421 FRENETTE DRIVE, CHIPPEWA FALLS, WI 54729 715 723-8506 800 472-5881
ARCHITECTURE • ENGINEERING • ENVIRONMENTAL • TRANSPORTATION

September 29, 1994

RE: Pilot Testing/Computer Modelling
Vapor Extraction System
Eau Claire County Highway
Altoona Shop
SEH File: EAUCO3358.00

RECEIVED
SEP 3 0 1994
DNR • ECA

Mr. John Grump, Hydrogeologist
Wisconsin Department of Natural Resources
2004 Highland Avenue
Eau Claire, Wisconsin 54701

Dear Mr. Grump:

SEH conducted a pilot test at the Eau Claire County Highway Department shop on March 30, 1994. The pilot test was performed by extracting air from VE-1, located as shown on Figure 1, "Pilot-Test Monitoring Points."

Pilot Test Methods

Air was extracted from the vent using a regenerative blower with maximum flow of 55 SCFM and maximum vacuum pressure of 35 inches of water. Air flow was measured throughout the duration of the pilot test at the discharge vent of the blower. Vacuum was measured using magnehelic gauges at the extraction vent and at monitoring points located 18 feet to 55 feet from the extraction point as shown on Figure 1. Three tests were run for a duration of 18 to 30 minutes with vacuum readings recorded at different combinations of monitoring points. Field measurements recorded during the pilot tests are summarized on the attached testing logs. Air samples were collected during each of the three tests using a carbon tube.

Pilot Test Results

The results of pilot testing indicate that flow rates are typically about 45 CFM with vacuum readings near 5 inches of water. Vacuum readings at monitoring points indicate that significant influence is being measured near the ground surface at a distance of 40 feet from the extraction well. The pilot test indicates a radius of influence for the site between 40 and 55 feet.

The results of air sampling indicate that benzene emissions ranged from .00061 lb/hr to .00258 lb/hr. The analytical results and calculations are attached.

Computer Modelling

Based on geologic information collected during the remedial investigation and airflow information collected from the pilot test, SEH performed computer modelling to represent site characteristics and finalize the design for vapor extraction at the site.

SEH used AIR3D to model airflow at the site. AIR3D uses MODFLOW to represent three dimensional air flow through the unsaturated zone. The program includes a preprocessor and postprocessor to convert input from airflow to hydraulic flow parameters for use in MODFLOW and then convert output from MODFLOW back to airflow parameters. AIR3D requires input of several parameters including horizontal and vertical components of air permeability in the unsaturated zone and pressure at the well. Output from the program includes volumetric flow rate, mass flow rate, and pressure information.

The program is based on assumptions including heterogeneous soil, transient flow conditions, and constant pressure at extraction wells and trenches. We can provide you with additional information regarding AIR3D at your request.

Pilot test information was used with AIR3D to determine a reasonable soil permeability for the site. The measured pressure at the well during the pilot test was entered, and AIR3D was run through several iterations with a range of values for soil permeability values until the output resulted in a volumetric flow rate and pressure values which corresponded to measured values obtained during the pilot test. A section through the model of pressure values generated by AIR3D is shown on the attached contour map figure. This iterative process indicated a horizontal permeability of 15.5 darcies and a vertical permeability of 14 darcies.

After soil permeability was determined, the vacuum pressure at the well was adjusted to represent expected conditions during operation of the SVE system. Using a 2 horsepower regenerative blower, the model indicated that a pressure of 14 inches of water would result in airflow through the system of 128 CFM. AIR3D calculated the pressure values at each cell in the model. A section through the model of pressure values is shown graphically in the attached figure.

