



Updated

WINTHROP/MASSACHUSETTS

In December 2001, GBI began injecting butane and air into groundwater to remediate petroleum contamination at a gasoline service station located in Winthrop, Massachusetts. The source of the contamination was a release resulting from a 1998 leak in a product line associated with a UST. Gasoline vapors were detected in an adjacent building. Product was removed via an ORS product recovery well and stored in a product recovery tank. Approximately 500 yards of contaminated soil were excavated and removed from the site. A soil vapor extraction system (SVES) was installed by another consultant and operated for 18 months before being shut down in early 2001 due to the high cost of monthly carbon canister replacement for off-gas treatment as well as the system's inability to treat contaminated groundwater.

The area of environmental concern was limited to the gas station and an adjoining downgradient property, with a total area covering approximately 2400 ft². The depth to groundwater at the Site is approximately seven to eight feet below the ground surface. The Site is paved and underlain by silty sand with some gravel and clay. Groundwater flow direction is southwesterly across the property toward a surface water body and wetlands, approximately 300 feet away. The subject Site and adjacent properties are zoned as a commercial area and are not situated within a Current Drinking Water Source Area. The area is serviced by the MWRA and the groundwater is classified as GW-2 and GW-3.

In November 2001, GBI installed seven *Butane Biosparging*TM injection wells to cut off plume migration to the downgradient property under a DEP approved Immediate Response Action Plan Modification. The SVES system previously installed at the Site was converted to a *Butane Bioventing*TM recirculating system for in-situ treatment of soil vapor without carbon treatment for off-gas and was operated concurrently with the *Butane Biosparging*TM groundwater treatment system. The *Butane Bioventing*TM System was also used to control potential migration of VOCs from the treatment area into adjacent buildings and to enhance microbial degradation of petroleum compounds at the capillary fringe and in the vadose zone. After remediating the downgradient source area (target of remedial effort), the *Butane Biosparging*TM and *Butane Bioventing*TM systems were shut down in November 2003. The downgradient property has been developed as a Dunkin Donuts. The remedial effort is continuing at the upgradient property at two monitoring wells using portable butane/air injection technology. Only the monitoring wells with exceedances (VW-2, VW-3, and GP-3) were sampled during 2005. All other monitoring wells have remained below the cleanup standards during several consecutive sampling events. After collection, the collected groundwater samples were transported to either GeoLabs located in Braintree, Massachusetts, or Alpha Laboratories located in Westborough, Massachusetts, using standard chain of custody protocols. The samples were analyzed for VPH. The results are summarized in Table 1.

BUTANE BIOSTIMULATION TECHNOLOGIESTM

Site Photos



Table 1 Summary of Groundwater Quality Data Atlantic Trust 30 Main Street Winthrop, Massachusetts 02152			System Startup 12/12/01 System shutdown 11/10/03 GW treatment continuing at wells GP-3 and VW-2 using portable butane/air injection							
Sample Location	Sample Date	Benzene	Ethylbenzene	MTBE	Naphthalene	Toluene	Xylenes	C5 - C8 Aliphatics	C9 - C12 Aliphatics	C9 - C10 Aromatics
GBI-1	6/8/2001	<5	<5	10.1	<20	<5	<5	<40	<15	<55
	10/17/2001	<5	<5	<5	<5	<5	<5	<10	<10	<10
	1/24/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	4/24/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	7/31/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	10/31/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	3/13/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/31/2003	<5	<5	<5	<5	<5	<5	<40	<15	<55
	10/31/2003	<5	<5	<5	<20	<5	<5	<40	<15	<55
	3/3/2004	<5	<5	<5	<10	<5	<5	<50	<50	<50
	5/11/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55
7/23/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55	
10/7/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55	
GBI-2	6/8/2001	<5	<5	<5	<20	<5	<5	<40	<15	<55
	10/17/2001	<5	<5	<5	<5	<5	<5	<10	<10	<10
	1/24/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	4/24/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	7/31/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	10/31/2002	<5	<5	<5	<20	<5	<5	<40	<15	<55
	3/13/2003	<5	<5	<5	<20	<5	<5	<40	<15	<55
	7/31/2003	<5	<5	<5	<5	<5	<5	45	<15	<55
	10/31/2003	<5	<5	<5	<20	<5	<5	<40	<15	<55
	3/3/2004	<5	<5	<5	<10	<5	<5	<50	<50	<50
	5/11/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55
7/23/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55	
10/7/2004	<5	<5	<5	<20	<5	<5	<40	<15	<55	
GBI-3*	6/8/2001	<5	<5	196	<20	<5	<5	<40	<15	<55
	10/17/2001	<5	<5	41	<5	<5	<5	<10	<10	<10
	1/24/2002	<5	<5	497	<20	<5	<5	<40	<15	<55
	4/24/2002	<25	<25	1,530	<100	<25	<25	<200	<75	<275
	7/31/2002	<5	<5	6,970	<20	<5	<5	<400	15.4	<55
	10/31/2002	14	<5	711	<20	<5	<5	229	35.3	<55
	3/13/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/31/2003	<25	<25	759	<100	<25	<25	<200	<75	<275
	10/31/2003	<5	<5	<5	<20	<5	<5	<40	<15	101
	3/3/2004	<10	<10	580	<20	<10	<10	<100	<100	<100
	5/11/2004	<5	<5	364	<20	<5	<5	<40	<15	<55
7/23/2004	<50	<50	1,320	<200	<50	<50	1,090	<150	<550	
10/7/2004	<5	<5	2,900	<5	<5	<5	<400	17.2	<55	
GW-2 STANDARD		2,000	30,000	50,000	6,000	6,000	6,000	1,000	1,000	5,000
GW-3 STANDARD		7,000	4,000	50,000	6,000	50,000	50,000	4,000	20,000	4,000

