N61165.AR.003887
CNC CHARLESTON
5090.3a

CORRECTIVE ACTION PLAN SUMMARY WITH TRANSMITTAL CNC CHARLESTON SC
7/31/1998
AMERADA HESS CORPORATION

AMERADA HESS CORPORATION

732-750-6000
732-750-6105 (FAX)

1 HESS PLAZA
WOODBRIDGE, NJ 07095-0961

July 31, 1998

Ms. Lori Murtaugh, Hydrogeologist
Ground water Quality Section
Bureau of Water
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Via Overnight Delivery

RE: Corrective Action Plan Summary
Amerada Hess - Charleston South Terminal
4650 Virginia Avenue
North Charleston, South Carolina
Site ID# 14003

Dear Ms. Murtaugh:

As per our discussion, attached is the Corrective Action Plan Summary for the Amerada Hess - Charleston South Terminal. The Final Corrective Action Plan (CAP) will be submitted to you by August 7, 1998.

Also enclosed are summary tables showing groundwater fluid level data and groundwater analytical data from the Second Semi-Annual Sampling Event conducted in May 1998. As proposed in our letter to you dated January 5, 1998, Navy wells NBCA-039-011, NBCA-039-014, NBCA-039-005, NBCA-039-002, NBCA-039-003, NBCA-039-010, NBCA-038-003, NBCA-039-012, and Charleston Terminal wells MW-5 through MW-30 were gauged for fluid level data. Any wells not exhibiting free product were sampled for BTEX, MTBE, naphthalene and PAHs. Figure 1 graphically depicts both the free and dissolved phase data in reference to the site monitoring wells.

Based on the data collected from the site monitoring wells, including data from the recently installed wells MW-27 through MW-30 proposed in our letter dated March 3, 1998, the site is now adequately delineated for both free and dissolved phase constituents. The CAP mentioned above has been designed for multi-phase extraction of dissolved and

free phase hydrocarbons within the saturated and unsaturated zones and will address the areas of concern.

If you have any questions or require additional information, please call me at (732) 750-6918.

Sincerely,

Alex Sagebien, Supervisor
Refining and Marketing Remediation

Enclosure (1)

cc: Daryle L. Fontenot, P.E.
Southern Division, Naval Facilities Engineering Command

CORRECTIVE ACTION PLAN SUMMARY

AMERADA HESS
CHARLESTON SOUTH TERMINAL
4650 Virginia Avenue, North Charleston, South Carolina

Alex Sagebien
Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095
(732) 750-6918

CORRECTIVE ACTION PLAN SUMMARY

AMERADA HESS
CHARLESTON SOUTH TERMINAL
4650 Virginia Avenue, North Charleston, South Carolina

Monitor wells containing free product and/or high dissolved petroleum hydrocarbons will be connected to a total fluids extraction system. The system is designed to remove air and liquids from the selected wells. Based on pilot test results using a vacuum truck it is anticipated that each well will produce approximately 2.5 gpm of water and approximately 50 cfm. The overall system flow is anticipated to be 10 gpm of ground water and 200 cfm of air.

Selected Extraction Wells

Monitor wells MW-5, MW-11, MW-14, and MW-19 (containing free product), and MW-6 (closest to the Navy well containing product) will be connected to the system.

Total Fluids Extraction Equipment

The selected wells will be retrofitted with a T fitting, a drop pipe, related valving, and an air-tight seal. The extraction equipment consists of three main components; 1) a Travaini TRO-200 vacuum pump, 2) a moisture separator/silencer, and 3) a transfer pump. Equipment will be controlled and protected from internal electrical damage by a control panel. Typical equipment schematic diagrams and information are included in Section 1.

Primary Ground Water Treatment System

The primary ground water treatment system will consist of three stages.

Stage One - Oil/Water Separation: A 990 gallon separator will be used to separate the entrained free product from the ground water. The product will be collected in a separate product tank, and will be removed with other waste product generated by the terminal operation.

Stage Two - Aeration/Transfer Vessel: The separator will discharge to a 550 gallon tank which will be used to aerate the ground water and to provide storage in front of the last stage of primary treatment.

Stage Three - Air Stripping: A transfer pump will move water from the aeration vessel to a 24-inch diameter by 30 foot tall air stripper.

Schematic drawings for the primary ground water treatment system are included in Section 2.

Secondary Ground Water Treatment

Activated carbon will be used for secondary treatment prior to discharge. Two sets of two 55-gallon drums of carbon will be connected in series to complete the ground water treatment. A transfer pump and bag filter wll be placed in front of the carbon to provide the necessary water pressure and particulate filtration. Typical activated carbon data is included in Section 3.

Treated Ground Water Discharge

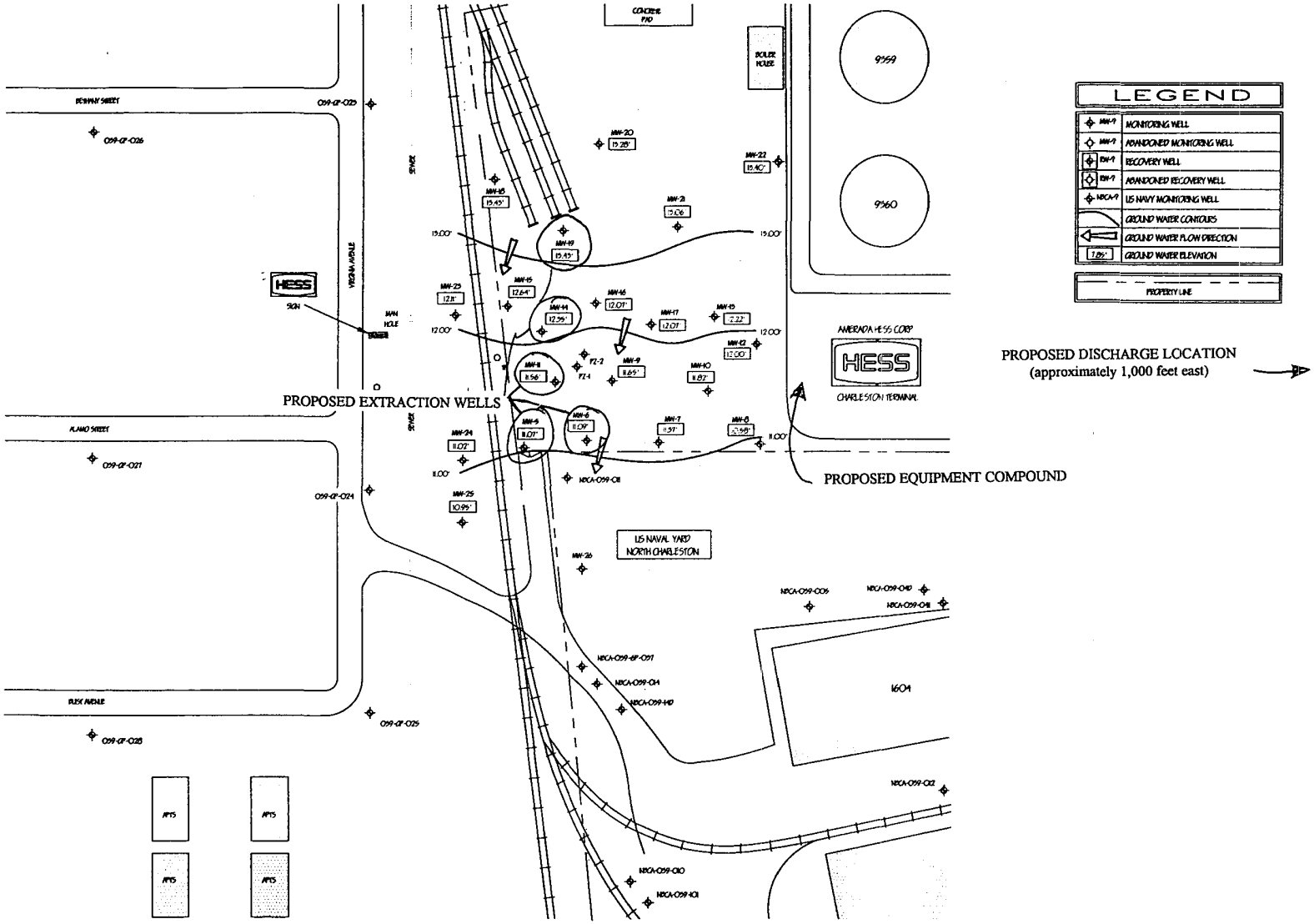
The treated ground water discharge will be directed to the storm water retention pond(s) located on the east side of the terminal property. The surface water discharge will be permitted through Hess' existing NPDES permit.

Remediation End-Points

The model published by DHEC in the guidance document "Risk-Based Corrective Action for Petroleum Releases" dated June 20, 1997 was used to calculate the Site Specific Target Levels (SSTLs) for the contaminates at the site. The receptor was considered to be the marsh and the Risk-Based Screening Levels (RBSL) were applied to that point. (Note: The DHEC RBSLs are largely equivalent to drinking water standards i.e., 5 ug/l for benzene, 1000 ug/l for toluene, etc.). The outputs for the models are contained in Section 4 and the results are summarized below:

Contaminant	SSTL (ug/l)
Benzene	477
Toluene	96,289
Ethyl Benzene	66,355
Xylenes	946,193
Naphthalene	2,389

Following removal of free product, the site remediation will be considered to be complete when the these levels are achieved on the site.



CAROLINA ENVIRONMENTAL, INC.
ENVIRONMENTAL ENGINEERING CONSTRUCTION
6-C SAINT ANDREWS ROAD, COLUMBIA, SC 29212
PHONE: 803 731 4477 FAX: 803 731 6444

GRAPHIC SCALE IN FEET
40' 0' 40' 80'

PREPARED FOR:
AMERADA HESS CORPORATION
1 HESS PLAZA
WOODBRIDGE, NEW JERSEY 07075

SITE ADDRESS:
AMERADA HESS CORPORATION
CHARLESTON TERMINAL
4650 VIRGINIA AVENUE
CHARLESTON, SOUTH CAROLINA

NORTH

DRAWN BY: CHRIS PINELLI
DATE DRAWN: 01/02/98
JOB NUMBER:
FIGURE NUMBER: 1.0

FIGURE TITLE: PARTIAL SITE MAP WITH GROUND WATER FLOW - DECEMBER 26, 1997

- Fluid Level Data and Groundwater Analytical Data Summary Tables
- Free and Dissolved Phase Isopleth Map from May 1998 Sampling Event

TABLE 1

SUMMARY OF LIQUID LEVEL MEASUREMENTS AND GROUND WATER ELEVATIONS

Amerada Hess - Charleston South Terminal
4650 Virginia Avenue
North Charleston, South Carolina

Well I.D.	Date Measured	Top of Casing (Ft)	Depth to Product (Ft)	Depth to Water (Ft)	Product Thickness (Ft)	Corr. Ground Water Elevation (Ft)
MW-5	12/21/96	14.89		6.21		8.68
	1/22/97		6.11	6.21	0.10	8.76
	12/26/97		3.72	4.20	0.48	11.07
	5/14/98		4.05	4.45	0.40	10.76
MW-6	12/21/96	16.88		6.87		10.01
	1/22/97			6.90		9.98
	12/26/97		5.76	5.90	0.14	11.09
	5/14/98		4.90	5.01	0.11	11.96
MW-7	12/21/96	16.22		6.79		9.43
	1/17/97			6.02		10.20
	12/26/97		4.85	4.86	0.01	11.37
	5/14/98		4.90	4.91	0.01	11.32
MW-8	12/21/96	16.51		7.60		8.91
	1/22/97			7.40		9.11
	12/26/97			5.93		10.58
MW-9	12/21/96	16.40		6.76		9.64
	1/22/97			6.69		9.71
	12/26/97		4.59	5.40	0.81	11.65
	5/14/98		4.68	4.92	0.24	11.67
MW-10	12/21/96	16.97		6.98		9.99
	1/22/97			6.91		10.06
	12/26/97			5.15		11.82
	5/14/98			5.12		11.85
MW-11	12/21/96	16.32	7.65	8.50	0.85	8.50
	1/22/97		6.25	9.04	2.79	9.51
	12/26/97		4.74	4.83	0.09	11.56
	5/14/98		4.50	4.58	0.08	11.80
MW-12	12/21/96	16.20		5.95		10.25
	1/22/97			5.91		10.29
	12/26/97			4.20		12.00
	5/14/98			4.16		12.04
MW-13	12/21/96	17.09		6.70		10.39
	1/22/97			6.64		10.45
	12/26/97			4.87		12.22
	5/14/98			4.87		12.22
MW-14	12/21/96	16.49		7.40		9.09
	1/22/97		6.29	6.58	0.29	10.14
	12/26/97		3.86	5.24	1.38	12.35
	5/14/98		3.95	4.21	0.26	12.49
MW-15	12/21/96	16.00		5.85		10.15
	1/22/97			5.90		10.10
	12/26/97			3.36		12.64
	5/14/98			3.43		12.57

