MEMORANDUM

#103

January 29, 1998
Richmond, California

Evaluation of Intrinsic Bioremediation
Chevron Service Station #9-0076
4265 Foothill Boulevard
Oakland, California

Mr. Phil Briggs:
San Ramon, California

I have reviewed the analytical data collected during the 9/17/97 groundwater sampling event for this site in order to make a determination of the presence of intrinsic bioremediation within the hydrocarbon plume at this site. Based on the attached plots of total BTEX versus indicator parameter, it is likely that intrinsic bioremediation is occurring within the hydrocarbon plume at this site. The effect of this process will be to stabilize the plume and reduce the plume as the source area is depleted.

Background

The demonstration of intrinsic bioremediation requires multiple lines of evidence, including analytical data which suggest that bioremediation is actually occurring in the field. The evaluation of indicator parameters across a dissolved contaminant plume can be used in the demonstration of intrinsic bioremedaition. One or more trends observed across a dissolved plume (with increasing contaminant concentration) would suggest the potential occurrence of intrinsic bioremediation. With increasing BTEX concentrations, the expected trend in indicator parameter concentrations would be:

Relative Decrease In:	Relative Increase In:
Dissolved Oxygen	Dissolved Iron (Ferrous)
Oxidation- Reduction Potential (Redox)	Alkalinity
Nitrate	
Sulfate	

In the attached plots, the sampled wells are presented on the X-axis from the upgradient wells to downgradient wells through the contaminant plume. The resulting order of the wells is C-1, C-2, C-4, C-6 and C-7 through the plume. Data was collected for well C-3 but it is apparent that this well is crossgradient to the plume, therefore being similar to the up- and downgradient wells, and was not presented on these plots. The sum of the BTEX results for each well for the 9/17/97 sampling event and the indicator parameter analytical result for each well are plotted on the Y-axis to create the attached plots. The plots are then evaluated by observation for apparent trends in the data.

Results

The nitrate versus BTEX plot does not indicate any trend because nitrate is apparently not present in the groundwater at the site. Therefore, nitrate cannot be utilized as an indicator parameter for this site for this sampling event.

The sulfate versus BTEX plot indicates that sulfate is present where BTEX concentrations are low and reduced when BTEX concentrations are elevated. This is an expected trend for sulfate in the presence of BTEX and intrinsic bioremediation. Therefore, the observed sulfate trend through the plume suggests that intrinsic bioremediation (anaerobic) is occurring in the groundwater at this site.

The alkalinity versus BTEX plot indicates that the upgradient waters at this site are low in alkalinity and the interior plume and downgradient waters are higher in alkalinity. An increase in alkalinity across a contaminant plume is a potential indicator of biologic activity. Therefore, the observed trend for alkalinity is consistent with the occurrence of intrinsic bioremediation in the groundwater at this site.

The dissolved (ferrous) iron versus BTEX plot indicates that higher concentrations of ferrous iron are present in the higher BTEX waters of the contaminant plume. An increase of ferrous iron in the interior of a plume is a potential indicator of biologic activity at the site. Therefore, the observed trend for ferrous iron is consistent with the occurrence of intrinsic bioremediation in the groundwater at this site.

The plots of indicator parameter versus total BTEX for site wells indicates the presence of intrinsic bioremediation occurring in the groundwater plume associated with this site. The effect of this process will be to stabilize the contaminant plume and reduce the size of the plume as the source area concentrations are reduced.

Please contact me at 242-7086 with questions or comments regarding this review.