**Table 1 (Cont.)
Summary of Groundwater Quality Data
Atlantic Trust
30 Main Street
Winthrop, Massachusetts 02152**

Sample Location	Sample Date	Benzene	Ethylbenzene	MTBE	Naphthalene	Toluene	Xylenes	C5 - C8 Aliphatics	C9 - C12 Aliphatics	C9 - C10 Aromatics
GBI-4*	6/8/2001	<50	<50	289	<200	<50	122	1,460	1,140	<550
	10/17/2001	<5	<5	200	<5	<5	<5	220	19	160
	1/24/2002	26.8	<5	923	24.9	5.7	14.4	<40	81.6	301
	4/24/2002	<50	<50	922	<200	<50	62.6	908	<150	<550
	7/31/2002	32	28.7	2,510	<20	58	48.7	<400	33.6	352
	10/31/2002	22	20.6	592	<20	22	15.0	515	577	487
	3/13/2003	36	12	977	<40	<10	<10	<80	<30	607
	7/31/2003	<25	<25	717	<100	<25	<25	<200	<75	726
	10/31/2003	<5	<5	460	<20	<5	<5	<200	<75	726
	3/3/2004	<10	<10	630	<20	<10	<10	<100	<100	140
	5/11/2004	<5	<5	431	<20	<5	<5	<40	<15	98.2
7/23/2004	21.5	<5	383	<20	<5	<5	132	42.3	<55	
10/7/2004	<5	<5	160	<20	<5	<5	558	<15	269	
VW-1*	6/8/2001	<100	<100	15,700	<400	120	2,404	22,600	27,800	2,440
	10/17/2001	<300	<300	16,000	<300	<300	<300	<500	930	<500
	1/24/2002	717	<5	10,600	<20	14.8	145	<800	<15	155
	4/24/2002	<25	<25	5,254	<100	<25	<25	<200	<75	<275
	7/31/2002	5.2	5.4	103	27.7	<5	40.9	<40	<15	303
	10/31/2002	189	32.4	9,040	37.2	10.4	145	<400	372	386
	3/13/2003	<10	<10	680	<40	25	171	<80	<30	397
	7/31/2003	14.0	6.5	906	<20	<5	11	<40	<15	97
	10/31/2003	254	417	2,290	<1,000	1,330	2,850	3,150	<15	3,720
	3/3/2004	<100	<100	7,100	<200	210	330	<1,000**	<1,000**	<1,000**
	5/11/2004	9.3	98	799	137	322	2,872	<400	<150	3,930
7/23/2004	<100	<100	2,860	<400	<100	<100	1,210	<300	<1,100	
10/7/2004	<5	<5	4,510	<20	6.80	<5	1,480	<15	<55	
VW-2*	6/8/2001	<500	1,510	109,000	<2,000	504	4,090	37,600	46,900	<5,500
	10/17/2001	400	<300	24,000	<300	<300	580	620	2,400	960
	1/24/2002	1,472	292	41,900	337	713	3,240	<2,000	<750	3,680
	4/24/2002	216	<100	35,200	<400	675	1,500	<800	<300	3,690
	7/31/2002	551	271	13,100	435	44.3	1,331	<2,000	1,500	4,710
	10/31/2002	364	107	10,100	435	39.8	39	<400	899	816
	3/13/2003	1,160	<500	48,200	<2,000**	2,420	3,740	<4,000**	<1,500**	6,290
	7/31/2003	472	112	4,410	<100	<25	177	<200	<75	318
	10/31/2003	2,020	21.0	870	<20	1,930	111.7	<400	<15	376
	3/3/2004	840	<100	150,000	<200	2,000	3,600	<1,000**	<1,000**	2,800
	5/11/2004	13.2	<5	1,310	<20	8.3	53.9	<400	<15	242
	7/23/2004	<500	<500	23,600	<2,000	<500	<500	4,400	<1,500	<5,500**
	10/7/2004	10.4	6.60	11,400	80.8	7.40	14.1	<4,000	<15	243
	2/23/2005	290.0	24.10	19,700	<20	90.4	84.3	<40	<15	163
7/22/2005	<100	<100	4,740	<500	<100	<100	<2,500**	<2,500**	<2,500**	
11/17/2005	<400	<400	28,000	<2,000	<400	<400	<10,000**	<10,000**	<10,000**	
GW-2 STANDARD		2,000	30,000	50,000	6,000	6,000	6,000	1,000	1,000	5,000
GW-3 STANDARD		7,000	4,000	50,000	6,000	50,000	50,000	4,000	20,000	4,000

