



Agenda Item Summary Sheet

Item No.

4

Meeting Date:

8/1/05

Item Title: Bowsertown Landfill Reconstruction Project

Item Summary:

Update by Manteo Rotary Club member, Tim Shearin on the recent screening assessment of chemical contaminants at the landfill site as well as speak on the possible future uses of this site.

(Use additional Paper if necessary)

Number of Attachments: _____

Will your presentation require audiovisual equipment? Yes No

Note. All audiovisual materials must be submitted in digital format to the Clerk of the Dare County Board of Commissioners with this sheet. Acceptable formats include: VHS, DVD, audio CD, Word document, Adobe Acrobat PDF files, PowerPoint files and jpeg files.

Specific Action Requested:

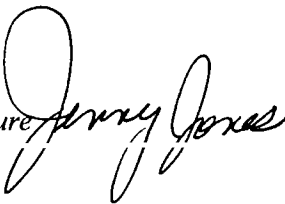
Mr. Shearin will speak about potential uses of this site as well as seek the advice of the commissioners as how The Manteo Rotary Club should proceed with public input regarding potential uses.

Submitted By: Jenny Jones, Adminsitrator Oregon Inlet & Waterways Com.

Date: 7/22/05

Dept. Head

Comments:

Signature 

Date: 7/22/05

Finance

Comments:

Signature

Date:

County Attorney

Comments:

Signature

Date:

County Manager

Approval:

Signature 

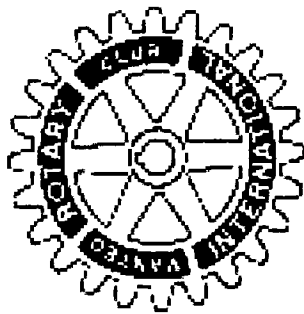
Date: 7/25/05

Commission Action:

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in

BOWSERTOWN LANDFILL RECONSTRUCTION PROJECT

Manteo Rotary Club
Centennial Project



In Partnership with:

- Dare County
- UNC Coastal Studies Institute
- CMAST
- NC Division of Water Resources



DRAFT FINAL REPORT

30 June 2005

**SCREENING ASSESSMENT OF CHEMICAL CONTAMINANTS AT THE
BOWSERTOWN LANDFILL, MANTEO, NC**

To

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and

**Dare County
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by

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Background

Dare County, NC would like to investigate the possibility of reclaiming and improving the Bowsertown Landfill Site in Manteo, NC for other public use. Prior to any formal action to reclaim this property, Dare County requested that a screening assessment for chemical contaminants be conducted to provide an initial assessment of the types and amounts of chemicals that might be present at or near the landfill.

Objectives and Scope

Discussions with interested parties led to a request for a chemical screening assessment in water and sediment surrounding the landfill. Chemical contamination at landfills typically is not distributed evenly across the site because significant chemical sources usually originate from the disposal of specific storage or waste containers. Therefore, random sampling of the landfill soils themselves could easily miss any possible chemicals. Instead, it was decided to assess the long term, chronic release of chemicals (through leaching and erosion) to the water and sediment that surrounds the landfill. The landfill is surrounded by water on three sides (Figure 1), though the north side of the site has only an intermittent stream/channel. The scope of work included sampling water and sediment, and deploying passive sampling devices in water surrounding the site and measuring a broad suite of chemicals in these samples. These data are intended to provide Dare County with an initial assessment of whether or not the site is obviously contaminated with significant quantities of chemicals.

Methods

Water, sediment, and passive sampling devices (PSDs) were collected from the waters surrounding the landfill (Figure 1). Sites 1-3 were along the channel on the south side of the landfill. Site 1 was near the boat ramp; Sites 2 and 3 were approximately one-third and two-thirds of the distance toward the open bay waters toward the west side of the landfill. Sites 4 and 5 were located on the western, bay-side of the landfill, approximately equidistant from the two channels surrounding the landfill. Sites 6-8 were on the stream/channel on the northern side of

the landfill. Sites 7 and 8 were nearly dry when the passive sampling devices were collected, so only water and sediment data are available for those two sites.

