



TETRA TECH NUS, INC.

661 Andersen Drive ■ Pittsburgh, Pennsylvania 15220-2745
(412) 921-7090 ■ FAX (412) 921-4040 ■ www.tetrattech.com

PITT-01-6-013

January 9, 2006

Project Number 0182

Mr. Frank Cellucci
Engineering Field Activity Northeast
Naval Facilities Engineering Command
10 Industrial Highway, Mailstop No. 82, Code EV21
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N62472-03-D-0057
Contract Task Order 041

Subject: Restoration Advisory Board (RAB) Meeting Minutes of November 15, 2005
Former Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Cellucci:

Enclosed please find the minutes from the RAB meeting held on November 15, 2005. Copies of the minutes are being sent to the individuals identified on the distribution list.

Please contact me if you have any questions or comments.

Sincerely,

A handwritten signature in black ink that reads "Jeff Orient".

Jeffrey P. Orient
Project Manager

JPO/sic

Enclosure

c: Distribution list
File 0182

DISTRIBUTION LIST

Ron Stoto (USGS)
April Flipse (PADEP)
Tony Sauder (Pennoni)
Dave Fennimore (Earth Data)
Garth Glenn (TINUS)
Rich Evans (ECOR)
Pat Schauble (ECOR)
Kathy Davies (U.S. EPA)
Andrew Barton (Battelle)
Mark Nielson (Battelle)
Chris Candela (ATC/Erickson)

**FORMER NAVAL AIR WARFARE CENTER (NAWC) WARMINSTER
MEETING MINUTES**

RESTORATION ADVISORY BOARD (RAB) MEETING NO. 103

REFERENCE: CLEAN CTO NO. 041

1. Meeting Date and Time: November 15, 2005, 9:20 A.M. to 10:30 A.M.
2. Location: Warminster Municipal Authority Board Room
3. Attendees: See Attachment 1 (attendance list)
4. Summary of Meeting Discussions: See below.

Introduction and Administrative Update

Mr. Frank Cellucci, the Navy's technical manager for the project, opened the meeting by welcoming the attendees and providing an agenda for the meeting (Attachment 2). Introductions were made for those in attendance and the minutes for the May 2005 RAB meeting were approved.

Treatment System O&M Update (ECOR)

Mr. Pat Schauble of ECOR Solutions Inc. provided an update on the treatment system O&M activities (see handout; Attachment 3). Some notable information presented includes data indicating that 394,440,179 gallons of water had been extracted and treated through September 2005; contaminant mass removed to date includes approximately 3,820 lbs of TCE, 141 lbs of carbon tetrachloride, and 87 lbs of PCE; and system up-time has been greater than 95%.

Mr. Schauble and Mr. Rich Evans (also of ECOR) asked Mr. Carson Freeman of Warminster Municipal Authority about obtaining access to the fenced-in area around the new municipal water treatment plant, in the event that ECOR needs to access the area for treatment system O&M-related activities outside of normal business hours. Mr. Freeman indicated that WMA would not provide a key to ECOR due to security issues, but would provide a name and contact number for off-hour access requests.

Performance Monitoring Update (ECOR)

Mr. Schauble indicated that the most recent quarterly report submitted in final form was the 2nd quarter FY 2005 report, and that the 3rd quarter report has been submitted to the Navy for internal review. Additional details regarding recent performance monitoring-related activities were provided in the ECOR handout (Attachment 3).

Long Term Monitoring Program Optimization (ECOR)

ECOR indicated that they have begun implementing the long term monitoring program modifications recommended by the Technical Evaluation Group (TEG) in the memo released by Jeff Orient (Tetra Tech NUS) in September 2004, starting in the 3rd quarter FY 2005 monitoring event. Streamlined quarterly reports will be prepared beginning with the 4th quarter FY 2005 report. Mr. Schauble suggested that the use of PDB sampling techniques in well HN-100I be reconsidered, as the initial sample analyses did not match up well with those obtained using conventional sampling methods. Mr. Tony Sauder (Pennoni Associates) questioned the use of PDB sampling methods in general at the site. Mr. Drew Barton (Battelle) explained Battelle's work at the site to evaluate the use of PDBs for sampling, and suggested that PDBs be tried again at HN-100I, monitoring 3 intervals around the target fracture zone instead of only 1.

Mr. Schauble and Mr. Evans indicated that anomalous PCE concentrations detected in the sample from monitoring well HN-52S suggested the presence of a separate (non-Navy) source of contamination in the area west/northwest of Area A. Mr. Jeff Orient (Tetra Tech NUS) indicated that a separate source has long been suspected based on earlier sampling data (including 1,1,1-TCA concentrations) and was discussed in the Area A Groundwater RI Report. Mr. Schauble indicated that 1,1,1-TCA concentrations have declined but PCE has recently increased (to up to 14 ppm), and TCE levels are now higher than those observed onsite in hydrogeologic unit A. Mr. Dave Fennimore (Earth Data) asked whether there was any data showing a hydrogeologic connection between HN-52S and municipal well WMA-26; Mr. Orient replied that the Navy performed a water level study to evaluate the hydrogeologic connection between WMA-26 and the monitoring wells between Area A and the municipal well, and that it is available in the Administrative Record file. The potential for additional investigation to identify other sources was discussed. Ms. April Flipse (PADEP) stated that there is no state funding available to initiate a state-lead investigation. Ms. Kathy Davies (USEPA) suggested that the Navy pull together a memo providing the rationale for believing that a separate, non-Navy source is contributing to the contamination in the vicinity of Area A, along with supporting data, and provide that memo to PADEP and the USEPA for their use as a mechanism to potentially get additional investigation

started. She also expressed a concern that the 14 ppm concentration of PCE in groundwater may indicate the presence of DNAPL nearby. Mr. Fennimore and Mr. Freeman also asked for copies of the Navy's recent sampling data for WMA-26, stating that they hadn't received any data for awhile.

Groundwater Extraction and Treatment System Optimization Study (Battelle)

Mr. Barton presented a summary of the GWETS optimization study that Battelle recently performed (see Attachment 4 for a summary of the presentation). A draft report was sent to the Navy, TEG, and Warminster Township/WMA consultants for review approximately 3 weeks prior to the RAB meeting. Some of the pertinent observations, findings, and related discussions brought up include:

- For the groundwater treatment plant, the sand filters (when in use) are the limiting factor regarding the volume of water that can be treated (~115 gpm maximum).
- The current pumping rate for Area A consistently exceeds the design rate required for plume capture, while the pumping rates for Areas C and D are at least occasionally slightly below the design rate. Mr. Orient pointed out that pumping rates had decreased in Areas C and D as a result of some extraction wells being shut down as the contaminant levels in them declined to negligible levels – not as much plume capture is now required since the extents of the plumes have shrunk somewhat in these areas.
- Most contaminant concentration trends are downward, with the exception of a 38% increase in PCE within Area A. Mr. Fennimore asked what was causing the increase in PCE levels. Mr. Barton replied that Battelle did not evaluate this since PCE is such a minor constituent compared to other contaminants (TCE, carbon tetrachloride).
- BioChlor modeling was performed by Battelle to evaluate the feasibility of relying on natural attenuation for remediation of groundwater associated with Areas C and D. A steady-state, continuous source assumption was used for the modeling. Ms. Davies stated that this assumption is not consistent with the application of natural attenuation as a groundwater remedy, since a CERCLA natural attenuation remedy should meet cleanup goals throughout the plume, not just at some compliance point located downgradient of the source. Ms. Davies also asked what the basis was for concluding that biodegradation was occurring downgradient of Area D, i.e. were biodegradation daughter products found. Mr. Barton stated that the BioChlor modeling only looked at

TCE, and that the inclusion of some biodegradation was necessary for model calibration purposes. Both Ms. Davies and Mr. Fennimore disagreed with the approach of employing a biodegradation assumption without having supporting site data (daughter products, microbes).

