Evidence

Material comparators for end-of-waste decisions

Construction materials: non-waste wood (construction and manufacturing)

Report – SC130040/R12

Version 2

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Executive summary

This report details the work carried out to characterise non-waste wood, a key comparator. This information will inform end-of-waste assessments for waste-derived materials intended to replace non-waste wood used in construction and manufacturing.

The Waste Framework Directive (Article 6) provides criteria for identifying when a waste material has become a product and no longer needs to be regulated as a waste. Through Article 6 the case law requires the Environment Agency to consider the environmental and human health impacts from materials in comparison with their non-waste material alternatives.

> ‘It should be enough that the holder has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as a [non-waste material], and with no worse environmental effects.’

Market research was used to define non-waste wood as an ordinary comparator and a literature review was used to identify any existing published data.

A limited number of suitable pre-existing datasets were found during the literature review.

Twelve samples of non-waste wood were collected from various suppliers across England. Analytical data from these samples are presented in this report.

We recommend comparing the concentrations of analytes in the comparators dataset to the concentrations in the waste-derived material, paying attention to the higher values. This comparison does not constitute a pass/fail test or an end of waste view. It will provide an indication of whether the waste material contains similar levels of analytes to non-waste materials and whether an end-of-waste application may be appropriate or that further analysis or improved treatment processes may be warranted.

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1 Introduction

To define end-of-waste criteria, the Environment Agency requires a set of ordinary material comparator data for use as a benchmark against which other materials and wastes can be assessed.

The Waste Framework Directive (Article 6) provides criteria for identifying when a waste material has become a product and no longer needs to be regulated as a waste. Through Article 6 the case law requires the Environment Agency to consider the environmental and human health impacts from materials in comparison with their non-waste material alternatives.

> 'It should be enough that the holder has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as a [non-waste material], and with no worse environmental effects.'

The purpose of this report is to provide an evidence base of the composition and characteristics of non-waste wood which is defined as an ordinary material comparator that is currently permitted for use in construction and manufacturing.

This report provides the results from the primary analysis of 12 wood samples.

Two other reports cover ordinary material comparators for construction materials:

- concrete blocks
- natural limestone aggregate

2 Definition

This category consists of:

- wood products used in the construction industry
- wood used to manufacture products such as furniture, joinery and mouldings, packaging, and paper products

Wood used in construction and manufacturing is also known as timber.

Wood used in construction and manufacturing can be derived from trees grown in the UK or from wood products imported into the UK. Finished products may also be imported into the UK. Some manufactured wood products contain recycled wood. Within this project, it is the non-waste solid wood and non-waste wood used to manufacture engineered wood that is defined as a comparator and not the finished product.

Non-waste wood chips, sawdust and solid wood from softwood and hardwood species can be formed into a number of finished products such as:

- particleboard
- medium density fibreboard (MDF)
- wet process fibreboards (hardboard, medium board, soft board)
- orientated strand board (OSB)

- plywood

Table 2.1 gives examples of hardwood and softwood species.

Table 2.1 Examples of hardwood and softwood species

Hardwood	Softwood
Ash, European	Cedar, Western Red
Beech, European	Douglas fir
Birch, European	Larch, European
Cherry, European	Larch, Japanese
Chestnut, Horse	Pines, Scots
Chestnut, Sweet	Spruce, Sika
Elm, European	
Lime, European	
Oak, European	
Plane, European	
Poplar	
Sycamore	
Yew	

2.1 Material properties relevant to use

Wood is a high-performance material, low in weight but high in density, with good load-bearing and thermal properties. A wide range of timbers is available, each with its own characteristics (Forestry Commission Wales 2013).

Timber can have defects such as knots and may also be prone to decay and insect damage. Some timbers are not naturally durable and so must be preserved with wood treatments. Within this project only untreated wood is considered as a comparator.

3 Comparator sub-types

A total of 12 non-waste wood samples were obtained from a variety of suppliers across England to provide a cross-section of the main types of non-waste wood used in construction and manufacturing. The samples can be further divided into sub-types. Figures 3.1 and 3.2 show a breakdown of the samples by sub-type and origin respectively.