Sample collection methods followed standard procedures. Water samples were collected in 1-L amber glass jars (for semi-volatile organics), 40-mL VOC vials (for volatile organic chemicals), or Teflon[®] bottles (for metals). Samples were placed on ice, transported to the laboratory, held at 4° C, and extracted within 24 hours of collection. Sediment samples were collected in the shallow waters by hand using a scoop. Sediment was scooped into a glass jar, placed on ice, transported to the laboratory, held at -20° C, and extracted within 30 days of collection. PSDs were placed in protective cages tethered to a line, submerged in the water, and retrieved ~30 days later. PSDs were placed in aluminum foil, placed on ice, transported to the laboratory, held at -20° C, and extracted within 30 days of collection. All materials that came in contact with water, sediment, or PSD samples were cleaned with solvents/acids or by baking at 400° C.

Samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) by gas chromatography mass spectrometry (GC-MS) using a modification of EPA Method 8270, volatile organic chemicals by GC-MS using EPA Method 8260, chlorinated pesticides and polychlorinated biphenyls (PCBs) by GC with dual-column electron capture detection (GC-ECD) using a combined EPA Method 8081/8082, and metals by inductively coupled plasma mass spectrometry (ICP-MS) using EPA Method 6020. Current-use pesticides were measured by GC-MS using a method similar to EPA Method 8270 that was developed by the Analytical Toxicology Laboratory at NCSU. Finally, water extracts were also analyzed by full-scan GC-MS to obtain spectra that can be matched with a computer library of spectra for over 100,000 organic chemicals (many synthetic and industrial chemicals). The intent was to determine whether any of these >100,000 chemicals were detectable in the water. The detection limits of this full-scan method is approximately 100-1000 times higher (that is, less sensitive) than the methods used above, but the full-scan method allows for the identification of many more chemicals. The methods discussed above target a specific list of chemicals of possible concern and allow both identification and quantification (how much) of the chemicals.

Results and Discussion

Water Analyses

Concentrations of chemicals in water samples are listed in Tables 1-5 (at the end of the report).

The only PCBs detected were PCBs 101 and 153 (Table 1). Concentrations of all PCBs were below 1 ng/L. These are very low concentrations, on the order expected in relatively pristine and uncontaminated waters, and indicate there is probably no significant human or ecological health hazard in these waters associated with PCBs. The listed concentration of total PCBs is well below the EPA chronic Water Quality Criteria (WQC) for the protection of aquatic life in salt water (30 ng/L), slightly below the NC aquatic life water quality standard for saltwater (1 ng/L), slightly below the EPA 10^{-5} cancer risk WQC for human health (0.64 ng/L), and above the NC water quality standard for human health (0.079 ng/L). The closeness of the measured PCB to the human health WQC should not be cause for alarm because the methodology used by EPA to establish this WQC (and the NC standard is based on the EPA criteria) has been widely criticized and is rarely used for regulation. The PCB concentrations measured here are similar to those measured throughout the coastal waters of NC and thus the landfill is probably not a significant contributor to the measured PCB concentrations.

The only chlorinated pesticides detected in the water were heptachlor and the chlordanes (alpha, gamma, and trans-nonachlor) and all were below 1 ng/L (Table 1). These are very low concentrations, approximately 10 times below the NC aquatic life water quality standard for saltwater (4 ng/L) and slightly above NC water quality standards for human health (0.214 ng/L for heptachlor and 0.588 ng/L for chlordanes). These human health criteria/standards have received the same criticism as the PCB criteria. The measured concentrations of heptachlor and chlordanes are similar to those reported in many waters adjacent to land and are even below the concentrations that often result from blank contamination in the laboratory. It is quite possible that the measured concentrations of chlordanes and heptachlor are a result of contamination.