TABLE 1

SUMMARY OF LIQUID LEVEL MEASUREMENTS AND GROUND WATER ELEVATIONS

Amerada Hess - Charleston South Terminal
4650 Virginia Avenue
North Charleston, South Carolina

Well I.D.	Date Measured	Top of Casing (Ft)	Depth to Product (Ft)	Depth to Water (Ft)	Product Thickness (Ft)	Corr. Ground Water Elevation (Ft)
MW-16	12/21/96	16.47		6.15		10.32
	1/22/97			6.18		10.29
	12/26/97			4.40		12.07
	5/14/98			3.92		12.55
MW-17	12/21/96	16.55		6.38		10.17
	1/22/97			6.31		10.24
	12/26/97			4.48		12.07
	5/14/98			4.39		12.16
MW-18	12/21/96	17.50		7.40		10.10
	1/22/97			7.54		9.96
	12/26/97		3.60	5.94	2.34	13.43
	5/14/98		5.23	5.24	0.01	12.27
MW-19	12/21/96	17.44		6.42		11.02
	1/22/97			6.47		10.97
	12/26/97		3.98	4.13	0.15	13.43
	5/14/98		3.90	4.11	0.21	13.50
MW-20	12/21/96	17.43		6.35		11.08
	1/22/97			6.32		11.11
	12/26/97		4.10	4.35	0.25	13.28
	5/14/98		4.20	4.22	0.02	13.23
MW-21	12/21/96	16.74		5.83		10.91
	1/22/97			5.75		10.99
	12/26/97			3.68		13.06
	5/14/98			3.73		13.01
MW-22	12/21/96	17.24		5.65		11.59
	1/22/97			5.59		11.65
	12/26/97			3.84		13.40
MW-23	12/26/97	15.73		3.62		12.11
	5/14/98			4.26		11.47
MW-24	12/26/97	14.82		3.80		11.02
	5/14/98			4.53		10.29
MW-25	12/26/97	14.10		3.15		10.95
	5/14/98			4.44		9.66
MW-26	12/26/97	11.94	NM	NM		NM
	5/14/98			2.55		9.39
MW-27	5/14/98	--		2.00		--
MW-28	5/14/98	--		4.25		--
MW-29	5/14/98	--		4.16		--
MW-30	5/14/98	14.10		3.15		10.95
PZ-1	12/21/96	16.23	6.35	7.55	1.2	9.64
	1/22/97		6.15	8.29	2.14	9.65
	12/26/97		4.87	4.96	0.09	11.34
	5/14/98		4.36	4.60	0.24	11.82
PZ-2	12/21/96	16.62	6.80	7.25	0.45	9.73
	1/22/97		6.60	7.94	1.34	9.75
	12/26/97		4.91	5.09	0.18	11.67
	5/14/98		4.65	5.04	0.39	11.89
039-011	5/14/98		4.63	4.73	0.10	

TABLE 2
SUMMARY OF GROUND WATER ANALYTICAL RESULTS
Amerada Hess - Charleston South Terminal
4650 Virginia Avenue
North Charleston, South Carolina

Well I.D.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Total BTEX	MTBE	Naphthalene	Total PAH
MW-1	12/26/97	<1.0	<1.0	<1.0	<1.0	ND	<5.0	<5.0	<10.0
MW-2	12/26/97	<1.0	<1.0	<1.0	<1.0	ND	<50	<50	<10.0
MW-3	12/26/97	<1.0	<1.0	<1.0	<1.0	ND	<5.0	<5.0	<10.0
MW-4	12/26/97	<1.0	<1.0	<1.0	<1.0	ND	<5.0	<5.0	<10.0
MW-5	12/23/96	90.8	<5.0	5.0	17.0	113	<40.0	51.3	<10.0
MW-6	12/23/96	598	5.09	121	409	1,130	<40.0	587	<10.0
MW-7	12/23/96	12.4	<5.0	<5.0	<5.0	12.4	<40.0	<5.0	<10.0
MW-8	12/23/96	<5.0	<5.0	<5.0	<5.0	BDL	<40.0	<5.0	<10.0
	12/26/97	<1.0	<1.0	<1.0	1.46	1.5	47.4	<5.0	<10.0
MW-9	12/23/96	490	1,030	900	2,920	5,340	<40.0	480	<10.0
MW-10	12/23/96	26.4	9.96	266	1,710	2,010	<40.0	35.4	<10.0
	12/26/97	11.6	<5.0	131	466	609	26.8	23.7	<10.0
	5/14/98	15.1	<1.0	114	474	603	<1.0	<1.0	<5.0
MW-12	12/23/96	<5.0	<5.0	<5.0	<5.0	BDL	76.3	<5.0	<10.0
	12/26/97	<1.0	<1.0	<1.0	10.1	10.1	52.6	<5.0	<10.0
	5/14/98	<1.0	<1.0	<1.0	<1.0	BDL	10.5	<1.0	<5.0
MW-13	12/23/96	32.1	<50	16.5	142	191	<40	<5.0	<10.0
	12/26/97	336	<50	413	1,170	1,919	<50	<50	<10.0
	5/14/98	866	55.2	1160	49,600	51,700	<10	42.5	132
MW-14	12/23/96	486	610	408	1,300	2,800	<40.0	<20.0	<10.0
MW-15	12/23/96	220	11,200	368	31,700	43,500	<40.0	<20.0	<10.0
	12/26/97	206	11,100	565	34,100	46,000	<50	<50	<10.0
	5/14/98	128	4,800	337	26,400	31,700	<10	92.0	68.8
MW-16	12/23/96	774	499	1,190	11,600	14,100	<40.0	737	<10.0
	12/26/97	1,010	392	1,610	14,500	17,500	<50	<50	<10.0
	5/14/98	798	529	1,600	1,990	4,920	<100	219	314
MW-17	12/23/96	<100	<100	4,400	15,000	19,400	NS	110	305
	12/26/97	<20	35.6	945	4,760	5741	<20	<20	<10.0
	5/14/98	180	603	3,090	139,000	143000	<100	268	326
MW-18	12/23/96	293	1,190	25.7	88,800	90,300	<40.0	<5.0	<10.0
MW-19	12/23/96	<100	<100	<100	30,000	30,000	NS	82	345
MW-20	12/23/96	<10.0	<10.0	<10.0	2,080	2,080	<40.0	<10.0	<10.0
MW-21	12/23/96	325	90.0	965	3,210	4,590	<50.0	<50.0	<10.0
	12/26/97	638	<50	1,090	3,450	5,180	<50	<50	<10.0
	5/14/98	824	109	1,280	4,990	7,200	<1.0	478	177
MW-22	12/23/96	<5.0	7.33	<5.0	89.4	96.7	<40.0	<5.0	<10.0
	12/26/97	<1.0	<1.0	27.1	25.2	52	<5.0	<5.0	<10.0
	5/14/98	<1.0	<1.0	18.9	23.4	42.3	<1.0	44.0	177
MW-23	8/27/97	1.7	29	5.2	460	489	<10	4.8	9.8
	12/26/97	<1.0	<1.0	<1.0	4.53	4.53	<5.0	<5.0	<10.0
	5/14/98	<1.0	<1.0	<1.0	4.93	4.93	<1.0	<1.0	<5.0
MW-24	8/27/97	73	1,200	150	880	2,300	<100	110	394
	12/26/97	21.1	260	75.7	302	659	<50	<50	<10.0
	5/14/98	12.0	80.0	53.7	270	416	<1.0	94	556

TABLE 2
SUMMARY OF GROUND WATER ANALYTICAL RESULTS

Amerada Hess - Charleston South Terminal
4650 Virginia Avenue
North Charleston, South Carolina

Well I.D.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Total BTEX	MTBE	Naphthalene	Total PAH
MW-25	8/27/97	12	160	39	190	401	<50	1.9	13
	12/26/97	<1.0	<1.0	<1.0	<1.0	ND	<5.0	<5.0	<10.0
	5/14/98	<1.0	<1.0	1.01	2.95	3.96	<1.0	<1.0	<5.0
MW-26	8/27/97	81	2.0	49	92	222	15	21	130
	5/14/98	183	5	123	206	517	<1.0	144	182
MW-27	5/14/98	<1.0	<1.0	<1.0	1.78	1.78	<10	<1.0	<5.0
MW-28	5/14/98	15.3	1.90	16.9	7390	7420	<1.0	<1.0	<5.0
MW-29	5/14/98	<1.0	<1.0	<1.0	<1.0	BDL	<1.0	<1.0	<5.0
MW-30	5/14/98	<1.0	<1.0	<1.0	13.2	13.2	<1.0	<1.0	<5.0

Well I.D.	Date Sampled	pH (su)	BOD
MW-12	12/23/96	6.7	.270

Notes:
All concentrations are in ug/l.
Total BTEX is the sum of benzene, ethyl benzene, toluene and xylenes .

TABLE 2.1

SUMMARY OF NAVY ANALYTICAL DATA

Amerada Hess - Charleston South Terminal
North Charleston, South Carolina

Well I.D.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Total BTEX	MTBE	Naphthalene	PAH
NBCA-038-001	12/7/96	<5	<5	<5	<5	0	NA		
NBCA-038-01D	2/7/95	<5	<5	<5	<5	ND	NA	<12	ND
NBCA-038-002	12/7/96	<5	<5	<5	<5	ND	NA		
NBCA-039-001	2/7/95	<5	<5	<5	<5	ND	NA		
	4/23/96	47	<3.9	9	68	124	NA	<11	ND
	6/20/96	35	<2.2	10	81	126	NA	<11	ND
	10/7/96	110	<4	34	72	216	NA	<10	ND
	5/14/98	198	<1.0	37.1	137	372	11	<1.0	11.6
NBCA-039-002	12/3/95	<5	<5	<5	<5	ND	NA	<12	ND
	12/5/95	<5	<5	<5	<5	ND	NA	<12	ND
	4/23/96	<5	<5	<5	<5	ND	NA	<10	ND
	6/20/96	<5	<5	<5	<5	ND	NA	<11	ND
	10/8/96	<5	<5	<5	<5	ND	NA	<11	ND
	5/14/98	<1.0	<1.0	<1.0	2.15	2.2	<1.0	<1.0	<5.0
NBCA-039-003	5/14/98	<1.0	<1.0	<1.0	<1.0	ND	3.91	<1.0	<5.0
NBCA-039-004	5/14/98	<1.0	<1.0	<1.0	1.67	1.7	21	<1.0	<5.0
NBCA-039-04D	12/6/95	<5	<5	<5	<5	ND	NA	<11	ND
	4/25/96	<5	<5	<5	<5	ND	NA	<11	ND
	6/21/96	<5	<5	<5	<5	ND	NA	<12	ND
	10/8/96	<5	<5	<5	<5	ND	NA	<12	ND
	10/21/96	<5	<5	<5	<5	ND	NA		
NBCA-039-005	12/6/95	90	<5	<1.4	<5	90	NA	<9.1	13
	4/24/96	100	<1.7	<3	11	111	NA	64	87
	6/21/96	170	<1.3	<1.1	<4.5	170	NA	<35	ND
	10/9/96	78	<5	<5	<5	78	NA	<10	ND
	5/14/98	71.7	<1.0	24.6	7.66	104	55.8	39.0	27.9
NBCA-039-010	8/1/96	<5	<5	<5	<5	ND	NA		
	10/11/96	<5	<5	<5	<5	ND	NA	<4	ND
	3/11/97	<5	<5	<5	<5	ND	NA	<10	ND
	5/14/98	<1.0	<1.0	<1.0	<1.0	ND	<1.0	<1.0	5.1
NBCA-039-10I	9/19/96	<5	<5	<5	<5	ND	NA		
	9/28/96	<5	<4	<5	<5	ND	NA	<10	ND
	11/6/96	<5	<5	<5	<5	ND	NA		
	3/11/97	<5	<5	<5	<5	ND	NA	<10	ND
NBCA-039-10D	9/19/96	<5	<5	<5	<5	ND	NA		
	9/28/96	<5	<5	<5	<5	ND	NA	<9.1	ND
	11/6/96	<5	<5	<5	<5	ND	NA	<10	ND
	3/11/97	<5	<5	<5	<5	ND	NA	<10	ND
NBCA-039-011	8/2/96	620	140	190	413	1363	NA	4	
	10/10/96	200	24	140	165	529	NA	330	540
	10/15/96	200	<5	190	440	830	NA	480	794
NBCA-039-012	5/14/98	33.8	<1.0	<1.0	3.47	37.3	361	<1.0	<5.0
NBCA-039-014	2/6/97	8	<5	<5	<5	8	NA	<5	ND
	3/20/97	23	<5	<5	<5	23	NA	<10	ND
	5/14/98	17.7	<1.0	<1.0	1.21	18.9	18.5	<1.0	11.6
NBCA-039-14D	2/6/97	<5	<5	<5	<5	0	NA	<5	ND
	3/21/97	<5	<5	<5	<5	ND	NA	<10	ND
NBCA-039-15D	2/6/97	<5	<5	<5	<5	ND	NA	<10	ND