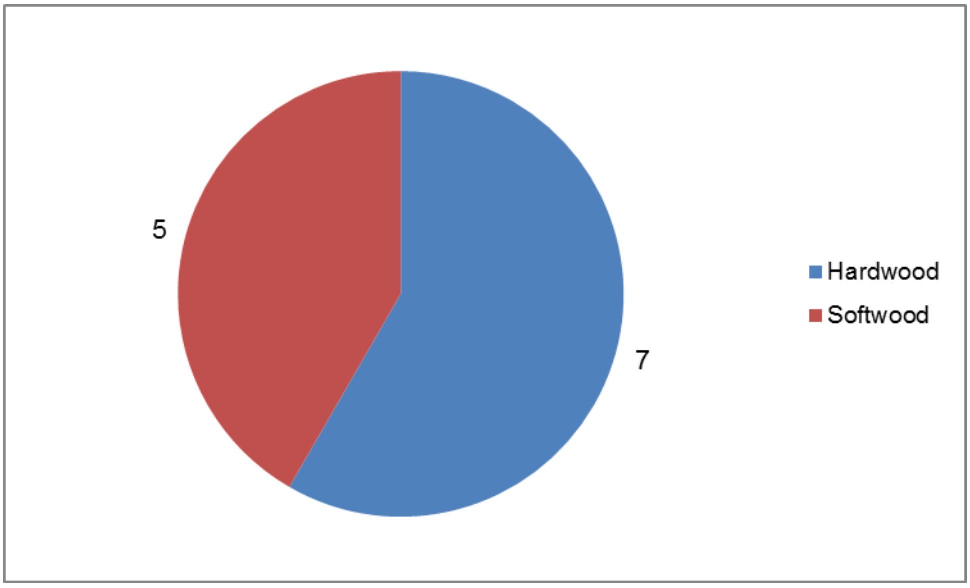

Figure 3.1 Number of non-waste wood samples by sub-type

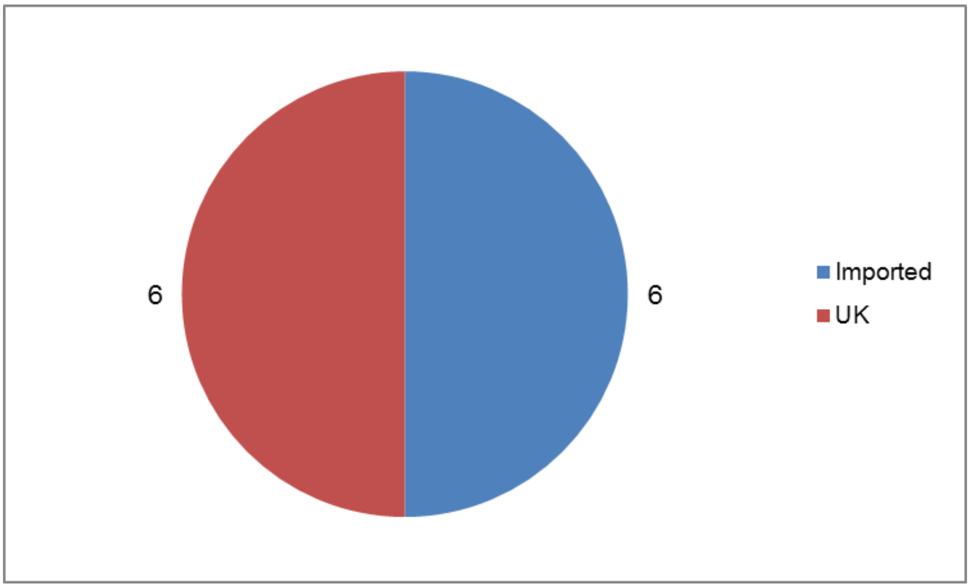

Figure 3.1 Number of non-waste wood samples by origin

4 Material sources and sampling procedure

An internet search was used to produce a list of non-waste wood suppliers. Non-waste wood samples were requested from all these suppliers to ensure a cross-section of wood types were sampled. Samples were collected from those willing to participate.

Non-waste wood samples were taken in accordance with BS EN 326-1:1994 (BSI 1994).

5 Analytical parameters

The main parameters determined, together with units of measurement, are summarised in Tables 5.1 to 5.4.

Testing was carried out in accordance with in-house methods documented by the Environment Agency's National Laboratory Service (NLS) which meet the requirements of the performance standards of the Environment Agency's monitoring certification scheme (MCERTS). Specific tests used are outlined in the tables. Other test methods are available.

In the tables, 'LE' refers to the NLS Leeds laboratory and 'SAL' refers to Scientific Laboratories Ltd.