Battelle recommended increasing the pumping rate within Area A and optimizing the individual extraction well pumping rates to increase mass removal. Ms. Davies suggested that this may pull in more clean water. Mr. Orient noted that since the wells are located within the source area, clean water pulled from outside the plume would move through highly-contaminated zones and accelerate the flushing/mass removal rate. Mr. Fennimore asked if Battelle had considered the potential for injection of a chemical oxidant to knock down the contaminant mass in the source area. Mr. Barton replied that it had not been looked at. Both Ms. Davies and Mr. Orient stated that they felt this would be worthwhile to consider, as the extensive network of monitoring and extraction wells within the source area would provide numerous injection/extraction points for the chemical oxidant, while at the same time maintaining hydraulic control of the source area. Mr. Ron Sloto (USGS) mentioned that the chemical oxidant would tend to move preferentially through the higher permeability fracture zones which also tend to have lower contaminant concentrations. Mr. Orient suggested that low permeability/high concentration wells could be targeted for possible injection, to maximize the benefit and offset the tendency for the oxidant to move preferentially through the more permeable fractures.

Treatment plant modifications recommended by Battelle included bypassing the equalization tank, taking the metals treatment equipment offline, installing an air stripper with a higher VOC removal efficiency, discontinuing the use of LGAC for polishing if the new stripper adequately removes VOCs, adding another VGAC unit in series with the two existing units (installed in parallel) to bring the system into compliance with current regulations, and modifying the long term groundwater monitoring program in accordance with TEG recommendations (with a few recommended changes as per Attachment 4). Potential cost savings from implementing the recommendations were projected to be approximately \$1.9 million over 30 years. One of the recommendations was to discontinue the sampling of WMA-13, located northeast of Area C. Given the recent discovery of higher concentrations of PCE in Area C, Mr. Fennimore asked that the sampling of WMA-13 be continued for awhile. Mr. Cellucci concurred.

Battelle also recommended suspending pumping from Areas C and D and implementing a natural attenuation sampling program. Ms. Davies objected to this as there would be no source control, which is required for an MNA remedy, and under the continuous source assumption ARARs would not be met throughout the plume for the foreseeable future. Ms. April Flipse (PADEP) also

pointed out that stopping the pumping in Areas C and/or D may cause chromium levels in the treated water to increase (less dilution) and exceed discharge limits, especially if metals treatment processes are taken offline.

Review comments on the draft optimization study were to be submitted to the Navy/Battelle by mid-December.

Miscellaneous Topics and Issues

The recent detection of 330 ug/L of PCE in a replacement monitoring well within Area C was discussed. Ms. Davies, Mr. Barton, and Mr. Orient all felt that the higher concentration recently detected is not a new release but is from an unknown source that has not been identified in the work done to date. As such, overall groundwater concentrations within and downgradient of Area C are not expected to increase over what has typically been found in the past. Mr. Orient stated that additional insitu remediation activities would likely be ineffective unless the source was found and targeted. Ms. Davies stated that she felt pumping should be continued in Area C, and that the Navy should consider additional work targeted at trying to find the source of this higher PCE concentration.

Mr. Sauder brought up that Warminster Township is looking at a plan for construction of a self-storage facility near the Area A extraction wells. Mr. Sauder wanted to know if there were any issues related to the planned construction of a stormwater basin. Both Ms. Davies and Ms. Flipse stated that there could be significant issues with the excavation/construction of a basin, including excavating potentially contaminated soil, altering the performance of the groundwater extraction system, and compliance with new NPDES requirements. Mr. Sauder asked if construction of a lined basin outside of any no-dig zones would be OK. Mr. Cellucci stated that the Navy and regulators would need to review a formal submittal of plans and specs before approving or disapproving the construction of the self-storage facility.

Next Meeting Date

The next RAB meeting date was tentatively set for Tuesday, May 2, 2006 at 9:30 A.M.

The meeting was adjourned at approximately 10:30 A.M.

**ATTACHMENT 1
ATTENDANCE LIST**

Warminster RAB Mtg
11/15/05

<u>Name</u>	<u>Affiliation</u>	<u>phone/email</u>
Jeff Orient	Tetra Tech NUS	412/921-8778/orientj@tetra
Frank Cellucci	NATAFAC-efane	(610) 595-0567, X722
Amenda Bell	ECOR	(610) 431-8731/bell@ecor-solutions.com
Richard Evans	ECOR	610 431 8731/evans@ecor-solutions.com
Ron Sloto	US Geological Survey	610-431-2343/rsloto@usgs.gov
Carson Freeman	W. M.A.	
DALE PENNIMORE	EARTH DATA/WAMA	610 524-9466 dpenimore@earthdata.gov
APRIL FLIPSE	PADEP	484-250-5721 aflipse@state.pa.us
Kathy Davies	EPA	215-814-3315 davies.kathy@epa.gov
Tony Sander	Pennoni/Warminster	215-222-3000 tsander@pennoni.com
Chris Cudde	ATC/EXCUSOW	610 313 3100 christopher.cudde@atcassociates.com
DAN HEALEY	ERICKSON RETIREMENT	215-443-3150
Andrew Barton	Battelle	412-782-6164 bartona@battelle.org
Carolyn Ohart	Battelle	215-504-5003 ohartc@battelle.org
Patrick Schauble	ECCR	610 431-8731 schauble@ecr-solutions.com

**ATTACHMENT 2
MEETING AGENDA**

**NAWC WARMINSTER
TECHNICAL SUBCOMMITTEE/RAB MEETING**

15 November 2005 9:00 AM

WMA Board Room

415 Gibson Ave

Warminster, PA

MEETING AGENDA

Administrative Update

Minutes of the Last Meeting (Tetra tech NUS)

Treatment System O&M Update (ECOR)

Performance Monitoring Update (ECOR)

OU-1A Downgradient PCE Detections (ECOR)

Groundwater Recovery System Optimization (Battelle)

Miscellaneous Topics and Issues

Time and Location of Next Meeting: May 2006 - Date to be determined

Directions to the WMA Board Room:

From County Line Rd - instead of turning north (right) onto Jacksonville, continue west on County Line to York Rd. Turn north (right) onto York Rd. Continue to Henry Ave. Turn west (left) onto Henry Ave. Continue to Gibson Ave. Turn right into the parking lot shared by the Warminster Township and WMA. The WMA building is located towards the rear.

From the former NAWC - proceed to the intersection of Street and Jacksonville Rd. Turn west (right) onto Street Rd. Continue west to York Rd. Turn south (left) onto York Rd. Continue to Henry Ave. Turn west (right) onto Henry Ave. Follow directions as above to the WMA building.