tes: All concentrations are in ug/l

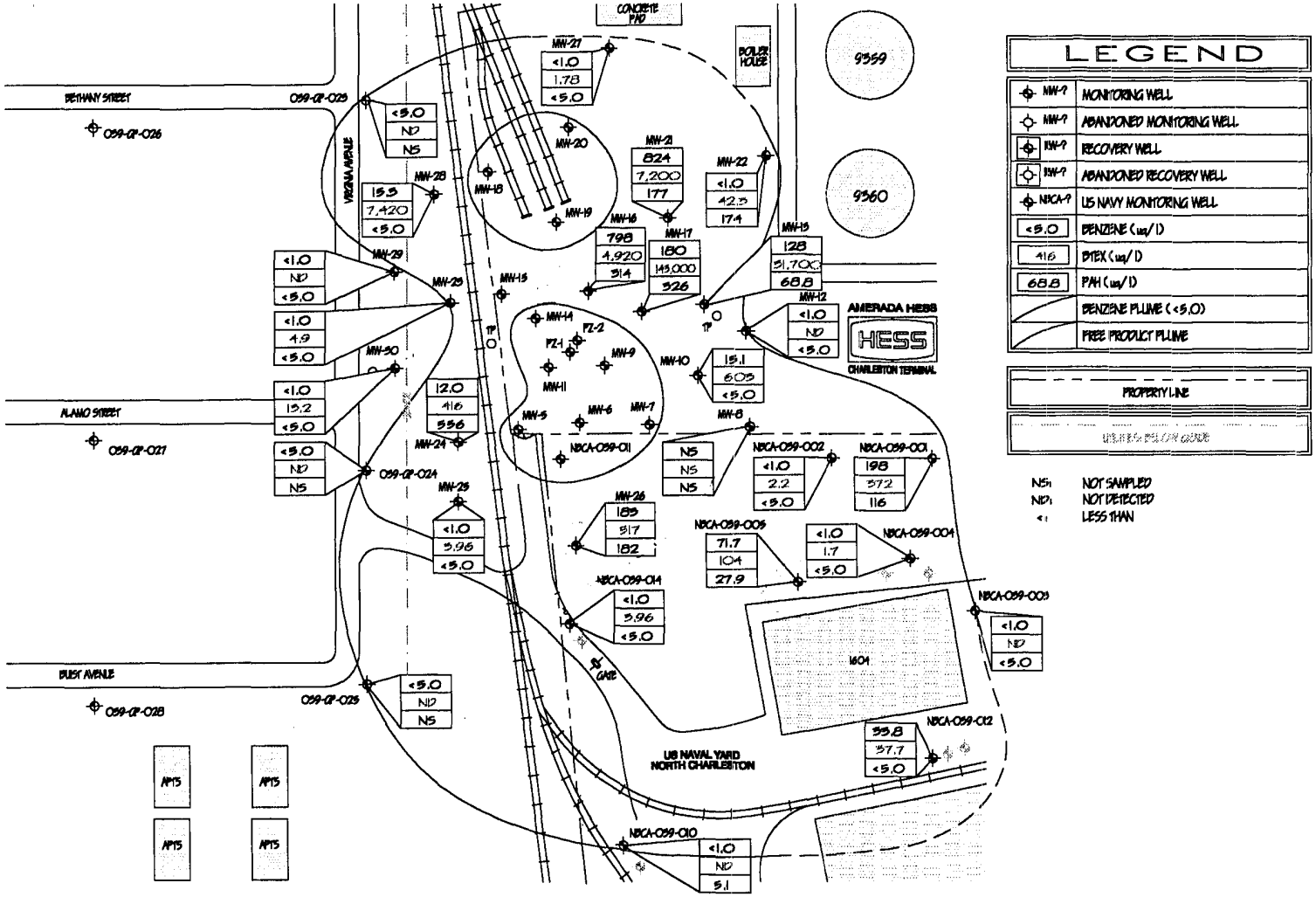
TABLE 2.2

NAVY OFFSITE GEOPROBE PROGRAM RESULTS

Amerada Hess - South Charleston Terminal
North Charleston, South Carolina

Well I.D.	Date Sampled	Benzene	Toluene	Ethyl- benzene	Total Xylenes	Total BTEX
039-G-P022-11	9/26/96	<5	5	<5	<5	5
039-G-P022-23	3/26/96	<5	<5	<5	<5	ND
039-G-P023-12	9/25/96	<5	<5	<5	<5	ND
039-G-P023-26	9/25/96	<5	<5	<5	<5	ND
039-G-P024-12	9/25/96	<5	<5	<5	<5	ND
039-G-P024-26	9/25/96	<5	<5	<5	<5	ND
039-G-P025-10	9/27/96	<4	<1	<5	10	10
039-G-P025-20	9/27/96	<3	<5	<5	8	8
039-G-P026-11	9/30/96	<5	<5	<5	<10	ND
039-G-P027-11	9/27/96	<5	<5	<5	<10	ND
039-G-P029-10	9/30/96	<5	<2	<5	<10	ND
039-G-P031-27	9/26/96	<5	<5	<5	<5	ND
039-G-P032-11	9/27/96	<5	<2	<5	<5	ND
039-G-P033-11	9/26/96	<5	<5	<5	<5	ND
039-G-P033-25	9/26/96	<5	<5	<5	<5	ND
039-G-P034-11	9/27/96	<5	<5	<5	<5	ND
039-G-P035-11	9/27/96	<5	<5	<5	<5	ND
039-G-P035-30	9/27/96	<5	<5	<5	<5	ND
039-G-P036-11	9/27/96	<5	<5	<5	<5	ND
039-G-P037-11	9/30/96	<2	<5	<5	<5	ND
039-G-P037-19	9/30/96	<5	<5	<5	<5	ND

Notes: All concentrations are in ug/l.



CAROLINA ENVIRONMENTAL, INC.
ENVIRONMENTAL ENGINEERING CONSTRUCTION
6316-C SAINT ANDREWS ROAD, COLUMBIA, SC 29212
PHONE: 803 731 4477 FAX: 803 731 6444

GRAPHIC SCALE IN FEET
40' 0' 40' 80'
SCALED FOR 24" X 36" PLAN SIZE

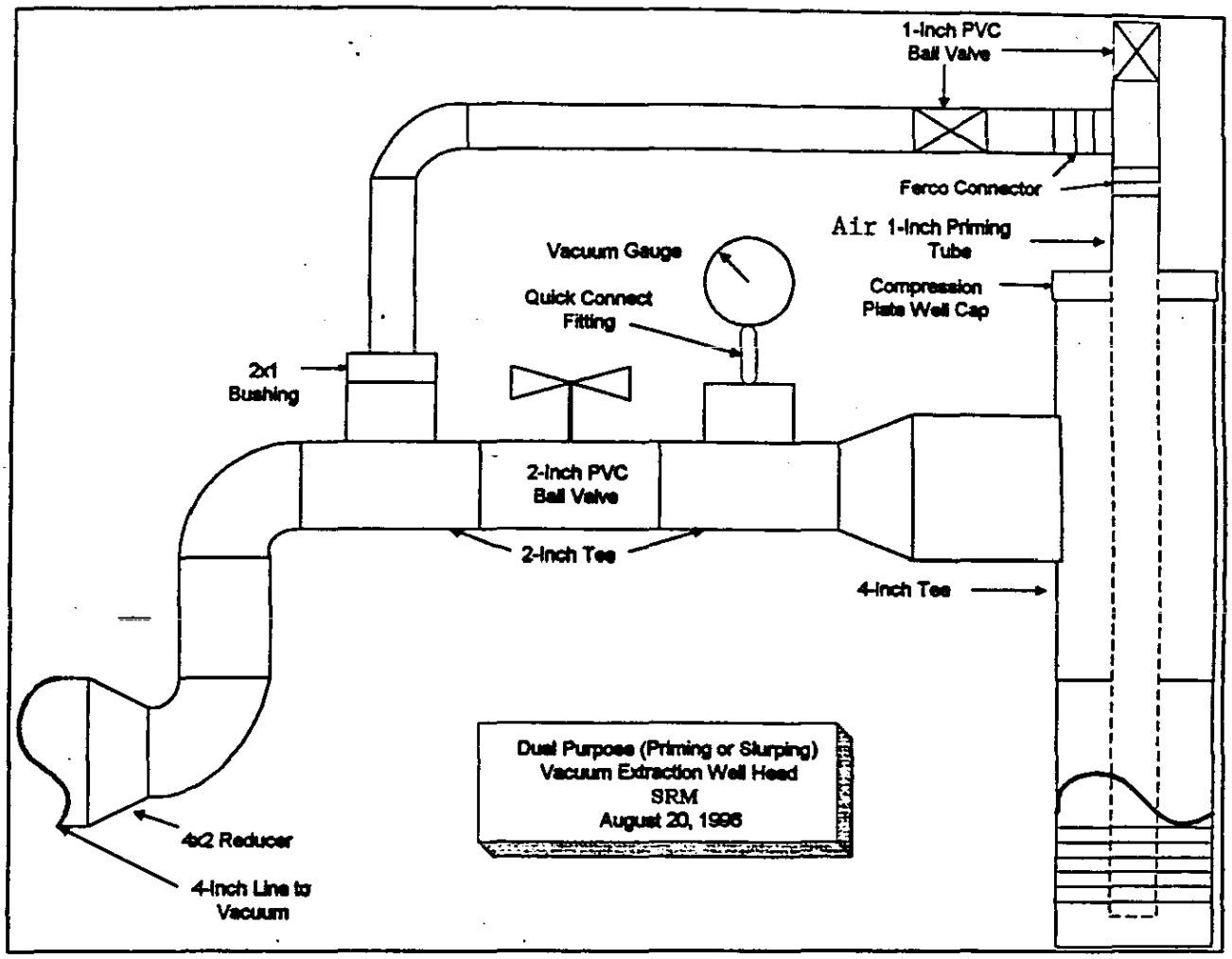
PREPARED FOR: HESS
AMERADA HESS CORPORATION
1 HESS PLAZA
WOODBRIDGE, NEW JERSEY 07075