Table 5.1 Analysis: physical properties

Parameter/ determinand	Test method used	Unit
Particle size distribution (PSD)	SAL determination of percentage particles. The particle size distribution calculates the percentage of a sample which is distributed via sieving between 2 and 20 mm, between 20 and 50 mm, and over 50 mm. The determination is performed on the >2 mm fraction of the sample (that is, the fraction of the sample that does not pass through the 2 mm sieve).	%
pH	LE I pH and EC 01 pH and conductivity – water extracted, determined by specific electrode from 'as received' sample	–
Electrical conductivity	LE I pH and EC 01 pH and conductivity – water extracted, determined by specific electrode from 'as received' sample	mS/cm
Dry solids @ 30°C	LE P soil preparation 01 – sample air dried at <30ºC in a controlled environment until constant weight is achieved	%
Dry solids @ 105°C	LE I dry solids (105ºC) – thermally treated, determined by gravimetry	%
Loss on ignition (LoI) @ 500°C (organic matter content)	Loss on ignition (500ºC) – thermally treated, determined by gravimetry	%
Moisture content	Parameter by calculation	%

Table 5.2 Analysis: metals

Parameter/ determinand	Test method used	Unit
Aluminium, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, vanadium, zinc	LE I metals (ICP-OES) 01–- digestion block aqua regia extracted under reflux; determined by inductively coupled plasma optical emission spectrometry (ICP-OES)	mg/kg
Chromium VI	Hexavalent chromium by spectrophotometry	mg/kg

Table 5.3 Analysis: organic contaminants

Parameter/ determinand	Test method used	Unit
Polycyclic aromatic hydrocarbons (PAHs) (USEPA16)[1]	Organics dichloromethane (DCM) extracted; hexane exchange determined by gas chromatography–mass spectrometry (GCMS) (scan mode)	µg/kg
Benzene, toluene, ethylbenzene and xylenes (BTEX)	Organics DCM extracted; hexane exchange determined by GCMS (scan mode)	µg/kg
Halogenated organics (including lindane, pentachlorophenol)	Organics DCM extracted; hexane exchange determined by GCMS (scan mode) and LE O Phenols (HPLC) 01 – methanol extracted; determined by high performance liquid chromatography (HPLC) with diode array detection (DAD) from ‘as received’ sample	µg/kg

Notes: [1] List of 16 PAHs classified by the US Environmental Protection Agency (USEPA) as priority pollutants.

Table 5.4 Analysis: microbiological contaminants

Parameter/ determinand	Test method used	Unit
Escherichia coli (E. coli)	NLS B ECOLI ENV – Enumeration of *Escherichia coli* by membrane filtration (confirmed) NLS B ECOLI ENV – Enumeration of *Escherichia coli* by membrane filtration (Presumptive)	Number present per g wet weight (WW) of sample
Salmonella spp.	NLS B SAL PA – Qualitative analysis for *Salmonella* spp. (not *S. typhi*) by membrane filtration	Present or absent

6 Existing data

A limited number of datasets relating to non-waste wood for construction and manufacturing were identified during the literature review. Data for metals from a WRAP study (WRAP 2005) are presented in Table 6.1.

Table 6.1 Primary data for wood: metals (mg/kg DW)

(a)

	Al	As	B	Ba	Ca	Cd	Cr	Cu	Fe
Spruce Scotland 2*		0.01				0.07	0.05	0.72	
Spruce Wales*		0.03				0.09	0.08	0.78	
Spruce N. Ireland*		0.00				0.04	0.03	1.36	
Spruce Finland 1*		0.00				0.03	0.03	0.59	
Spruce Finland 2*		0.00				0.02	0.03	0.33	
Spruce Finland 3*		0.00				0.02	0.01	0.40	
Spruce Sweden 1*		0.00				0.02	1.96	0.66	
Spruce Latvia*		0.00				0.07	0.06	0.54	
Spruce Scotland 1+	170	<0.10	62	453	10799	<0.10	<0.10	1.44	381
Spruce Scotland 2+	123	<0.10	65	275	11585	<0.10	<0.10	0.87	246
Spruce Wales+	101	<0.10	67	184	6366	<0.10	<0.10	0.80	176
Spruce N. Ireland +	67	<0.10	67	329	11964	<0.10	<0.10	1.20	90
Spruce Finland 1+	5	<0.10	2	11	788	<0.10	<0.10	0.83	2
Finland 2+	3	<0.10	3	16	1002	<0.10	<0.10	1.11	3
Finland 3+	2	<0.10	2	20	687	<0.10	<0.10	0.61	2
Sweden 1+	3	<0.10	3	11	736	<0.10	<0.10	1.01	4
Sweden 2+	3	<0.10	3	13	923	<0.10	<0.10	0.89	2
Spruce Latvia+	4	<0.10	3	11	762	<0.10	<0.10	1.33	4
Spruce Russia 1+	3	<0.10	3	18	918	<0.10	<0.10	1.22	3
Spruce Russia 2+	3	<0.10	2	17	600	<0.10	<0.10	0.95	3
Pine Scotland 2*		0.04				0.05	0.13	0.76	
Pine England*		0.00				0.08	0.50	0.56	
Pine Finland 1*		0.00				0.10	0.03	0.38	
Pine Finland 2*		0.00				0.04	0.01	0.15	
Pine Finland 3*		0.00				0.07	0.02	0.21	
Pine Finland 4*		0.00				0.04	0.04	0.36	
Pine Finland 5*		0.00				0.09	0.02	0.04	
Pine Sweden*		0.00				0.12	0.02	0.34	
Pine Latvia*		0.00				0.08	0.04	0.51	
Pine Russia*		0.00				0.05	0.03	0.36	
Pine Scotland 1+	87	<0.10	52	121	13305	<0.10	<0.10	1.85	179