Sincerely,

Curtis A. Peck

Curtis A. Peck
Hydrogeologist

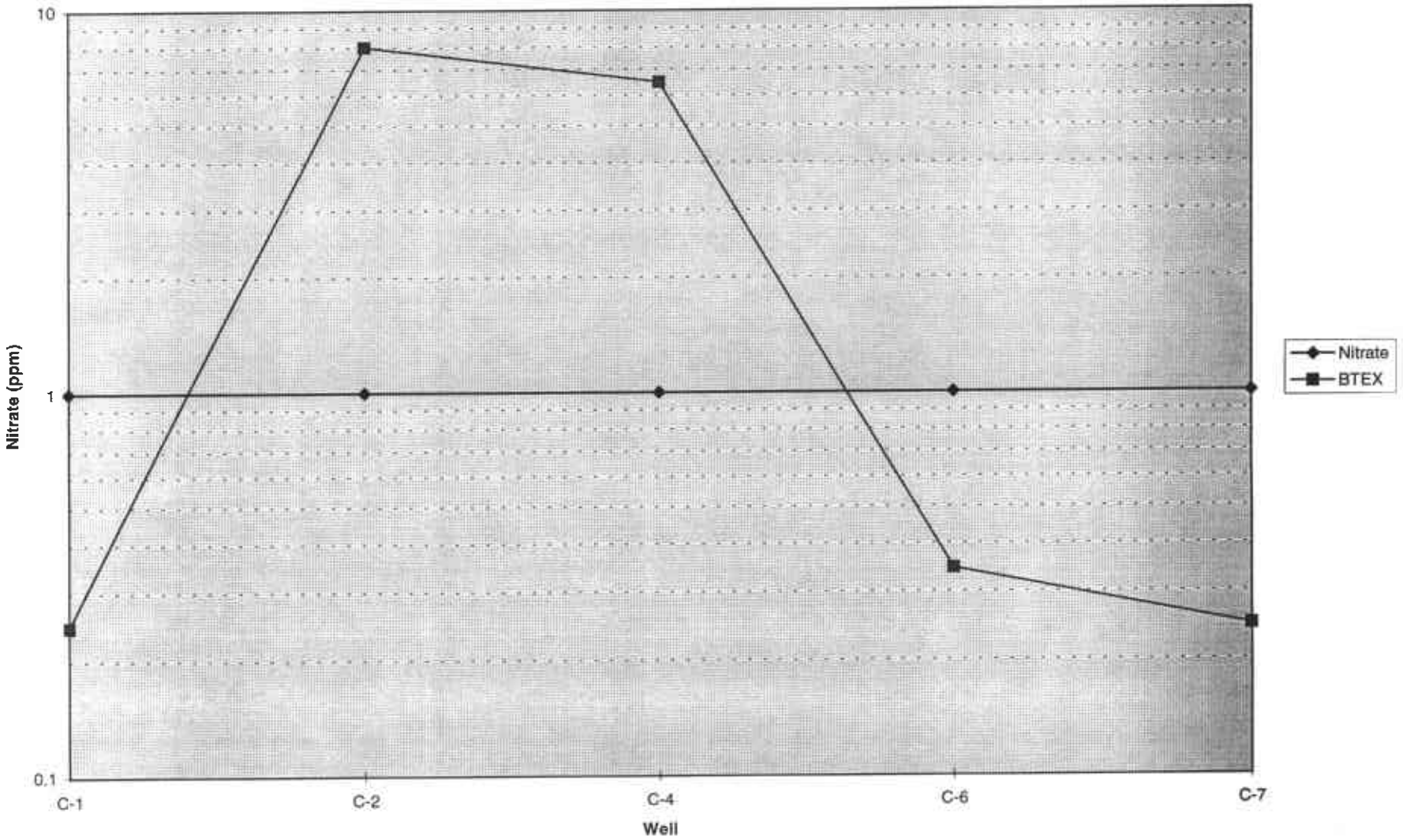
Attachments:

- Data Table
- Nitrate vs. BTEX
- Sulfate vs. BTEX
- Alkalinity vs. BTEX
- Ferrous Iron vs. BTEX