No volatile organic chemicals were detected in any of the water samples (Table 2).

Several of the lower molecular weight PAHs were detected in water samples, but no higher molecular weight PAHs were detected. Note that the molecular weight of the PAH generally increases as one goes down the list of PAH in Table 3. More specifically, the naphthalenes were detected along with small amounts of phenanthrene. This is indicative of petroleum and with the highest concentrations being in the channel used for boats (Sites 1-3), the source of these PAHs is likely dominated by boat traffic. All of the PAH concentrations listed are below the EPA WQC. The NC water quality standard for human health is based on the sum of the 16 EPA Priority Pollutant PAH (PP-PAH): naphthalene and phenanthrene were the only PP-PAH detected and their sum is below the NC standard (31.1 ng/L).

No current-use pesticides were detected in any water samples (Table 4), excepting the chlordanes discussed above.

All of the metals were detected in all samples, except cadmium which was only detected at Sites 1 and 2. We used a particularly sensitive method to measure the metals and all concentrations measured are well below both EPA WQC and NC standards.

The full-scan GC-MS analysis identified very few additional chemicals from the library search of over 100,000 chemicals. In addition to identifying some of those chemicals already identified above, phthalates and nonylphenol were detected in all water samples. These chemicals are used in plastics and are commonly detected in the environment and often even just in laboratory blank samples (contamination of laboratory plastic ware). Although this full-scan method is not quantitative, there was no apparent pattern to the magnitude of instrument response (which is related to the amount present) and all samples seemed to have about the same amount of these chemicals and similar to that often found in uncontaminated waters. Therefore, the landfill does not appear to be a dominant source of these chemicals and they may simply be a result of laboratory contamination. Water samples from Sites 1 and 2 also had detections of N,N-diethyl-m-toluamide (the insect repellent DEET), acetaminophen (Tylenol), and mesalamine (a drug

used to treat colitis) DEET is often found in waters where people in or on the water use DEET; the person sampling was not using DEET. The other two chemicals have been found in waters that receive municipal or septic or hospital wastes, acetaminophen is particularly common. It is not clear what the source of these two chemicals would be in the boat channel and it is possible that some other chemical(s) of similar structure was interfering with the analysis. The library match of the mass spectra was very good, but uncertainty in this identification still exists. There were no other chemicals identified that are not commonly found in natural waters. For example, many plant sterols were detected but they are naturally occurring

Passive Sampling Device (PSD) Analyses

The PSDs are made of an inert polymer and they passively accumulate persistent hydrophobic chemicals such as PCBs, chlorinated pesticides, and PAHs from water. PSDs can provide an indication of what chemicals are present in the water below the detection limit of standard water analysis and what chemicals could potentially accumulate in the food chain. There are no state or Federal guidelines associated with chemical residues in PSDs. Using calibration data that we have previously published, we can convert measured residues in the PSDs to estimated average concentrations of the chemicals in the water over the period of time that the PSDs were deployed (~30 days). These estimated concentrations of chemicals in water are listed in Tables 6 and 7 and they are similar to those measured directly in the water. This provides some confirmation that the values we reported in Tables 1 and 3 using more standard methods (grabbing a water sample, extracting it, and analyzing it) are probably representative of chronic longer term exposure in these waters. Note that a few chemicals not detected by the standard methods (Tables 1 and 3) were detected by the PSDs, such as a few of the PCBs and a DDT degradation product (4,4'-DDL). This is likely a result of better detection limits using the PSDs and these very low estimated concentrations in water confirm the statement above that concentrations of PCBs, chlorinated pesticides, and PAHs are very low in the waters surrounding the landfill.