**ATTACHMENT 3
ECOR UPDATE**

**NAWC WARMINSTER
15 NOVEMBER 2005 RAB MEETING**

ECOR SOLUTIONS, INC. PRESENTATION

Groundwater Treatment Plant Performance

- 394,440,179 gallons recovered and treated (1999 start up through September 2005 reporting period).
- System up-time >95%.
- Replaced groundwater pumps and motors as needed.
- Cumulative dissolved-phase hydrocarbon recovery through September 2005 reporting period:
 - Tetrachloroethene (PCE) – 87 pounds
 - Trichloroethene (TCE) – 3,820 pounds
 - Carbon Tetrachloride (CCl₄) – 141 pounds
- Mass recovery during 2005:
 - PCE: 86% - Area A, 12% - Area C, 2% - Area D
 - TCE: 98% - Area A, 2% - Area D
 - CCl₄: 100% - Area A

Performance Monitoring (Long Term Monitoring)

- Events completed by ECOR:
 - 3rd Quarter FY 2004 – April and May 2004
 - 4th Quarter FY 2004 – July and August 2004
 - 1st Quarter FY 2005 – October 2004
 - 2nd Quarter FY 2005 – January and February 2005
 - 3rd Quarter FY 2005 – April 2005
 - 4th Quarter FY 2005 – July 2005
 - 1st Quarter FY 2006 – October 2005
- Reports submitted:
 - 3rd Quarter FY 2004 Final Report
 - 4th Quarter FY 2004 Final Report
 - 1st Quarter FY 2005 Final Report
 - 2nd Quarter FY 2005 Final Report
 - 3rd Quarter FY 2005 Internal Draft
 - Revised QAPP/LTPMP Draft Final

- Reports to be submitted:
 - 4th Quarter FY 2005 Internal Draft (est. 1 December 2005)
 - 1st Quarter FY 2006 Internal Draft (est. 31 December 2005)
- Groundwater levels have decreased by up to 20 feet from October 2004 to October 2005.
- Repairs to several monitoring wells were completed (replacement of concrete pads, well protectors, etc.) during April 2005. Resurveying of modified and repaired wells was completed during July 2005. The new top of casing elevations have been utilized for recent groundwater contouring.
- Revised Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), and Long Term Performance Monitoring Plan (LTPMP) were submitted on 2 November 2005 in Draft Final.
- A well schedule with updated off-site address and property owner information and a revised map were completed since the last RAB meeting.
- Access has been denied to monitoring wells HN-661 (Aztec Machinery Company), R-6 (Young Residence), and R-7 (Martindell residence). These monitoring wells are proposed for abandonment during 2005. The Navy is working to obtain an access agreement with the property owners.
- *The Revised Long-Term Performance Monitoring Plan for Operable Units 1A, 3, and 4 Remedial Actions (LTPMP) (Battelle, June 2003) indicates that Warminster Municipal Supply Well WMA-13 is to be removed from the long term monitoring after four consecutive quarters of laboratory analytical data indicating that all contaminants are below the maximum contaminant levels (MCL). During the 4 May 2004 RAB meeting, Battelle indicated that if all contaminants were below the MCLs during the next monitoring event (3rd Quarter 2004), that sampling may be discontinued at WMA-13. Through the 4th Quarter FY 2005, all analytes remain below the MCL. Per previous recommendations, discontinuation of sampling at WMA-13 may be appropriate at this time.*

Long Term Monitoring Program Optimization

- A copy of a 2 September 2004 memo (TEG-recommended changes) was distributed by Jeff Orient of Tetra tech NUS during the 9 November 2004 RAB meeting detailing proposed changes to the Long Term Monitoring Program. No comments have been received to date. The proposed changes were implemented with the 3rd Quarter 2005 monitoring event (April 2005), including reduced sampling frequencies. As recommended in the memo, ECOR will present a reduced deliverable for quarterly LTM reports beginning with the 4th Quarter FY 2005 report.

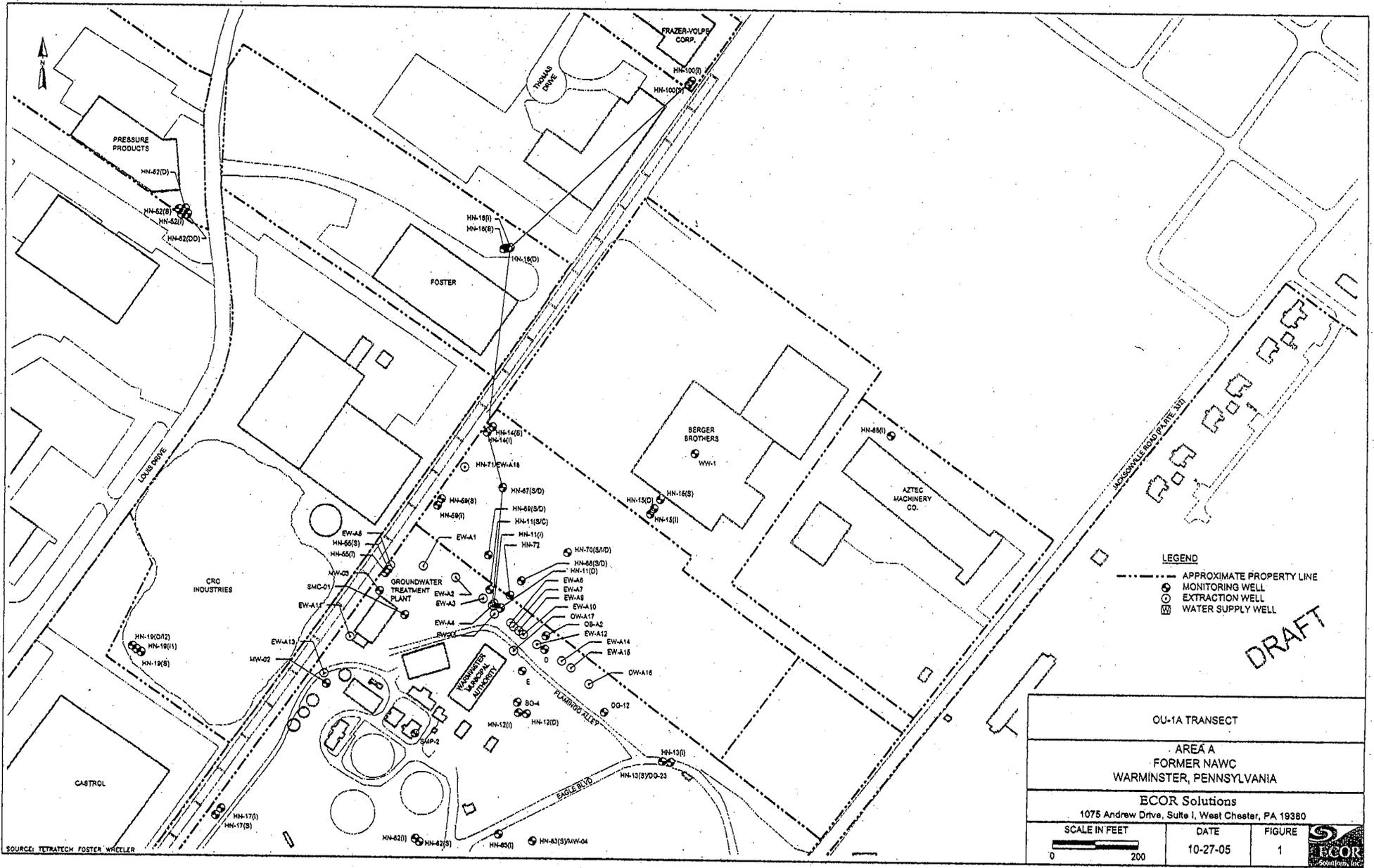
Area A Cross Gradient and Down Gradient TCE and PCE Concentrations