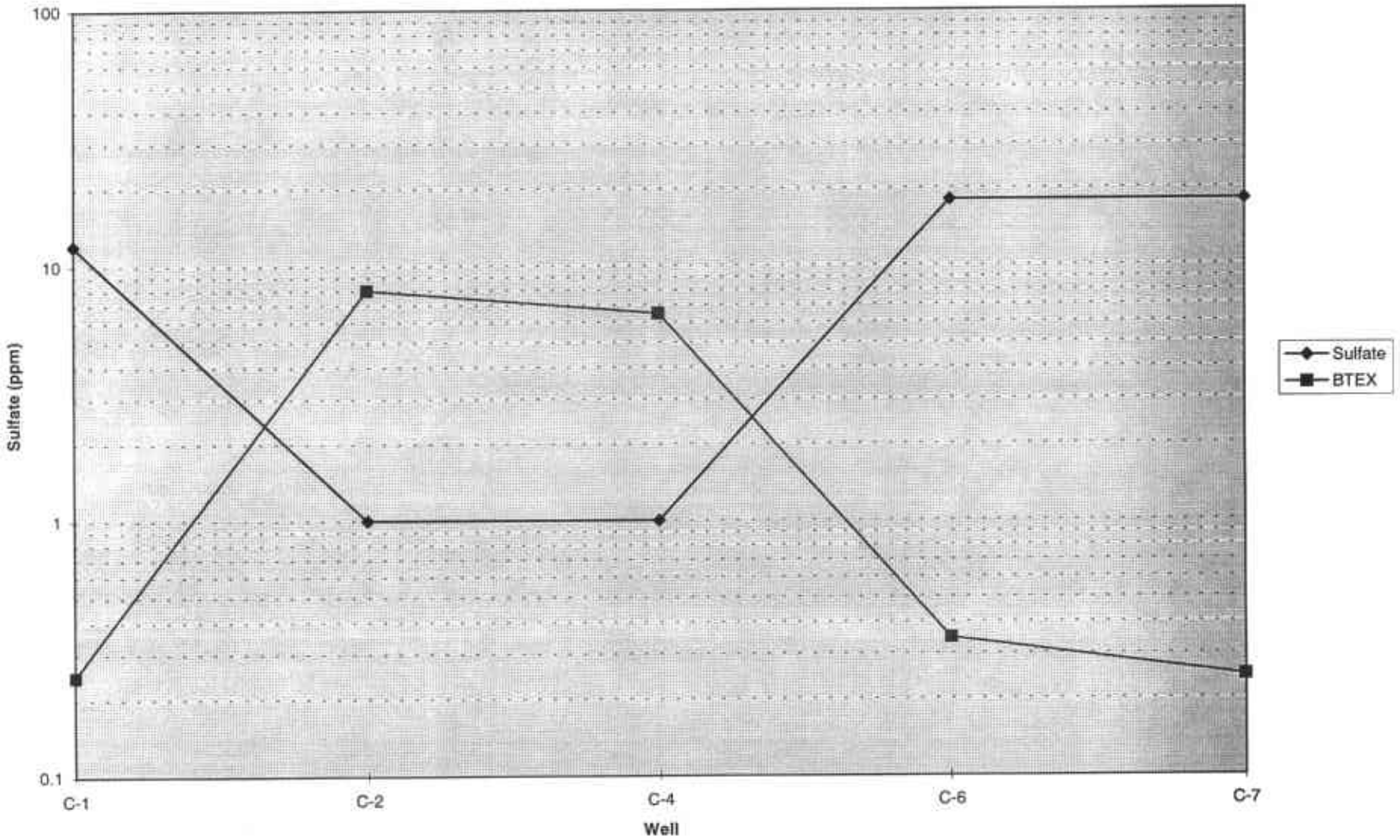
Analytical Results - 9/17/97
Chevron Station #9-0076