Table 1 (Cont.)
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Sample Location	Sample Date	Benzene	Ethylbenzene	MTBE	Naphthalene	Toluene	Xylenes	C5 - C8 Aliphatics	C9 - C12 Aliphatics	C9 - C10 Aromatics
VW-3*	6/8/2001	2,170	3,130	12,700	<5,000	34,600	18,110	<10,000	12,200	<13,750
	10/17/2001	130	300	72	130	3,200	1,590	4,800	310	1,900
	1/24/2002	527	820	770	271	11,400	4,760	<2,000	<750	3,610
	4/24/2002	<50	771	587	<200	182	753	<400	<150	3,220
	7/31/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/31/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/13/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/31/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/31/2003	<5	<5	73	<20	5	235	<40	<15	185
	3/3/2004	<25	310	85	51	480	2,100	930	700	1,800
	5/11/2004	<5	190	15.1	43.8	41.9	1,246	72	<15	1,060
	7/23/2004	<5	54.1	51.9	<20	37.9	873	143	<15	333
	10/7/2004	15.6	1,340	41.1	372	4,180	17,360	<4,000	<1,500	6,650
2/23/2005	5.40	417	352	135	318	5,940	695	763	2,720	
7/22/2005	<200	1,540	<300	<1,000	1,240	15,640	<5,000	12,600	7,870	
11/17/2005	<20	22.2	<30	<100	78.2	1,356	<500	556	1,160	
VW-4	6/8/2001	247	1,540	2,500	517	799	10,250	6,610	<375	5,260
	10/17/2001	360	1,600	7,100	340	440	9,600	1,700	3,600	10,000
	1/24/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4/24/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/31/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/31/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/13/2003	<10	10	964	<40	<10	80	<80	<30	163
	7/31/2003	<5	11	16	<20	<5	<5	121	<15	<55
	10/31/2003	<5	<5	215	<20	<5	79.3	<40	<15	130
	3/3/2004	NS	NS	NS	NS	NS	NS	NS	NS	NS
	5/11/2004	21.7	258	150	72	16.2	845	<40	<15	1,150
7/23/2004	44.8	251	202	76.3	22.2	612	347	<15	1,040	
10/7/2004	27.0	215	22.9	85.0	41.7	799	385	<15	1,310	
VW-6	6/8/2001	942	1,260	7,800	332	85.8	3,740	18,500	8,470	3,800
	10/17/2001	690	1,500	4,500	160	110	3,250	1,900	1,900	6,300
	1/24/2002	126	1,810	8,700	283	467	3,070	<400	<150	3,810
	4/24/2002	1,250	1,930	10,600	<1,000	<250	4,068	<2,000	<750	9,030
	7/31/2002	513	799	5,170	418	116	1,073	<2,000	888	3,740
	10/31/2002	280	424	4,360	160	43	1,012	<400	3,280	1,930
	3/13/2003	203	406	1,770	87	86.2	1,461	<40	<15	2,060
	7/31/2003	314	357	2,300	<100	<25	123	<40	<15	1,060
	10/31/2003	120	185	518	<20	8.7	156.4	<40	<15	659
	3/3/2004	130	63	450	<20	<10	22	130	110	520
	5/11/2004	164	269	335	47.7	31	402	<40	<15	1,470
	7/23/2004	309	25.6	177	<20	<5	21	417	<15	428
	10/7/2004	1,435	169	70.0	70.6	13.0	228	<40	<15	1,100
GW-2 STANDARD		2,000	30,000	50,000	6,000	6,000	6,000	1,000	1,000	5,000
GW-3 STANDARD		7,000	4,000	50,000	6,000	50,000	50,000	4,000	20,000	4,000

