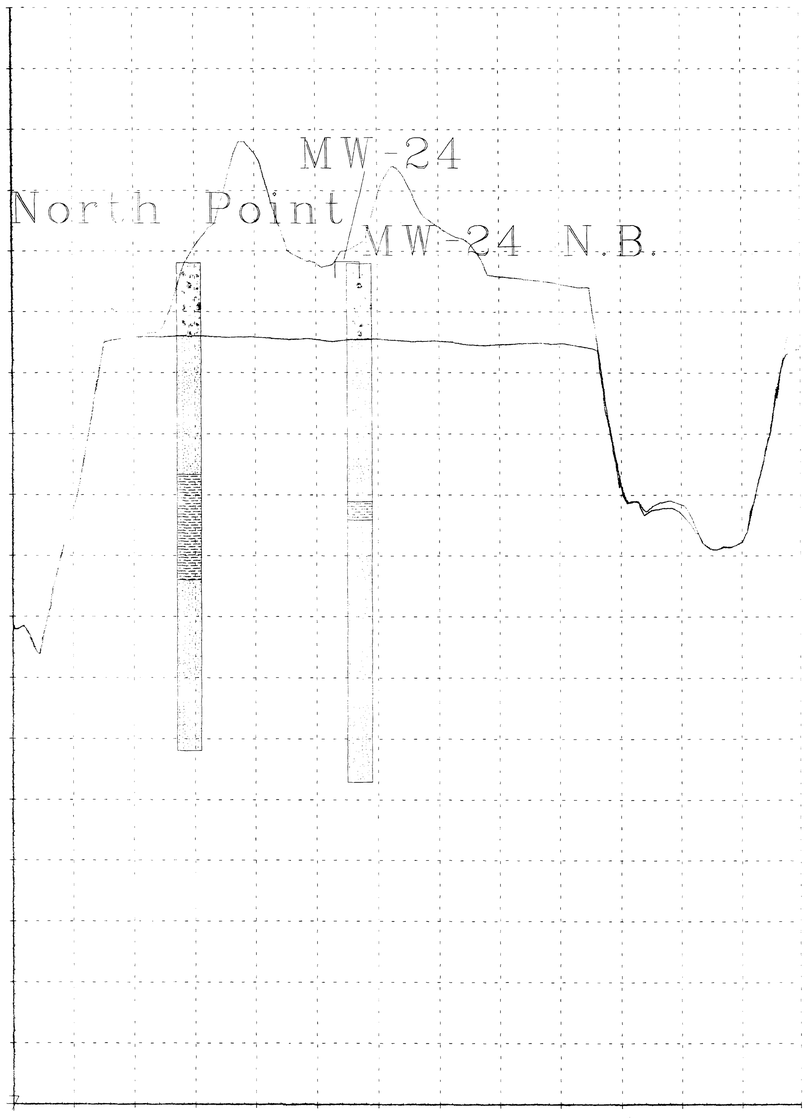
Looking SE

PRECISION ENGINEERING, INC.