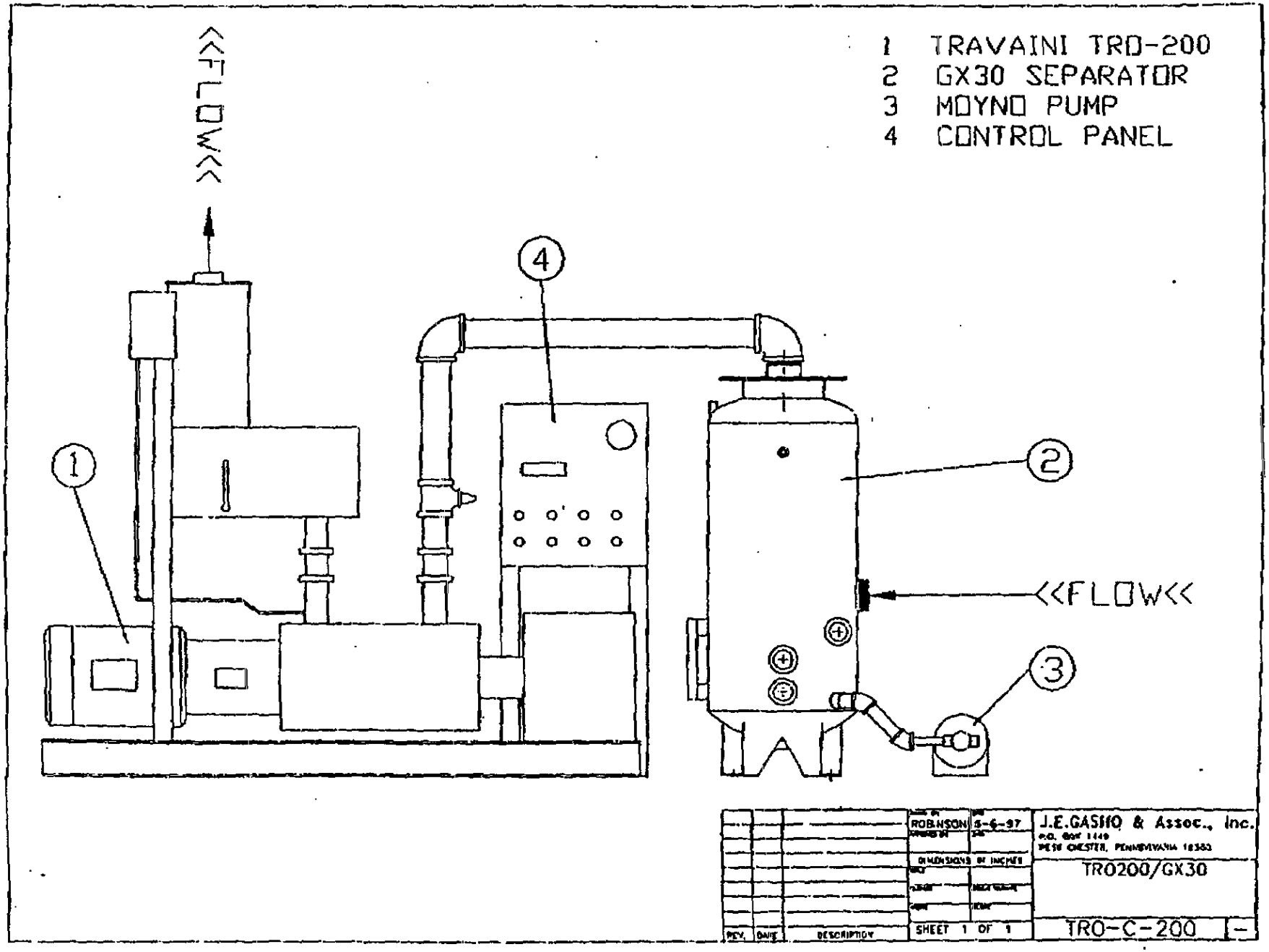
SITE ADDRESS:
AMERADA HESS CORPORATION
CHARLESTON TERMINAL
4650 VIRGINIA AVENUE
CHARLESTON, SOUTH CAROLINA

NORTH

DRAWN BY: CHRIS PINELLI
DATE DRAWN: 06/05/98
JOB NUMBER: 4OTCS
FIGURE NUMBER: 1.0

FIGURE TITLE: GROUND WATER QUALITY MAP - MAY 14, 1998


1-Inch PVC
Ball Valve
Ferco Connector
Air 1-Inch Priming
Tube
Vacuum Gauge
Compression
Plate Well Cap
Quick Connect
Fitting
2x1
Bushing
2-Inch PVC
Ball Valve
2-Inch Tee
4-Inch Tee
Dual Purpose (Priming or Slurping)
Vacuum Extraction Well Head
SRM
August 20, 1996
4x2 Reducer
4-Inch Line to
Vacuum


1 TRAVAINI TRO-200
2 GX30 SEPARATOR
3 MOYNO PUMP
4 CONTROL PANEL
<<FLOW<<
<<FLOW<<
1
2
3
4
ROBINSON
5-6-97
J.E.GASHO & Assoc., Inc.
P.O. Box 1149
WEST CHESTER, PENNSYLVANIA 19380
DIMENSIONS IN INCHES
TRO200/GX30
SHEET 1 OF 1
TRO-C-200
REV. DATE DESCRIPTION

J. E. Gasho and Associates, Inc.
Authorized Manufacturer's Representatives
P.O. Box 1449
WEST CHESTER, PENNSYLVANIA 19380

(610) 692-5650 FAX (610) 692-5837

QUOTATION

J7198-C
Please indicate the above number when ordering

Quote Date: 7/10/97
Inquiry Date: 7/10/97
Salesman: J. Hopon

TO: Amerada Hess / Natalie
Site Remediation / Steve Morrow

Attn.: Natalie / Steve Morrow
FAX: (908) 750-6105

Reference: ST. Croix Terminal

Estimated Shipping Date:	Shipped Via:	F.O.B.:	Terms:
Delivery 2 to 3 Weeks.	Best Way	West Chester, PA	Net 30

Quantity	Description
1	J.E.Gasho & Assoc., Inc. Hi Vac. Remediation blower package consisting of the following items mounted and wired on a common skid:

A. Travaini Dynaseal Liquid Ring Pump Model TRO-200V-1A, 15 hp, TEFC, 230/3/60, Motor, rated for nominal flow of 200 acfm and max. Vacuum at 29" Hg.
- High Efficiency discharge separator element, air cooled heat exchanger, automatic temp. control valve, seal liquid solinoid valve

B. Inline filter, check valve, relief valve, low oil level switch

C. GX-60 Inlet moisture separator with sight gauge, (3) level switches, demister pad in basket, Moyno Progressive Cavity Transfer Pump, 1/2 hp, 230 volt, 3 phase

D. (2) Vacuum Gauges

E. Rotron Air Flow Meter FM30A350Q rated for 70-350 scfm with piping**

F. Totalizing Meter on Moyno Pump Discharge (.25 to 20 GPM), max temp.=105 deg. F., max. Pressure=150 psi, 3/4" NPT, ± 1% accuracy

G. Nema 4 control panel consisting of:
- Power Disconnect Switch
- 15 hp and 1/2 hp Motor Starters, 230 volt, 3 phase
- (2) HOA switches with green run lights
- Hi liquid level, Low oil level, Hi Temp. faults with red indication lights
- manual reset button

Net Price Ea. $19923.00

** discharge stack with flow meter supplied loose for field instalation.

Notes:
1. Manufacturer's Standard Terms & Warranty apply.
2. Place orders with: J.E. Gasho & Assoc., Inc.
3. Terms: Net 30 upon credit approval
4. Valid for 30 days.

By _____ Accepted _____ Date _____

JEG

Thank you!

UNIVERSAL SILENCER
A DIVISION OF NELSON INDUSTRIES, INC.
P.O. Box 411, Stoughton, Wisconsin 53589
608-873-4272 Fax 608-873-4298

APPLICATION GUIDE
VACUUM PUMP WATER SEPARATOR SILENCERS

Technical Bulletin 88-1114 (Pg 1 of 2) | Revised 8-1-92

Separator silencers are used to remove water from a flow of air in vacuum systems using either liquid ring vacuum pumps or water sealed rotary positive blowers. On the inlet side of the pump, the separator removes process water from the flow before going into the pump and on the discharge side the separator removes either process water or seal water or both and prevents it from being discharged into the atmosphere. Vacuum systems have two different phases of operation that must be considered in sizing and selecting the proper separator silencer. The first phase is a start-up phase where the pump has just begun evacuating the system; the other phase is normal operation where the system has reached its operating vacuum level. Two aspects of separator silencer performance, water removal and pressure drop, must be considered during both system operating phases for proper separator silencer selection.

Separator silencers may be required for both the inlet (vacuum) and the discharge (atmospheric) of a vacuum system. However, only the most critical applications require significant inlet silencing. An inlet separator provides corrosion protection for the pump by removing most, if not all, of the process liquid before it enters the pump.

The atmospheric discharge is normally extremely noisy and, in most instances, must be provided with a high performance separator silencer. When an inlet separator is not provided, both the inlet water and the seal-water is released to the pump discharge. In these cases, the discharge separator may have to be over-sized to prevent the liquid capacity of the separator from being exceeded.

When in doubt regarding a specific application, contact the factory.

VACUUM PUMP OPERATION AND CAPACITY

When a vacuum pump first starts operating at normal atmospheric pressure, system pressure drops and power requirements are at their maximum. As the pump continues to evacuate the system, the inlet pressure decreases so the system pressure losses and power requirements decrease. The inlet volume flow, (ACFM) stays essentially constant throughout system operation, but because of decreasing inlet pressure the discharge volume decreases until normal operating conditions are reached.

Vacuum pump capacities at operating conditions are given by the inlet volume flow of air and the amount that the inlet pressure has been reduced below atmospheric pressure. Thus pump capacities are stated as inlet actual cubic feet per minute (ACFM) at a relative vacuum usually measured in inches of mercury ("Hg).

WATER SEPARATION PERFORMANCE

Separator silencers meet their rated water separation efficiency at a nozzle velocity of 5500 fpm. At lower velocities their performance improves, at higher velocities their efficiency decreases. The nozzle velocity is the air velocity in the inlet or discharge nozzle and is equal to the actual volume flow rate divided by the nozzle area.

Since the inlet volume flow rate is nearly constant during vacuum pump operation, the inlet separator silencer should be sized so the velocity does not exceed 5500 fpm during all phases of operation (see Table 1).

The discharge flow rate decreases from start-up to normal operation and in some applications it may be acceptable to exceed a velocity of 5500 fpm during start-up. If it is not acceptable to discharge water during start-up, the velocity must be reduced (see Table 1). If some water by-pass is allowed during start-up, the selection of the discharge separator silencer should be based on pressure drop.

Inlet and discharge separator silencers require drain systems to remove the water. These systems (both inlet and discharge) must provide an adequate drain sealing system to offset the vacuum on the inlet side and prevent blow-out on the discharge side.