- The six wells utilized in the OU-1A transect for Hydrogeologic Unit B (EW-A4, EW-A9, HN-67D, HN-14I, HN-16I, and HN-100I) consistently demonstrate that TCE is detected at significantly higher concentrations than PCE (i.e. 1 to 3 orders of magnitude). The transect is depicted in Figure 1. Select TCE and PCE concentrations are summarized in Table 1.
- Off-site downgradient monitoring well HN-52I (not considered in the transect) exhibits similar TCE to PCE detection ratios to the transect.
- Monitoring wells located in Hydrogeologic Unit A have varying TCE to PCE ratios. Monitoring well HN-55S, located on the former NAWC, and monitoring well HN-110S, located downgradient of the former NAWC, generally indicate TCE to PCE ratios similar to the Hydrogeologic Unit B wells. However, monitoring wells HN-52S and HN-16S, located cross gradient and downgradient, respectively, of the former NAWC, exhibit significantly higher PCE concentrations than TCE concentrations.
- Supply well WMA-26 demonstrates a similar trend to HN-52S and HN-16S with higher PCE concentrations than TCE concentrations.
- Supply well WMA-26 was reportedly withdrawing approximately 250 gallons per minute (gpm) during October 2005. Approximately 55 gpm was continuously extracted by the pumping system at OU-1A during October 2005.
- The data indicate that a potential unidentified source of PCE exists cross gradient of the former NAWC that may be contributing to groundwater quality degradation in the vicinity of the former NAWC. Supply well WMA-26 appears to be providing partial capture of the PCE-impacted groundwater and may be inducing a downward gradient component for impacted groundwater.
- Additional investigation of this potential unidentified PCE source may be warranted.

TABLE 1
NAWC WARMINSTER
TCE & PCE CONCENTRATION TREND SUMMARY

Well ID HGU	EW-A9			EW-A4			HN-67D			HN-141			HN-161			HN-1001			HN-521		
	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO												
30-Jun-99	46,000	370	124	8,800	0	INF				3,900	97	40	3,500	65	54				920	45	20
17-Feb-00	24,000	0	INF	11,000	0	INF				910	15	61	1,100	15	73				870	0	INF
17-May-00	40,000	340	118	14,000	0	INF				820	12	68	980	11	89				620	0	INF
25-Sep-01	8,400	86	98	14,000	93	151	720	14	51	870	14	62	550	10	55				570	30	19
19-Nov-01	16,000	140	114	16,000	46	348	810	11	74	950	14	68	500	10	50				670	29	23
5-Feb-02	6,400	78	82	3,300	28	118	980	13	75	770	14	55	620	13	48				610	38	16
7-May-02	54,000	220	245	12,000	80	150	680	4	170	380	2	190	580	8	73				260	2	130
21-Aug-02	31,000	240	129	9,100	170	54	1,300	8	163	210	1	210	490	28	18				270	2	135
18-Nov-02	13,000	67	194	15,000	81	185	1,700	3	567	510	3	170	530	7	76				230	3	77
11-Mar-03	20,000	150	133	5,600	55	102	460	5	92	330	0	INF	410	7	59				170	0	INF
2-Jun-03	20,000	71	282	5,100	92	55	800	5	160	240	1	240	510	6	85				230	14	16
4-Feb-04	19,000	200	95	4,400	190	23	560	3	187	360	4	90	600	7	86				200	2	100
12-May-04	13,000	130	100	3,400	45	76	330	0	INF	14	0	INF	420	0	INF	130	0	INF	340	18	19
5-Aug-04	58,000	0	INF	2,500	69	36	3,999	0	INF	120	0	INF	330	3	97	9	0	INF			
6-Oct-04	9,800	84	117	1,900	37	51	360	0	INF	10	0	INF	410	3	137	8	0	INF	100	1	101
24-Feb-05	18,000	0	INF	2,400	80	30	400	0	INF	190	2.4	INF	380	7	54	9	0	INF			
05-Apr-05	15,000	590	25	2,100	66	32	460	0	INF	63	0	INF	180	1	188	8	0	INF	370	17	22
07-Jul-05	7,000	110	64	1,600	34	47										200	3	74			

Well ID HGU	HN-55S			HN-52S			HN-16S			HN-100S			WMA-26		
	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO	TCE	PCE	TCE:PCE RATIO
30-Jun-99															
17-Feb-00															
17-May-00															
25-Sep-01															
19-Nov-01															
5-Feb-02															
7-May-02															
21-Aug-02															
18-Nov-02															
11-Mar-03															
2-Jun-03	71	0	INF	870	4,100	0.21	33	360	0.09				94	120	0.78
4-Feb-04				990	11,000	0.09							89	170	0.52
12-May-04	27	0.23	117	260	1,400	0.19	23	280	0.08	99	0	INF	79	190	0.42
5-Aug-04										64	160	0.40			
6-Oct-04				420	8,500	0.05							76	140	0.54
24-Feb-05													68	200	0.34
05-Apr-05	45	0	INF	470	14,000	0.03	23	150	0.15	140	0.92	152	69	250	0.28
07-Jul-05										130	2.7	48	44	180	0.24



LEGEND
 - - - - - APPROXIMATE PROPERTY LINE
 ○ ● MONITORING WELL
 ⊗ EXTRACTION WELL
 ⊠ WATER SUPPLY WELL

DRAFT

OU-1A TRANSECT		
AREA A FORMER NAWC WARMINSTER, PENNSYLVANIA		
ECOR Solutions 1075 Andrew Drive, Suite 1, West Chester, PA 19380		
SCALE IN FEET 0 200	DATE 10-27-05	FIGURE 1

SOURCE: TETRA TECH FOSTER WHEELER

**ATTACHMENT 4
BATTELLE UPDATE**

Battelle

The Business of Innovation

GWETS Optimization Study

NAWC Warminster, Pennsylvania

Presentation Overview

- Remedial Action Objectives and Selected Remedy
- GWETS Evaluation
- Recommended Remedial Alternatives
- GWETS Optimization Recommendations
- Cost Evaluation

Remedial Action Objectives

- Area A
 - Contain DNAPL and contaminated groundwater inside of the TI waiver zone
 - Achieve MCLs outside the TI waiver zone

- Area C and D
 - Contain source area groundwater in the vicinity of extraction wells
 - Achieve MCLs