**Table 1 (Cont.)
Summary of Groundwater Quality Data
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Sample Location	Sample Date	Benzene	Ethylbenzene	MTBE	Naphthalene	Toluene	Xylenes	C5 - C8 Aliphatics	C9 - C12 Aliphatics	C9 - C10 Aromatics
VW-7	6/8/2001	<5	<5	6.13	<20	<5	<5	<40	<15	<55
	10/17/2001	<5	<5	<5	<5	<5	<5	13	<10	<10
	1/24/2002	38.2	<5	11.5	<20	<5	10	<40	<15	<55
	4/24/2002	<5	<5	56.4	<20	<5	<5	<40	<15	<55
	7/31/2002	<5	<5	385	<20	<5	<5	<40	39.4	<55
	10/31/2002	<5	<5	385	<20	<5	<5	<40	<15	<55
	3/13/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
	7/31/2003	<25	<25	700	<100	<25	<25	<200	<75	<275
	10/31/2003	<5	<5	269	<20	<5	<5	<40	<15	<55
	3/3/2004	<5	<5	<5	<10	<5	<5	<50	<50	<50
	5/11/2004	<5	<5	58	<20	<5	<5	<40	<15	<55
7/23/2004	307	<5	<5	<20	<5	<5	<40	371	<55	
10/7/2004	<5	<5	240	<20	<5	<5	65	<15	<55	
GP-3*	6/8/2001	1,380	689	140,000	473	9,740	17,520	<400	<150	6,770
	10/17/2001	<500	<500	74,000	<500	<500	1,500	<1,000	3,500	3,400
	1/24/2002	4,320	1,000	83,300	947	16,900	22,700	<4,000	<1,500	9,440
	4/24/2002	3,950	1,610	210,000	<2,000	16,600	24,750	<8,000	<1,500	19,600
	7/31/2002	740	958	41,400	<2,000	243	16,920	<4,000	<1,500	14,500
	10/31/2002	9	5	27,000	<20	16	54	<2,000	12,700	4,470
	3/13/2003	3,800	<2,500**	196,000	<10,000**	16,900	12,350	<20,000**	<7,500**	<27,500**
	7/31/2003	584	444	11,400	446	145	4,100	521	<150	6,270
	10/31/2003	<5,000**	<5,000**	128,000	<20,000**	8,700	<5,000**	40,300	<15,000**	<55,000**
	3/3/2004	<1,500**	<1,500**	91,000	<3,000**	2,000	5,000	<15,000**	<15,000**	<15,000**
	5/11/2004	1,390	717	15,700	385	3,700	6,490	9,210	<1,500	7,090
	7/23/2004	5,720	1,200	138,000	<4,000**	1,800	12,020	10,480	7,380	<11,000**
	10/7/2004	1,260	1,100	34,300	511	54.3	2,701	<4,000	<1,500	7,590
	3/14/2005	<2,000	<2,000	110,000	<10,000	2,270	<2,000	<50,000	<50,000	<50,000
7/22/2005	738	<400	20,100	<2,000	<400	913	<10,000**	10,800	<10,000**	
11/17/2005	<400	<400	37,100	<2,000	<400	664	<10,000**	<10,000**	<10,000**	
GW-2 STANDARD		2,000	30,000	50,000	6,000	6,000	6,000	1,000	1,000	5,000
GW-3 STANDARD		7,000	4,000	50,000	6,000	50,000	50,000	4,000	20,000	4,000

NOTES: All concentrations expressed in µg/l (ppb).
 Bold values exceed GW-2 and/or GW-3 Standards.
 VW-4 was dry on 1/24/02, 4/24/02, 7/31/02, 10/31/02 and 3/3/04
 VW-3 was dry on 7/31/02, 10/31/02, 3/13/03 and 7/31/03
 Well* = Classified as GW-3
 Detection limits** altered due to increased MTBE level.
 NS = Not sampled.

Dark yellow shading represents background concentrations.

REFERENCES

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