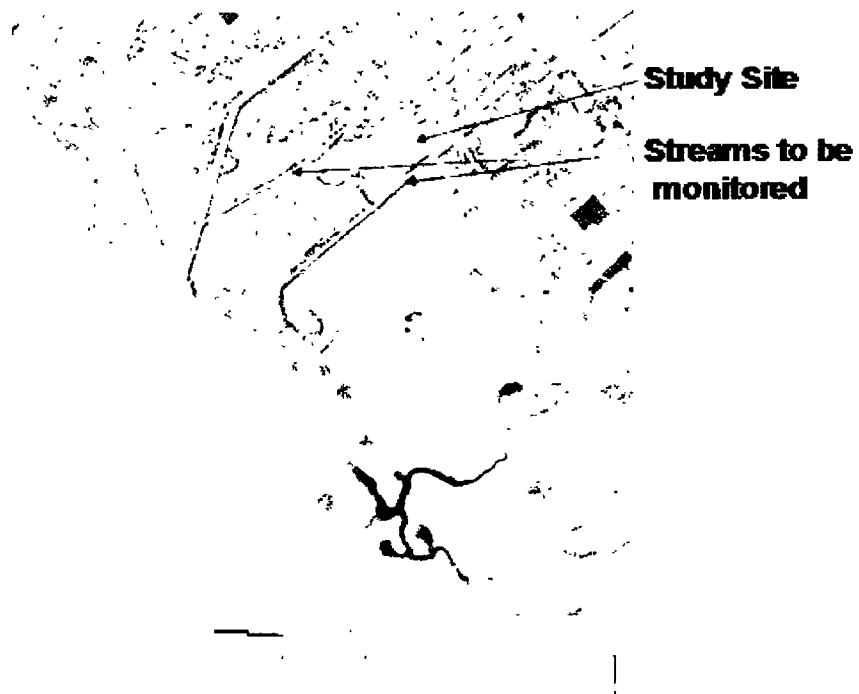
Sediment Analyses

Sediments often serve as a sink and the ultimate repository for persistent chemicals that enter water and thus they provide a complementary means of assessing chronic input of chemicals to a system. Trace levels of PCBs and chlorinated pesticides were detected in sediments at Sites 1-3 and 6-8 (Table 8). The concentrations are in the range expected for relatively uncontaminated sediment and the data provide no indication of potential hazards associated with PCBs or pesticides. Concentrations of PAH were low and dominated by the higher molecular weight PAH (Table 9) that are known to be associated with combustion sources and to have a preference to absorb into the organic carbon (detritus) in sediment rather than remain dissolved in the water. The lower molecular weight PAH (e.g., naphthalene) prefer to remain dissolved in water and thus it is not surprising to see lower concentrations of these PAHs in the sediment even though they were found in the water above the sediment. It appears that Sites 1-3, that are in the boat channel, are receiving PAH input from boat motor exhaust and that these PAHs are absorbing into the sediment. However, even the highest PAH concentrations in the sediment are not a cause for concern. Although there are no EPA criteria or NC standards for chemicals in sediment, various "guidelines" do exist for many PAH and those guidelines are much higher than what has been measured at these sites. Metals were detected in all samples (Table 10), but the concentrations were within the range expected for clean or minimally contaminated sediment.

Summary

Based on the analyses of water, sediment, and passive sampling device (PSD) samples, there is no evidence of significant risk to human or ecological health from concentrations of PCBs, pesticides, PAHs, volatile organic chemicals or metals in the aquatic area surrounding the Bowsertown Landfill. Concentrations of most chemicals are similar to what one would expect for a relative clean environment. The only chemicals that are at somewhat elevated concentrations are certain PAHs and they appear to be coming from boat traffic in the channel on the south side of the landfill.

This study was intended only as a screening assessment and the data provided here cannot be used to perform a risk assessment or to “clear” the site for improvement. However, given the generally uncontaminated condition of the waters and sediment surrounding the Bowsertown Landfill, there is no apparent reason not to begin more formal proceedings to reclaim the site for other public use as prescribed by State and Federal regulations.



Dare County Transfer Station Assessment Project

Figure 1.