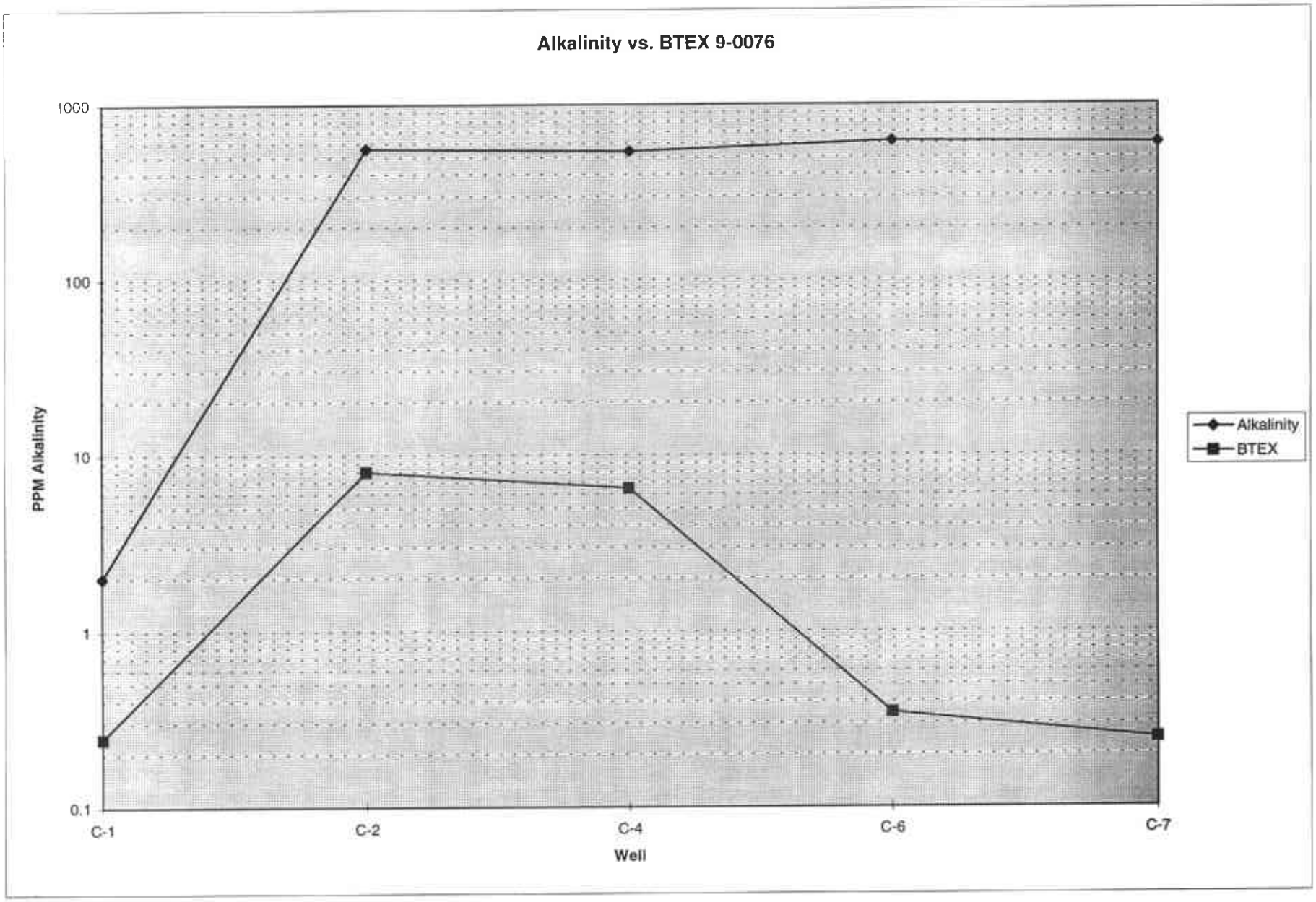
#9-0076 - 9/17/97 Analytical Data									
NOTE: Values presented in mg/L (ppm)									
Well	Alkalinity	Fe	Nitrate	Sulfate	B	T	E	X	BTEX
C-1	2	1.1	1	12	0.16	0.023	0.013	0.049	0.245
C-2	560	4.7	1	1	4.8	0.22	1.2	1.8	8.02
C-3*	340	0.012	100	33	0.019	0.019	0.0066	0.04	0.0846
C-4	540	5.9	1	1	4.3	0.14	0.94	1.1	6.48
C-6	620	1.1	1	18	0.33	0.005	0.005	0.005	0.345
C-7	600	4.8	1	18	0.12	0.011	0.031	0.084	0.246
* - Well C-3 is located crossgradient to the plume and will not be used in plots									