Profile Window 4



Profile Window 5

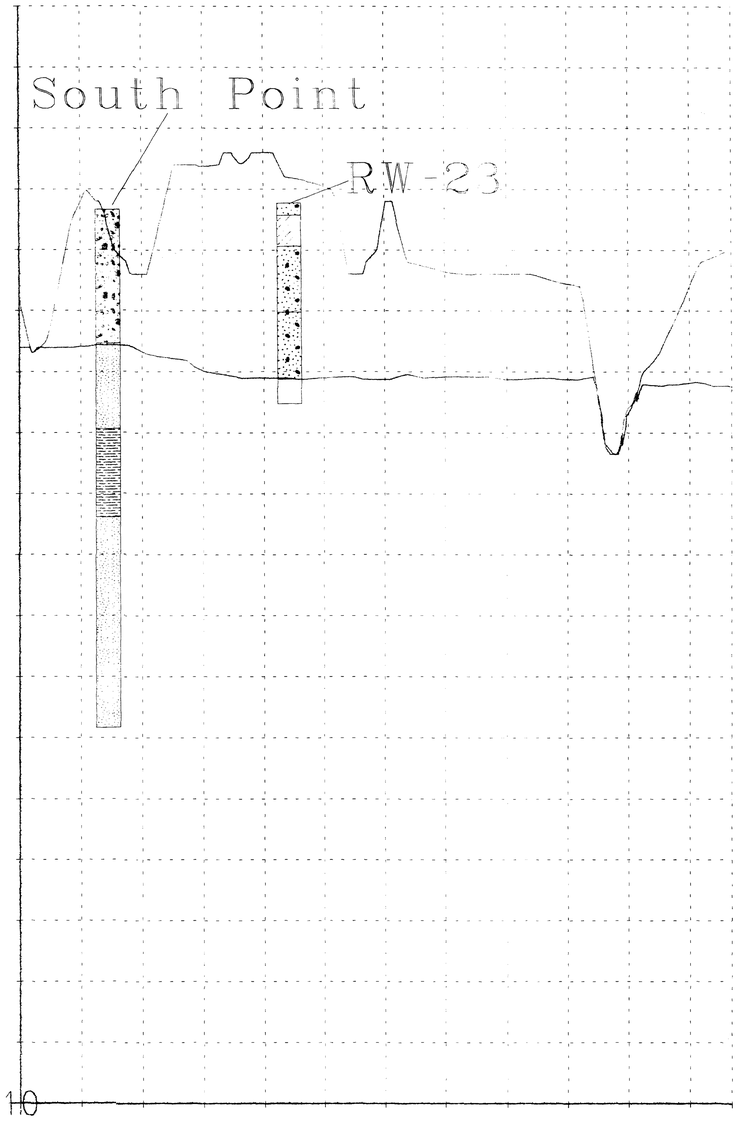
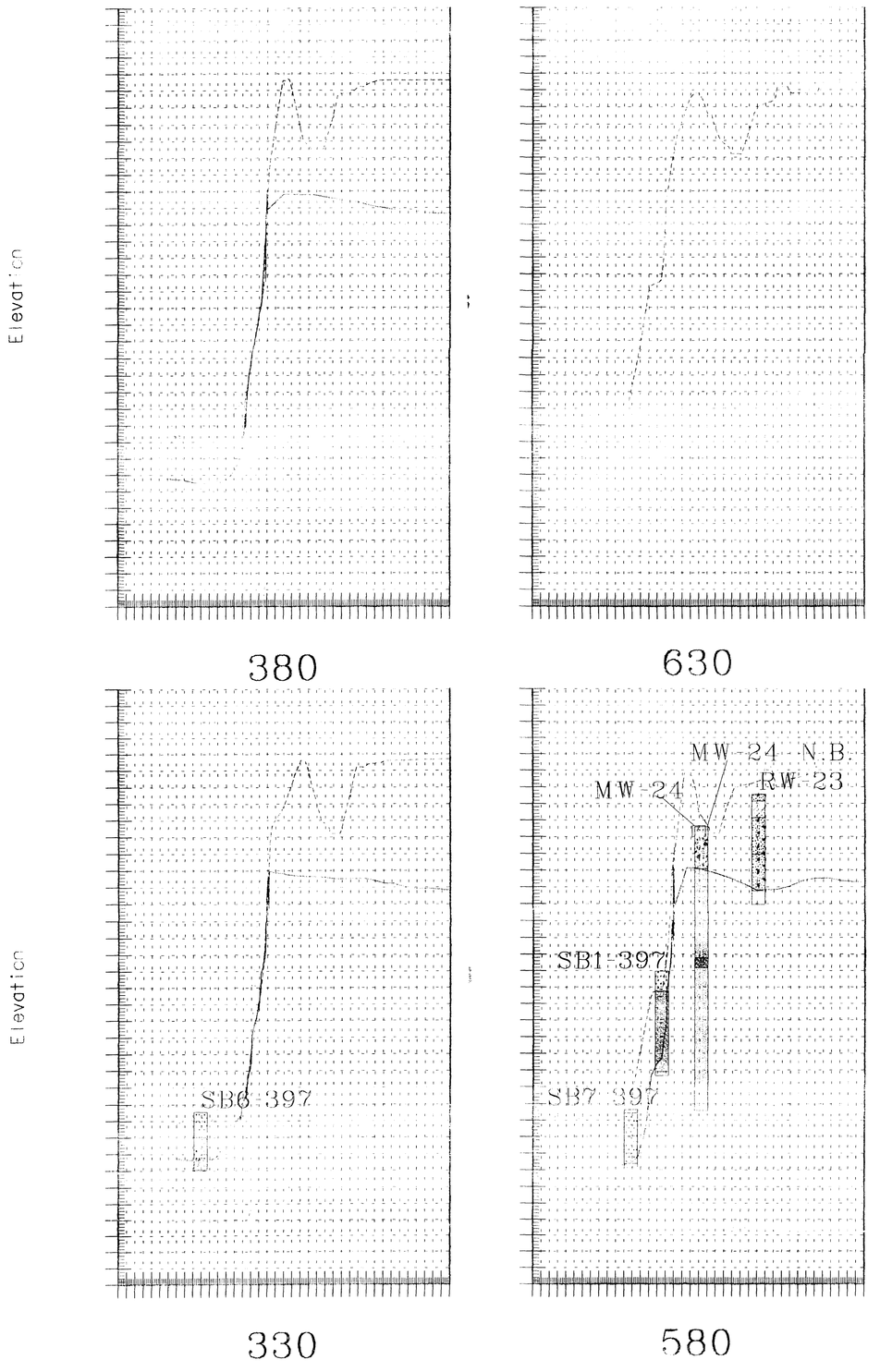