Table 1 Concentrations of PCBs and pesticides in water collected from BowserTown Landfill (ng/L)

Analyte	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
PCBs								
PCB 8	bd	bd	bd	bd	bd	bd	bd	bd
PCB 18	bd	bd	bd	bd	bd	bd	bd	bd
PCB 28	bd	bd	bd	bd	bd	bd	bd	bd
PCB 52	bd	bd	bd	bd	bd	bd	bd	bd
PCB 44	bd	bd	bd	bd	bd	bd	bd	bd
PCB 66	bd	bd	bd	bd	bd	bd	bd	bd
PCB 101	0.24	0.11	bd	bd	bd	bd	bd	bd
PCB 77	bd	bd	bd	bd	bd	bd	bd	bd
PCB 118	bd	bd	bd	bd	bd	bd	bd	bd
PCB 153	0.17	0.19	bd	bd	bd	bd	bd	bd
PCB 165	bd	bd	bd	bd	bd	bd	bd	bd
PCB 135	bd	bd	bd	bd	bd	bd	bd	bd
PCB 126	bd	bd	bd	bd	bd	bd	bd	bd
PCB 157	bd	bd	bd	bd	bd	bd	bd	bd
PCB 128	bd	bd	bd	bd	bd	bd	bd	bd
PCB 180	bd	bd	bd	bd	bd	bd	bd	bd
PCB 170	bd	bd	bd	bd	bd	bd	bd	bd
PCB 195	bd	bd	bd	bd	bd	bd	bd	bd
PCB 206	bd	bd	bd	bd	bd	bd	bd	bd
PCB 209	bd	bd	bd	bd	bd	bd	bd	bd
Sum of PCBs	0.41	0.33	0.00	0.00	0.00	0.00	0.00	0.00
Pesticides								
chlorpyrifos	bd	bd	bd	bd	bd	bd	bd	bd
alpha-BHC	bd	bd	bd	bd	bd	bd	bd	bd
beta-BHC	bd	bd	bd	bd	bd	bd	bd	bd
alpha-BHC (indane)	bd	bd	bd	bd	bd	bd	bd	bd
delta-BHC	bd	bd	bd	bd	bd	bd	bd	bd
hexachlorobenzene	bd	bd	bd	bd	bd	bd	bd	bd
heptachlor	0.37	0.25	0.18	bd	bd	bd	bd	0.29
heptachlor epoxide	bd	bd	bd	bd	bd	bd	bd	bd
alpha-endosulfan	0.45	0.39	0.00	bd	bd	bd	bd	0.38
gamma-chlordane	0.52	0.26	0.35	bd	bd	bd	bd	0.41
trans-nonachlor	0.22	0.16	0.39	bd	bd	bd	bd	0.27
aldrin	bd	bd	bd	bd	bd	bd	bd	bd
dieldrin	bd	bd	bd	bd	bd	bd	bd	bd
alpha-endosulfan	bd	bd	bd	bd	bd	bd	bd	bd
beta-endosulfan	bd	bd	bd	bd	bd	bd	bd	bd
endosulfan sulfate	bd	bd	bd	bd	bd	bd	bd	bd
endos	bd	bd	bd	bd	bd	bd	bd	bd
endrin aldehyde	bd	bd	bd	bd	bd	bd	bd	bd
endrin acetate	bd	bd	bd	bd	bd	bd	bd	bd
methoxychlor	bd	bd	bd	bd	bd	bd	bd	bd
mirex	bd	bd	bd	bd	bd	bd	bd	bd
4,4'-DDE	bd	bd	bd	bd	bd	bd	bd	bd
4,4'-DDD	bd	bd	bd	bd	bd	bd	bd	bd
4,4'-DDE	bd	bd	bd	bd	bd	bd	bd	bd
2,4'-DDD	bd	bd	bd	bd	bd	bd	bd	bd
2,4'-DDE	bd	bd	bd	bd	bd	bd	bd	bd
2,4'-DDD	bd	bd	bd	bd	bd	bd	bd	bd
Sum of DDEs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surrogate Recoveries (%)								
DBP-B	75.37	85.26	87.60	83.41	84.12	96.73	92.85	87.40
PCB 112	99.41	102.05	97.50	101.08	101.47	103.23	97.21	105.21
PCB 197	103.28	98.21	101.69	99.85	105.28	104.17	102.88	103.37

bd: Below detection limit (0.1 ng/L)