	Al	As	B	Ba	Ca	Cd	Cr	Cu	Fe
Pine Scotland 2+	203	<0.10	68	85	16056	<0.10	<0.10	0.68	127
Pine England +	189	<0.10	74	32	16813	<0.10	<0.10	1.26	84
Pine Finland 1+	4	<0.10	3	3	642	<0.10	<0.10	0.71	6
Pine Finland 2+	4	<0.10	2	2	547	<0.10	<0.10	0.52	4
Pine Finland 3+	2	<0.10	2	1	458	<0.10	<0.10	0.44	2
Pine Finland 4+	10	<0.10	2	5	537	<0.10	<0.10	0.52	7
Pine Finland 5+	3	<0.10	2	4	663	<0.10	<0.10	0.74	2
Pine Sweden+	6	<0.10	2	6	540	<0.10	<0.10	0.63	3
Pine Latvia+	5	<0.10	3	6	575	<0.10	<0.10	1.01	3
Pine Russia+	7	<0.10	4	4	1021	<0.10	<0.10	1.09	6
Douglas Fir Scotland 1+	81	<0.10	51	233	5938	<0.10	<0.10	0.68	89
Douglas Fir Scotland 2+	122	<0.10	58	108	3025	<0.10	<0.10	2.88	115
Douglas Fir England+	637	<0.10	212	467	25470	<0.10	<0.10	5.94	1040
Douglas Fir Scotland 2*		0.06				0.33	0.20	16.98	
Douglas Fir England*		0.08				0.19	0.20	4.10	
Larch Scotland 2*		0.08				0.20	0.37	4.79	
Larch England*		0				0.10	0.03	0.87	
Larch Scotland 1+	127	<0.1	67	290	5505	<0.10	<0.10	0.83	79
Larch Scotland 2+	133	<0.1	61	212	3455	<0.10	<0.10	2.42	158
Larch England+	64	<0.1	93	140	6408	<0.10	<0.10	1.40	93

(b)