SEPARATOR SILENCER PRESSURE DROP

Separator Silencer pressure drop depends upon velocity and pressure. In a vacuum system it is maximum during start-up. Under normal atmospheric conditions the pressure drop at start-up for either an inlet or discharge separator silencer is:

Pressure Drop Coefficients	
Separator/Silencer Model	Pressure Drop Coefficient - C
VI	2.5
UVS	4.0
VDY	4.2
USVY	4.2
UCS	4.0
USS	5.5
URS	5.5
PDY	4.2

$$\Delta P = \frac{C}{477}\left(\frac{ACFM}{p^2}\right)^2 = C\left(\frac{V}{4005}\right)^2$$

ACFM = Inlet volume flow
C = sep/silencer ΔP coefficient
ΔP = Pressure drop in inches of water
p = Silencer size (nozzle diameter) in inches
V = Velocity in feet per minute

If the start-up pressure drop is excessive, use the flow given for a lower relative vacuum, or calculate a silencer size using:

$$p = 4.674\sqrt{ACFM\sqrt{\frac{C}{\Delta P}}}$$

C = sep/silencer ΔP coefficient
ΔP = Desired pressure drop in inches of water
p = Silencer size (nozzle diameter) in inches

TABLE 1: MAXIMUM CAPACITY (INLET ACFM) FOR FULL WATER SEPARATION EFFICIENCY AT OPERATING VACUUM

Nominal Size	Operating Vacuum, "Hg						
	0*	5	10	15	18	20	25**
1	30	36	45	60	75	90	98
1.5	70	81	101	135	169	204	221
2	120	144	180	241	301	362	393
2.5	190	225	282	376	471	565	614
3	270	324	406	541	678	814	884
3.5	370	441	552	737	922	1110	1200
4	480	576	721	963	1200	1450	1570
5	750	900	1130	1500	1880	2260	2450
6	1080	1300	1620	2170	2710	3260	3530
8	1920	2310	2880	3850	4820	5790	6280
10	3000	3600	4510	6020	7530	9050	9800
12	4300	5190	6490	8660	10800	13000	14100
14	5900	7060	8830	11800	14800	17700	19200
16	7700	9220	11500	15400	19300	23200	25100
18	9700	11670	14600	19500	24400	29300	31800
20	12000	14410	18000	24100	30100	36200	39300
22	14500	17430	21800	29100	36400	43800	47500
24	17300	20750	26000	34700	43400	52100	56500
26	20300	24350	30500	40700	50900	61200	66400
28	23500	28240	35300	47200	59000	70900	77000
30	27000	32420	40600	54100	67800	81400	88400

*This column is used for inlet separator silencers and discharge separator silencers with no water bypass during start-up.

**Capacity at operating vacuum greater than 20 "Hg is limited by start-up conditions.

Universal's Vacuum Pump Silencers and Separator Silencers

Whether your vacuum pump problems are inlet or discharge noises – water or liquid droplets being carried over into vacuum pump inlet or discharged into the atmosphere – or a combination of both – Universal has the unit ideally suited for your operational requirements.

Universal can attenuate inlet or discharge noises – as well as separate out liquids – which costs you needless horsepower.

Any way you look at it, Universal's Vacuum Pump Separators Silencers can save you money – will create better employee relations – and make your community a quieter place to live in.

REFERENCE TABLE

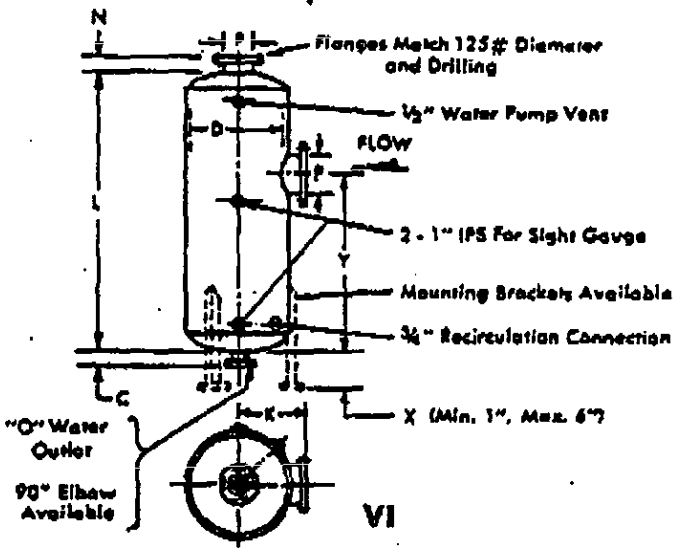
INLET SEPARATOR SILENCERS

VI Series	Medium degree silencing, 95% water removal.
UVS Series	Medium degree silencing, 99%+ water removal.

DISCHARGE SEPARATOR SILENCERS

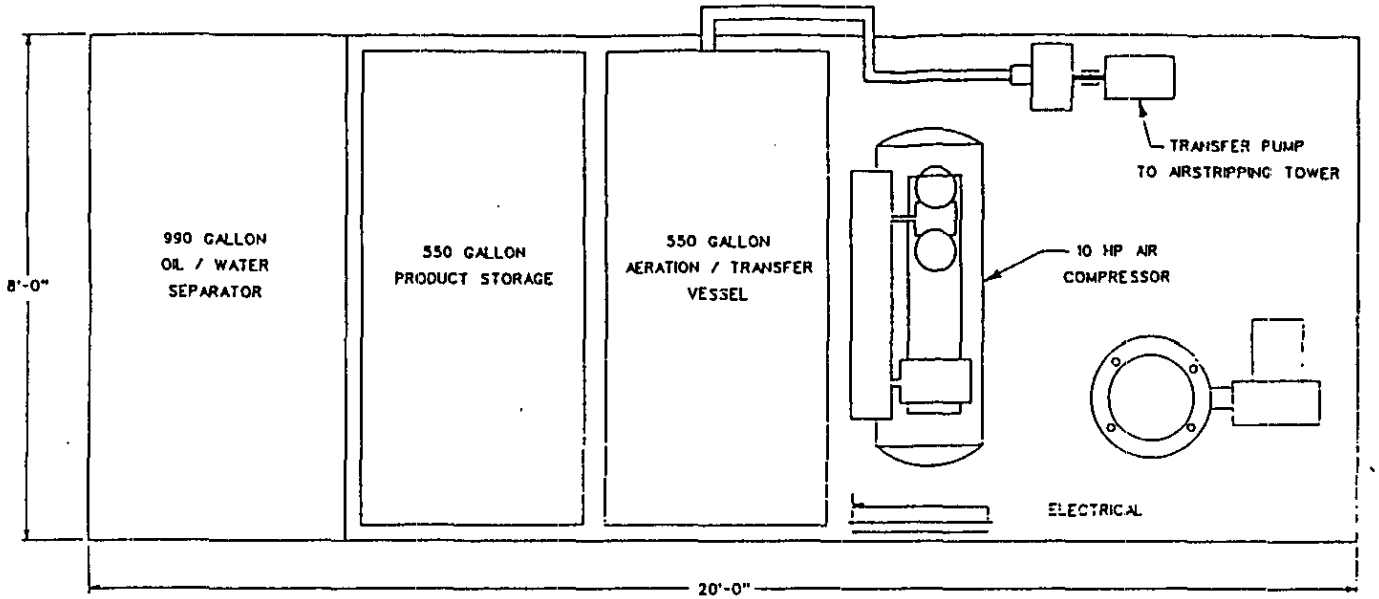
VDY Series USVY Series	High degree silencing, 95% water removal.
UCS Series	Medium degree silencing, 99%+ water removal.
USS Series	High degree silencing, 99%+ water removal.
URS Series	Critical degree silencing, 99%+ water removal.

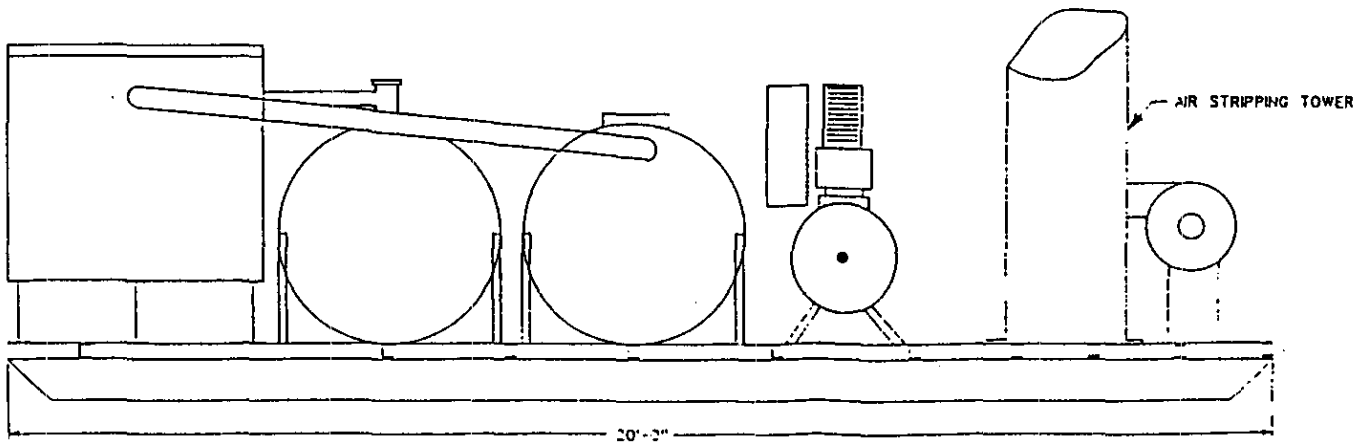
Inlet Separator Silencers



Model	Capacity CFM	Capacity GPM	P	D	N	L	K	C	Y	G	Weight	** Gal.
VI-4	500	25	4	14	3	41½	10½	***	21	2	130	11
VI-5	800	40	5	16	3	47½	11½	***	24	3	180	16
VI-6	1,300	60	6	18	3	54	12½	***	27	3	325	22
VI-8	2,600	100	8	22	3½	64½	14½	3½	33	4	350	40
VI-10	3,250	140	10	26	3½	92	16½	3½	47	4	550	70
VI-12	4,700	180	12	30	3½	103	18½	3½	56	4	825	130
VI-14	6,000	210	14	36	3½	113	21½	3½	56	6	1,100	195
VI-16	8,000	250	16	42	3½	121	24½	3½	64	6	1,400	285
VI-18	10,000	300	18	48	3½	128½	27½	3½	66	6	2,000	375
VI-20	12,000	350	20	54	4½	136	31½	3½	68	8	2,500	475
VI-22	15,000	400	22	60	4½	138	34½	3½	70	8	2,800	590
VI-24	18,000	450	24	60	4½	154	34½	3½	77	8	3,100	660
VI-26	21,500	500	26	66	4½	175½	39½	3½	85	8	4,000	875
VI-30	28,500	650	30	72	4½	189	45½	3½	106	8	5,700	1,250

** Gal. Storage Capacity before carryover occurs.
*** Tank Flange Drain

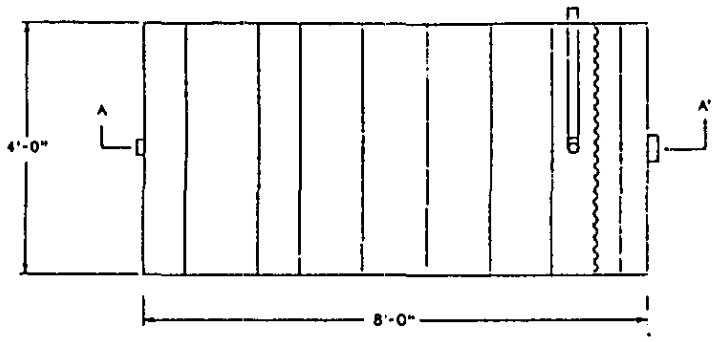




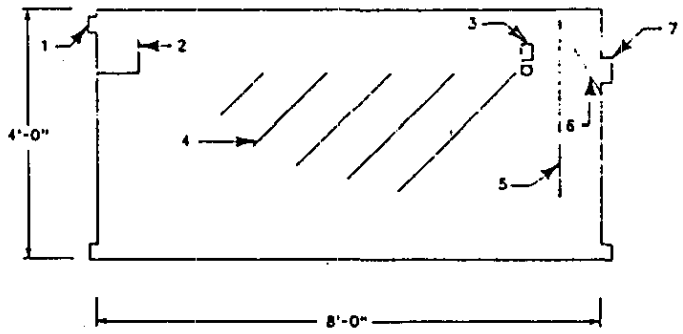
SKID MOUNTED WATER
TREATMENT AND POWER UNIT
ISACOR MODEL NO. 40-C-10

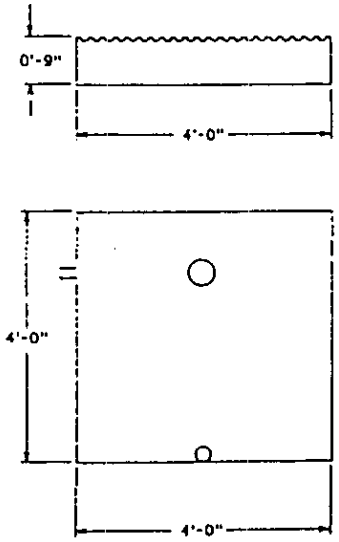
ISACOR INC.