FIGURE 8



BLOOMFIELD REFINERY

SANDBAR AREA

PRECISION ENGINEERING, INC.

SCALE 1"=100'

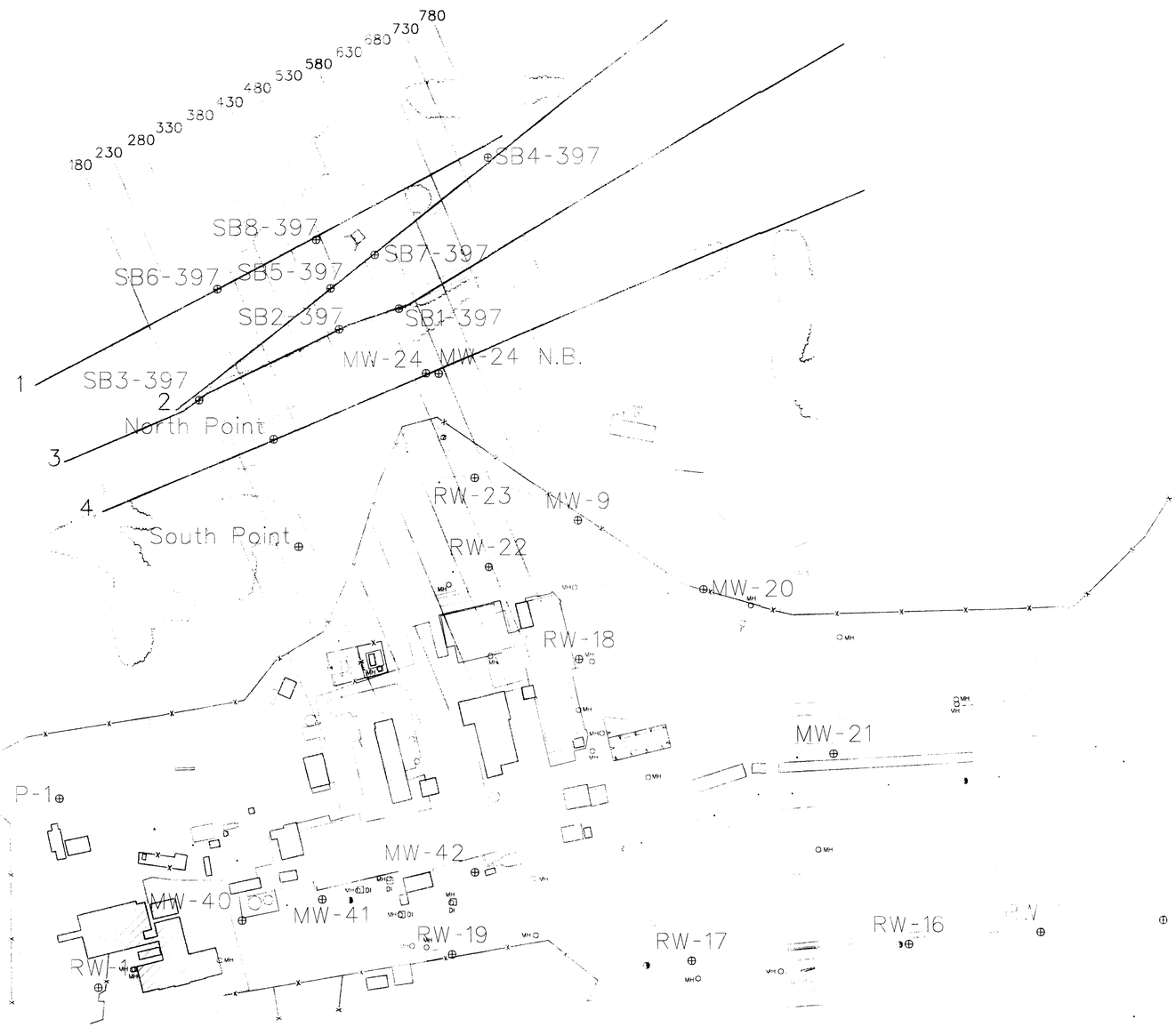
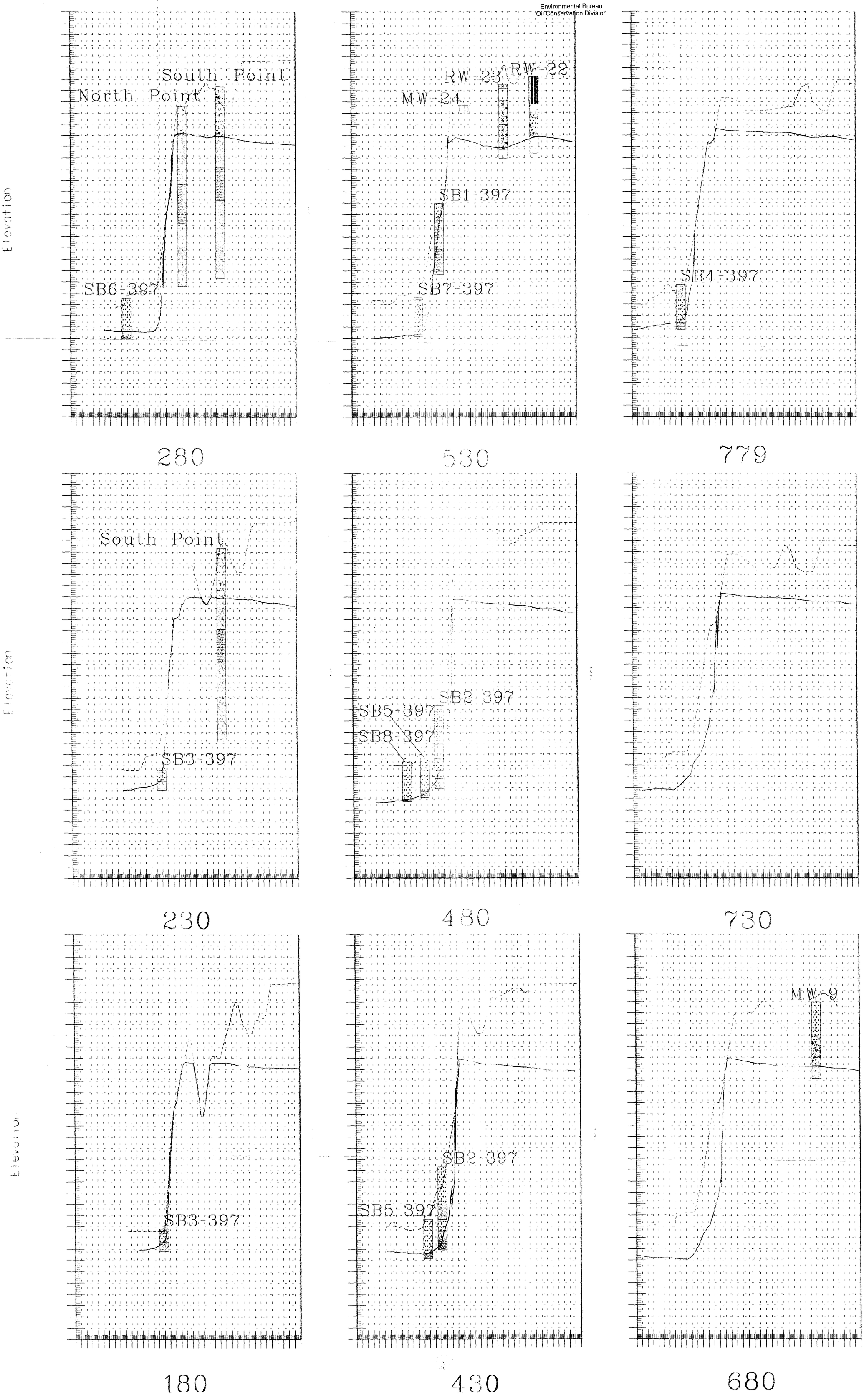