	Mg	Mn	Na	Ni	P	Pb	Si	Sr	Zn
Spruce Scotland 2*				0.03		0.22			3.03
Spruce Wales*				0.02		0.10			1.98
Spruce N. Ireland*				0.03		1.21			1.70
Spruce Finland 1*				0.04		0.09			3.23
Spruce Finland 2*				0.03		0.04			2.51
Spruce Finland 3*				0.02		0.22			2.68
Spruce Sweden 1*				0.05		0.04			4.70
Spruce Latvia*				0.03		0.09			2.64
Spruce Scotland 1+	1954	1646	668	<0.10	221	<0.10	283	159	7.61
Spruce Scotland 2+	1955	2607	869	<0.10	94	<0.10	340	94	11.3
Spruce Wales+	1340	1005	813	<0.10	92	<0.10	276	59	8.43
Spruce N. Ireland +	1570	1495	748	<0.10	332	<0.10	232	127	35.89
Spruce Finland 1+	87	62	25	<0.10	16	<0.10	11	6	9.95
Finland 2+	95	53	43	<0.10	18	<0.10	16	7	13.35
Finland 3+	83	65	22	<0.10	4	0.20	6	5	10.71
Sweden 1+	91	114	68	<0.10	4	<0.10	5	3	12.43
Sweden 2+	104	122	26	<0.10	4	<0.10	7	4	20.54
Spruce Latvia+	83	119	32	<0.10	7	<0.10	12	3	12.26
Spruce Russia 1+	73	129	26	<0.10	5	<0.10	6	3	21.12
Spruce Russia 2+	47	79	22	<0.10	4	<0.10	6	2	9.78
Pine Scotland 2*				0.03		0.15			2.80
Pine England*				0.24		0.11			1.72
Pine Finland 1*				0.02		0.06			2.80
Pine Finland 2*				0.01		0.20			1.23
Pine Finland 3*				0.01		0.16			2.16
Pine Finland 4*				0.04		0.05			3.72
Pine Finland 5*				0.03		0.04			1.49
Pine Sweden*				0.02		0.05			3.87
Pine Latvia*				0.02		0.04			1.55
Pine Russia*				0.05		0.02			3.66
Pine Scotland 1+	4628	2487	810	<0.10	283	3.24	139	69	8.56
Pine Scotland 2+	3718	930	651	<0.10	735	<0.10	161	85	13.86
Pine England +	3468	1366	1471	<0.10	2312	<0.10	179	21	12.19
Pine Finland 1+	132	61	61	<0.10	7	<0.10	7	4	13.20

	Mg	Mn	Na	Ni	P	Pb	Si	Sr	Zn
Pine Finland 2+	109	52	29	<0.10	2	0.52	5	2	12.25
Pine Finland 3+	107	59	24	<0.10	1	<0.10	4	2	11.55
Pine Finland 4+	106	78	19	<0.10	2	<0.10	3	3	9.71
Pine Finland 5+	162	71	20	<0.10	3	<0.10	3	4	9.33
Pine Sweden+	127	111	27	<0.10	6	<0.10	4	2	12.06
Pine Latvia+	139	68	41	<0.10	2	<0.10	8	1	6.43
Pine Russia+	204	77	30	<0.10	18	<0.10	8	4	13.49
Douglas Fir Scotland 1+	1230	721	1230	<0.10	848	<0.10	174	42	3.73
Douglas Fir Scotland 2+	382	108	1584	<0.10	202	<0.10	144	58	16.71
Douglas Fir England+	3396	5306	4033	<0.10	2335	0.85	1358	106	20.38
Douglas Fir Scotland 2*				0.13		0.71			21.09
Douglas Fir England*				0.09		1.04			3.97
Larch Scotland 2*				0.28		1.36			17.60
Larch England*				0.02		4.67			1.18
Larch Scotland 1+	1754	599	1694	<0.10	260	<0.10	236	79	2.66
Larch Scotland 2+	1091	297	970	<0.10	97	<0.10	176	67	26.67
Larch England+	874	4602	757	<0.10	157	7.92	175	35	5.13

Notes: Source: WRAP (2005)
DW = dry weight
* ICP Lab 1
+ ICP Lab 2

7 Primary data

7.1 Statistical analysis of data

All ‘less than’ values were taken as the measured value. The mean, median, minimum, maximum and 90th percentile were calculated for each analyte.

Box plots can be used to graphically represent groups of quantitative data. The sample minimum, lower quartile (Q1), median (Q2), upper quartile (Q3) and sample maximum are used. The median is indicated by the horizontal line that runs across the box. The top of the box is 75th percentile (upper quartile or Q3). The bottom of the box is the 25th percentile (lower quartile or Q1). The interquartile range is represented by the height of the box (Q3 – Q1). A smaller interquartile range indicates less variability in the dataset while a larger interquartile range indicates a variable dataset. Whiskers extend out of the box to represent the sample minimum and maximum. Outliers are plotted as asterisks and are defined as data points that are 1.5 times the interquartile range.

Outliers can adversely affect the statistical analysis by:

- giving serious bias or influence to estimates that may be of less interest
- increasing the error variance and reducing the power of statistical tests
- decreasing normality (if non-random) and altering the odds of type I and II errors

A box and whisker plot of potassium concentration in non-waste wood is shown in Figure 7.1. This diagram demonstrates the issue of outliers in the dataset.

It is important to provide a reasonable sized dataset for comparison purposes. Where there is sufficient sample size (≥10) to calculate a 90th percentile of the data, the 90th percentile has been calculated.

