



Infrastructure, buildings, environment, communications

Sharon Schaver
Regional Hydrogeologist
Southeast Region – Milwaukee River Basin Team
Bureau of Drinking Water and Groundwater
Wisconsin Department of Natural Resources



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Subject:

Information Needed to Complete Application for Request for Temporary Exemption for Injection of Remedial Material to Enhance In-Situ Groundwater Remediation Process, Decorah Shopping Center Annex, West Bend, Wisconsin, FID# 267161400, BRRTS# 02-67-151266.

Date:
20 October 2004

Contact:
Jim Bannantine

Dear Ms. Schaver:

Phone:
414 276 7742

ARCADIS is in receipt of your electronic message to Binyoti Amungwafor of the Wisconsin Department of Natural Resources (WDNR) regarding the above referenced permit application. We have prepared the following responses to the issues raised. Each of your questions is restated below, followed by our response.

Email:
jbannantine@arcadis-us.com

A) Is the site investigation complete? and B) How do we know?

The site investigation activities were completed by Key Engineering Group (Key) for this project. The site investigation activities were approved by the WDNR in a letter dated April 8, 2003, except that soil vapor testing was required. Soil vapor testing was performed by Key and documented in a report dated August 21, 2003. Wisconsin Department of Health and Family Services (WDHFS) issued a report dated January 13, 2004 which stated that there were no current concerns regarding vapor intrusion at the Site. These documents should be included within the WDNR project file.

In reviewing the Site investigation data, the groundwater flow direction has been established through several years of monitoring, and there are downgradient and sidegradient wells within the study area that contain no concentrations of volatile organic compounds (VOCs). Piezometers at the site have had low to no detected VOCs, suggesting that the vertical extent of the plume is largely defined. Figure 4 from the Key document "*Site Investigation Status Update/Site Investigation Completion*" dated August 21, 2003 shows contour lines for the perchloroethene (PCE) plume with the outer contour labeled "not detected". A copy of this drawing is included in Attachment 1. ARCADIS may install additional wells and piezometers for remediation monitoring or to obtain additional site information as necessary.

Part of a bigger picture

Question 1: Identify the sources and water quality of the make-up water used for the potassium permanganate solution.

Potable water will be obtained either from the city of Milwaukee or the city of West Bend potable water system. To remove chlorine and trihalomethanes, the water will be passed through a carbon filter as the tank is filled from the water tap.

Question 2: Is perchloroethene (PCE) the only contaminant of concern at the site?

A: PCE is the primary contaminant of concern at the site. Low concentrations of trichloroethane (TCE) (less than 10 micrograms per liter [$\mu\text{g/L}$]) have been detected in some of the wells, but the concentrations have been very low in relation to PCE (up to 1,100 $\mu\text{g/L}$). ARCADIS recently completed a groundwater sample collection event that included sampling for VOCs as well as Resource Conservation and Recovery Act (RCRA) metals. No other contaminants of concern have been detected at the site in elevated concentrations.

Question 3: Identify the target zone (vertical and areal extent) for the pilot study.

A: As stated in the NR 140 Exemption application, two injection wells are proposed for the pilot study, located on the west side of Lincoln Drive West in the vicinity of Monitoring Well MW-13 (Figure 1). The locations for the injection wells were selected because MW-13 has had the highest concentrations of PCE (530 to 1,100 $\mu\text{g/L}$) and can be used as a monitoring point for the pilot test. The injection wells will consist of 1-inch diameter PVC piping installed with a Geoprobe, and will be installed to an approximate depth of 13 feet below ground surface with 5-foot screens at the base. This construction was selected because the depth to water is approximately 7 to 8 feet below ground surface. The injection wells will be screened from 8 to 13 feet below ground surface so that the approximate top 5 feet of the aquifer will be treated. Based on the large lateral extent of the plume and the low concentrations of PCE in the piezometers at the site, we believe that treatment of the top 5 feet of the aquifer will address most of the contaminant mass at the site.

A total of nine monitoring points will be installed downgradient from the injection wells as shown on Figure 1. The monitoring points will also be installed with a Geoprobe and will consist of 1-inch diameter PVC piping, with 5-foot screens installed from approximately 8 to 13 feet below ground surface. The wells will be spaced at approximate 8-foot intervals in the north-south direction and approximate 10-foot intervals in the east-west direction, with two monitoring probes located approximately 5 feet west of the injection points.

Question 4: Provide information regarding:

Site History

Cross-sections

Well construction and boring logs

Summary of past investigative and remedial work for the site
Contaminant trends at the site

Site History

The Site is located at the southern most portion of a strip mall ,and began dry cleaning operations in 1965. Mr. Bob Krueger took over the business from his father in 1981 and continued the dry cleaning operations until December 2003. There is no business currently operating in this portion of the strip mall. Mr. Krueger stated that his father had periodically discharged PCE to the back alley and sewer system, as was legal and customary at the time. Mr. Krueger stated that he operated a closed loop system during the time he operated the dry cleaning business (1981-2003).

Cross-sections

Key did not prepare lithologic cross-sections for their reports. ARCADIS has prepared two cross sections for the facility. These cross sections are shown in Attachment 2.

Well Construction and Boring Logs

Well construction and boring logs for the wells installed to date are in the WDNR project file. Copies of the boring logs and construction forms for MW-13, MW-16 and GP-24 are included in Attachment 3 of this submittal for your review.

Summary of Past Investigative and Remedial Work for this Site

The past investigative work at the site was completed by Key and is documented in the project file. Tables summarizing the soil and groundwater analytical data for the site are included in Attachment 4. Also, a copy of Key's figure showing the historical TCE and PCE concentrations is included in Attachment 4. ARCADIS' recent groundwater sample collection data is also summarized on this drawing. There has been no remediation work completed at the site; the pilot study will be the initial remedial task completed.

Contaminant Trends on the Site

Attachment 4 contains a site map showing the historical TCE and PCE concentrations at the site. The PCE concentration at MW-13 decreased from 1,000 µg/L to 530 µg/L between November 2001 and March 2003, and increased to 1,100 µg/L in August 2004. The data from MW-14 has shown an increase with time, while the concentrations of the downgradient wells appear to have decreased.

Question 4: Please supply information about the occurrence of NAPL at your site.

A: Nonaqueous Phase Liquids (NAPL) has not been documented at any soil sample or monitoring well location. Given that the source (dry cleaner) has been removed and the highest PCE concentration in the groundwater was 1,100 µg/L and has not increased substantially with time, site conditions do not suggest the presence of NAPL at this site.

Question 5: Identify the locations and depth of utilities (gas lines, electrical, sewer lines, catch basins, etc.) and supply a map.

Figure 1 shows the proposed drilling locations and the location depths of utilities in the area.

Question 6: Please use the WDNR monitoring well form to indicate proposed injection well and monitoring well specifications. WDNR is concerned that materials, annular space, surface seal, etc. are appropriate for the life of the project and are appropriate for the proposed injection rate and pressure head.

A: Attachment 5 contains a WDNR monitoring form showing the proposed construction details for the injection and monitoring wells at the site. Attachment 5 also contains corrosion resistance tables showing that polyvinyl chloride construction is compatible with up to 10 percent and 20 percent potassium permanganate solution; these are much higher concentrations than those proposed for this study. Attachment 5 also contains a study performed by Carus Chemical showing that bentonite clay does not react with permanganate, and that the clay exerts a minor oxidant demand. Linda Warren of Carus Chemical informed ARCADIS via telephone that silica sand will not react with potassium permanganate and will not exert a significant oxidant demand on the system.

Question 7: Specify the monitoring frequency and the analytical methods.

We plan to collect VOCs (EPA method 8260) and RCRA metals (barium by 6010B, arsenic by 7060A, cadmium by 7131A, chromium by 7191, lead by 7421, mercury by 7470A, selenium by 7741A and silver by 7761) data from the nine monitoring points at monthly intervals for a minimum of 2 months. We may utilize a sodium bromide tracer at part of the study, and would then collect bromide samples from each of the nine sampling points on a weekly basis for a minimum of 2 months. The sampling frequency and length of the test may be altered depending upon the analytical results. We plan to adjust the sampling frequency in order to obtain sufficient data for full-scale treatment.

ARCADIS

Sharon Schaver
20 October 2004

Closing

We appreciate the opportunity to provide the enclosed response, and we look forward to your approval of the permit at your earliest convenience. If you have any questions or require additional information, please contact us.

Sincerely,

ARCADIS G&M, Inc.



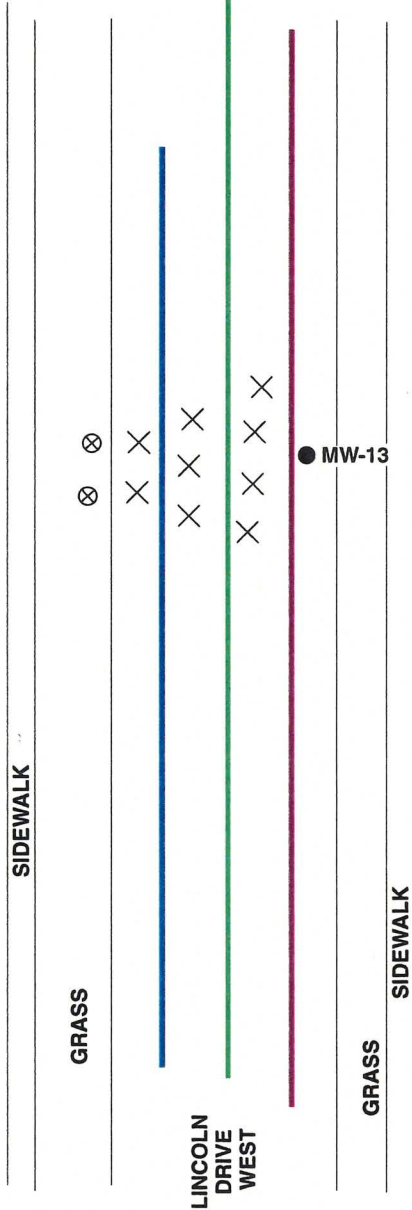
James E. Bannantine, PG
Senior Geologist



Edmund Buc, PE
Senior Engineer

Copies:

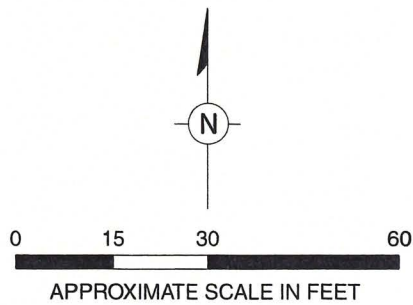
Binyoti Amungwafor, Wisconsin Department of Natural Resources
Don P. Gallo, Esq., Reinhart, Boerner & Van Dueren, S.C.
Mary L. Mokwa, Continental VI Fund, L.P.