Table 2 Concentrations of Volatile Organic Chemicals in water collected from BowserTown Landfill (ng/L)

Analysis	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Benzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Bromobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Bromochloromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Bromodichloromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Bromoform	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Bromomethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
n-Butylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
sec-Butylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
tert-Butylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Carbon tetrachloride	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chlorodibromomethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chloroform	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Chloromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
2-Chlorotoluene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
4-Chlorotoluene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2-Dibromo-3-chloropropane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2-Dibromoethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Dibromomethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2-Dichlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,3-Dichlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,4-Dichlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Dichlorodifluoromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1-Dichloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2-Dichloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1-Dichloroethene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
cis-1,2-Dichloroethene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
trans-1,2-Dichloroethene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2-Dichloropropane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
2,2-Dichloropropane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,3-Dichloropropane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1-Dichloropropene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Ethylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Hexachlorobutadiene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Isopropylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
p-Isopropyltoluene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Methylene chloride	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Naphthalene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
n-Propylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Styrene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1,1,2-Tetrachloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1,2,2-Tetrachloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Tetrachloroethene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Toluene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2,4-Trichlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2,3-Trichlorobenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1,1-Trichloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,1,2-Trichloroethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Trichloroethene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Trichlorofluoromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2,3-Trichloropropane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,2,4-Trimethylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
1,3,5-Trimethylbenzene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Vinyl chloride	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
o-Xylene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
m-Xylene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
p-Xylene	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Methyl-t-butyl ether	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Dichlorofluoromethane	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl

bdl: below detection limit (100 ng/L or 1 µg/L)

Table 3 Concentrations of PAHs in water collected from BowserTown Landfill (ng/L)

PAHs	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Naphthalene	21.31	22.44	20.67	2.20	1.43	4.13	2.99	3.62
2-Methylnaphthalene	34.48	41.65	42.41	5.87	1.86	13.07	8.69	10.47
1-Methylnaphthalene	11.95	10.91	10.71	0.96	0.44	3.22	2.82	4.05
Biphenyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,6-Dimethylnaphthalene	33.87	27.58	23.21	3.43	1.37	8.73	6.24	7.50
Acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acenaphthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzofuran	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3,5-Trimethylnaphthalene	20.99	15.67	13.39	0.00	0.00	1.42	0.00	0.00
C1-Naphthalenes	47.25	54.02	53.91	3.82	3.10	14.64	13.01	17.98
C2-Naphthalenes	86.35	74.25	67.31	5.35	3.70	18.17	12.49	14.28
C3-Naphthalenes	226.30	157.72	124.62	0.00	0.00	4.76	0.00	0.00
C4-Naphthalenes	172.04	204.85	181.56	0.00	0.00	8.62	0.00	0.00
Fluorene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylfluorene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1-Fluorenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2-Fluorenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3-Fluorenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1-Dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2-Dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3-Dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phenanthrene	2.41	2.81	1.24	0.46	0.22	0.62	0.47	0.45
Anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-Methylphenanthrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1-Phenanthrenes/Anthracenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2-Phenanthrenes/Anthracenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3-Phenanthrenes/Anthracenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4-Phenanthrenes/Anthracenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fluoranthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1-Fluoranthenes/Pyrenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Retene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benz[a]anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chrysene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1-Chrysenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2-Chrysenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3-Chrysenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4-Chrysenes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo[b]fluoranthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo[k]fluoranthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo[e]pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo[a]pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indeno[1,2,3-cd]pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dibenz[a,h]anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzo[g,h,i]perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coronene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum of PAH	656.95	611.90	539.10	22.09	12.11	77.39	46.71	58.35
Sum of EPA Priority Pollutant PAHs	21.72	25.25	21.91	2.67	1.65	4.75	3.46	4.07