7.1.1 Organics analytical data

Due to difficulties encountered during sample preparation, the limit of detection (LOD) for some analytes was elevated above the target limit of detection. This was particularly the case for many of the organics analyses where all the analytical results were less than a LOD. Due to the difficult nature of the matrices the LODs achieved varied across different samples.

The Environment Agency considers that these natural, non-waste materials do not contain the substances analysed for. A decision has been taken that in these cases the 90th percentile has been replaced by a target concentration corresponding to the lowest LOD actually achieved for any of the comparators for that substance. Those results are highlighted in red in the tables 7.1 to 7.7.

We consider this a reasonable and proportionate position.

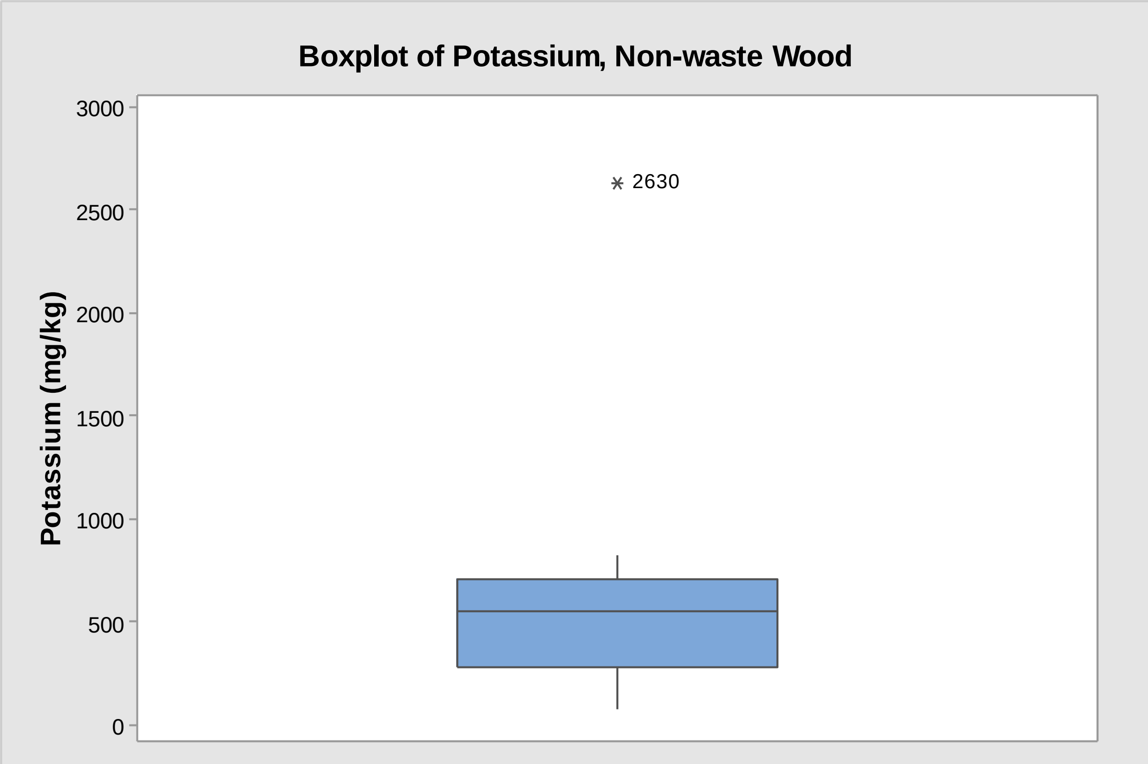

Figure 7.1 Boxplot of potassium, non-waste wood

7.2 Using the data tables

Data are presented in tables summarising:

- physical properties
- metals
- microbiological contaminants
- organic contaminants

We recommend comparing the concentrations of analytes in the comparators dataset to the concentrations in the waste-derived material, paying attention to the higher values. This comparison does not constitute a pass/fail test or an end of waste view. It will provide an indication of whether the waste material contains similar levels of analytes to non-waste materials and whether an end-of-waste application may be appropriate or that further analysis or improved treatment processes may be warranted.

Due to difficulties encountered during sample preparation, the limit of detection (LOD) for some analytes was elevated above the target limit of detection.

7.3 Primary data tables

Primary data are shown in Tables 7.1 to 7.7.