NOTES:
EXTERIOR PLATES 12 GAGE STEEL
BAFFLES 14 GAGE STEEL
INTERIOR MIG WELDED
VENTS NOT SHOWN
NOT TO SCALE



SECTION A - A'



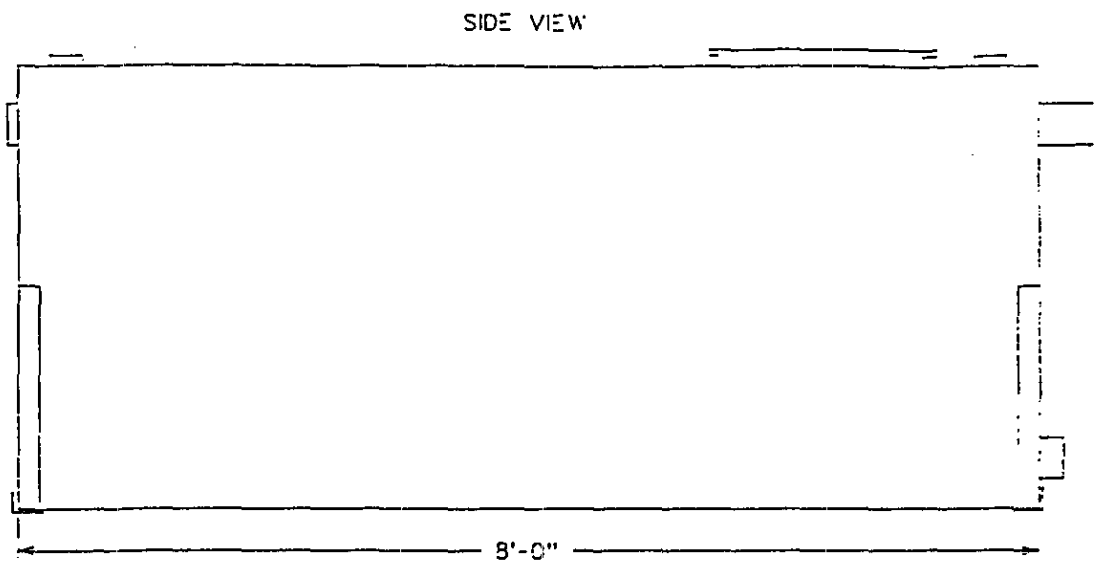


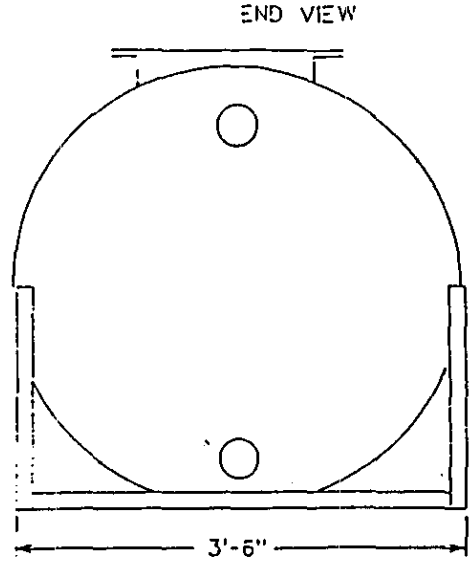
Detention Time = 34 minutes

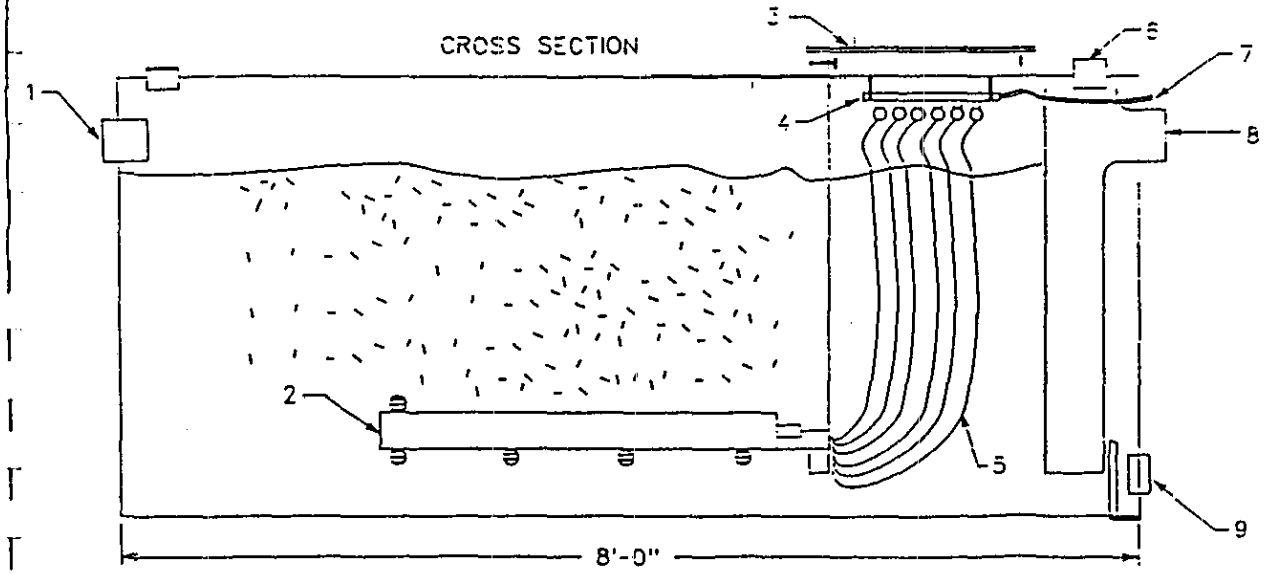
1 - INFLUENT OIL - WATER MIXTURE
2 - INLET WEIR
3 - OIL SKIMMER
4 - TILTED PLATE SEPARATORS
5 - OIL DAM
6 - OUTLET WEIR
7 - CLEAN WATER EFFLUENT

TILTED PLATE OIL - WATER SEPARATOR (990 GAL.)
ISACOR MODEL NO. 990S

ISACOR INC.





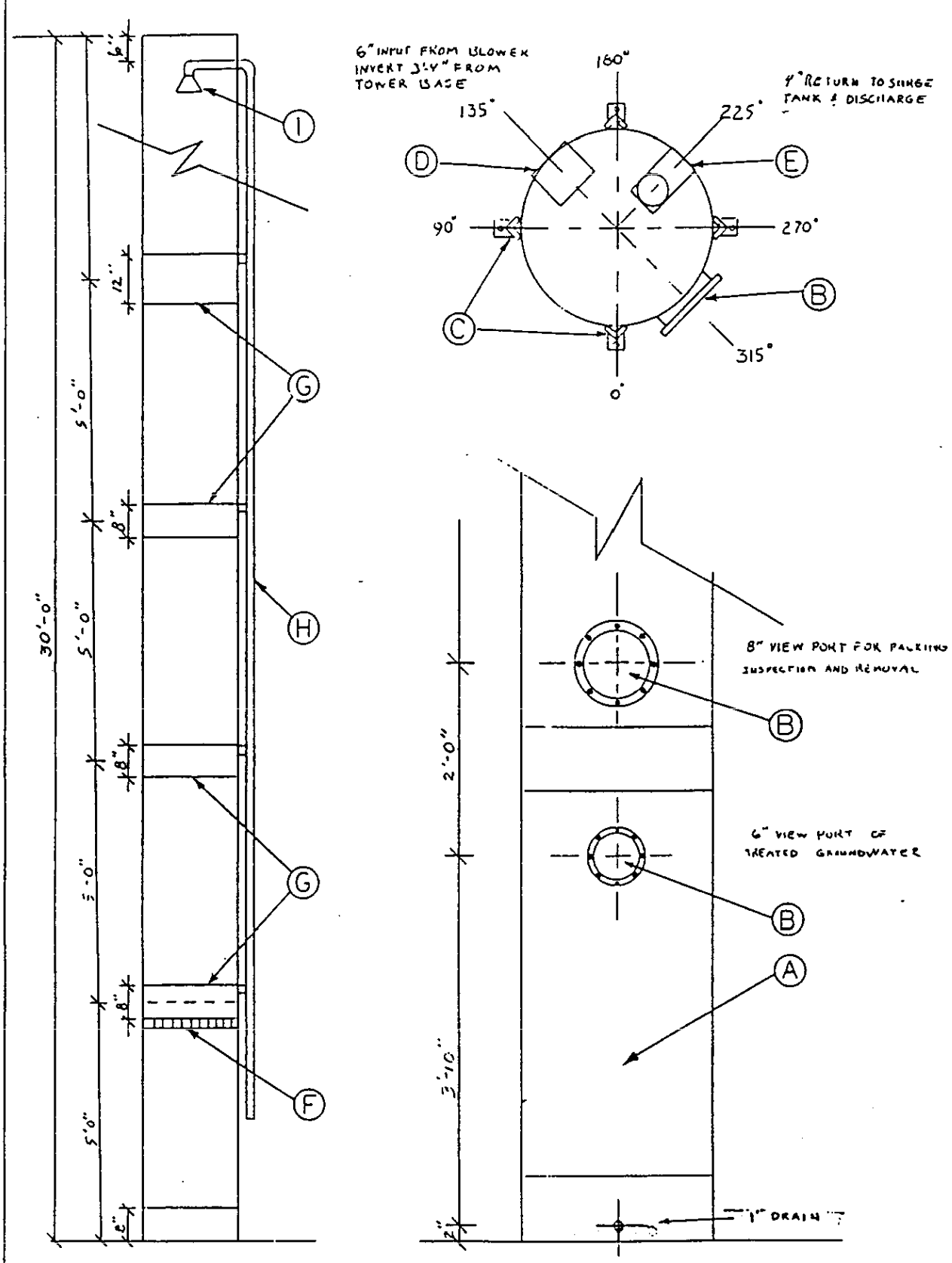


Detention Time = 17 minutes

1 - INFLUENT WATER FROM OIL - WATER SEPARATOR
2 - AERATION STONES 6 EA.
3 - MANWAY
4 - COMPRESSED AIR MANIFOLD AND VALVING
5 - AIR LINES TO AERATION STONES
6 - VENT
7 - AIR LINE TO COMPRESSOR
8 - GRAVITY DISCHARGE POINT
9 - TO TRANSFER PUMP

AERATION - SURGE VESSEL
550 GALLON
ISACOR MODEL NO. 550AT

ISACOR INC.



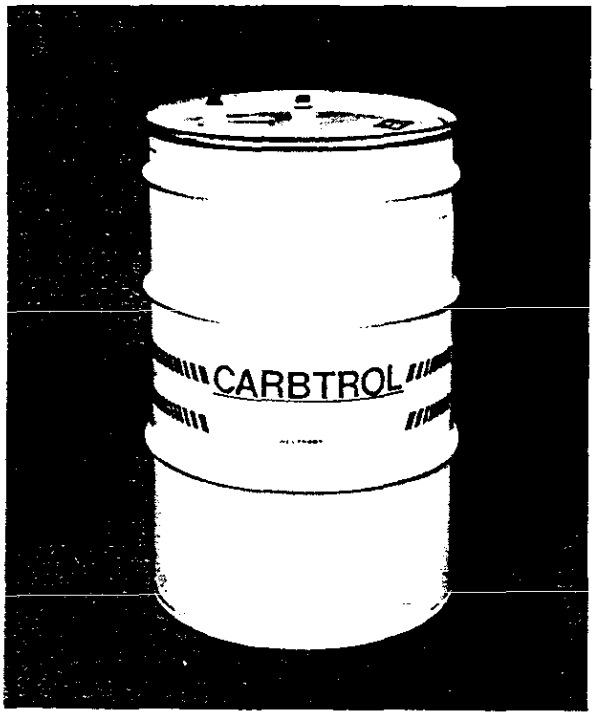
WESTINGHOUSE
GROUNDWATER
RECOVERY

24 INCH DIAMETER
AIR STRIPPING TOWER
MODEL NO. 40-20-25

CARBTROL®

WATER PURIFICATION CANISTER 200 POUND ACTIVATED CARBON

L-1



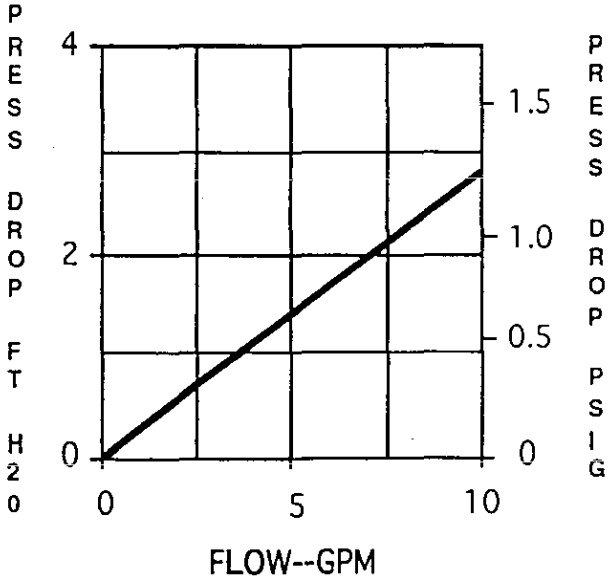
The CARBTROL L-1 (liquid) Canister handles up to 10 gpm.