Table 4 Concentrations of current-use pesticides in water collected from BowserTown Landfill (ng/L)

ANALYTE	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
alachlor	nd	nd	nd	nd	nd	nd	nd	nd
2,6-diethylaniline	nd	nd	nd	nd	nd	nd	nd	nd
atrazine	nd	nd	nd	nd	nd	nd	nd	nd
deethylatrazine	nd	nd	nd	nd	nd	nd	nd	nd
benfluramin	nd	nd	nd	nd	nd	nd	nd	nd
butylate	nd	nd	nd	nd	nd	nd	nd	nd
carbaryl	nd	nd	nd	nd	nd	nd	nd	nd
carbofuran	nd	nd	nd	nd	nd	nd	nd	nd
chlorothalonil	nd	nd	nd	nd	nd	nd	nd	nd
chlorpyrifos	nd	nd	nd	nd	nd	nd	nd	nd
cyanazine	nd	nd	nd	nd	nd	nd	nd	nd
dacthal	nd	nd	nd	nd	nd	nd	nd	nd
diazinon	nd	nd	nd	nd	nd	nd	nd	nd
dimethoate	nd	nd	nd	nd	nd	nd	nd	nd
disulfoton	nd	nd	nd	nd	nd	nd	nd	nd
EPTC	nd	nd	nd	nd	nd	nd	nd	nd
ethionfluralin	nd	nd	nd	nd	nd	nd	nd	nd
ethopros	nd	nd	nd	nd	nd	nd	nd	nd
forofos	nd	nd	nd	nd	nd	nd	nd	nd
linuron	nd	nd	nd	nd	nd	nd	nd	nd
malathion	nd	nd	nd	nd	nd	nd	nd	nd
methy parathion	nd	nd	nd	nd	nd	nd	nd	nd
metolachlor	nd	nd	nd	nd	nd	nd	nd	nd
metribuzin	nd	nd	nd	nd	nd	nd	nd	nd
molinate	nd	nd	nd	nd	nd	nd	nd	nd
napropamide	nd	nd	nd	nd	nd	nd	nd	nd
pebulate	nd	nd	nd	nd	nd	nd	nd	nd
pendimethalin	nd	nd	nd	nd	nd	nd	nd	nd
permethrin	nd	nd	nd	nd	nd	nd	nd	nd
prometon	nd	nd	nd	nd	nd	nd	nd	nd
phorate	nd	nd	nd	nd	nd	nd	nd	nd
simazine	nd	nd	nd	nd	nd	nd	nd	nd
tebuthiuron	nd	nd	nd	nd	nd	nd	nd	nd
terbufos	nd	nd	nd	nd	nd	nd	nd	nd
trifluralin	nd	nd	nd	nd	nd	nd	nd	nd
Surrogate Recoveries (%)								
HCH alpha-d6	94.74	62.00	98.44	65.70	80.35	73.69	73.10	85.78
diazinon-d10	88.83	78.60	73.03	96.16	87.47	91.75	69.07	77.40
turbuthylazine	131.45	99.10	103.71	88.72	87.00	94.74	88.00	98.00

Table 5 Concentrations of metals in water collected from BowserTown Landfill (ng/L)

Analyte	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Copper	48	46	29	19	16	21	15	24
Cadmium	2.1	1.4	bdl	bdl	bdl	bdl	bdl	bdl
Chromium	85	42	23	18	21	24	20	27
Lead	25	19	7	4	5	8	9	11
Mercury	4.2	4.7	3.2	3.1	1.8	2.7	2.5	3.4
Zinc	76	60	49	24	18	26	22	28

bdl: below detection limit (1 ng/L)