FIGURE 6

FIGURE 9



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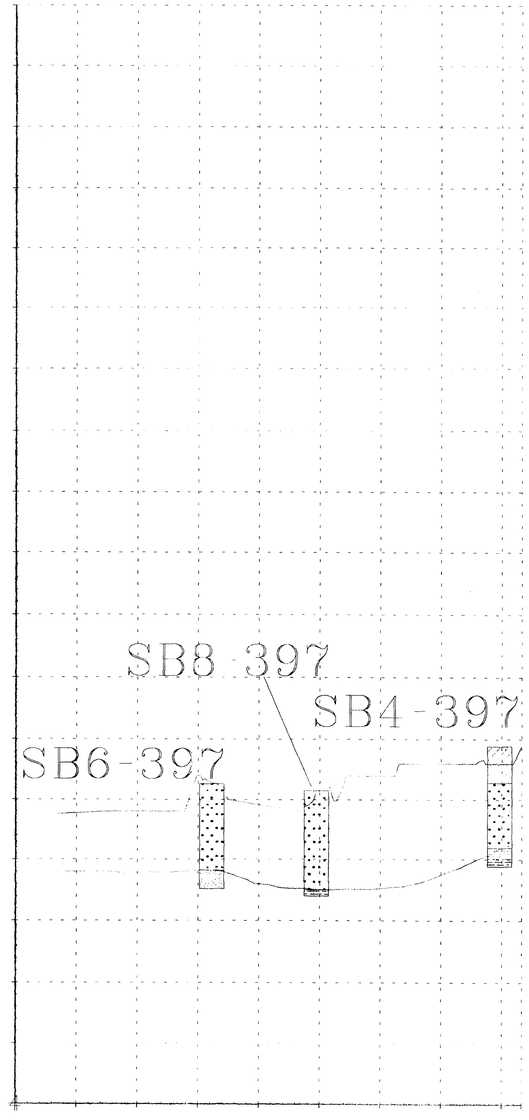