FEATURES

- 200 pounds of high activity carbon.
- Large 1 1/4" internal piping. Low pressure drop allows operation of three canisters in series.
- Standard FPT couplings for easy installation - saves time and money.
- Special "no leak" lid gasket.
- Heavy duty steel drums, DOT 17C, suitable for shipment of spent hazardous carbon.
- Piping design eliminates channeling.

SPECIFICATIONS

DRUM:	24" Ø x 34" high, mild steel, epoxy phenolic internal coating, with polyethylene liner.
CARBON:	200 lbs.
SHIPPING WEIGHT:	250 lbs.
INLET:	1 1/4" FPT, steel
OUTLET:	1 1/4" FPT, steel
INTERNAL PIPING:	1 1/4" PVC
DRAIN:	3/4" bung
PRESSURE DROP:	1.25 psi @ 10 gpm
MAX. OPERATING PRESSURE:	10 psi



CARBTROL® CORPORATION

51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

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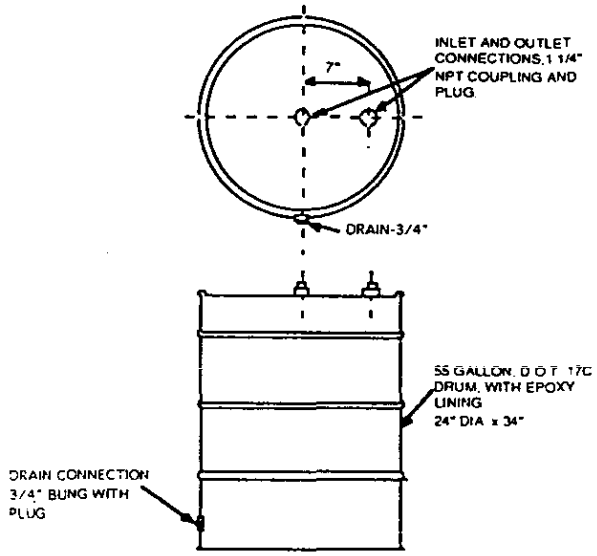
AT-100/#2

CARBTROL®

WATER PURIFICATION CANISTER 200 POUND ACTIVATED CARBON

L-1



OPTIONS

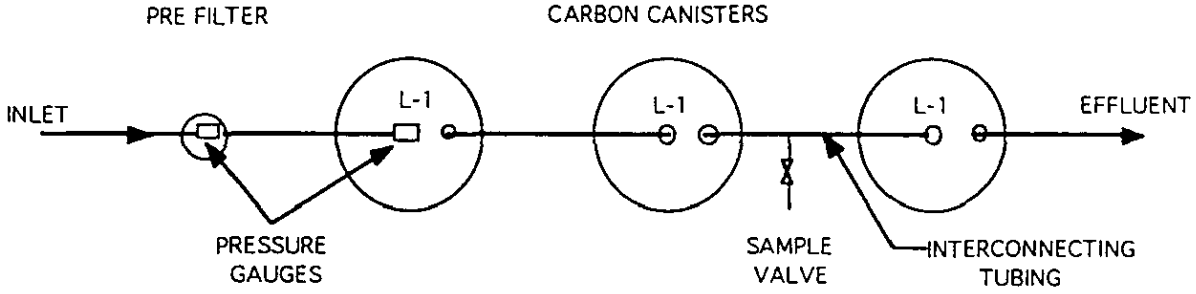
Interconnecting Piping Kit

Flexible 1 1/4" diameter PVC tubing with hose clamps. Includes inlet pressure gauge and intermediate sample valve.

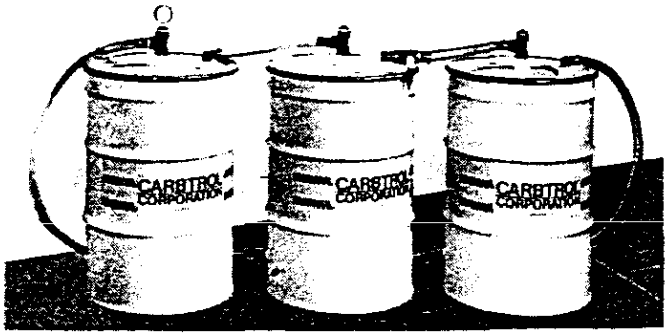
Pre-filter For Suspended Solids Removal

Pre-filter consisting of a basket filter piped and mounted on support frame. Filter is of carbon steel construction.

ARRANGEMENT (3) L-1 Canisters in series for 10 gpm flow (contact time @ 10 gpm - 15 minutes)



TYPICAL INSTALLATION



CARBTROL®
CORPORATION

51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

DOMENICO MODEL

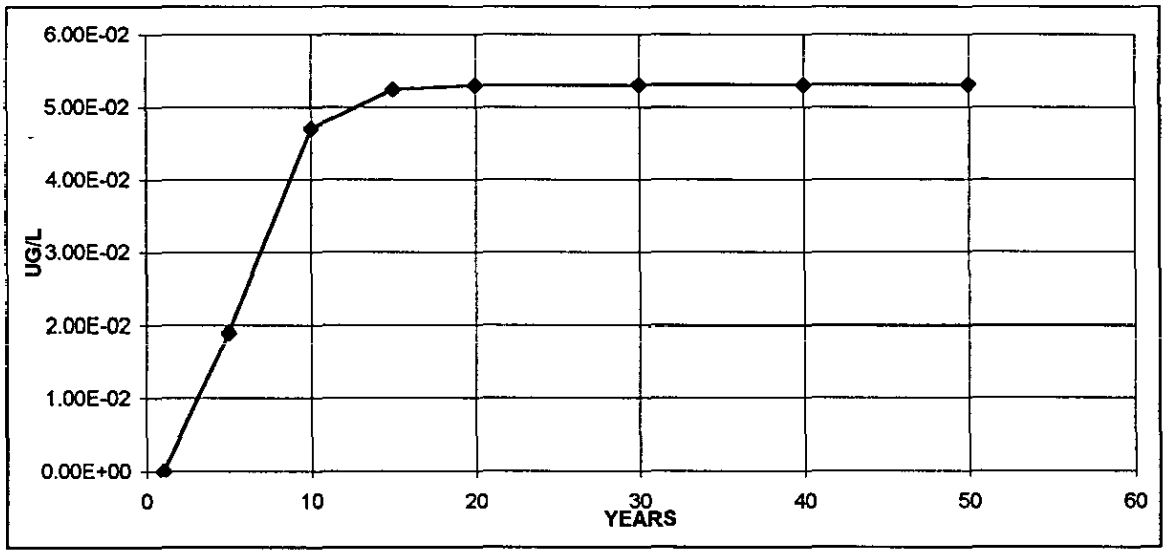
SSTL for Benzene
Hess Charleston - South Terminal
4650 Virginia Avenue
Charleston, South Carolina
GWPD # 14003

Benzene

0.477026	Co	Concentration at Source (mg/l)	477 (ug/l)		
10	Y	Width of Source Perpendicular to Ground Water Flow (m)			
2	Z	Vertical Thickness of Source (m)			
152	X	Distance from Source to Well in x direction (x)		YEARS	UG/L
0	y	y Coordinate of well relative to Source (y,z)		1	3.35E-08
0	z	z Coordinate of well relative to Source (y,z)		5	0.019019
15.2	ax	Longitudinal Dispersivity (x/10)		10	0.047115
5.07	ay	Transverse Dispersivity (ax/3)		15	0.052408
0.76	az	Vertical Dispersivity (ax/20)		20	0.053015
8.8	K	Hydraulic Conductivity (m/day)		30	0.053075
0.0093	I	Gradient (ft/ft)		40	0.053075
0.234	v	Ground Water Flow Velocity (m/day)		50	0.053075
81	Koc	Soil/Water Partitioning Coefficient			
1.63	Bd	Bulk Density (gm/cc)			
0.35	n	Porosity			
0.0061	Fcs	Organic Carbon Content (%)			
3.301094	R	Retardation (-)			
0.070834	Vr	Seepage Velocity (m/day)			
0	I	First Order Decay Rate			
15	t	Time (years)	From graph use 15 years		

		erfc(x)	erfc(-x)
-1.5357	erfc1	1.975	0.025	1.975
0.090086	erf2	0.101		
0.09304	erf3	0.105		

0.005 C(x,y,z,t)



DOMENICO MODEL

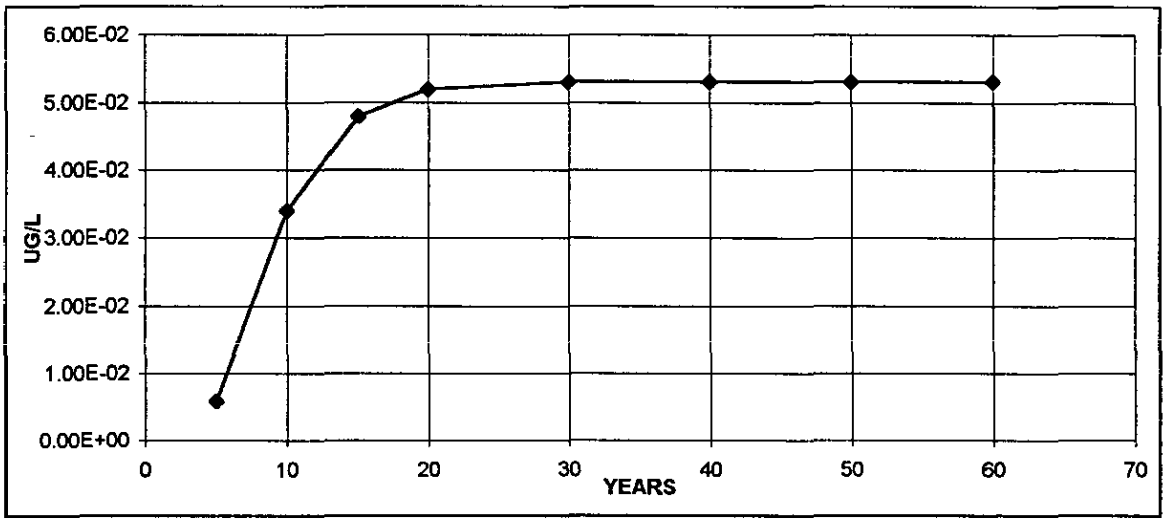
SSTL for Toluene
Hess Charleston - South Terminal
4650 Virginia Avenue
Charleston, South Carolina
GWPD # 14003