Nitrate vs. BTEX 9-0076

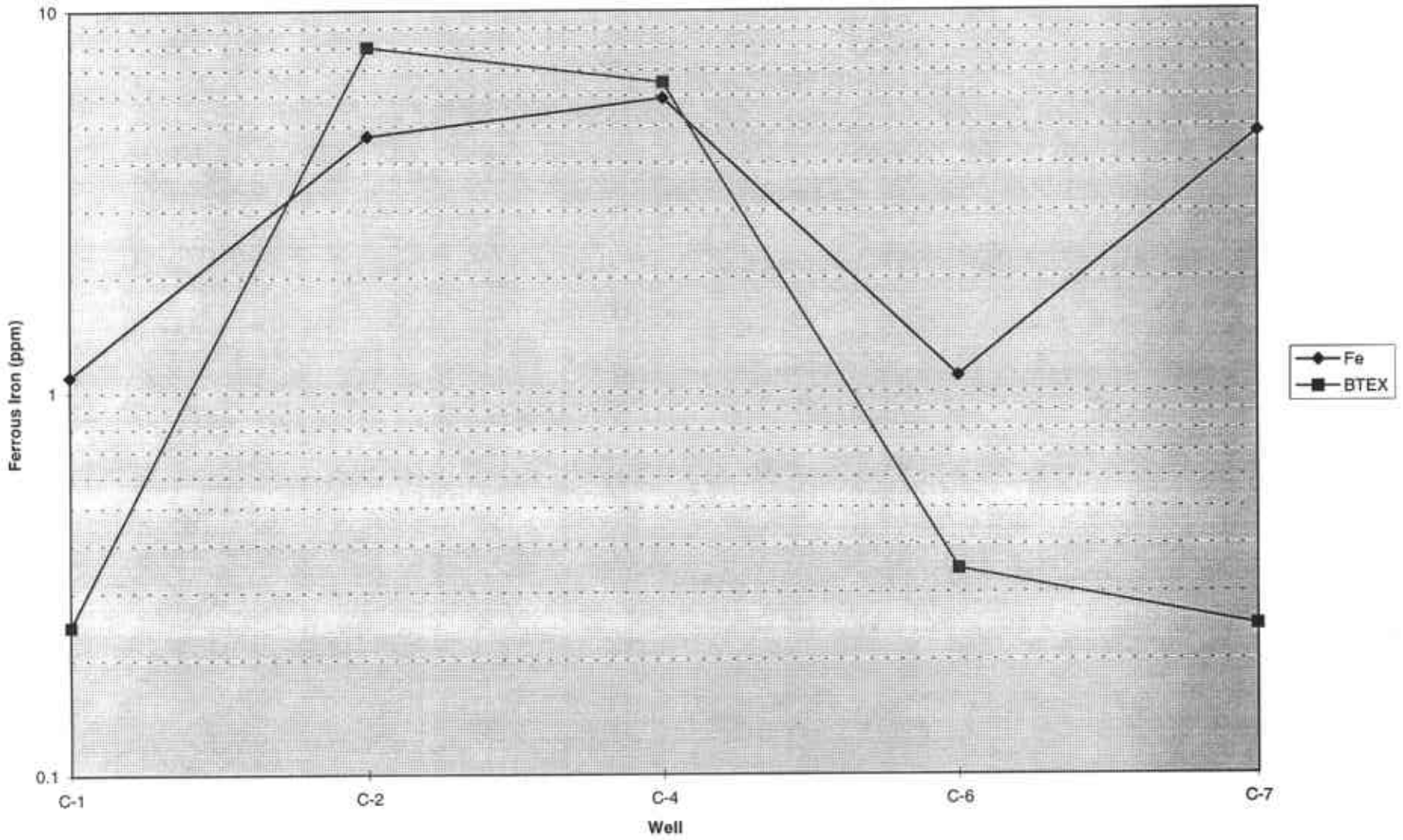


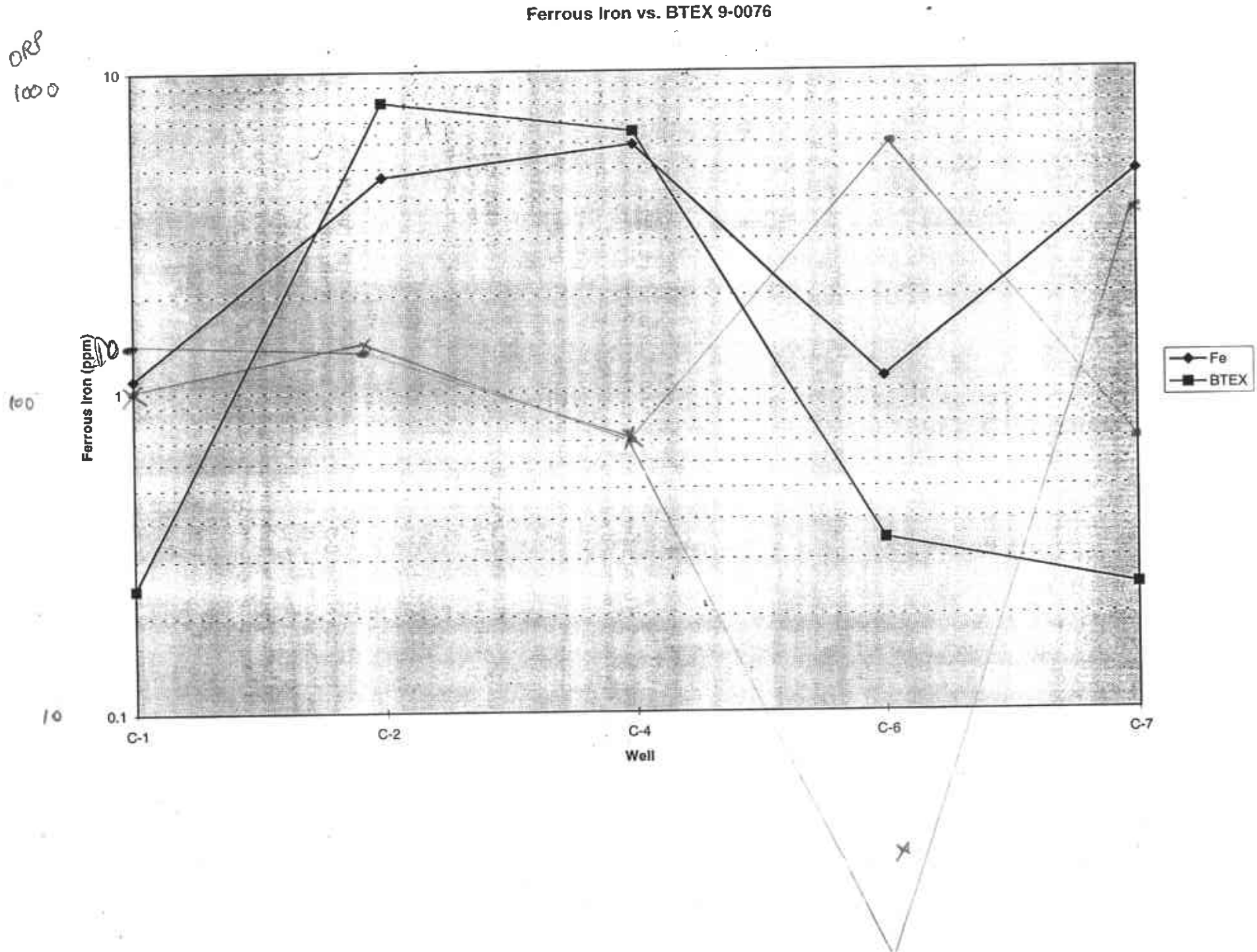
Sulfate vs. BTEX 9-0076




Alkalinity vs. BTEX 9-0076
1000
100
10
1
0.1
PPM Alkalinity
C-1
C-2
C-4
C-6
C-7
Well
Alkalinity
BTEX

Ferrous Iron vs. BTEX 9-0076




Ferrous Iron vs. BTEX 9-0076
ORP
1000
100
10
10
1
0.1
Ferrous Iron (ppm)
C-1
C-2
C-4
C-6
C-7
Well
Fe
BTEX