LEGEND

- EXISTING MONITORING WELL
- ⊗ PROPOSED INJECTION WELL
- × PROPOSED MONITORING LOCATION
- WATER (Depth = 6 feet)
- SANITARY SEWER (Depth = 7.2 feet)
- STORM SEWER (Depth = 5.3 feet)

Approximate Depth to Water Table = 8-9.5 feet below land surface

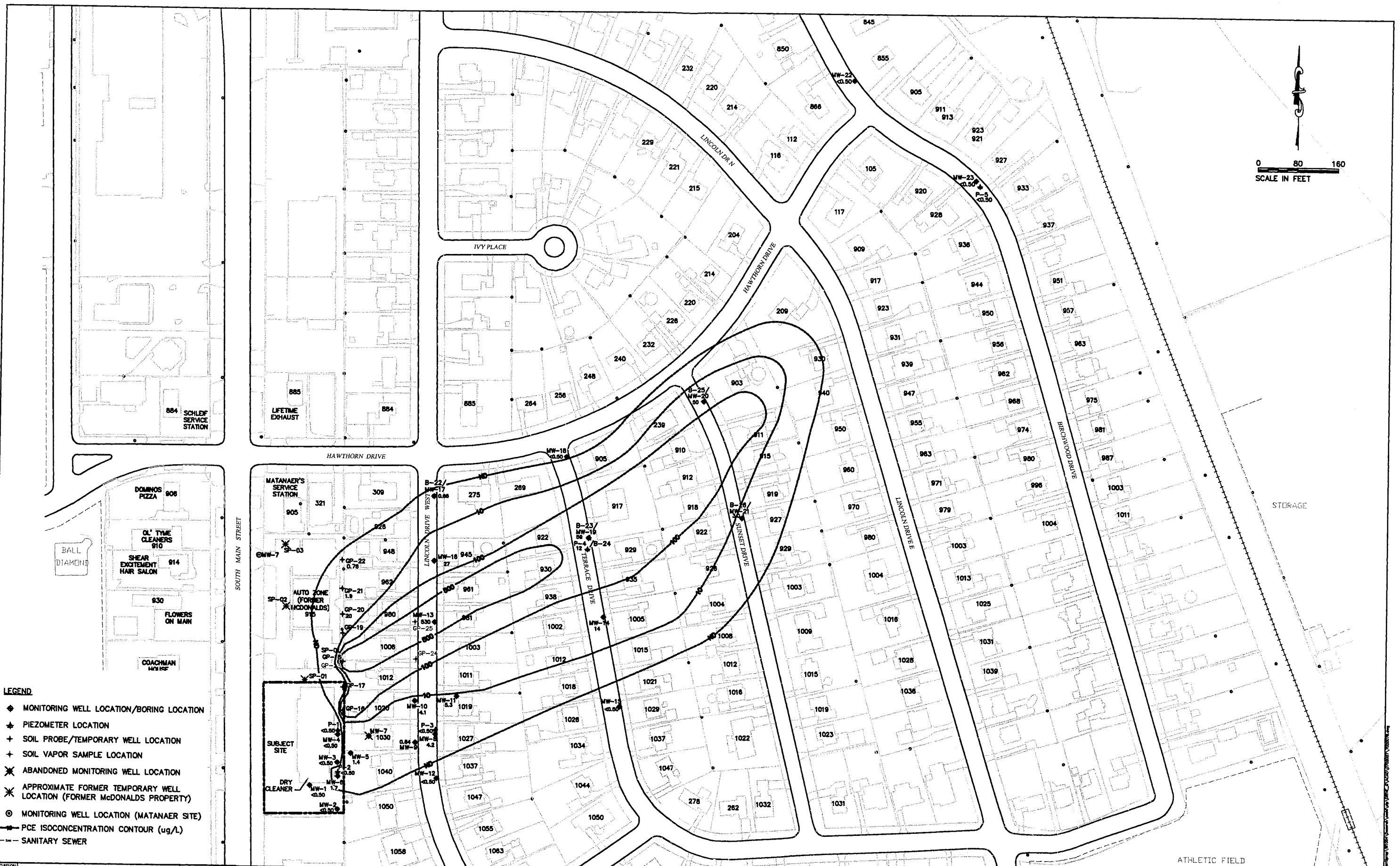
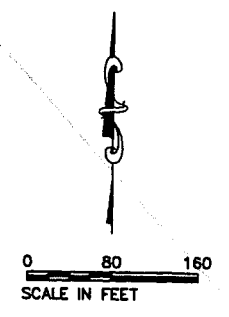


PROPOSED PILOT STUDY

DECORAH SHOPPING CENTER ANNEX
1011-1025 SOUTH MAIN STREET
WEST BEND, WISCONSIN

FIGURE

1



- LEGEND**
- ◆ MONITORING WELL LOCATION/BORING LOCATION
 - ⊕ PIEZOMETER LOCATION
 - + SOIL PROBE/TEMPORARY WELL LOCATION
 - + SOIL VAPOR SAMPLE LOCATION
 - ✕ ABANDONED MONITORING WELL LOCATION
 - ✕ APPROXIMATE FORMER TEMPORARY WELL LOCATION (FORMER MCDONALD'S PROPERTY)
 - ⊙ MONITORING WELL LOCATION (MATANAER SITE)
 - PCE ISOCONCENTRATION CONTOUR (ug/L)
 - - - SANITARY SEWER

REVISION NO.	DESCRIPTION	DATE	BY	DESIGNED BY	DATE
				KTK	07/25/03
				CTM	07/25/03
				DJG	07/25/03
	CADFILE XREF LMAN Jay				

FIGURE 4
PCE ISOCONCENTRATION CONTOUR MAP
DECORAH SHOPPING CENTER ANNEX
WEST BEND, WI

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KEY PROJECT NUMBER	0702007
PROJECT SCALE	
SHEET NUMBER	1

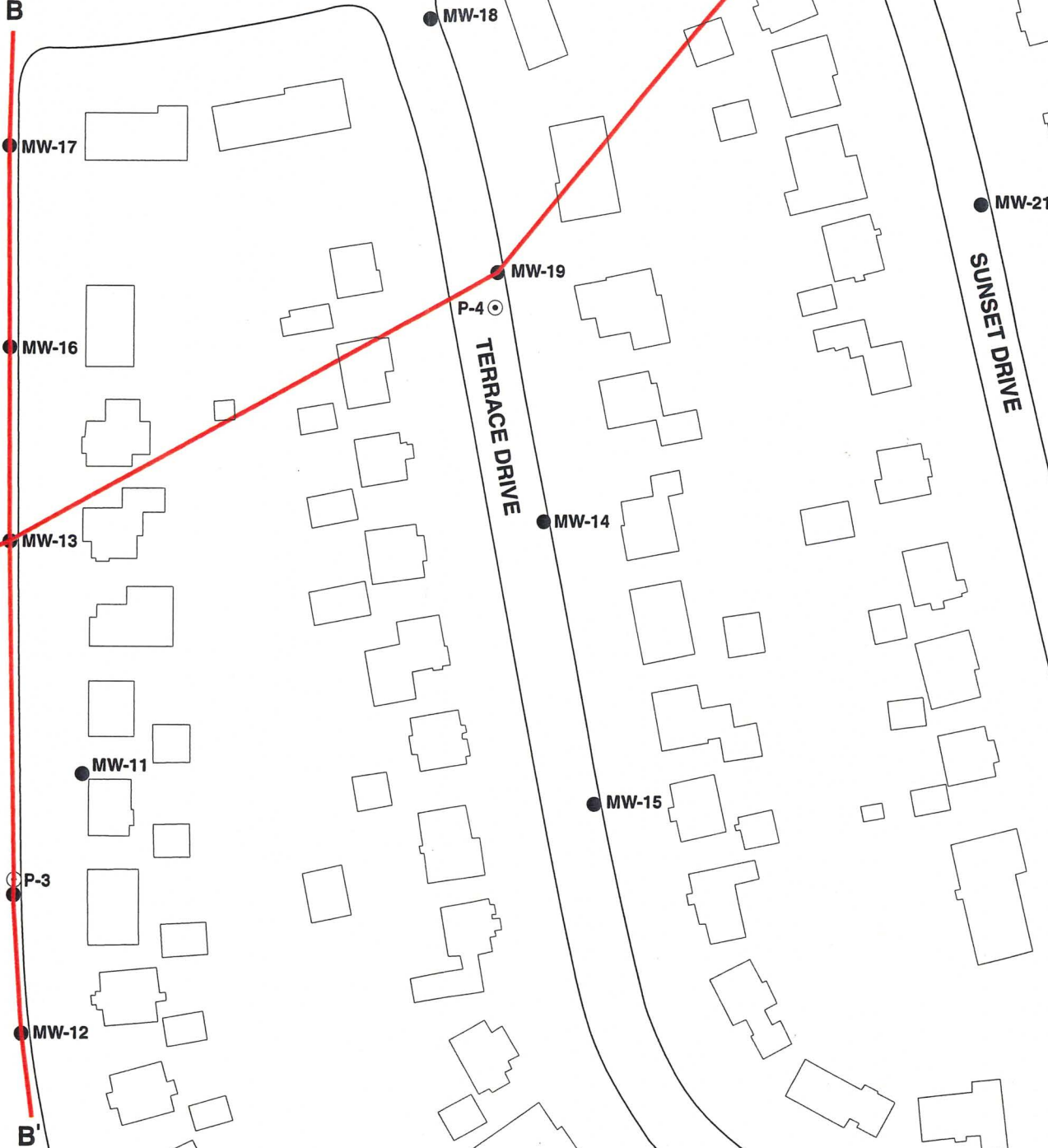
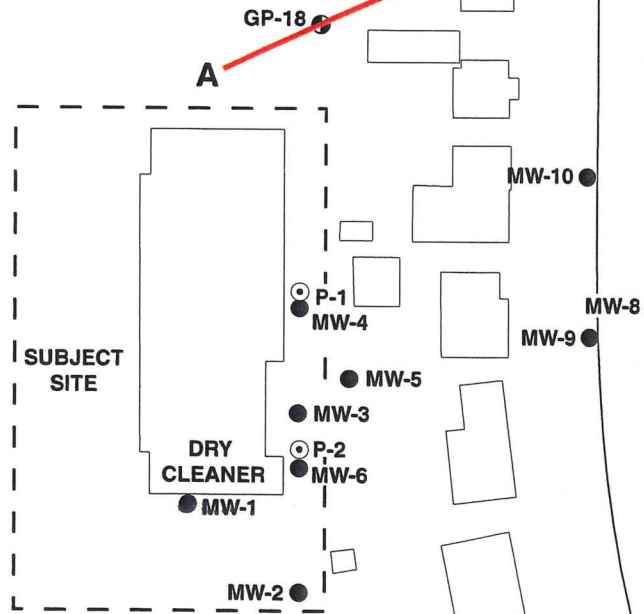
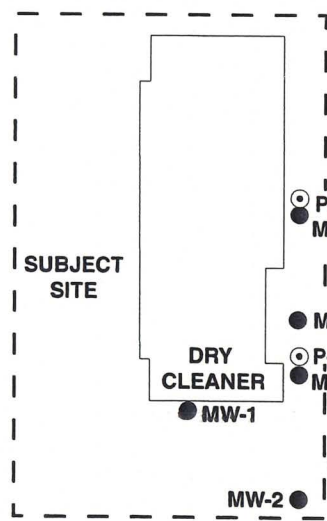
SOUTH MAIN STREET