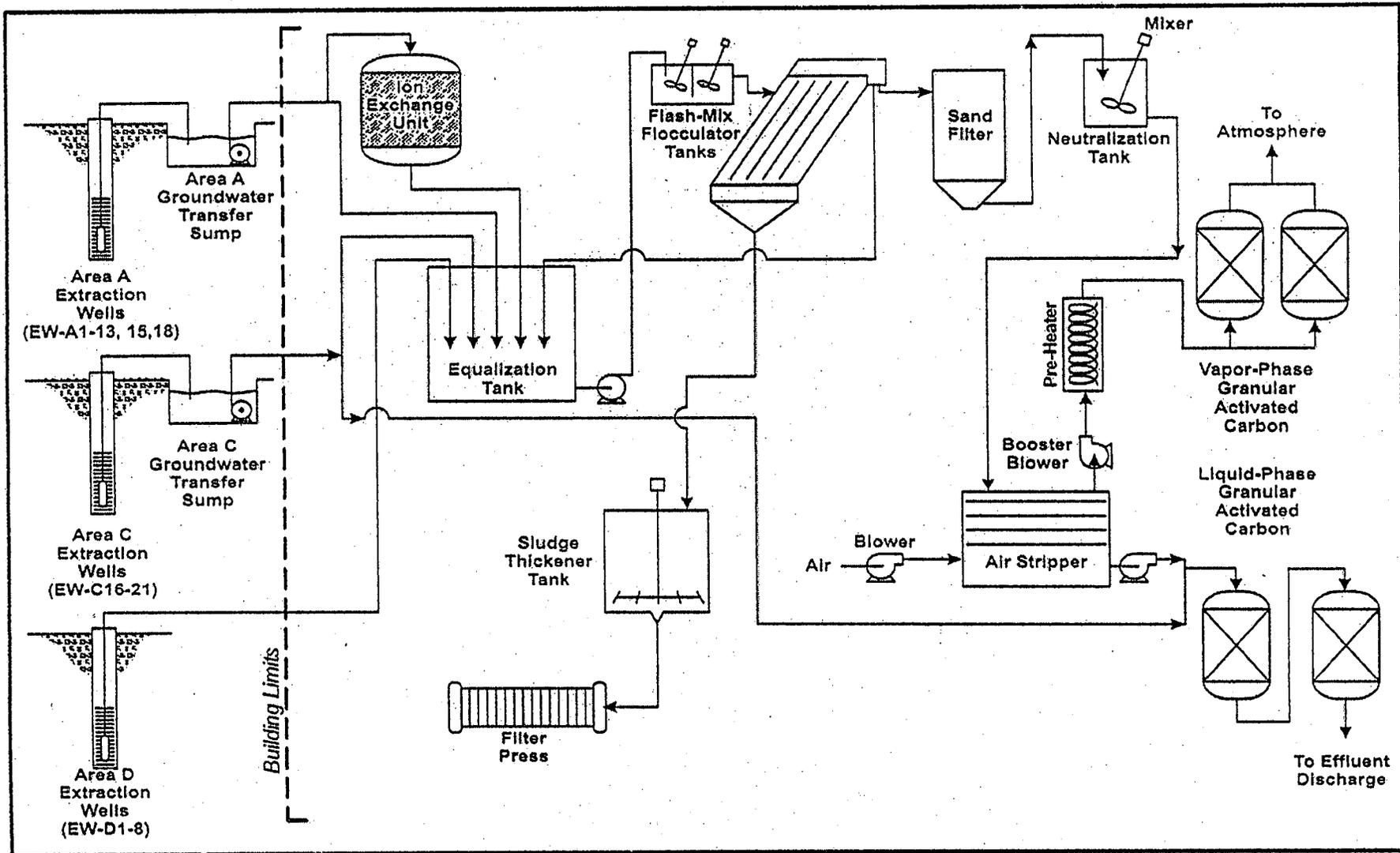
Selected Remedial Actions

- Groundwater extraction and treatment for each OU
- Groundwater extraction from a total of 29 wells with a combined pumping rate of 80 – 140 gpm
- Area A and D groundwater extraction system designed to allow municipal production well WMA-26 capture any contamination not contained by the on-site extraction wells
- Remedial action for Area D includes use of MNA for groundwater not contained by extraction wells
- Institutional controls

Current Treatment System

- Ion exchange – treatment of Cr(VI) from a split stream of Area A groundwater only
- Equalization tank
- Flash-mix and flocculator tank with inclined plate separator and sand filter for metals treatment (no chemical addition)
- Sludge thickener and filter press for sludge handling (currently no sludge generated)
- Air stripping for VOC treatment
- LGAC for VOC polishing before treated water discharge to surface water
- VGAC for VOC treatment of air stripper off-gas

Current Treatment System



GWETS Summary

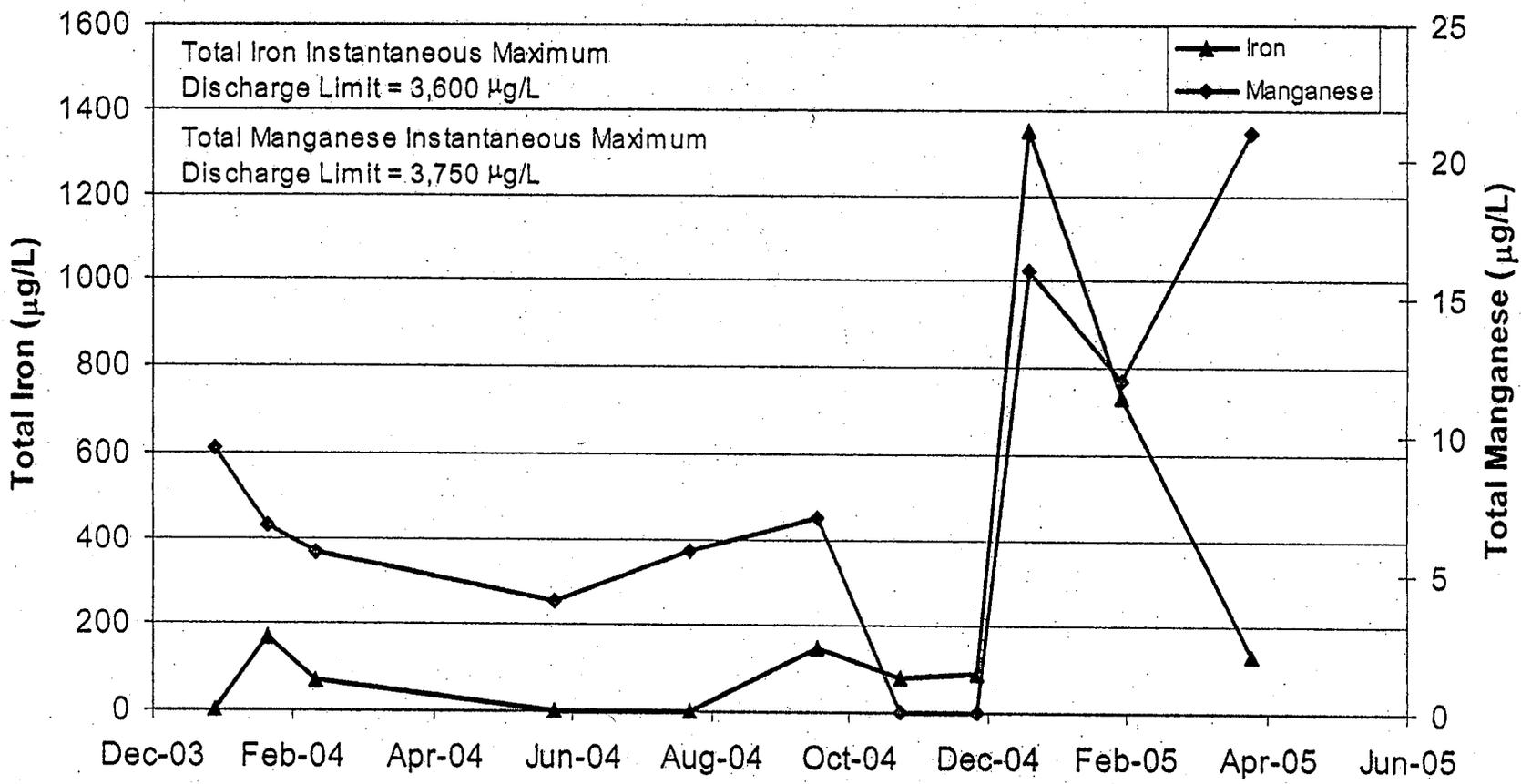
Parameter	Area		
	A	C	D
Source	DNAPL	Dissolved	Dissolved
Primary contaminant	TCE	PCE	TCE
Max. concentration detected at startup	>200,000 µg/L	40-50 µg/L	~1,000 µg/L
Max. concentration detected May 2004	>10,000 µg/L	25 µg/L*	70 µg/L
GWETS	15 EWs	5 EWs	8 EWs
Years of operation	6 (1999-2005)	9 (1996-2005)	6 (1999-2005)
Typical combined pumping rate	35-50 gpm	10-40 gpm	40-60 gpm
Total extracted	~101 MG	~28 MG	~134 MG