Toluene

96.28902	Co	Concentration at Source (mg/l)	96289 (ug/l)		
10	Y	Width of Source Perpendicular to Ground Water Flow (m)			
2	Z	Vertical Thickness of Source (m)			
152	X	Distance from Source to Well in x direction (x)		YEARS	UG/L
0	y	y Coordinate of well relative to Source (y,z)		5	5.95E-03
0	z	z Coordinate of well relative to Source (y,z)		10	0.034029
15.2	ax	Longitudinal Dispersivity (x/10)		15	0.047936
5.07	ay	Transverse Dispersivity (ax/3)		20	0.051927
0.76	az	Vertical Dispersivity (ax/20)		30	0.053033
8.8	K	Hydraulic Conductivity (m/day)		40	0.053074
0.0093	I	Gradient (ft/ft)		50	0.053075
0.234	v	Ground Water Flow Velocity (m/day)		60	0.053075
133	Koc	Soil/Water Partitioning Coefficient			
1.63	Bd	Bulk Density (gm/cc)			
0.35	n	Porosity			
0.0061	Fcs	Organic Carbon Content (%)			
4.77834	R	Retardation (-)			
0.048935	Vr	Seepage Velocity (m/day)			
0	I	First Order Decay Rate			
20	t	Time (years)	From graph use 20 years		

			erfc(x)	erfc(-x)
-1.39255	erfc1	1.957	0.043	1.957
0.090086	erf2	0.101		
0.09304	erf3	0.105		

1 C(x,y,z,t)



DOMENICO MODEL

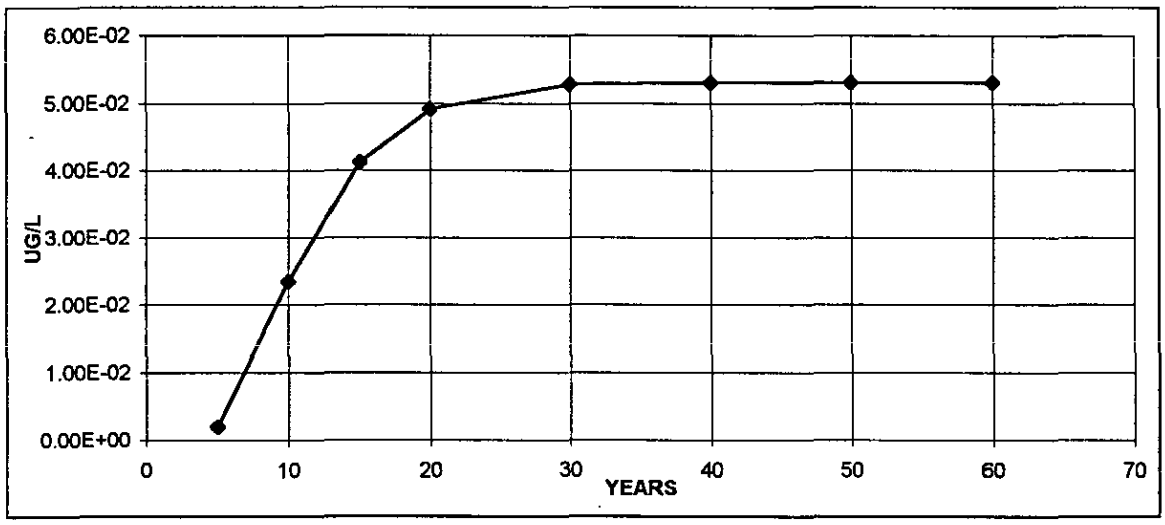
SSTL for Ethyl Benzene
Hess Charleston - South Terminal
4650 Virginia Avenue
Charleston, South Carolina
GWPD # 14003

Ethyl Benzene

66.35506	Co	Concentration at Source (mg/l) 66355 (ug/l)		
10	Y	Width of Source Perpendicular to Ground Water Flow (m)		
2	Z	Vertical Thickness of Source (m)		
152	X	Distance from Source to Well in x direction (x)	YEARS	UG/L
0	y	y Coordinate of well relative to Source (y,z)	5	2.01E-03
0	z	z Coordinate of well relative to Source (y,z)	10	0.023409
15.2	ax	Longitudinal Dispersivity (x/10)	15	0.04129
5.07	ay	Transverse Dispersivity (ax/3)	20	0.049139
0.76	az	Vertical Dispersivity (ax/20)	30	0.052747
8.8	K	Hydraulic Conductivity (m/day)	40	0.053053
0.0093	I	Gradient (ft/ft)	50	0.053074
0.234	v	Ground Water Flow Velocity (m/day)	60	0.053075
176	Koc	Soil/Water Partitioning Coefficient		
1.63	Bd	Bulk Density (gm/cc)		
0.35	n	Porosity		
0.0061	Fcs	Organic Carbon Content (%)		
5.999909	R	Retardation (-)		
0.038972	Vr	Seepage Velocity (m/day)		
0	I	First Order Decay Rate		
30	t	Time (years) From graph use 30 years		

			erfc(x)	erfc(-x)
-1.70566	erfc1	1.988	0.012	1.988
0.090086	erf2	0.101		
0.09304	erf3	0.105		

0.7 C(x,y,z,t)



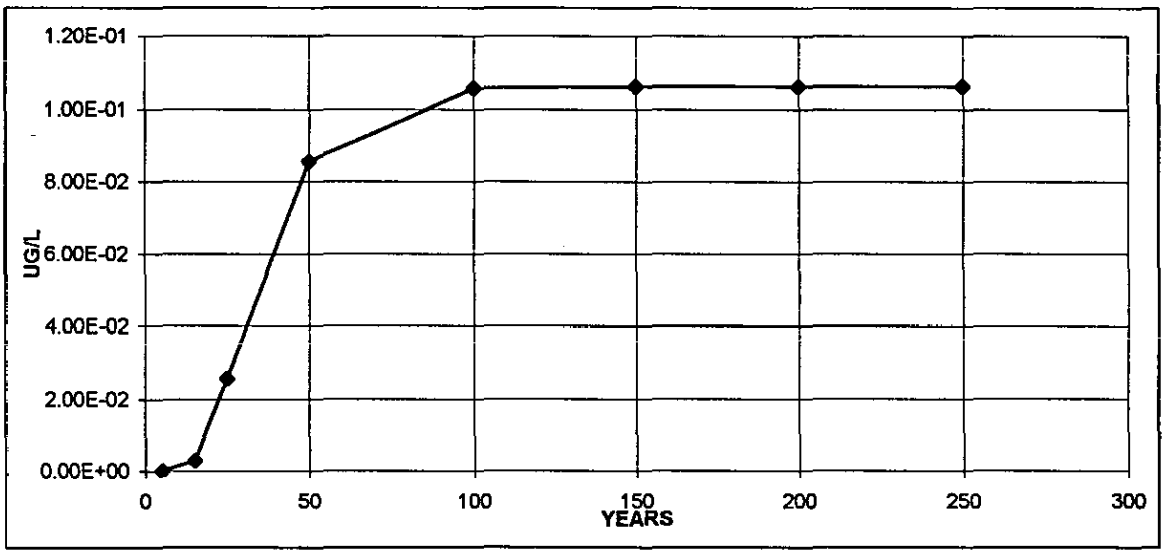
DOMENICO MODEL

SSTL for Xylenes
Hess Charleston - South Terminal
4650 Virginia Avenue
Charleston, South Carolina
GWPD # 14003

Xylenes

946.1928	Co	Concentration at Source (mg/l)	946193 (ug/l)		
10	Y	Width of Source Perpendicular to Ground Water Flow (m)			
2	Z	Vertical Thickness of Source (m)			
152	X	Distance from Source to Well in x direction (x)		YEARS	UG/L
0	y	y Coordinate of well relative to Source (y,z)		5	3.59E-09
0	z	z Coordinate of well relative to Source (y,z)		15	0.00281
15.2	ax	Longitudinal Dispersivity (x/10)		25	0.025679
5.07	ay	Transverse Dispersivity (ax/3)		50	0.085609
0.76	az	Vertical Dispersivity (ax/20)		100	0.105687
8.8	K	Hydraulic Conductivity (m/day)		150	0.106144
0.0093	I	Gradient (ft/ft)		200	0.10615
0.234	v	Ground Water Flow Velocity (m/day)		250	0.106151
639	Koc	Soil/Water Partitioning Coefficient			
1.63	Bd	Bulk Density (gm/cc)			
0.35	n	Porosity			
0.0061	Fcs	Organic Carbon Content (%)			
19.15308	R	Retardation (-)			
0.012208	Vr	Seepage Velocity (m/day)			
0	I	First Order Decay Rate			
100	t	Time (years)	From graph use 100 years		
		erfc(x)	erfc(-x)		
-1.78377	erfc1	1.991	0.009	1.991	
0.090086	erf2	0.101			
0.09304	erf3	0.105			

10 C(x,y,z,t)

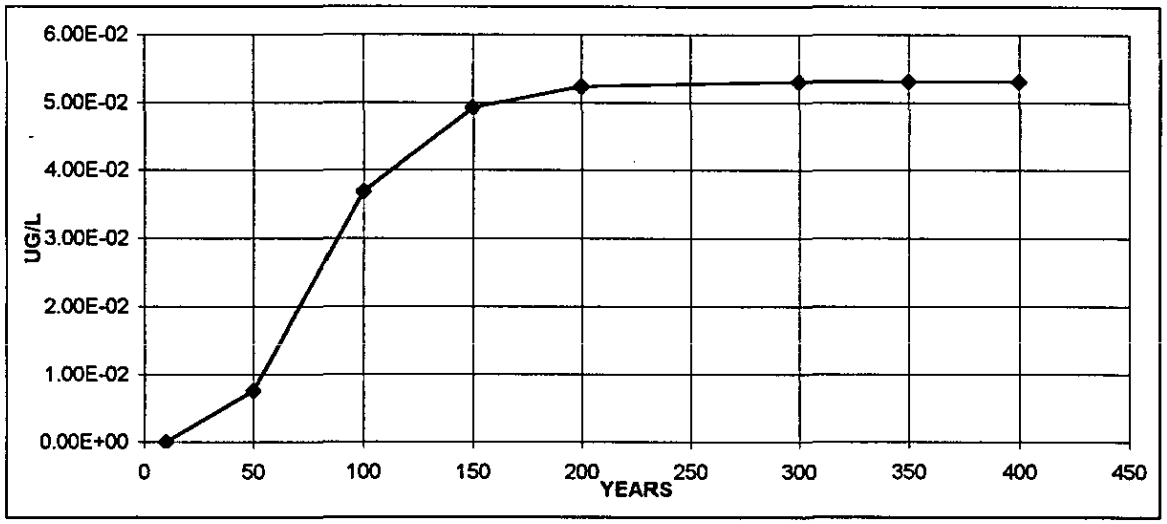


DOMENICO MODEL

SSTL for Naphthalene
Hess Charleston - South Terminal
4650 Virginia Avenue
Charleston, South Carolina
GWPD # 14003

Naphthalene

2.389247	Co	Concentration at Source (mg/l)	2389 (ug/l)	
10	Y	Width of Source Perpendicular to Ground Water Flow (m)		
2	Z	Vertical Thickness of Source (m)		
152	X	Distance from Source to Well in x direction (x)	YEARS	UG/L
0	y	y Coordinate of well relative to Source (y,z)	10	4.75E-11
0	z	z Coordinate of well relative to Source (y,z)	50	0.007614
15.2	ax	Longitudinal Dispersivity (x/10)	100	0.036797
5.07	ay	Transverse Dispersivity (ax/3)	150	0.049205
0.76	az	Vertical Dispersivity (ax/20)	200	0.052318
8.8	K	Hydraulic Conductivity (m/day)	300	0.053054
0.0093	I	Gradient (ft/ft)	350	0.053072
0.234	v	Ground Water Flow Velocity (m/day)	400	0.053075
1543	Koc	Soil/Water Partitioning Coefficient		
1.63	Bd	Bulk Density (gm/cc)		
0.35	n	Porosity		
0.0061	Fcs	Organic Carbon Content (%)		
44.83443	R	Retardation (-)		
0.005215	Vr	Seepage Velocity (m/day)		
0	l	First Order Decay Rate		
200	t	Time (years)	From graph use 200 years	

			erfc(x)	erfc(-x)
-1.50333	erfc1	1.971	0.029	1.971
0.090086	erf2	0.101		
0.09304	erf3	0.105		

0.025 C(x,y,z,t)