HAWTHORN DRIVE

LINCOLN DRIVE WEST

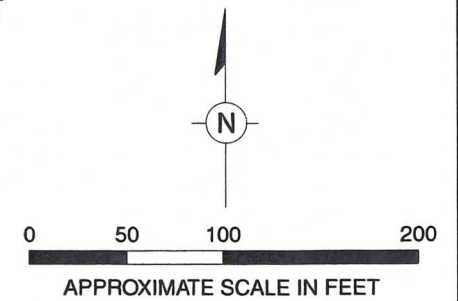
TERRACE DRIVE

SUNSET DRIVE



LEGEND

- MONITORING WELL LOCATION
- PIEZOMETER LOCATION
- ⊕ SOIL BORING LOCATION



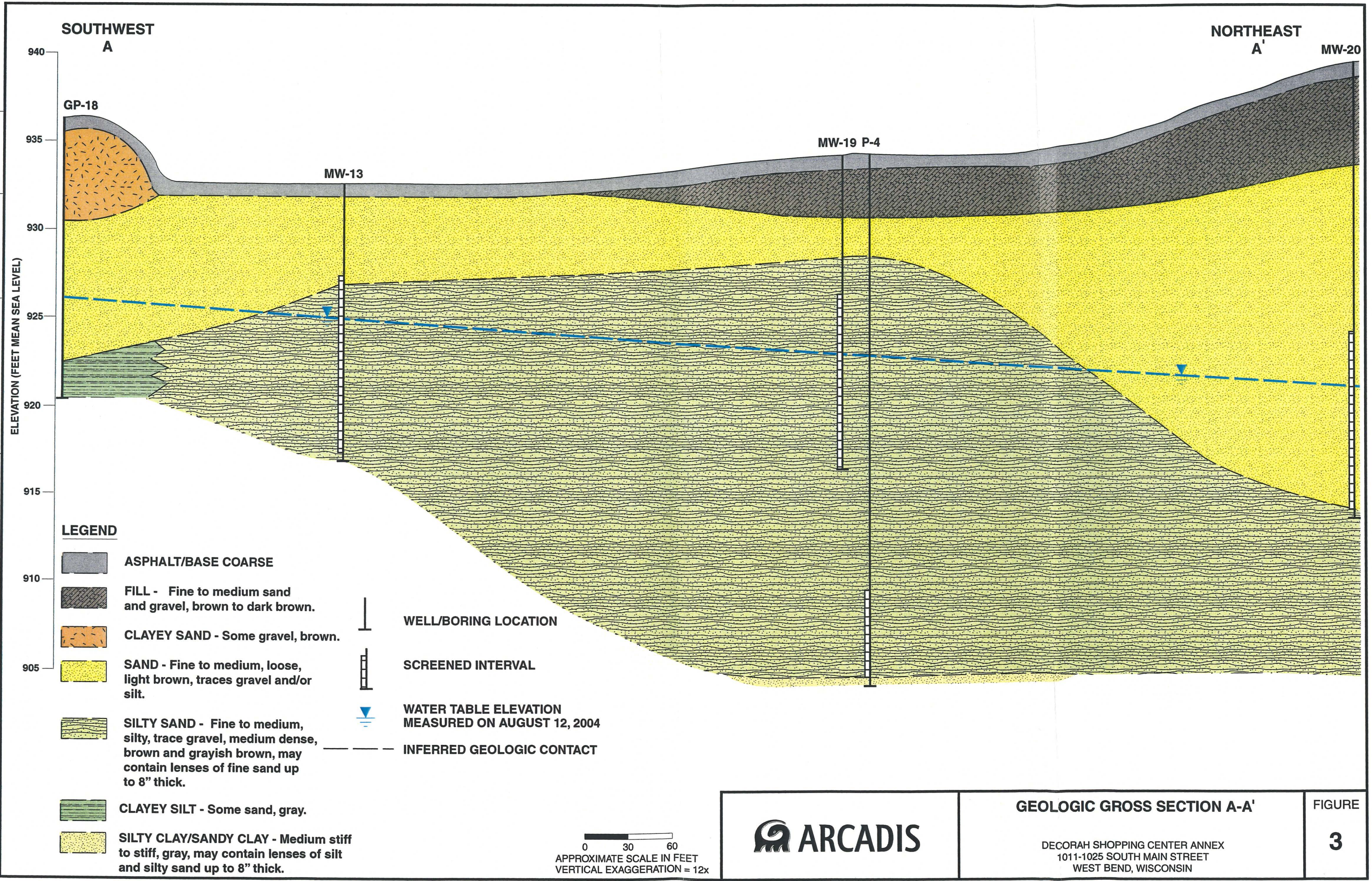
SITE PLAN AND CROSS-SECTION LOCATIONS

DECORAH SHOPPING CENTER ANNEX
1011-1025 SOUTH MAIN STREET
WEST BEND, WISCONSIN

FIGURE

2

DWG DATE: 08OCT04 | PN: CONTLPROP\W101054\DECORAH | FILE NO.: GRAPHICS | DRAWING: XSEC_A_A'-A1 | CHECKED: DMG | APPROVED: | DRAFTER: LMB



SOUTHWEST
A

NORTHEAST
A'

MW-20

GP-18

MW-19 P-4

MW-13

ELEVATION (FEET MEAN SEA LEVEL)

LEGEND

- ASPHALT/BASE COARSE**
- FILL - Fine to medium sand and gravel, brown to dark brown.**
- CLAYEY SAND - Some gravel, brown.**
- SAND - Fine to medium, loose, light brown, traces gravel and/or silt.**
- SILTY SAND - Fine to medium, silty, trace gravel, medium dense, brown and grayish brown, may contain lenses of fine sand up to 8" thick.**
- CLAYEY SILT - Some sand, gray.**
- SILTY CLAY/SANDY CLAY - Medium stiff to stiff, gray, may contain lenses of silt and silty sand up to 8" thick.**
- WELL/BORING LOCATION**
- SCREENED INTERVAL**
- WATER TABLE ELEVATION MEASURED ON AUGUST 12, 2004**
- INFERRED GEOLOGIC CONTACT**

0 30 60
APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 12x



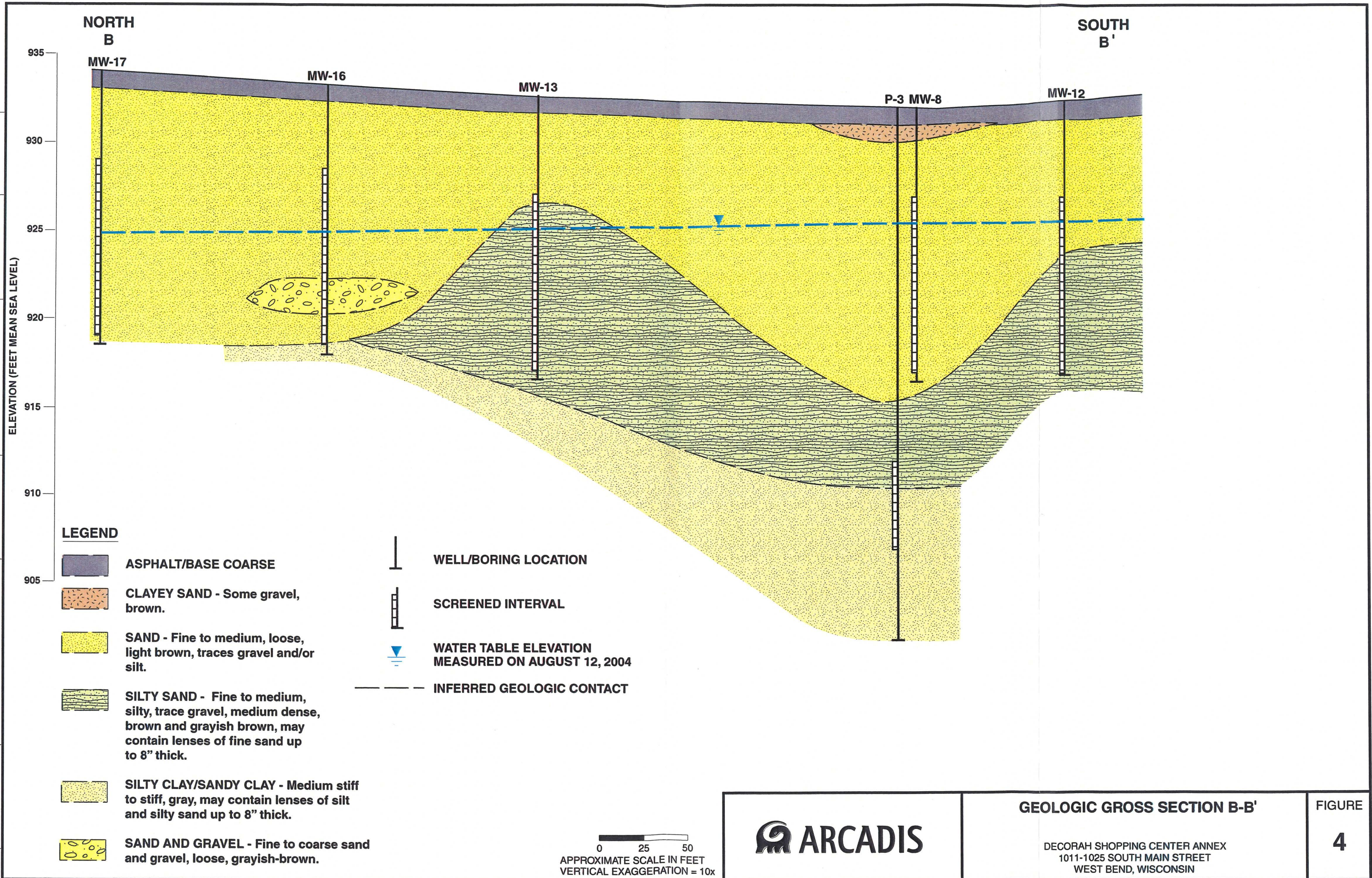
GEOLOGIC GROSS SECTION A-A'

DECORAH SHOPPING CENTER ANNEX
1011-1025 SOUTH MAIN STREET
WEST BEND, WISCONSIN

FIGURE

3

DWG DATE: 07OCT04 | PN: CONTLPROP\W01054\DECORAH | FILE NO.: GRAPHICS | DRAWING: XSEC_B_B'.AI | CHECKED: DMG | APPROVED: | DRAFTER: LMB



Route To: Watershed/Wastewater Waste Management
 Remediation/Redevelopment Other

Facility/Project Name Decorah Shopping Center Annex		License/Permit/Monitoring Number -		Boring Number B-17	
Boring Drilled By: Name of crew chief (first, last) and Firm Dan & Kevin Wisconsin Soil Testing		Date Drilling Started 10/31/2001		Date Drilling Completed 10/31/2001	
WI Unique Well No. PD 219		DNR Well ID No. MW-13		Common Well Name MW-13	
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/>		Final Static Water Level Feet MSL		Surface Elevation Feet MSL	
State Plane SW 1/4 of NW 1/4 of Section 24, T 11 N, R 19 E		Lat _____ "		Local Grid Location <input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W	
Facility ID		County Washington		County Code 67	
				Civil Town/City/ or Village West Bend	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					Pocket Penetrometer
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
AUGER 1 SS	12 24	6 4 5	1	Asphalt Sand and gravel base course	GW			<1	9					
AUGER 2 SS	6 24 8	2 2 4	2	Light brown, loose, fine to medium SAND, with trace of silt, moist	SM			<1*	6					
AUGER 3 SS	6 24 12	5 8 3	3	Light brown, medium dense, silty fine to medium SAND, with trace of gravel				<1	11					
AUGER 4 SS	6 24 12	2 4 4	4	-Loose -Wet	SM			<1	8					
AUGER 5 SS	6 24 14	6 9 9	5					<1	18					

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Firm **KEY ENGINEERING GROUP, LTD.** Tel. (262) 375-4750
W66 N215 COMMERCE CT. CEDARBURG, WI 53012 Fax: (262) 375-9680


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Route To: Watershed/Wastewater Waste Management
Remediation/Redevelopment Other

Facility/Project Name Decorah Shopping Center Annex		License/Permit/Monitoring Number -		Boring Number B-21	
Boring Drilled By: Name of crew chief (first, last) and Firm Chuck Wisconsin Soil Testing		Date Drilling Started 3/11/2003		Date Drilling Completed 3/11/2003	
Drilling Method HSA		WI Unique Well No. PK-921		DNR Well ID No.	
Common Well Name MW-16		Final Static Water Level Feet MSL		Surface Elevation Feet MSL	
Borehole Diameter 8.3 inches		Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/> State Plane N, E S/C/N		Local Grid Location <input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W	
SW 1/4 of NW 1/4 of Section 24, T 11 N, R 19 E		Lat _____ "		Long _____ "	
Facility ID		County Washington		County Code 67	
		Civil Town/City/ or Village West Bend			