GWETS Evaluation – Hydraulic Containment

- Minimum pumping rate required to maintain hydraulic control (according to groundwater models):
 - Area A = 40 gpm
 - Area C = 27 gpm
 - Area D = 74 gpm
- Current pumping rates in each area:
 - Area A = 52.7 – 61.8 gpm
 - Area C = 19.7 – 32 gpm
 - Area D = 42.8 – 52.5 gpm
- Monitoring data indicates that hydraulic containment of source area is currently achieved in all areas

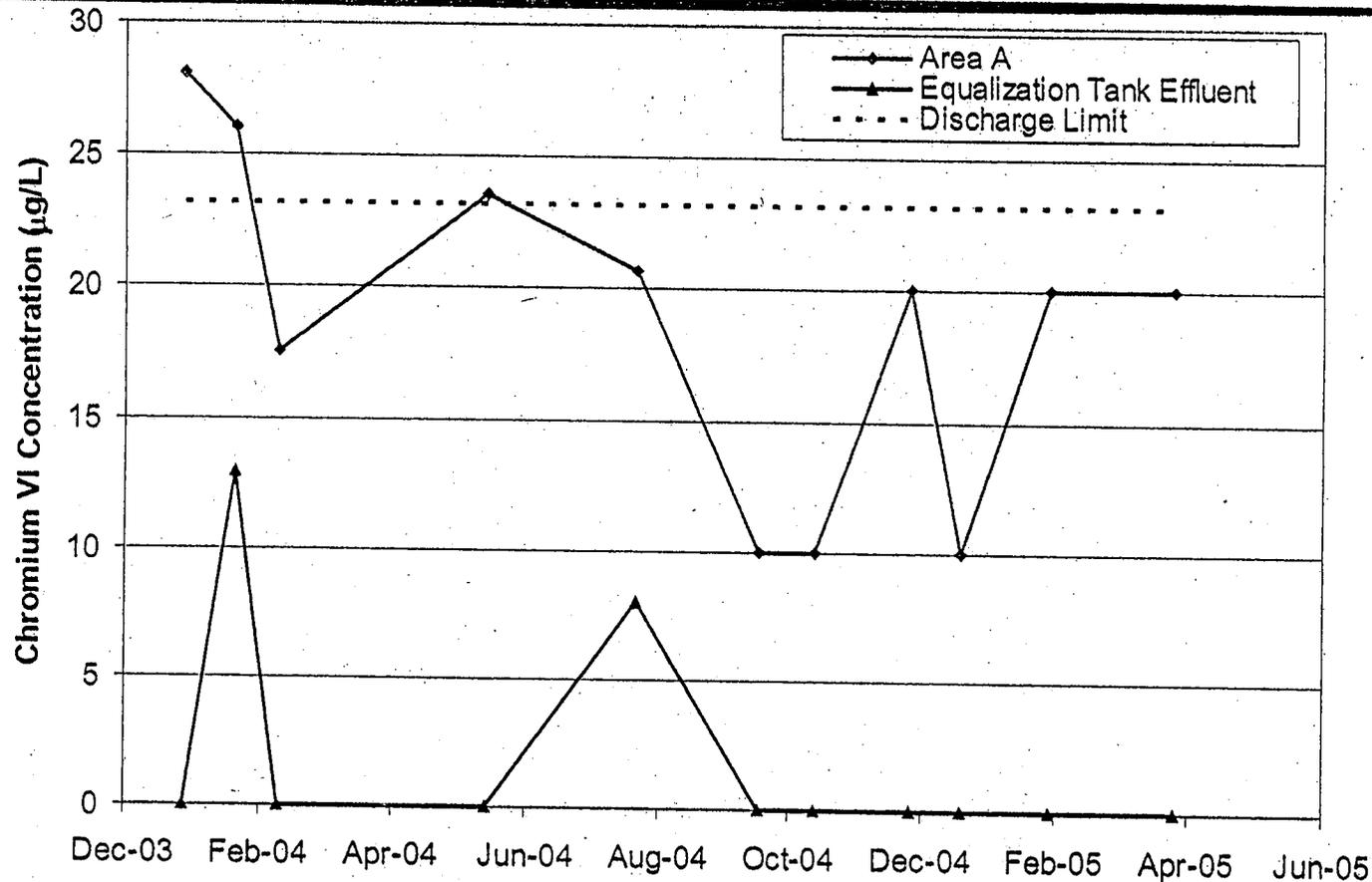
GWETS Evaluation – Metals Removal

Metals Concentrations in EQ Tank Effluent



- Currently no chemicals added during treatment; no sludge is generated.
- Metals are below concentrations that require treatment.