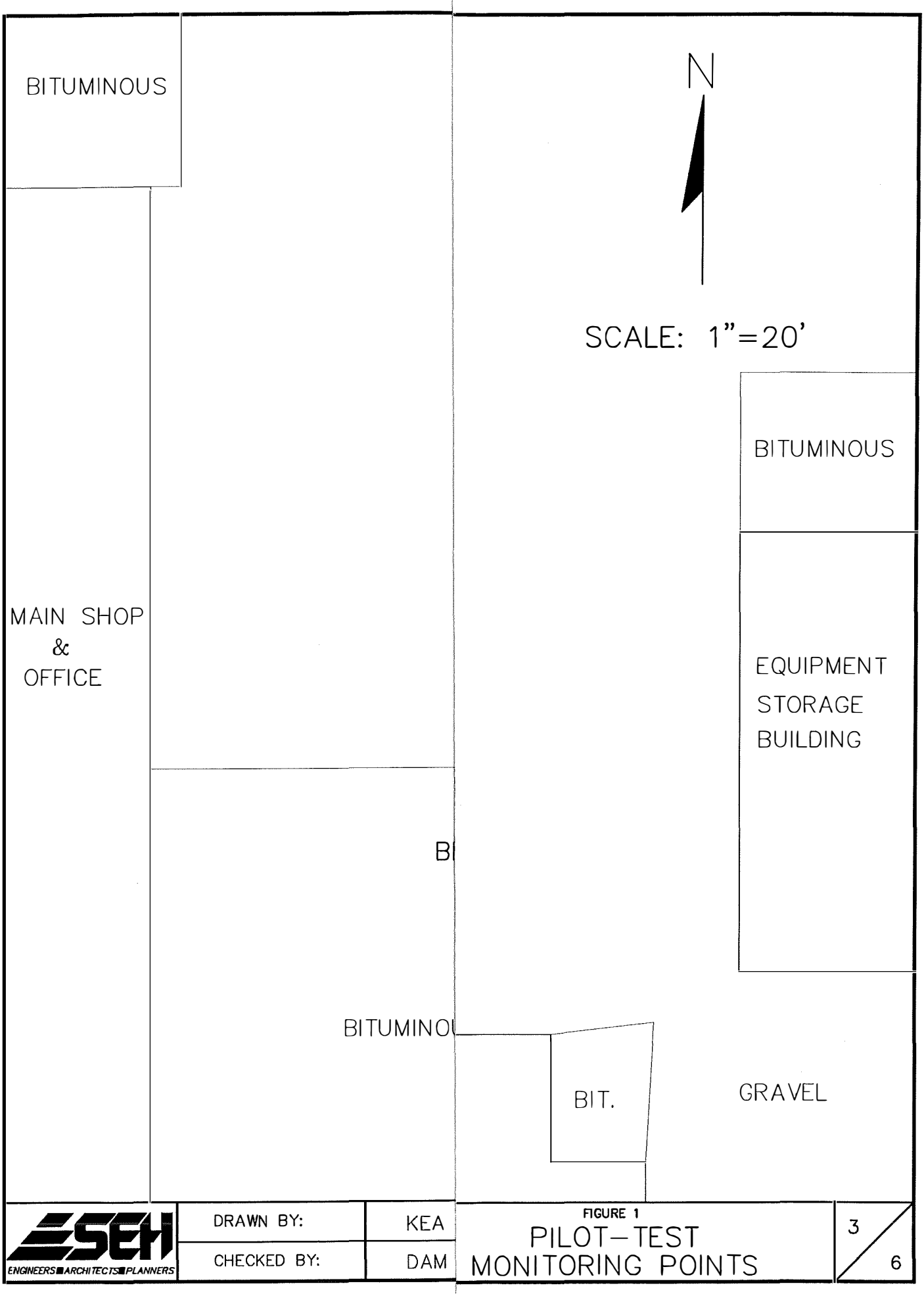
If you have any questions regarding our pilot test or computer modelling please call me at 715/720-6223. The SVE system is scheduled for installation in October 1994.

Sincerely

David McDaniel

David McDaniel, P.E.
Project Manager

Enclosure



ENGINEERS ■ ARCHITECTS ■ PLANNERS	DRAWN BY:	KEA	FIGURE 1 PILOT–TEST MONITORING POINTS	3 6
	CHECKED BY:	DAM		

ANALYTICAL REPORT

ENVIROSCAN

Short Elliott Hendrickson,Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: EAUC03358.02
SAMPLED BY: Client
DATE REC'D: 04/01/94
REPORT DATE: 06/24/94
PREPARED BY: JRS
REVIEWED BY: JRS

Attn: Dave McDaniel

	Units	Detection Limit	AS-1	AS-2
Benzene	µg	5.0	45.8 *	124.
Ethylbenzene	µg	5.0	X	X
Toluene	µg	5.0	47.5 *	217.
m- & p-Xylene	µg	5.0	X	X
o-Xylene & Styrene	µg	5.0	X	X
Analytical No.:			5001	5002

X = Analyzed but not detected.
* = Estimated concentration due to carry over. Result may be biased slightly high.