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					Pocket Penetrometer
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
AUGER 1 SS	12 24 22	5 4 5 3	1 2	ASPHALT Light brown, loose, fine to medium SAND with trace gravel				7	8					
AUGER 2 SS	6 24 20	5 4 3 2	3 4 5					5	5					
AUGER 3 SS	6 24 22	5 5 6 5	6 7		SP			4	11					
AUGER 4 SS	6 24 20	6 4 5 4	8 9 10					4*	10					
AUGER 5 SS	6 24 15	6 5 4	11	Grayish brown, loose, fine to coarse SAND and gravel, wet	SP			5	10					

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature  Firm **KEY ENGINEERING GROUP, LTD.** Tel: (262) 375-4750
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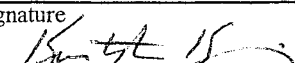
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Route To: Watershed/Wastewater Waste Management
Remediation/Redevelopment Other

Facility/Project Name Decorah Shopping Center Annex			License/Permit/Monitoring Number -		Boring Number GP-24	
Boring Drilled By: Name of crew chief (first, last) and Firm Dave Paulson Soil Essentials			Date Drilling Started 6/10/2003		Date Drilling Completed 6/10/2003	
WI Unique Well No.		DNR Well ID No.	Common Well Name	Final Static Water Level Feet MSL		Surface Elevation Feet MSL
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/>		State Plane N, E S/C/N		Local Grid Location		Borehole Diameter 2.0 inches
SW 1/2 of NW 1/4 of Section 24, T 11 N, R 19 E		Lat _____ ' _____ "		Feet <input type="checkbox"/> N <input type="checkbox"/> E		Feet <input type="checkbox"/> S <input type="checkbox"/> W
Facility ID		County Washington	County Code 67	Civil Town/City/ or Village West Bend		

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties						Pocket Penetrometer
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200		
1 SS	48 42		1	TOPSOIL Dark brown, fine to medium SAND with trace gravel				<1							
			2					<1							
			3					<1							
			4		SP			<1							
2 SS	36 32		5					<1							
			6					<1							
			7	End of soil boring at 7'				<1							

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature:  Firm: **KEY ENGINEERING GROUP, LTD.**
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Route To: Watershed/Wastewater Waste Management
Remediation/Redevelopment Other

Facility/Project Name Decorah Shopping Center Annex			License/Permit/Monitoring Number -		Boring Number GP-25	
Boring Drilled By: Name of crew chief (first, last) and Firm Dave Paulson Soil Essentials			Date Drilling Started 6/10/2003		Date Drilling Completed 6/10/2003	
WI Unique Well No.		DNR Well ID No.	Common Well Name		Final Static Water Level Feet MSL	Surface Elevation Feet MSL
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Boring Location <input checked="" type="checkbox"/>		State Plane N, E S/C/N		Lat _____ "		Local Grid Location <input type="checkbox"/> N <input type="checkbox"/> E
SW 1/2 of NW 1/4 of Section 24, T 11 N, R 19 E		Long _____ "		Feet <input type="checkbox"/> S <input type="checkbox"/> W		Borehole Diameter 2.0 inches
Facility ID		County Washington	County Code 67	Civil Town/City/ or Village West Bend		

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties						Pocket Penetrometer
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200		
1 SS	48 48		1	TOPSOIL Brown, fine to medium SAND and GRAVEL (fill)	GP			<1							
			2	Reddish brown, fine to medium SAND with trace gravel				<1							
2 SS	36 36		4		SP			<1							
			7	End of soil boring at 7'				<1							

I hereby certify that the information on this form is true and correct to the best of my knowledge.

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TABLE 1
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

	B-1		B-2	B-3	B-4		B-5		GP-7		GP-8		GP-9	GP-10		GP-11	GP-12	GP-13	GRCL
Depth (feet)	1-3	6-8	3.5-5.5	1-3	1-3	6-8	1-3	6-8	2-4	8-10	2-4	8-10	4-6	2-4	8-10	5-7	7-9	7-9	NE
Date	4/1/98	4/1/98	4/1/98	4/1/98	4/1/98	4/1/98	4/1/98	4/1/98	10/23/98	10/23/98	9/3/99	9/3/99	9/3/99	9/3/99	9/3/99	9/3/99	9/3/99	9/3/99	NE
PID (i.u.)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	NE
Detected VOCs (µg/kg)																			
1,2,3-Trichlorobenzene	30	34	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	NE
Trimethylbenzenes	99	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NE
Napthalene	51	36 (Q)	50	38 (Q)	42	<25	42	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	400 ¹
Xylenes	<50	35	<50	<50	<50	<50	<50	<50	<50	<50	<75	<75	<75	<75	<75	<75	<75	<75	4,100
MTBE	<25	43	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	NE
Tetrachloroethene	<25	<25	<25	<25	79	212	31	<25	<25	107	240	120	<25	87	1,400	340	620	60	1839 ²
Benzene	<25	<25	<25	<25	<25	<25	<25	<25	28	<25	<25	<25	<25	<25	<25	<25	<25	<25	5.5
Toluene	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	1,500

Notes:

¹ - WDNR interim guidance

² - Site specific residual contaminant level based on the protection of groundwater (Supplemental Site Investigation Report, KEY, January 18, 2000)

Bold concentrations exceed NR 720 GRCL

GRCL - NR 720 generic residual contaminant level based on the protection of groundwater

i.u. - instrument units

MTBE - methyl tert-butyl ether

NE - not established

PID - photoionization detector

Q - concentration detected between laboratory limit of quantitation and limit of detection

µg/kg - micrograms per kilogram

VOCs - volatile organic compounds

TABLE 1 (CONTINUED)

SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX

1011-1025 South Main Street

West Bend, Wisconsin

	B-10	GP-14	GP-15	P-3	B-15	B-16	B-17	B-18	B-19	GP-16	GP-17	GP-18	GP-19	GP-20	GP-21	GP-22	GRCL
Depth (feet)	6-7.5	6-8	6-8	3.5-5	6-7.5	3.5-5.5	3.5-5.5	3.5-5.5	3.5-5.5	0-4	0-4	0-4	0-4	0-4	0-4	0-4	NE
Date	8/18/00	11/3/00	11/3/00	4/11/01	9/12/01	10/31/01	10/31/01	10/31/01	10/31/01	9/27/02	9/27/02	9/27/02	9/27/02	9/27/02	9/27/02	9/27/02	NE
PID (i.u.)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	NE
Detected VOCs (µg/kg)																	
1,2,3-Trichlorobenzene	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	NE
Trimethylbenzenes	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NE
Naphthalene	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	400 ¹
Xylenes	<75	<75	<75	<75	<75	<75	<75	<75	<75	<50	<50	<50	<50	<50	<50	<50	4,100
MTBE	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	NE
Tetrachloroethene	<25	<25	<25	<25	<25	<25	<25	<25	<25	77	<25	32 Q	<25	<25	<25	<25	1839 ²
Benzene	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	5.5
Toluene	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	1,500

Notes:

¹ - WDNR interim guidance² - Site specific residual contaminant level based on the protection of groundwater
(Supplemental Site Investigation Report, KEY, January 18, 2000)

Bold concentrations exceed NR 720 GRCL

GRCL - NR 720 generic residual contaminant level based on the protection of groundwater

i.u. - instrument units

MTBE - methyl tert-butyl ether

NE - not established

PID - photoionization detector

Q - concentration detected between laboratory limit of quantitation and limit of detection

µg/kg - micrograms per kilogram

VOCs - volatile organic compounds

TABLE 1 (CONTINUED)

SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX

1011-1025 South Main Street
West Bend, Wisconsin

	B-20	B-21		B-22		B-23		B-24	B-25		B-26		B-27	B-28	GRCL
Depth (feet)	8.5-10.5	8.5-10.5	13.5-15.5	11-13	16-18	8.5-10.5	16-18	28-30	18.5-20.5	23.5-25.5	21-23	26-28	5-7	12.5-14.5	NE
Date	3/11/03	3/11/03	3/11/03	3/11/03	3/11/03	3/11/03	3/11/03	3/11/03	3/12/03	3/12/03	3/12/03	3/12/03	6/3/03	6/3/03	NE
PID (i.u.)	4	4	<1	5	3	<1	4	<1	<1	<1	<1	<1	<1	<1	NE
Detected VOCs (µg/kg)															
1,2,3-Trichlorobenzene	<27	<26	<30	<30	<32	<29	<30	<31	<27	<32	<26	<32	<27	<26	NE
Trimethylbenzenes	<54	<52	<60	<60	<64	<58	<60	<62	<54	<64	<52	<64	<54	<52	NE
Naphthalene	<27	<26	<30	<30	<32	<29	<30	<31	<27	<32	<26	<32	<27	<26	400 ¹
Xylenes	<38	<37	<42	<42	<44	<40	<41	<43	<38	<45	<37	<44	<38	<37	4,100
MTBE	<27	<26	<30	<30	<32	<29	<30	<31	<27	<32	<26	<32	<27	<26	NE
Tetrachloroethene	<27	<26	94	<30	<32	<29	86	<31	<27	69	<26	<32	<27	<26	1839 ²
Benzene	<27	<26	<30	<30	<32	<29	<30	<31	<27	<32	<26	<32	<27	<26	5.5
Toluene	67	52	<30	36	<32	<29	<30	74	<27	<32	<26	<32	<27	<26	1,500

Notes:

¹ - WDNR interim guidance² - Site specific residual contaminant level based on the protection of groundwater
(Supplemental Site Investigation Report, KEY, January 18, 2000)

Bold concentrations exceed NR 720 GRCL

GRCL - NR 720 generic residual contaminant level based on the protection of groundwater

i.u. - instrument units

MTBE - methyl tert-butyl ether

NE - not established

PID - photoionization detector

Q - concentration detected between laboratory limit of quantitation and limit of detection