GWETS Evaluation – Cr(VI) Treatment

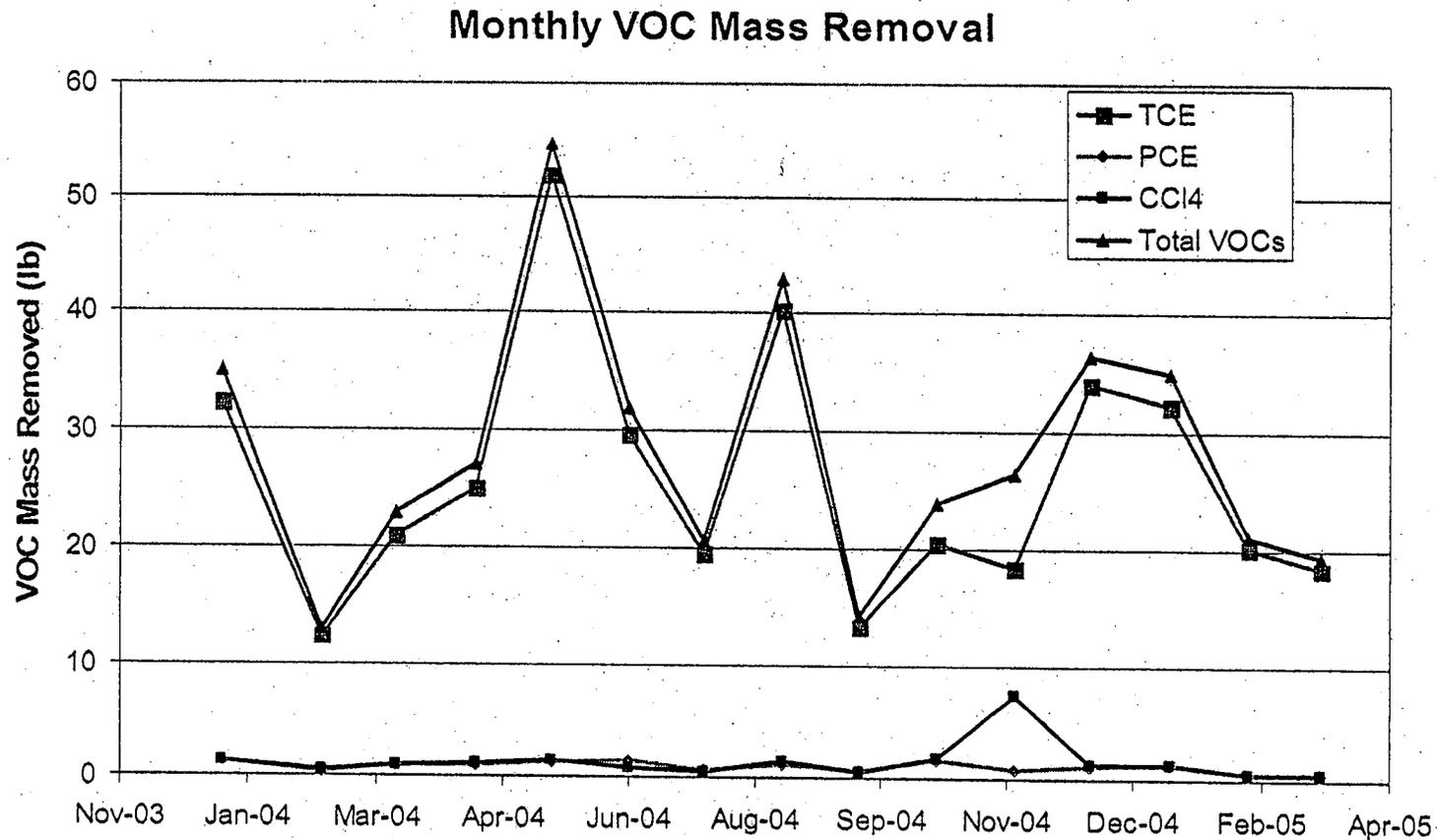


- Cr(VI) concentrations in Area A extraction wells range from <math><10</math> to - Ion exchange influent Cr(VI) = - Ion exchange effluent Cr(VI) =

GWETS Evaluation – VOC Treatment

- Treatment system effluent has not exceeded the permitted discharge limits
- Air stripper is 92.3% - 98.2% effective
- Concentrations of TCE occasionally exceed the discharge criteria after air stripping, but LGAC effectively removes any remaining VOCs

GWETS Evaluation – Achieving Cleanup Levels

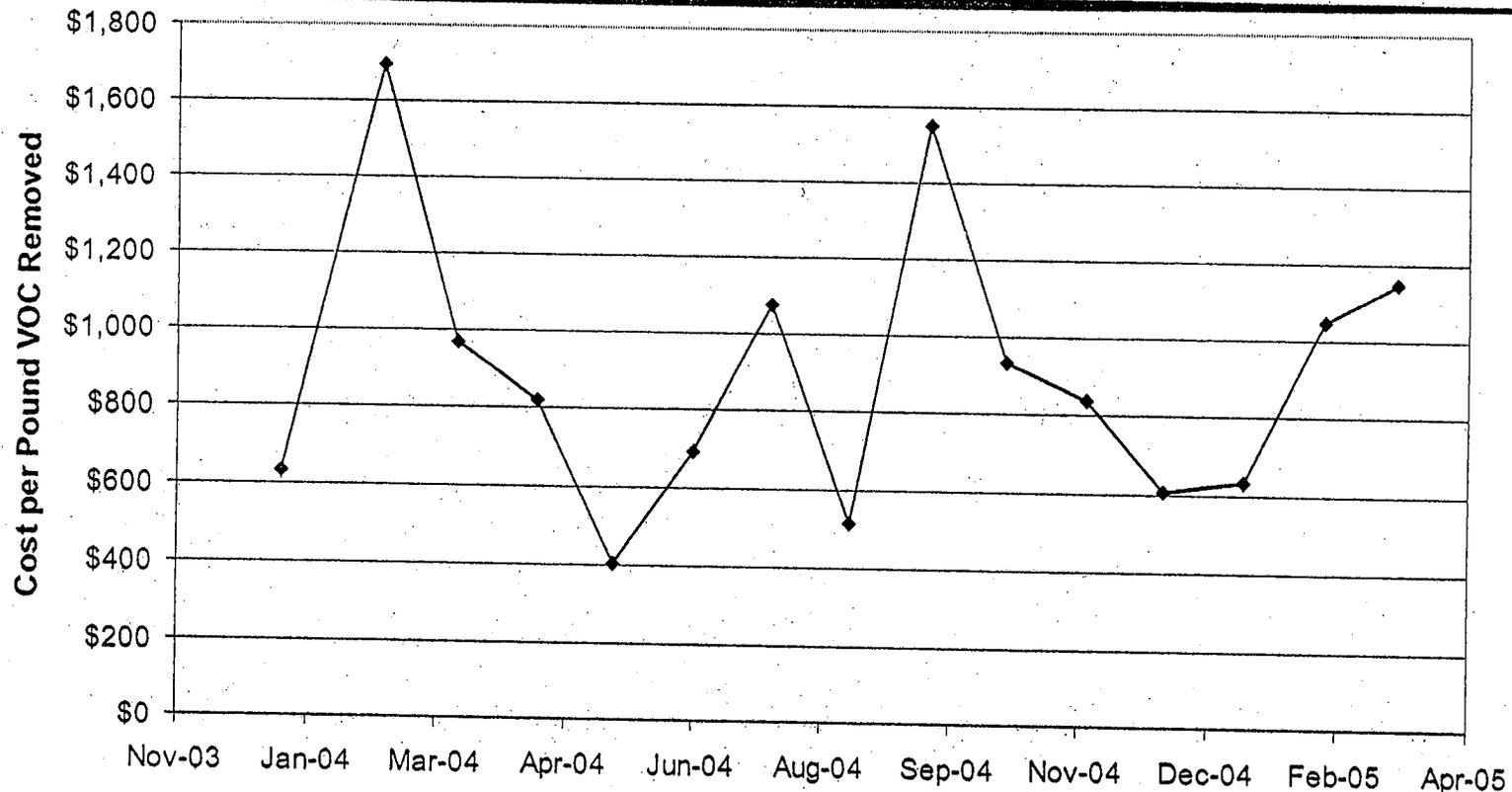


- A total of ~4,000 lb of VOCs removed by GWETS to date
- TCE accounts for >90% of VOCs; primarily from Area A

GWETS Evaluation – Achieving Cleanup Levels

- Statistical analyses performed to determine contaminant trends in each Area
 - Area A: $\text{CCl}_4 = -15\%/yr$; TCE = $-24\%/yr$; PCE = $+38\%/yr$
 - Area C: PCE = $-10\%/yr$
 - Area D: TCE = $-15\%/yr$
- Estimated time to achieve cleanup levels based on statistical trends
 - Area A = 56 yrs (TCE outside of DNAPL source area)
 - Area C = 32 yrs (15 yrs for EW concentrations)
 - Area D = 17 yrs

GWETS Evaluation – Cost Efficiency



- Average cost per pound VOC removed: \$400 to \$1,700
- Continued operation of the existing system would cost an additional \$5.2 million over the next 30 years

Recommended Remedial Alternatives

- Due to relatively low contaminant concentrations in Areas C and D, the feasibility of MNA was evaluated
 - Used a natural attenuation analytical groundwater model (BIOCHLOR) as screening tool
 - Models constructed using site-specific parameters determined during previous site investigations
 - Models do not account for extraction well operation
 - Models constructed conservatively with continuous source
 - Calibrated to existing concentrations

Recommended Remedial Alternatives (cont.)