Table 7.1 Primary data for non-waste wood: physical properties

Sample ID	Dry solids @ 30°C	Dry solids @ 105°C	LoI @ 500°C	PSD 2–20 mm	PSD 20–50 mm	PSD > 50 mm	Conductivity	pH
	%	%	%	%	%	%	mS/cm	
Wood 01	77.3	78.9	99.8	<0.1	100.0	<0.1	0.028	5.67
Wood 02	99.3	89.3	99.5	100.0	<0.1	<0.1	0.043	4.48
Wood 03	99.5	91.2	99.6	100.0	<0.1	<0.1	0.159	3.75
Wood 04	99.4	90.7	99.5	100.0	<0.1	<0.1	0.454	5.63
Wood 05	99.7	88.1	98.9	100.0	<0.1	<0.1	0.319	5.62
Wood 06	87.4	83.5	99.8	<0.1	100.0	<0.1	0.083	4.92
Wood 07	92.9	88.6	99.7	<0.1	100.0	<0.1	0.094	5.83
Wood 08	43.4	55.1	81.3	<0.1	100.0	<0.1	0.026	5.61
Wood 09	68.0	69.5	99.1	<0.1	100.0	<0.1	0.043	5.75
Wood 10	48.5	53.3	99.5	<0.1	100.0	<0.1	0.041	5.84
Wood 11	48.1	44.1	99.6	<0.1	100.0	<0.1	0.035	5.74
Wood 12	65.3	62.2	99.6	<0.1	100.0	<0.1	0.047	5.95
Mean	77.4	74.5	98.0	33.4	66.7	0.1	0.114	5.40
Median	82.4	81.2	99.6	0.1	100.0	0.1	0.045	5.65
Minimum	43.4	44.1	81.3	0.1	0.1	0.1	0.026	3.75
Maximum	99.7	91.2	99.8	100.0	100.0	0.1	0.454	5.95
No. of samples	12	12	12	12	12	12	12	12
90th percentile	99.5	90.6	99.8	100.0	100.0	0.1	0.303	5.84
LOD	0.5	0.5	0.5	n/a	n/a	n/a	0.01	0.2

n/a = not applicable

Table 7.2 Primary data for non-waste wood: metals (mg/kg DW)

(a)

Sample ID	Al	Sb	As	Ba	Be	Bo	Cd	Ca	Cr	Cr VI	Co	Cu	Fe	Pb	Li
Wood 01	<50	<1	0.972	6.470	0.124	2.76	<0.200	211	<0.500	<0.60	<0.1	1.31	<200	<1.00	<1
Wood 02	537	<1	0.895	50.200	<0.100	7.27	<0.200	797	0.504	7.30	<0.1	11.10	414	1.27	<1
Wood 03	<50	<1	0.950	15.700	<0.100	4.19	<0.200	759	<0.500	3.10	<0.1	2.36	<200	<1.00	<1
Wood 04	293	<1	1.060	34.800	<0.100	4.92	<0.200	1090	<0.500	4.80	<0.1	9.68	<200	<1.00	<1
Wood 05	200	<1	1.020	19.000	<0.100	4.06	<0.200	3340	<0.500	9.10	<0.1	19.00	210	<1.00	<1
Wood 06	<50	<1	0.833	0.653	<0.100	1.61	<0.200	439	<0.500	<0.60	<0.1	1.07	<200	<1.00	<1
Wood 07	<50	<1	0.647	2.090	<0.100	1.28	<0.200	501	<0.500	<0.60	<0.1	<1.00	<200	<1.00	<1
Wood 08	<50	<1	0.646	2.820	<0.100	<1.00	<0.200	557	<0.500	<0.60	<0.1	1.03	<200	<1.00	<1
Wood 09	<50	<1	0.756	9.770	<0.100	2.29	<0.200	778	<0.500	<0.60	<0.1	1.03	<200	<1.00	<1
Wood 10	<50	<1	<0.500	8.550	<0.100	2.50	<0.200	375	<0.500	<0.60	<0.1	1.66	<200	<1.00	<1
Wood 11	<50	<1	0.614	2.500	<0.100	2.71	<0.200	583	<0.500	<0.60	<0.1	1.65	<200	<1.00	<1
Wood 12	<50	<1	0.964	11.400	<0.100	3.56	0.321	778	<0.500	<0.60	<0.1	<1.00	<200	2.14	<1
Mean	123	1	0.821	13.663	0.102	3.18	0.210	851	0.500	2.43	0.1	4.32	219	1.12	1
Median	50	1	0.864	9.160	0.100	2.74	0.200	671	0.500	0.60	0.1	1.48	200	1.00	1
Minimum	50	1	0.500	0.653	0.100	1.00	0.200	211	0.500	0.60	0.1	1.00	200	1.00	1
Maximum	537	1	1.060	50.200	0.124	7.27	0.321	3340	0.504	9.10	0.1	19.00	414	2.14	1
No. of samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
90^{th} percentile	284	1	1.015	33.220	0.100	4.85	0.200	1061	0.500	7.05	0.1	10.96	209	1.24	1
LOD	50	1	0.5	0.5	0.1	1	0.2	60	0.5	0.6	0.1	1	200	1	1