SVE PILOT STUDY

PROJECT NAME Eau Claire Co. Shops - Altoona **PROJECT NO.** EAUCO3358.05

DATE 3/30/94 **BY:** Kevin Accola and Jim Thornton

EXTRACTION FROM VE-1 **START TIME:** 10:51 A.M.

Elapsed Time	Flow (SCFM)	Vacuum VE-1	Vacuum VE-2	Vacuum BP-3	Vacuum _____	PID (Units)	Sample AS-1
15 Seconds	47.8	4" H2O	0" H2O	0" H2O			
30 Seconds	47.6	4	0	.025			
45 Seconds	47.3	4	0	.070			
60 Seconds	47.0	4	0.005	.095			
90 Seconds	47.4	5	.01	.155			
2 Minutes	47.1	5	.02	.21			
3 Minutes	47.1	5	.055	.23			
4 Minutes	47.1	5	.07	.24		3470	
5 Minutes	47.1	5	.095	.25 +			
6 Minutes	47.3	5	.10	.25 +			
7 Minutes	47.1	5	.10	.25 +			5 min. at 0.5CFH =
8 Minutes	47.1	5	.11	.25 +			1 Liter of Air
9 Minutes	47.1	5	.11	.25		3660	Sampled
10 Minutes	46.9	5	.11	.185			
11 Minutes							
12 Minutes						3620	
15 Minutes	46.5	5	.145	.175			
20 Minutes	46.9	5	.15	.18		3622	
25 Minutes	46.9	5	.130	.165			
30 Minutes							

SVE PILOT STUDY

PROJECT NAME Eau Claire Co. Shops - Altoona **PROJECT NO.** EAUCO3358.05

DATE 3/30/94 **BY:** Kevin Accola and Jim Thornton

EXTRACTION FROM VE-1 **START TIME:**

Elapsed Time	Flow (SCFM)	Vacuum VE-1	Vacuum BP-5	Vacuum BP-6	Vacuum _____	PID (Units)	Sample AS-3
15 Seconds	45.5	5	0	0			
30 Seconds	45.9	5	0	0			
45 Seconds	45.9	5	0	0			
60 Seconds	46.0	5	0	0			
90 Seconds	46.3	5	0	0			
2 Minutes	46.2	5	0	0			
3 Minutes	45.8	5	0	0		4191	
4 Minutes	46.8	5	0	0			
5 Minutes	46.4	5	.005	.005			
6 Minutes	46.4	5	.035	.032			
7 Minutes	46.1	5	.055	.055			
8 Minutes	46.4	5	.057	.04			2.5 min. at
9 Minutes	46.5	5	.085	.05			0.5CFH = 0.5
10 Minutes	46.3	5	.092	.057		3934	liters of air
11 Minutes	46.1	5	.085	.045			sampled
12 Minutes	46.2	5	.092	.04			
13 Minutes	46.3	5	.085	.03			
14 Minutes	46.4	5	.092	.042			
15 Minutes	46.5	5	.12	.05			
16 Minutes	46.1	5	.10	.047			
17 Minutes	46.3	5	.09	.065			
18 Minutes	46.2	5	.09	.06			
19 Minutes	46.4	5	.115	.070			
20 Minutes	46.6	5	.115	.075			
21 Minutes	46.1	5	.135	.088		3827	
22 Minutes	46.4	5	.12	.088			
23 Minutes	46.4	5	.09	.11			
28 Minutes	46.5	5	.10	.095			

SVE PILOT STUDY

PROJECT NAME Eau Claire Co. Shops - Altoona **PROJECT NO.** EAUCO3358.05

DATE 3/30/94 **BY:** Kevin Accola and Jim Thornton

EXTRACTION FROM VE-1 **START TIME:** 11:40 A.M.