Profile Window 2

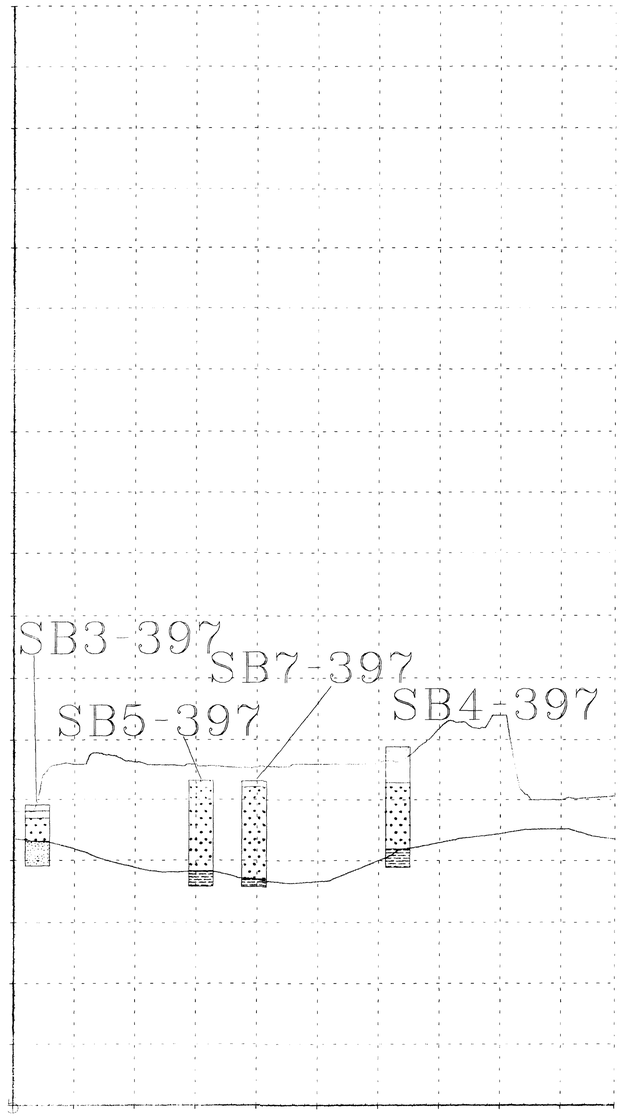
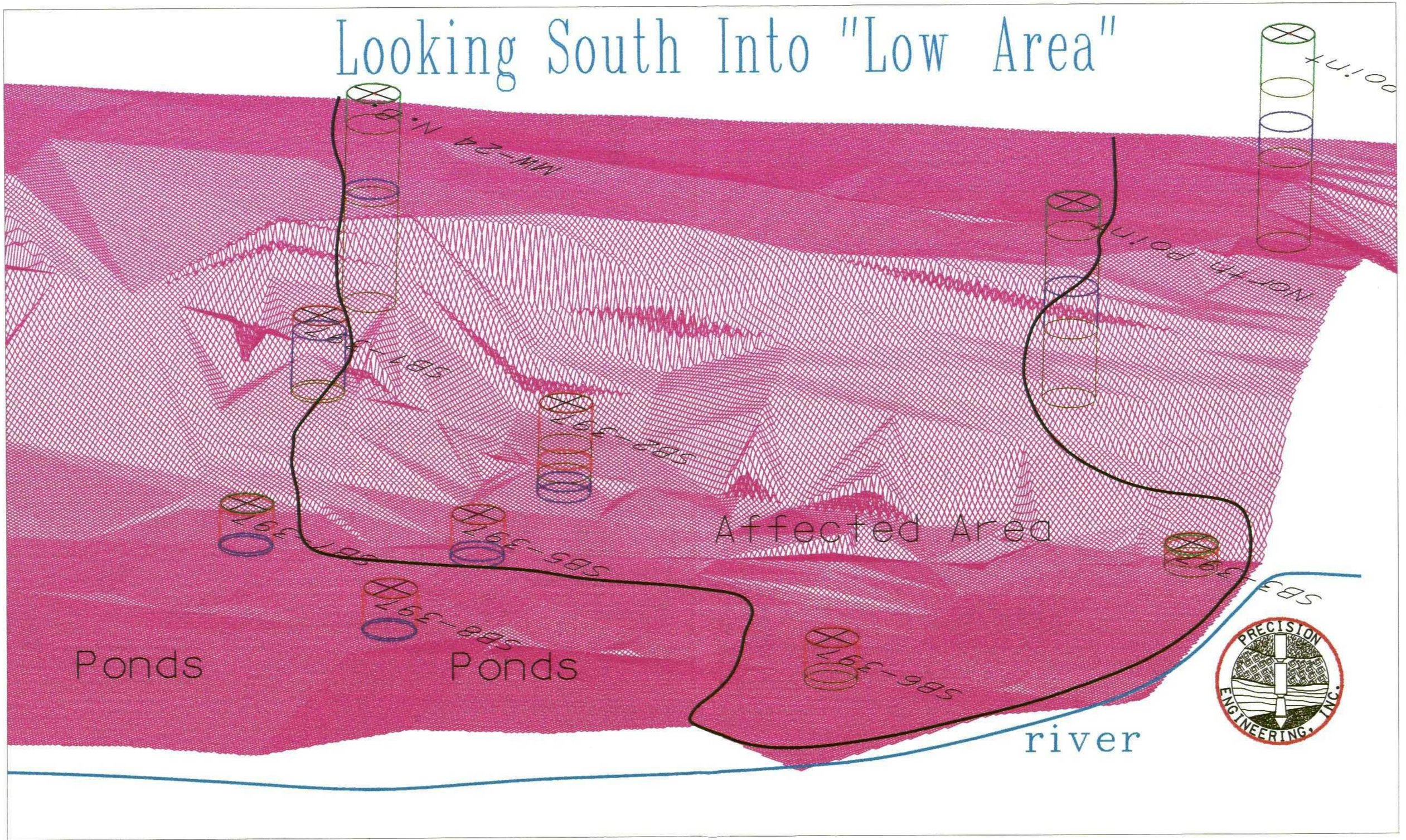


FIGURE 10

Looking South Into "Low Area"



d:\win32app\ingr\insitu\bloomfld\n Jun. 08, 1997 14:52:37