µg/kg - micrograms per kilogram

VOCs - volatile organic compounds

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

Date	MW-1					MW-2				MW-3								NR 140		
	4/7/98	7/31/98	10/8/99	3/19/03	6/10/03	4/7/98	7/31/98	10/8/99	3/19/03	4/7/98	7/31/98	10/8/99	3/31/00	8/31/00	12/4/00	4/12/01	11/5/01	3/19/03	ES	PAL
Detected VOCs (µg/l)																				
Trimethylbenzenes	<0.5	<0.5	<0.70	<0.50	---	0.3 (Q)	<0.5	<0.70	<0.50	0.2	<0.5	<0.70	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	480	96
Benzene	<0.2	<0.2	<0.25	<0.25	---	0.3 (Q)	0.2 (Q)	<0.25	<0.25	<0.2	<0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	5	0.5
Toluene	<0.3	<0.3	<0.38	<0.25	---	<0.3	<0.3	<0.38	<0.25	<0.3	<0.3	<0.38	<0.22	<0.22	<0.22	<0.22	<0.22	<0.25	1,000	200
Ethylbenzene	<0.2	<0.2	<0.32	<0.50	---	0.3 (Q)	<0.2	<0.32	<0.50	<0.2	<0.2	<0.32	<0.12	<0.12	<0.12	<0.12	<0.12	<0.50	700	140
Xylenes	<0.6	<0.6	<1.04	<0.50	---	1.0 (Q)	<0.6	<1.04	<0.50	0.5 (Q)	<0.6	<1.04	<0.74	<0.74	<0.74	<0.74	<0.74	<0.50	10,000	1,000
MTBE	0.5 (Q)	<0.2	<0.21	<0.50	---	<0.2	<0.2	<0.21	<0.50	<0.2	<0.2	<0.21	<0.53	<0.53	<0.53	<0.53	<0.53	60	12	
Isopropylbenzene	<0.2	<0.2	<0.33	<0.25	---	0.4 (Q)	<0.2	<0.33	<0.25	<0.2	<0.2	<0.33	<0.15	<0.15	<0.15	<0.15	<0.15	<0.25	NE	NE
n-Butylbenzene	<0.2	<0.2	<0.43	<0.25	---	0.4 (Q)	<0.2	<0.43	<0.25	<0.2	<0.2	<0.43	<0.29	<0.29	<0.29	<0.29	<0.29	<0.25	NE	NE
n-Propylbenzene	<0.3	<0.3	<0.36	<0.50	---	0.3 (Q)	<0.3	<0.36	<0.50	<0.3	<0.3	<0.36	<0.18	<0.18	<0.18	<0.18	<0.18	<0.50	NE	NE
Naphthalene	<0.5	<0.5	<0.73	<0.25	---	0.7 (Q)	<0.5	<0.73	<0.25	0.7 (Q)	<0.5	<0.73	<0.68	<0.68	<0.68	<0.68	<0.68	<0.25	40	8
Chloroform	<0.30	<0.30	<0.26	<0.25	---	<0.30	<0.30	<0.26	<0.25	<0.30	<0.30	<0.26	<0.32	<0.32	<0.32	<0.32	<0.32	<0.25	6	0.6
Chloromethane	<0.8	<0.8	<0.29	<0.25	---	<0.8	<0.8	<0.29	<0.25	<0.8	<0.8	<0.29	<0.24	0.72 (Q)	<0.24	<0.24	<0.24	<0.25	3	0.3
cis-1,2-Dichloroethene	<0.2	<0.2	<0.34	<0.50	---	<0.2	<0.2	<0.34	<0.50	<0.2	<0.2	<0.34	<1	<1	<1	<1	<0.50	70	7	
trans-1,2-Dichloroethene	<0.20	<0.20	<0.46	<0.50	---	<0.20	<0.20	<0.46	<0.50	<0.20	<0.20	<0.46	<0.23	<0.23	<0.23	<0.23	<0.23	<0.50	100	20
Tetrachloroethene	<0.3	<0.3	<0.56	<0.50	---	<0.3	<0.3	<0.56	<0.50	<0.3	1.6	1.3 (Q)	0.43 (Q)	1.1	0.33 (Q)	0.33 (Q)	<0.25	<0.50	5	0.5
Trichloroethene	<0.2	<0.2	<0.39	<0.25	---	<0.2	<0.2	<0.39	<0.25	<0.2	<0.2	<0.39	<0.36	<0.36	<0.36	<0.36	<0.25	5	0.5	
Natural Attenuation Parameters																				
Nitrate (mg/l)	---	---	---	<0.50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Sulfate (mg/l)	---	---	---	49	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Dissolved Iron	---	---	---	<0.042	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Total Iron	---	---	---	1.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Dissolved Manganese	---	---	---	0.32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Total Manganese	---	---	---	0.33	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
D.O. (mg/l)	---	---	---	2.74	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Specific Conductance (uS/cm)	---	---	---	7,411	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Resistivity (Ko/cm)	---	---	---	0.135	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Salinity (g/l)	---	---	---	4.13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
pH (s.u.)	---	---	---	6.98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
O.R.P. (mv)	---	---	---	351	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	

Notes:

- Bold concentrations exceed NR 140 PAL
- Shaded concentrations exceed NR 140 ES
- D.O. - dissolved oxygen
- ES - NR 140 enforcement standard
- g/l - grams per liter
- Ko/cm - kilohms per centimeter
- mg/l - milligrams per liter
- MTBE - methyl tert-butyl ether
- mv - millivolts
- NE - not established
- O.R.P. - oxygen reduction potential
- PAL - NR 140 preventive action limit
- Q - concentration detected laboratory limit of quantitation and limit of detection
- s.u. - standard units
- µg/l - micrograms per liter
- uS/cm - microsiemens per centimeter
- VOCs - volatile organic compounds

TABLE 3 (CONTINUED)

SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

Date	MW-4								MW-5								MW-6					NR 140					
	4/7/98	7/31/98	10/8/99	3/31/00	8/31/00	12/4/00	4/12/01	3/19/03	2/9/99	10/8/99	12/3/99	3/31/00	8/31/00	12/4/00	4/12/01	11/5/01	3/19/03	10/8/99	3/31/00	8/31/00	12/4/00	4/12/01	11/5/01	3/19/03	ES	PAL	
Detected VOCs (µg/l)																											
Trimehlybenzenes	<0.5	<0.5	<0.70	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	<0.70	<0.70	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	6.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	480	96
Benzene	<0.2	<0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.52 (Q)	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	5	0.5
Toluene	<0.3	<0.3	<0.38	<0.22	<0.22	<0.22	<0.22	<0.25	<0.3	<0.38	<0.38	<0.22	<0.22	<0.22	<0.22	<0.22	<0.25	1.2 (Q)	<0.22	<0.22	<0.22	0.39 (Q)	<0.22	<0.25	1,000	200	
Ethylbenzene	<0.2	<0.2	<0.32	<0.12	<0.12	<0.12	<0.12	<0.50	<0.2	<0.32	<0.32	<0.12	<0.12	<0.12	<0.12	<0.12	<0.50	1.9	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.50	700	140
Xylenes	<0.6	<0.6	<1.04	<0.74	<0.74	<0.74	<0.74	<0.50	<0.6	<1.04	<1.04	<0.74	<0.74	<0.74	<0.74	<0.74	<0.50	7.2	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.50	10,000	1,000
MTBE	<0.2	<0.2	<0.21	<0.53	<0.53	<0.53	<0.53	<0.50	<0.2	<0.21	<0.21	<0.53	<0.53	<0.53	<0.53	<0.53	<0.50	<0.21	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.50	60	12
Isopropylbenzene	<0.2	<0.2	<0.33	<0.15	<0.15	<0.15	<0.15	<0.25	<0.2	<0.33	<0.33	<0.15	<0.15	<0.15	<0.15	<0.15	<0.25	<0.33	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.25	NE	NE
n-Butylbenzene	<0.2	<0.2	<0.43	<0.29	<0.29	<0.29	<0.29	<0.25	<0.2	<0.43	<0.43	<0.29	<0.29	<0.29	<0.29	<0.29	<0.25	0.49 (Q)	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.25	NE	NE
n-Propylbenzene	<0.3	<0.3	<0.36	<0.18	<0.18	<0.18	<0.18	<0.50	<0.3	<0.36	<0.36	<0.18	<0.18	<0.18	<0.18	<0.18	<0.50	0.82 (Q)	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.50	NE	NE
Naphthalene	<0.5	<0.5	<0.73	<0.68	<0.68	<0.68	<0.68	<0.25	<0.5	<0.73	<0.73	<0.68	<0.68	<0.68	<0.68	<0.68	<0.25	1.1 (Q)	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.25	40	8
Chloroform	<0.30	<0.30	<0.26	<0.32	<0.32	<0.32	<0.32	<0.25	<0.30	<0.26	<0.26	<0.32	<0.32	<0.32	<0.32	<0.25	<0.25	<0.26	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.25	5	0.6
Chloromethane	<0.6	<0.8	<0.29	<0.24	6.8	0.49 (Q)	<0.24	<0.25	<0.8	<0.29	<0.29	<0.24	<0.24	11	<0.24	<0.24	<0.25	<0.29	<0.24	0.48 (Q)	17	<0.24	<0.24	<0.25	3	0.3	
cis-1,2-Dichloroethene	<0.2	<0.2	<0.34	<1	<1	<1	<1	<0.50	<0.2	<0.34	<0.34	<1	<1	<1	<1	<0.50	0.38 (Q)	<1	<1	<1	<1	<1	<1	<0.50	70	7	
trans-1,2-Dichloroethene	<0.20	<0.20	<0.46	<0.23	<0.23	<0.23	<0.23	<0.50	<0.20	<0.46	<0.46	<0.23	<0.23	<0.23	<0.23	<0.50	<0.46	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.50	100	20	
Tetrachloroethene	1.9	0.6 (Q)	<0.56	<0.25	<0.25	<0.25	<0.25	<0.50	2.5	13	4	12	12	18	6.6	1.4	4.1	3.4	2.5	3.2	3.8	1.8	1.7	5	0.5		
Trichloroethene	<0.2	<0.2	<0.39	<0.36	<0.36	<0.36	<0.36	<0.25	0.6	0.5 (Q)	0.9 (Q)	0.81 (Q)	1 (Q)	0.9 (Q)	0.46 (Q)	0.48 (Q)	0.53	<0.39	<0.36	<0.36	<0.36	<0.36	<0.36	<0.25	5	0.5	
Natural Attenuation Parameters																											
Nitrate (mg/l)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Sulfate (mg/l)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Dissolved Iron	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Total Iron	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Dissolved Manganese	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Total Manganese	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
D.O. (mg/l)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Specific Conductance (uS/cm)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Resistivity (KΩ/cm)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Salinity (g/l)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
pH (s.u.)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
O.R.P. (mv)	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

Notes:

- Bold concentrations exceed NR 140 PAL
- Shaded concentrations exceed NR 140 ES
- D.O. - dissolved oxygen
- ES - NR 140 enforcement standard
- g/l - grams per liter
- KΩ/cm - kilohms per centimeter
- mg/l - milligrams per liter
- MTBE - methyl tert-butyl ether
- mv - millivolts
- NE - not established
- O.R.P. - oxygen reduction potential
- PAL - NR 140 preventive action limit
- Q - concentration detected between laboratory limit of quantitation and limit of detection
- s.u. - standard units
- µg/l - micrograms per liter
- uS/cm - microsiemens per centimeter
- VOCs - volatile organic compounds

TABLE 3 (CONTINUED)

SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

Date	MW-7			MW-8			MW-9			MW-10			MW-11			MW-12		NR 140								
	9/20/00	12/4/00	4/12/01	11/5/01	4/12/01	4/30/01	11/5/01	3/19/03	4/12/01	4/30/01	11/5/01	3/19/03	4/12/01	4/30/01	11/5/01	3/19/03	9/14/01	11/5/01	3/19/03	11/5/01	3/19/03	ES	PAL			
Detected VOCs (µg/l)																										
Trimethylbenzenes	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	480	96		
Benzene	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	5	0.5		
Toluene	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	1,000	200		
Ethylbenzene	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.50	<0.12	<0.12	<0.12	<0.50	<0.12	<0.12	<0.12	<0.50	<0.12	<0.12	<0.50	<0.12	<0.50	<0.12	<0.50	700	140	
Xylenes	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.50	<0.74	<0.74	<0.74	<0.50	<0.74	<0.74	<0.74	<0.50	<0.74	<0.74	<0.50	<0.74	<0.50	<0.74	<0.50	10,000	1,000	
MTBE	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.50	<0.53	<0.53	<0.53	<0.50	<0.53	<0.53	<0.53	<0.50	<0.53	<0.53	<0.50	<0.53	<0.53	<0.50	<0.53	<0.50	60	12
Isopropylbenzene	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.25	<0.15	<0.15	<0.15	<0.25	<0.15	<0.15	<0.15	<0.25	<0.15	<0.15	<0.25	<0.15	<0.15	<0.25	<0.15	<0.25	NE	NE
n-Butylbenzene	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.25	<0.29	<0.29	<0.29	<0.25	<0.29	<0.29	<0.29	<0.25	<0.29	<0.29	<0.25	<0.29	<0.29	<0.25	<0.29	<0.25	NE	NE
n-Propylbenzene	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.50	<0.18	<0.18	<0.18	<0.50	<0.18	<0.18	<0.18	<0.50	<0.18	<0.18	<0.50	<0.18	<0.18	<0.50	<0.18	<0.50	NE	NE
Naphthalene	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.25	<0.68	<0.68	<0.68	<0.25	<0.68	<0.68	<0.68	<0.25	<0.68	<0.68	<0.25	<0.68	<0.68	<0.25	<0.68	<0.25	40	8
Chloroform	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.25	<0.32	<0.32	<0.32	<0.25	<0.32	<0.32	<0.32	<0.25	<0.32	0.39 (Q)	<0.25	<0.32	<0.25	<0.32	<0.25	6	0.6	
Chloromethane	<0.24	0.55 (Q)	<0.24	<0.24	<0.24	<0.24	<0.24	<0.25	<0.24	<0.24	<0.24	<0.25	<0.24	<0.24	<0.24	<0.25	1.8	<0.24	<0.25	<0.24	<0.25	<0.24	<0.25	3	0.3	
cis-1,2-Dichloroethene	<1	<1	<1	<1	<1	<1	<1	<0.50	<1	<1	<1	0.67	<1	<1	<1	<0.50	<1	<1	<0.50	<1	<1	<0.50	<1	<0.50	70	7
trans-1,2-Dichloroethene	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.50	<0.23	<0.23	0.25 (Q)	<0.50	<0.23	<0.23	<0.23	<0.50	<0.23	<0.23	<0.50	<0.23	<0.23	<0.50	<0.23	<0.50	100	20
Tetrachloroethene	4.7	3.3	3.4	4.4	3.5	4.3	5.6	4.2	3.1	3.8	4.2	0.84	8.2	5	6.4	4.1	8.7	10	5.3	<0.25	<0.50	5	0.5	5	0.5	
Trichloroethene	2.4	2.3	2.2	3.2	1.1 (Q)	1.2 (Q)	2.3	1.2	3	1.6	8.9	11	1.9	0.76 (Q)	0.61 (Q)	0.53	2.8	1.5	1.3	<0.36	<0.25	5	0.5	5	0.5	
Natural Attenuation Parameters																										
Nitrate (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Sulfate (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Dissolved Iron	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Total Iron	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Dissolved Manganese	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Total Manganese	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
D.O. (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Specific Conductance (uS/cm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Resistivity (Ko/cm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Salinity (g/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
pH (s.u.)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
O.R.P. (mv)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	

Notes:

- Bold concentrations exceed NR 140 PAL
- Shaded concentrations exceed NR 140 ES
- D.O. - dissolved oxygen
- ES - NR 140 enforcement standard
- g/l - grams per liter
- Ko/cm - kilohms per centimeter
- mg/l - milligrams per liter
- MTBE - methyl tert-butyl ether
- mv - millivolts
- NE - not established
- O.R.P. - oxygen reduction potential
- PAL - NR 140 preventive action limit
- Q - concentration detected between laboratory limit of quantitation and limit of detection
- s.u. - standard units
- µg/l - micrograms per liter
- uS/cm - microsiemens per centimeter
- VOCs - volatile organic compounds

TABLE 3 (CONTINUED)

SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

Date	MW-13			MW-14		MW-15		MW-16	MW-17	MW-18	MW-19	MW-20	MW-21	MW-22	MW-23	NR 140		
	11/5/01	3/19/03	6/10/03	11/5/01	3/19/03	11/5/01	3/19/03	3/19/03	3/19/03	3/19/03	3/19/03	3/19/03	3/19/03	6/10/03	6/10/03	ES	PAL	
Detected VOCs (µg/l)																		
Trimethylbenzenes	<5.0	<0.50	---	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	480	96	
Benzene	<2.5	<0.25	---	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	5	0.5	
Toluene	<2.2	<0.25	---	<0.22	<0.25	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1,000	200	
Ethylbenzene	<1.2	<0.50	---	<0.12	<0.50	<0.12	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	700	140	
Xylenes	<7.4	<0.50	---	<0.74	<0.50	<0.74	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	10,000	1,000	
MTBE	<5.3	<0.50	---	<0.53	<0.50	<0.53	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	60	12	
Isopropylbenzene	<1.5	<0.25	---	<0.15	<0.25	<0.15	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NE	NE	
n-Butylbenzene	<2.9	<0.25	---	<0.29	<0.25	<0.29	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NE	NE	
n-Propylbenzene	<1.8	<0.50	---	<0.18	<0.50	<0.18	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	NE	NE	
Naphthalene	<6.8	<0.25	---	<0.68	<0.25	<0.68	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	40	8	
Chloroform	<3.2	<0.25	---	<0.32	<0.25	0.77 (Q)	<0.25	<0.25	7.9	5.8	<0.25	2.1	<0.25	<0.25	0.91	6	0.6	
Chloromethane	<2.4	<0.25	---	<0.24	<0.25	<0.24	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.63	3	0.3
cis-1,2-Dichloroethene	<10	<0.50	---	<1	0.68	<1	<0.50	0.58	<0.50	<0.50	1.4	<0.50	<0.50	<0.50	<0.50	70	7	
trans-1,2-Dichloroethene	<2.3	<0.50	---	<0.23	<0.50	<0.23	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	100	20	
Tetrachloroethene	1,000	530	---	77	14	<0.25	<0.50	27	0.66	<0.50	59	50	3.0	<0.50	<0.50	5	0.5	
Trichloroethene	12	8.9	---	<0.36	0.45	<0.36	<0.25	6.7	<0.25	<0.25	2.0	<0.25	<0.25	<0.25	<0.25	5	0.5	
Natural Attenuation Parameters																		
Nitrate (mg/l)	---	---	<0.50	---	---	---	---	---	---	---	---	---	---	---	4.8	---	---	
Sulfate (mg/l)	---	---	56	---	---	---	---	---	---	---	---	---	---	---	32	---	---	
Dissolved Iron	---	---	<0.042	---	---	---	---	---	---	---	---	---	---	---	<0.042	---	---	
Total Iron	---	---	1.7	---	---	---	---	---	---	---	---	---	---	---	1.4	---	---	
Dissolved Manganese	---	---	0.071	---	---	---	---	---	---	---	---	---	---	---	0.014	---	---	
Total Manganese	---	---	0.14	---	---	---	---	---	---	---	---	---	---	---	0.13	---	---	
D.O. (mg/l)	---	---	3.07	---	---	---	---	---	---	---	---	---	---	---	6.53	---	---	
Specific Conductance (uS/cm)	---	---	5,372	---	---	---	---	---	---	---	---	---	---	---	1,934	---	---	
Resistivity (Ko/cm)	---	---	0.186	---	---	---	---	---	---	---	---	---	---	---	0.518	---	---	
Salinity (g/l)	---	---	2.96	---	---	---	---	---	---	---	---	---	---	---	1.03	---	---	
pH (s.u.)	---	---	7.10	---	---	---	---	---	---	---	---	---	---	---	7.40	---	---	
O.R.P. (mv)	---	---	352	---	---	---	---	---	---	---	---	---	---	---	355	---	---	

Notes:

Bold concentrations exceed NR 140 PAL
Shaded concentrations exceed NR 140 ES

D.O. - dissolved oxygen

ES - NR 140 enforcement standard

g/l - grams per liter

Ko/cm - kilohoms per centimeter

mg/l - milligrams per liter

MTBE - methyl tert-butyl ether

mv - millivolts

NE - not established

O.R.P. - oxygen reduction potential

PAL - NR 140 preventive action limit

Q - concentration detected between laboratory limit of quantitation and limit of detection

s.u. - standard units

µg/l - micrograms per liter

uS/cm - microsiemens per centimeter

VOCs - volatile organic compounds

TABLE 3 (CONTINUED)
SUMMARY OF GROUNDWATER SAMPLE ANALYTICAL RESULTS

DECORAH SHOPPING CENTER ANNEX
1011-1025 South Main Street
West Bend, Wisconsin

Date	P-1								P-2					P-3			P-4	P-5	NR 140			
	4/7/98	7/31/98	10/8/99	3/31/00	8/31/00	12/4/00	4/12/01	3/19/03	10/8/99	3/31/00	8/31/00	12/4/00	4/12/01	3/19/03	4/12/01	11/5/01	3/19/03	3/19/03	6/10/03	ES	PAL	
Detected VOCs (µg/l)																						
Trimethylbenzenes	<0.5	<0.5	<0.70	<0.50	<0.50	<0.50	<0.50	<0.50	8.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	480	96	
Benzene	<0.2	<0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.58 (Q)	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	5	0.5	
Toluene	<0.3	<0.3	<0.38	<0.22	<0.22	<0.22	<0.22	<0.25	1.5	<0.22	<0.22	<0.22	<0.22	<0.25	0.31 (Q)	<0.22	<0.25	<0.25	<0.25	1,000	200	
Ethylbenzene	<0.2	<0.2	<0.32	<0.12	<0.12	<0.12	<0.12	<0.50	2.2	<0.12	<0.12	<0.12	<0.12	<0.50	<0.12	<0.12	<0.50	<0.50	<0.50	700	140	
Xylenes	<0.6	<0.6	<1.04	<0.74	<0.74	<0.74	<0.74	<0.50	8.7	<0.74	<0.74	<0.74	<0.74	<0.50	<0.74	<0.74	<0.50	<0.50	<0.50	10,000	1,000	
MTBE	<0.2	<0.2	<0.21	<0.53	<0.53	<0.53	<0.53	<0.50	<0.21	<0.53	<0.53	<0.53	<0.53	<0.50	<0.53	<0.53	<0.50	<0.50	<0.50	60	12	
Isopropylbenzene	<0.2	<0.2	<0.33	<0.15	<0.15	<0.15	<0.15	<0.25	0.35 (Q)	<0.15	<0.15	<0.15	<0.15	<0.25	<0.15	<0.15	<0.25	<0.25	<0.25	NE	NE	
n-Butylbenzene	<0.2	<0.2	<0.43	<0.29	<0.29	<0.29	<0.29	<0.25	<0.43	<0.29	<0.29	<0.29	<0.29	<0.25	<0.29	<0.29	<0.25	<0.25	<0.25	NE	NE	
n-Propylbenzene	<0.3	<0.3	<0.36	<0.18	<0.18	<0.18	<0.18	<0.50	0.88 (Q)	<0.18	<0.18	<0.18	<0.18	<0.50	<0.18	<0.18	<0.50	<0.50	<0.50	NE	NE	
Naphthalene	<0.5	<0.5	<0.73	<0.68	<0.68	<0.68	<0.68	<0.25	0.86 (Q)	<0.68	<0.68	<0.68	<0.68	<0.25	<0.68	<0.68	<0.25	<0.25	<0.25	40	8	
Chloroform	<0.30	<0.30	<0.26	<0.32	<0.32	<0.32	<0.32	<0.25	<0.26	<0.32	<0.32	<0.32	<0.32	<0.25	<0.32	<0.32	<0.25	<0.25	0.37	6	0.6	
Chloromethane	<0.8	<0.8	<0.29	<0.24	<0.24	<0.24	<0.24	<0.25	<0.29	<0.24	0.56 (Q)	<0.24	<0.24	<0.25	<0.24	<0.24	<0.25	<0.25	<0.25	3	0.3	
cis-1,2-Dichloroethene	<0.2	<0.2	<0.34	<1	<1	<1	<1	<0.50	<0.34	<1	<1	<1	<1	<0.50	<1	<1	<0.50	<0.50	<0.50	70	7	
trans-1,2-Dichloroethene	<0.20	<0.20	<0.46	<0.23	<0.23	<0.23	<0.23	<0.50	<0.46	<0.23	<0.23	<0.23	<0.23	<0.50	<0.23	<0.23	<0.50	<0.50	<0.50	100	20	
Tetrachloroethene	<0.3	<0.3	<0.56	<0.25	<0.25	<0.25	<0.25	<0.50	<0.56	<0.25	<0.25	<0.25	<0.25	<0.50	<0.25	<0.25	<0.50	12	<0.50	5	0.5	
Trichloroethene	<0.2	<0.2	<0.39	<0.36	<0.36	<0.36	<0.36	<0.25	<0.39	<0.36	<0.36	<0.36	<0.36	<0.25	<0.36	<0.36	<0.25	2.4	<0.25	5	0.5	
Natural Attenuation Parameters																						
Nitrate (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Iron	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total Iron	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Manganese	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total Manganese	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
D.O. (mg/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Specific Conductance (uS/cm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Resistivity (KΩ/cm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Salinity (g/l)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pH (s.u.)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
O.R.P. (mv)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Notes:

- Bold concentrations exceed NR 140 PAL
- Shaded concentrations exceed NR 140 ES
- D.O. - dissolved oxygen
- ES - NR 140 enforcement standard
- g/l - grams per liter
- KΩ/cm - kilohms per centimeter
- mg/l - milligrams per liter
- MTBE - methyl tert-butyl ether
- mv - millivolts
- NE - not established
- O.R.P. - oxygen reduction potential
- PAL - NR 140 preventive action limit
- Q - concentration detected between laboratory limit of quantitation and limit of detection
- s.u. - standard units
- µg/l - micrograms per liter
- uS/cm - microsiemens per centimeter
- VOCs - volatile organic compounds

Facility/Project Name Decorah Shopping Center Annex		Local Grid Location of Well ft. <input type="checkbox"/> N. <input type="checkbox"/> S. <input type="checkbox"/> E. <input type="checkbox"/> W.		Well Name	
Facility License, Permit or Monitoring Number		Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/>) or Well Location <input type="checkbox"/>		Wis. Unique Well Number	
Facility ID		Lat. _____ Long. _____ or		DNR Well Number	
Type of Well		St. Plane _____ ft. N, _____ ft. E		Date Well Installed	
Well Code		Section Location of Waste/Source 1/4 of _____ 1/4 of Sec. _____ T. _____ N,R _____ <input type="checkbox"/> E. <input type="checkbox"/> W.		Well Installed By: Name (first, last) and Firm	
Distance from Waste/ Source _____ ft.		Enf. Stds. Apply <input type="checkbox"/>		Location of Well Relative to Waste/Source u <input type="checkbox"/> Upgradient s <input type="checkbox"/> Sidegradient d <input type="checkbox"/> Downgradient n <input checked="" type="checkbox"/> Not Known	
		Gov. Lot #			

- A. Protective pipe, top elevation _____ ft. MSL
- B. Well casing, top elevation _____ ft. MSL
- C. Land surface elevation NA ft. MSL
- D. Surface seal, bottom _____ ft MSL or _____ ft.

12. USCS classification of soil near screen:
 GP GM GC GW SW SP
 SM SC ML MH CL CH
 Bedrock

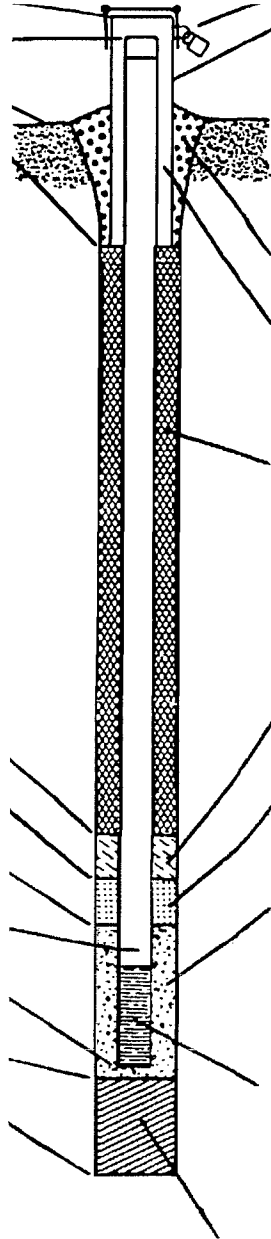
13. Sieve analysis attached? Yes No

14. Drilling method used: Rotary 5 0
 Hollow Stem Auger 4 1
Geoprobe Other

15. Drilling fluid used: Water 0 2 Air 0 1
 Drilling Mud 0 3 None 9 9

16. Drilling additives used? Yes No
 Describe _____

17. Source of Water (attach analysis if required):



- 1. Cap and lock? Yes No
- 2. Protective cover pipe:
 - a. Inside diameter: .4 in.
 - b. Length: 0.5 ft.
 - c. Material: Steel 0 4
Other
 - d. Additional protection? Yes No
If yes, describe: _____
- 3. Surface seal: Bentonite 3 0
Concrete 0 1
Other
- 4. Material between well casing and protective pipe: Bentonite 3 0
Annular space seal
None Other
- 5. Annular space seal: a. Granular Bentonite 3 3
b. _____ Lbs/gal mud weight... Bentonite-sand slurry 3 5
c. _____ Lbs/gal mud weight... Bentonite slurry 3 1
d. _____ % Bentonite..... Bentonite-cement grout 5 0
e. _____ Ft³ volume added for any of the above
f. How installed: Tremie 0 1
Tremie pumped 0 2
Gravity 0 8
- 6. Bentonite seal: a. Bentonite granules 3 3
b. 1/4 in. 3/8 in. 1/2 in. Bentonite pellets 3 2
c. _____ Other
- 7. Fine sand Material: Manufacturer, product name & mesh size
a. Red Flint 45-55
b. Volume added _____ ft³
- 8. Filter pack material: Manufacturer, product name and mesh size
a. Red Flint 30
b. Volume added _____ ft³
- 9. Well casing: Flush threaded PVC schedule 40 2 3
Flush threaded PVC schedule 80 2 4
Other
- 10. Screen material: PVC
a. Screen type: Factory cut 1 1
Continuous slot 0 1
Other
b. Manufacturer Monoflex
c. Slot size: .010 in.
d. Slotted length: 5 ft.
- 11. Backfill material (below filter pack): None 1 4
Other

- E. Bentonite seal, top _____ ft. MSL or 1 ft.
- F. Fine sand, top _____ ft. MSL or 7.0 ft.
- G. Filter pack, top _____ ft. MSL or 7.5 ft.
- H. Screen joint, top _____ ft. MSL or 8 ft.
- I. Well bottom _____ ft. MSL or 13 ft.
- J. Filter pack, bottom _____ ft. MSL or 13 ft.
- K. Borehole bottom _____ ft. MSL or 13 ft.
- L. Borehole diameter 2 in.
- M. O.D. well casing 2.1 in.
- N. I.D. well casing 1.9 in.

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm ARCADIS 126 N. Jefferson St. Suite 400 Milwaukee, WI 53202 414-276-7742
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CARUS CHEMICAL COMPANY
Technology and Quality
Remediation Report

12 April 2004

To: Bob Kelley

Cc: P. Vella
B. Veronda
L. Warren

From: Kelly Frasco

Keywords: KMnO₄
Bentonite Clay

Tech # 9551

Subject: CAIROX[®] Potassium Permanganate Bentonite Clay Demand

Summary

The bentonite clay natural oxidant demand (NOD) for the potassium permanganate (KMnO₄) dose of 14.7 g/kg at 48 hours was determined to be 7.5 g/kg.

Background

A sample of bentonite clay was obtained from the pilot plant. It was requested that the natural oxidant demand be determined on the sample. The measurement of the natural oxidant demand is used to estimate the concentration of KMnO₄ that will be consumed by the natural reducing agents in a sample during a given time period.

Experimental

A reaction vessel for each soil sample was filled with 9 grams of soil and diluted to 90 mls with deionized water for a low and medium concentration of KMnO₄. At the start of each experimental run, 10 mls of concentrated oxidant solution was introduced into the reaction vessels. The reaction vessels were placed on a rotating apparatus to ensure uniform mixing at a constant speed. After 48 hours the samples were centrifuged and analyzed for residual permanganate (MnO₄⁻).

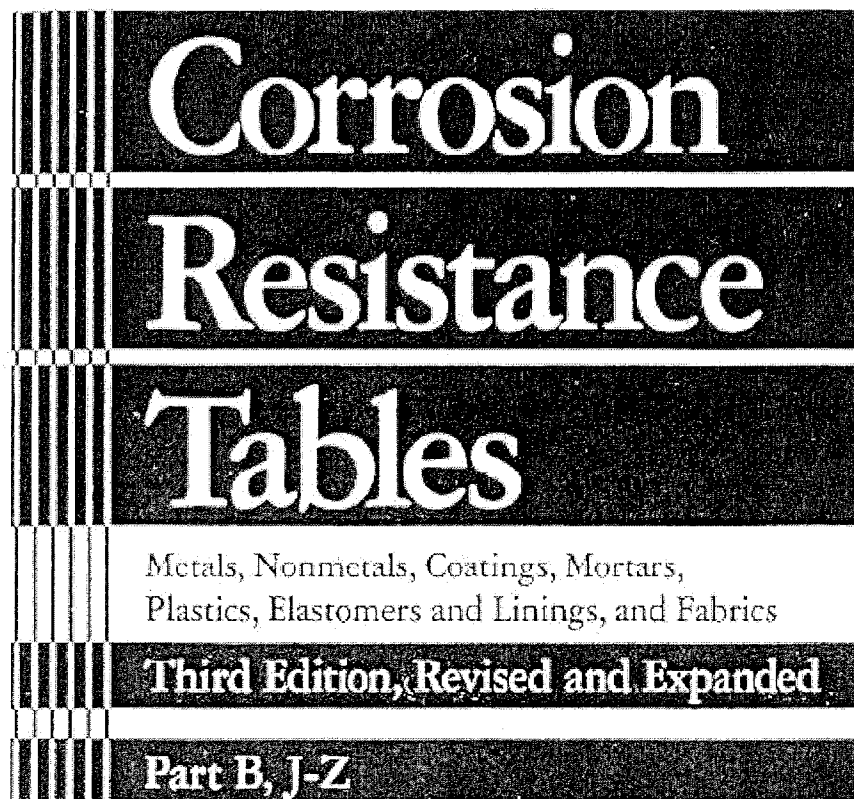
Results

The KMnO₄ demand is the amount of permanganate consumed in a given amount of time. It should be noted that in a soil or groundwater sample, the oxidation of any compound by permanganate is dependent on the initial dose of permanganate and the reaction time available. As the permanganate dose is increased, the reaction rate and oxidant consumption may also increase. Some compounds that are not typically oxidized by permanganate under low doses can become reactive with permanganate at higher concentrations.

The 48-hour NOD result for the low (3.1 g/kg) KMnO₄ dose was >3.1 g/kg. The 48-hour NOD result for the medium (14.7 g/kg) KMnO₄ dose was 7.5 g/kg.

CAIROX[®] is a registered trademark of Carus Corporation.

20%



Philip A. Schweitzer, P.E.

*Consultant
Chester, New Jersey*

Marcel Dekker, Inc.