- Area C

- Model indicates minimal biodegradation is occurring
- Assuming maximum concentration observed in extraction wells (25 $\mu\text{g/L}$), MCL achieved by NA within 500 ft
- Assuming maximum concentrations observed in upgradient monitoring wells (330 $\mu\text{g/L}$), MCL achieved by NA within 2,000 ft

- Area D

- Model suggests that biodegradation is occurring
- Assuming maximum concentration observed in Area D wells (70 $\mu\text{g/L}$), MCL achieved by NA within 400 ft
- Assuming no biodegradation, MCL achieved by NA within 1,200 ft

Optimization Recommendations

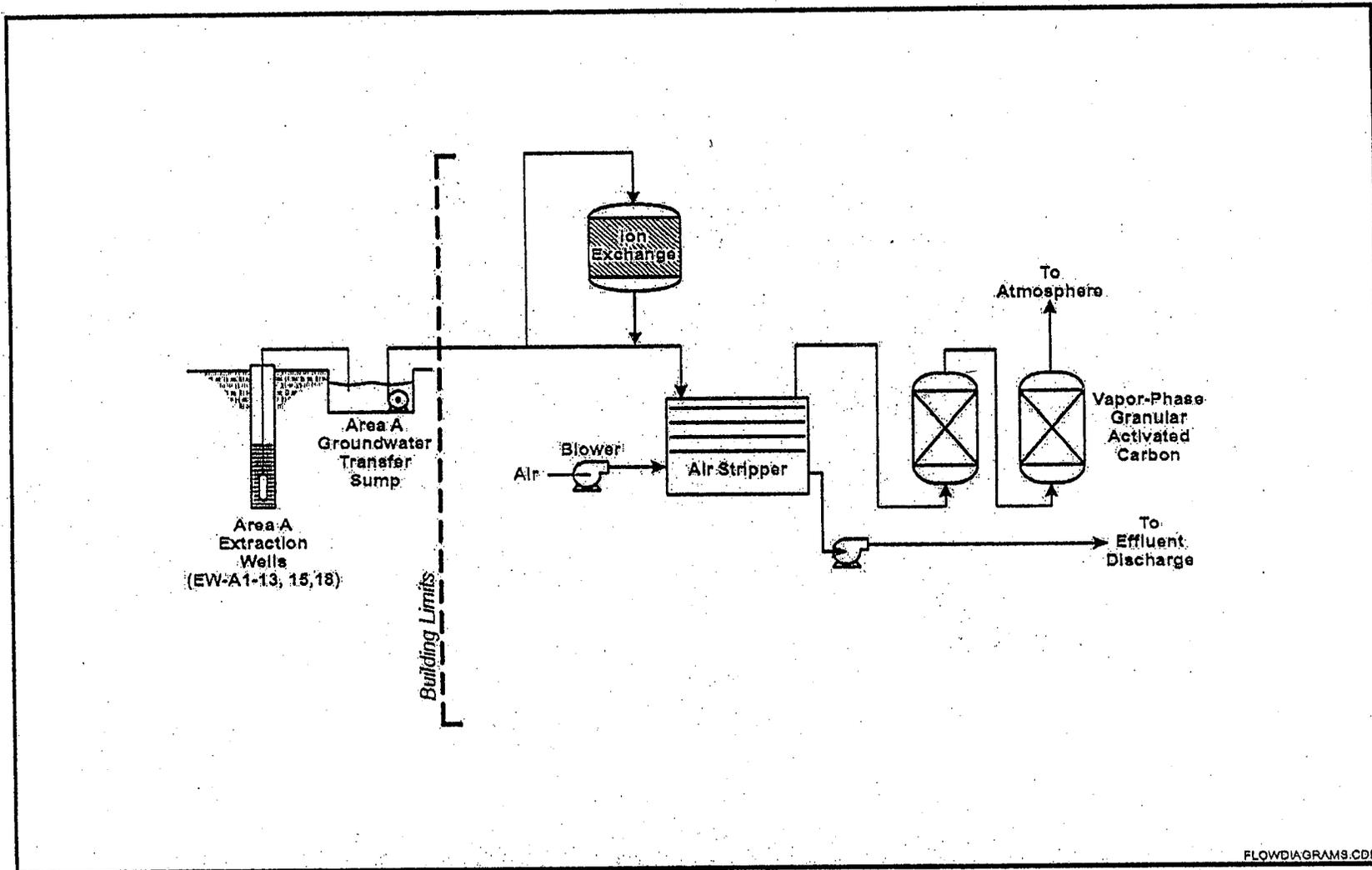
Area A Extraction Wells

- Monitoring indicates current pumping rates (52.7-61.8 gpm) are adequate to maintain hydraulic control in Area A
 - Pumping rates are below the projected long-term sustainable yields of 110-148 gpm
 - Higher mass extraction rates may be realized if higher extraction rates can be achieved in selected wells
- Conducted short term pumping test to estimate maximum achievable pumping rates and appropriate level set points for each well
 - Results indicate a 35% increase in pumping rates could result in a 50% increase in mass extraction rates

GWETS Optimization Recommendations

- Suspend pumping from Areas C and D and implement natural attenuation monitoring program
- Optimize Area A pumping rates
- Bypass EQ tank - Area A sump can be used to equalize flow to the treatment system
- Take metals removal equipment off-line
- Install AS with higher VOC removal efficiency
- Discontinue use of LGAC if monitoring data indicate that new AS can consistently achieve permit limits
- Install additional VGAC unit to operate in series with the two existing units

GWETS Optimization Recommendations



FLOWDIAGRAMS.CDR

LTM Optimization Recommendations

- Implement TEG recommendations, except continue semi-annual sampling of EW-A18
- Reduce extraction well sampling to ^{semi-}annual
- Reduce groundwater-level monitoring to annual in hydrogeologic units A and C (Areas A and D)
- Discontinue monitoring in WMA-13 (Area C)
- Remove monitoring well HN-69S from monitoring program (Area A)

Cost Evaluation

- \$54,500 to implement GWETS recommendations
- \$46,400 annual GWETS O&M cost savings
- \$53,400 annual LTM cost savings
- Present worth cost for current GWETS operation and LTM = \$8.5 million
- Estimated present worth cost with recommendations = \$6.6 million
- Long-term savings of \$1.9 million over 30 years

Cost Evaluation