Elapsed Time	Flow (SCFM)	Vacuum VE-1	Vacuum VE-2	Vacuum BP-4	Vacuum _____	PID (Units)	Sample AS-2
15 Seconds	45.6	4" H2O	0" H2O	0" H2O			
30 Seconds	46.3	5	0	0			
45 Seconds	46.3	5	0	0			
60 Seconds	46.6	5	0	0			
90 Seconds	46.8	5	0	0			
2 Minutes	46.9	5	0	0			
3 Minutes	46.8	5	0	0			
4 Minutes	46.8	5	0	0			
5 Minutes	46.9	5	.015	0			
6 Minutes	46.5	5	.03	0			
7 Minutes	46.5	5	.06	0			
8 Minutes	46.1	5	.07	.005			10 min. at 0.5CFH=
9 Minutes	46.2	5	.08	.005			2 liters of air
10 Minutes	46.5	5	.095	.002			sampled
11 Minutes	46.4	5	.10	.007		3995	
12 Minutes	46.3	5	.10	.01			
13 Minutes	46.1	5	.09	.01			
14 Minutes	46.5	5	.09	.01			
15 Minutes	46.4	5	.095	.01			
16 Minutes	46.5	5	.08	0			
17 Minutes	46.4	5	.08			4106	
18 Minutes							

EAU CLAIRE COUNTY
ESTIMATED EMISSIONS
FROM PILOT TEST CONDUCTED 3-30-94

SEPT 26, 94

SAMPLE ID	FLOWRATE (CFH)	SAMPLE TIME(MIN)	BENZENE (ug)	(lb)	ESTIMATED EMISSIONS (lb/cf)	(lb/hour)
AS-1	0.5	5	45.8	1.02E-07	2.44E-06	1.91E-02
AS-2	0.5	10	124	2.76E-07	3.31E-06	2.58E-02
AS-3	0.5	2.5	7.3	1.62E-08	7.79E-07	6.07E-03

BASED ON OPERATING FLOWRATE OF 130 CFM

Estimated Emissions

Assume: 1. AS-3 represents expected operation of system after initial startup
2. Benzene composes 0.21% of weathered gasoline by total weight

Total Benzene = 0.006074 (lb/hr)

Total VOCs = 0.006074 (lb/hr) / 0.0021
= 2.89219 (lb/hr)

ANALYTICAL REPORT

ENVIROSCAN

Short Elliott Hendrickson,Inc.
421 Frenette Drive
Chippewa Falls , WI 54729

CUST NUMBER: EAUCO3358.02
SAMPLED BY: Client
DATE REC'D: 04/01/94
REPORT DATE: 06/24/94
PREPARED BY: JRS
REVIEWED BY:

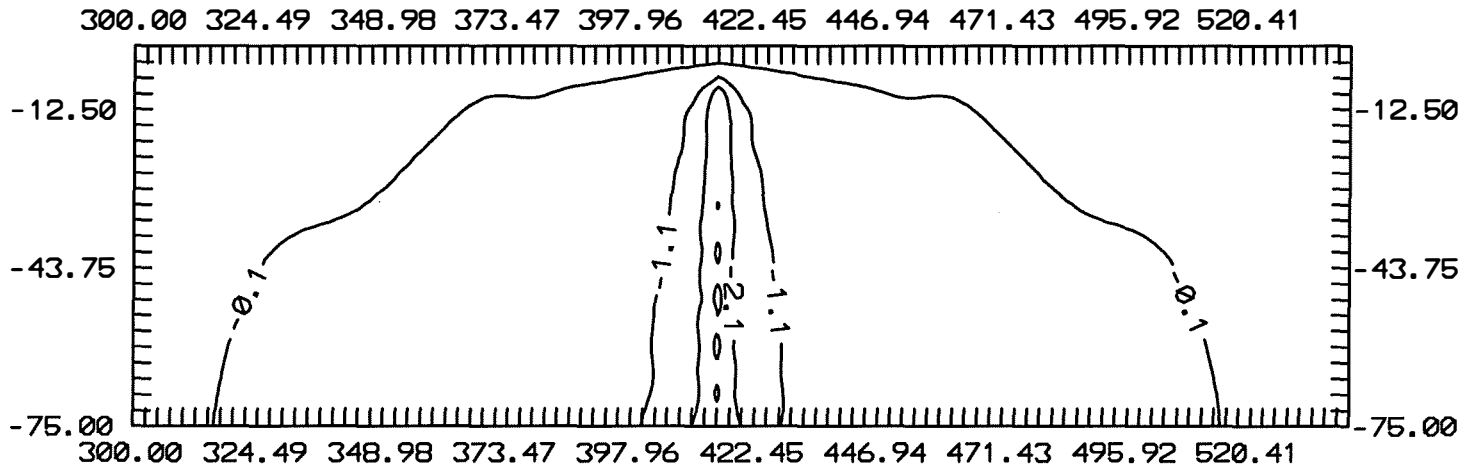
Attn: Dave McDaniel

	Units	Detection Limit	AS-3
Benzene	µg	5.0	7.3 *
Ethylbenzene	µg	5.0	X
Toluene	µg	5.0	13.8 *
m- & p-Xylene	µg	5.0	X
o-Xylene & Styrene	µg	5.0	X

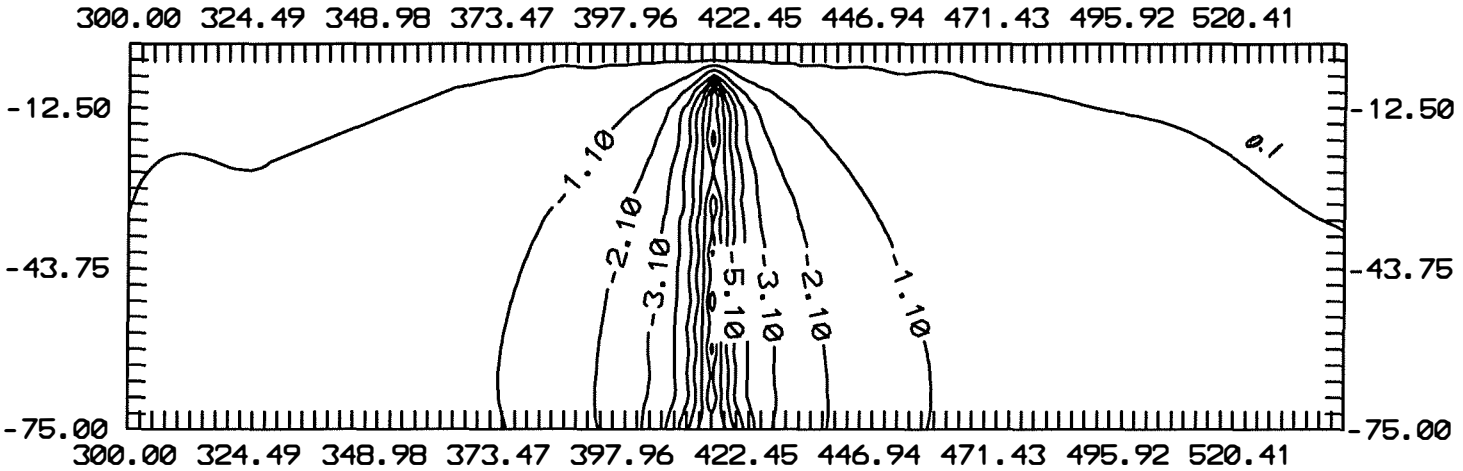
Analytical No.: 5003

X = Analyzed but not detected.
* = Estimated concentration due to QC anomaly. Spike recovery did not fall within limits established by Enviroscan's QC program.

SECTION THROUGH CENTER OF MODEL SHOWING
EQUAL PRESSURE CONTOURS
(PRESSURE IN INCHES OF WATER)



CONDITIONS RECORDED DURING PILOT TEST
FLOW = 45 CFM
PRESSURE AT WELL = -5" WATER



CONDITIONS MODELLED FOR SYSTEM AS DESIGNED
FLOW = 128 CFM
PRESSURE AT WELL = -14" WATER