New York • Basel • Hong Kong

POTASSIUM PERMANGANATE 20%

METALS	°C		°F	
	18	20	60	68
ADMIRALTY BRASS				
ALUMINUM	G			
ALUMINUM BRONZE	G			
BRASS	G			
BRONZE	G			
CARBON STEEL	G			
COLUMBIUM (NIOBIUM)				
COPPER	G			
HASTELLOY B/B-2	U			
HASTELLOY C/C-276	E-G			
HASTELLOY D	U			
HASTELLOY G/G-3				
HIGH SILICON IRON	G			
INCONEL	G			
INCOLLOY	G			
LEAD	U			
MONEL	G			
NAVAL BRONZE	G			
NICKEL	G			
NI-RESIST TO 5%	G			
STAINLESS STEELS				
Type 304/347	G			
Type 316	G			
Type 400 series	G			
Type 904-L				
17-4 PH	G			
20 Cr 3	G			
E-Bright 26-1				
SILICON BRONZE	G			
SILICON COPPER				
STELLITE	G			
TANTALUM	G			
TITANIUM	E			
ZIRCONIUM				
	°F	°C	120	130
			140	150
			160	170
			180	190
			200	210
			220	230
			240	250
			260	270
			280	290
			300	310
			320	330
			340	350
			360	370
			380	390
			400	410
			420	430
			440	450
			460	470
			480	490
			500	510
			520	530
			540	550
			560	570
			580	590
			600	610

FOR METALS
 E = < 2 Mils Penetration/Year; G = < 20 Mils Penetration/Year
 S = < 50 Mils Penetration/Year; U = > 50 Mils Penetration/Year

FOR NONMETALLICS
 R = Resistant
 U = Unsatisfactory

POTASSIUM PERMANGANATE 20%

	°C		°F	
	60	75	80	85
NONMETALLIC MATERIALS				
BOROSILICATE GLASS	R			
CARBON	R			
CARBON-GRAPHITE RESIN				
IMPREGNATED	R			
CERAMICS				
COATINGS				
ACRYLIC				
ASPHALT				
CHLORINATED RUBBER				
COAL TAR				
COAL TAR EPOXY	R			
EPOXY GENERAL PURPOSE				
EPOXY CHEMICAL RESISTANT				
EPOXY POLYAMIDE	R			
OIL BASE (ALKYD, EPOXY, URETHANE)				
PHENOLIC				
POLYESTER	R			
POLYVINYL CHLORIDE				
SILICONES				
URETHANES				
VINYLS	R			
WATER BASE				
ZINC RICH				
MORTARS				
SILICATE	R			
SODIUM SILICATE	R			
POTASSIUM SILICATE				
SILICA	R			
SULFUR	R			
FURAN RESIN	R			
POLYESTER	R			
EPOXY	U			
	°F	°C	°F	°C
	80	15	100	38
	90	32	110	43
	100	38	120	49
	110	43	130	55
	120	49	140	60
	130	55	150	67
	140	60	160	73
	150	67	170	78
	160	73	180	83
	170	78	190	89
	180	83	200	93
	190	89	210	99
	200	93	220	104
	210	99	230	110
	220	104	240	116
	230	110	250	122
	240	116	260	128
	250	122	270	133
	260	128	280	139
	270	133	290	145
	280	139	300	150
	290	145	310	156
	300	150	320	160
	310	156	330	167
	320	160	340	171
	330	167	350	177
	340	171	360	182
	350	177	370	188
	360	182	380	193
	370	188	390	199
	380	193	400	204
	390	199	410	209
	400	204	420	215
	410	209	430	220
	420	215	440	227
	430	220	450	232
	440	227	460	238

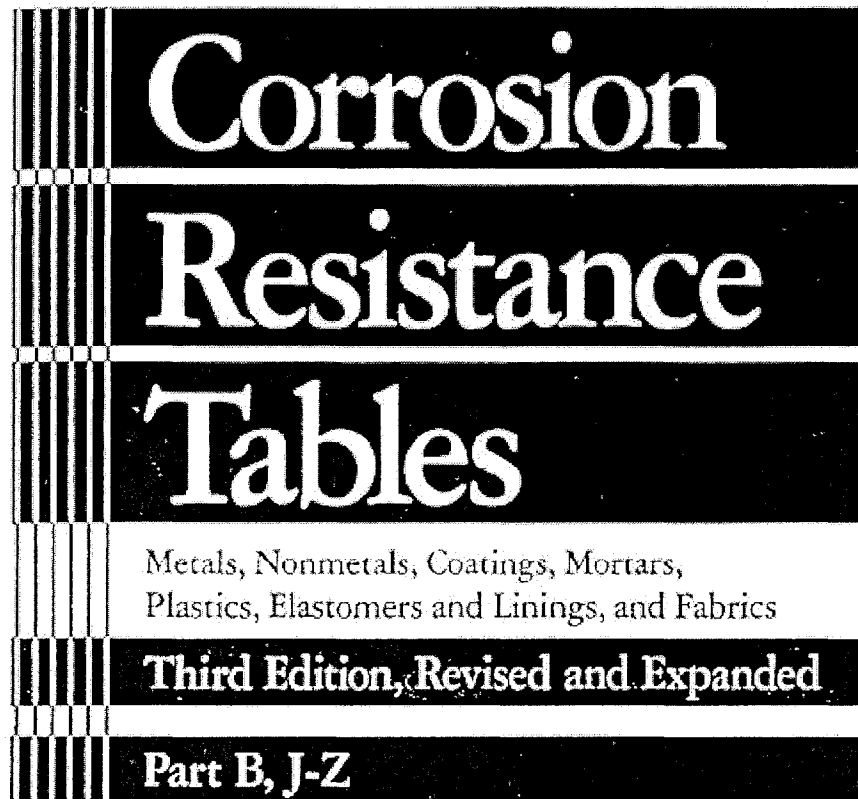
POTASSIUM PERMANGANATE 20%

	°C	°F																							
		60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	236		
PLASTICS																									
ABS	R																								
ACETAL																									
ACRYLICS	U																								
ASBESTOS REINFORCED EPOXY	R																								
ASBESTOS REINFORCED PHENOLIC	R																								
CHLORINATED POLYETHER (Penton)	R																								
CPVC	R																								
E-CTFE (Halar)	R																								
EPOXY	R																								
ETFE (Tefzel)	R																								
FEP	R																								
FURAN (FURFURAL ALCOHOL)	R																								
NORYL	R																								
NYLON 6	U																								
NYLON 11	U																								
NYLON 66	U																								
PHENOLIC	R																								
PFA (Teflon)	R																								
POLYAMIDE-IMIDE																									
POLYESTERS																									
Bisphenol A-fumarate	R																								
Halogenated	R																								
Hydrogenated Bisphenol A																									
-Bisphenol A																									
Isophthalic	R																								
Terephthalate (PET)	R																								
POLYETHERIMIDE (ULTEM)																									
POLYETHERETHERKETONE (PEEK)																									
POLYETHERSULFONE (PES)																									
POLYETHYLENE HMW	R																								
POLYETHYLENE UHMW	R																								
POLYMETHYLPENTENE																									
POLYPROPYLENE (PP)	R																								
POLYSTYRENE	R																								
POLYSULFONE																									
POLYVINYLIDENE CHLORIDE	R																								
PVC TYPE 1	R																								
PVC TYPE 2	R																								
PVDF (Kynar)	R																								
RYTON	R																								
TFE (Teflon)	R																								
VINYL ESTER	R																								

POTASSIUM PERMANGANATE 20%

	°C	°F
ELASTOMERS* AND LININGS	15	60
ACRYLATE-BUTADIENE (ABR)	26	80
BUTYL GR-1 (IIR)	38	100
CARBOXYLIC-ACRYLONITRILE-BUTADIENE (XNBR)	49	120
CHEMRAZ (FPM)	60	140
CHLORO-ISOBUTENE-ISOPRENE (CIIR)	71	160
HYPALON (CHLORO-SULFONYL-POLYETHYLENE (CSM)	82	180
ETHYLENE-ACRYLIC (EA)	93	200
ETHYLENE-PROPYLENE (EPM)	104	220
ETHYLENE-PROPYLENE-DIENE (EPDM)	116	240
ETHYLENE-PROPYLENE TERPOLYMER (EPT)	127	260
FKM (Viton A)	138	280
HARD RUBBER	149	300
SOFT RUBBER	160	320
ISOPRENE (IR)	171	340
KALREZ (FPM)	182	360
KOROSEAL	193	380
NATURAL RUBBER (GRS)	204	400
NEOPRENE GR-M (CR)	216	420
NITRILE BUNA-N (NBR)	227	440
NORDEL (EPDM)	238	460
POLYBUTADIENE (BR)		
POLYESTER (PE)		
POLYETHER-URETHANE (EU)		
POLYISOPRENE (IR)		
POLYSULFIDES (T)		
POLYURETHANE (AU)		
SBR STYRENE (BUNA-S)		
SILICONE RUBBERS		
FABRICS		
COTTON		
FELT (WOOL)		
RAYON VISCOSE		
*See also Nylon 11 under PLASTICS		
	15	60
	26	80
	38	100
	49	120
	60	140
	71	160
	82	180
	93	200
	104	220
	116	240
	127	260
	138	280
	149	300
	160	320
	171	340
	182	360
	193	380
	204	400
	216	420
	227	440
	238	460

10%



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POTASSIUM PERMANGANATE 10%

METALS	°C		°F	
	15	104	60	217
ADMIRALTY BRASS				
ALUMINUM	E			
ALUMINUM BRONZE				
BRASS	G			
BRONZE	G			
CARBON STEEL	C			
COLUMBIUM (NIOBIUM)				
COPPER	G			
HASTELLOY B/B-2	U			
HASTELLOY C/C-276	E-G			
HASTELLOY D	U			
HASTELLOY G/G-3				
HIGH SILICON IRON	G			
INCONEL	G			
INCOLLOY				
LEAD	U			
MONEL	G			
NAVAL BRONZE	G			
NICKEL	G			
NI-RESIST				
STAINLESS STEELS				
Type 304/347	G			
Type 316	G			
Type 400 series	G			
Type 904-L				
17-4 PH	G			
20 Cb 3	G			
E-Bright 26-1				
SILICON BRONZE				
SILICON COPPER				
STELLITE	G			
TANTALUM	G			
TITANIUM	G			
ZIRCONIUM				

FOR METALS

E = < 2 Mils Penetration/Year; G = < 20 Mils Penetration/Year
 S = < 50 Mils Penetration/Year; U = > 50 Mils Penetration/Year

FOR NONMETALLICS

R = Resistant
 U = Unsatisfactory

POTASSIUM PERMANGANATE 10%

		°C	
		15	25
		°F	
		60	80
ELASTOMERS* AND LININGS			
ACRYLATE-BUTADIENE (ABR)			
BUTYL GR-1 (IIR)	R		
CARBOXYLIC-ACRYLONITRILE-BUTADIENE (XNBR)			
CHEMHAZ (FPM)	R		
CHLORO-ISOBUTENE-ISOPRENE (CIIR)			
HYPALON (CHLORO-SULFONYL-POLYETHYLENE (CSM)	R		
ETHYLENE-ACRYLIC (EA)			
ETHYLENE-PROPYLENE (EPM)			
ETHYLENE-PROPYLENE-DIENE (EPDM)	R		
ETHYLENE-PROPYLENE TERPOLYMER (EPT)	R		
FKM (Viton A)	R		
HARD RUBBER	R		
SOFT RUBBER	U		
ISOPRENE (IR)	U		
KALREZ (FPM)	R		
KOROSEAL			
NATURAL RUBBER (GRS)	U		
NEOPRENE GR-M (CR)	R		
NITRILE BUNA-N (NBR)	R		
NORDEL (EPDM)	R		
POLYBUTADIENE (BR)			
POLYESTER (PE)			
POLYETHER-URETHANE (EU)			
POLYISOPRENE (IR)			
POLYSULFIDES (T)			
POLYURETHANE (AU)			
SBR STYRENE (BUNA-S)			
SILICONE RUBBERS			
FABRICS			
COTTON			
FELT (WOOL)			
RAYON VISCOSE	5% R		
*See also Nylon 11 under PLASTICS			
		°C	
		15	25
		°F	
		60	80
		100	120
		140	160
		180	200
		220	240
		260	280
		300	320
		340	360
		380	400
		420	440
		460	480