(b)

Sample ID	Mg	Mn	Hg	Mo	Ni	P	K	Se	Ag	Na	Sr	Tl	Sn	Ti	V	Zn
Wood 01	<20	46.10	<0.2	<1	<0.6	<10.0	650	<1.00	<1	17.0	1.01	<1	<1	<3	0.132	4.44
Wood 02	26	5.41	<0.2	<1	13.5	<10.0	78	<1.00	<1	57.3	3.92	<1	<1	<3	0.203	38.80
Wood 03	<20	7.95	<0.2	<1	4.4	<10.0	546	<1.00	<1	12.1	5.31	<1	<1	<3	<0.100	3.35
Wood 04	416	27.60	<0.2	<1	33.2	30.7	2630	<1.00	<1	28.6	5.03	<1	<1	<3	0.126	17.90
Wood 05	635	2.31	<0.2	<1	41.8	13.6	827	1.04	<1	27.9	21.30	<1	<1	<3	0.108	23.60
Wood 06	123	39.30	<0.2	<1	<0.6	<10.0	210	<1.00	<1	13.1	<1.00	<1	<1	<3	<0.100	10.30
Wood 07	116	54.50	<0.2	<1	<0.6	21.3	251	<1.00	<1	11.4	2.57	<1	<1	<3	<0.100	12.40
Wood 08	110	40.90	<0.2	<1	<0.6	43.9	369	<1.00	<1	12.4	2.13	<1	<1	<3	<0.100	11.00
Wood 09	499	83.70	<0.2	<1	<0.6	67.5	509	<1.00	<1	<10.0	1.84	<1	<1	<3	<0.100	9.59
Wood 10	98	59.60	<0.2	<1	<0.6	159.0	732	<1.00	<1	23.0	1.60	<1	<1	<3	<0.100	11.30
Wood 11	270	95.50	<0.2	<1	<0.6	94.6	634	<1.00	<1	14.8	1.98	<1	<1	<3	<0.100	13.80
Wood 12	332	20.20	<0.2	<1	<0.6	109.0	562	<1.00	<1	95.7	<1.00	<1	<1	<3	<0.100	20.00
Mean	222	40.26	0.2	1	8.1	48.3	666	1.00	1	26.9	4.06	1	1	3	0.114	14.71
Median	120	40.10	0.2	1	0.6	26.0	554	1.00	1	15.9	2.06	1	1	3	0.100	11.85
Minimum	20	2.31	0.2	1	0.6	10.0	78	1.00	1	10.0	1.00	1	1	3	0.100	3.35
Maximum	635	95.50	0.2	1	41.8	159.0	2630	1.04	1	95.7	21.30	1	1	3	0.203	38.80
No. of samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
90th percentile	491	81.29	0.2	1	31.2	107.6	817.5	1.00	1	54.4	5.28	1	1	3	0.131	23.24
LOD	20	2	0.2	1	0.6	10	50	1	1	10	1	1	1	3	0.1	2

Table 7.3 Primary data for non-waste wood: microbiological contaminants

Sample ID	E. coli confirmed	E. coli presumptive	Salmonella
	No. per g WW	No. per g WW	Present/Absent (WW)
Wood 01	<1	<1	Abs
Wood 02	<9	<9	Abs
Wood 03	<9	<9	Abs
Wood 04	<9	<9	Abs
Wood 05	<9	<9	Abs
Wood 06	<1	<1	Abs
Wood 07	<1	<1	Abs
Wood 08	<1	<1	Abs
Wood 09	<1	<1	Abs
Wood 10	<1	<1	Abs
Wood 11	<1	<1	Abs
Wood 12	<1	<1	Abs
Mean	4	4	n/a
Median	1	1	n/a
Minimum	1	1	n/a
Maximum	9	9	n/a
No. of samples	12	12	12
90th percentile	9	9	n/a
LOD	1	1	n/a

Abs = absent; n/a = not applicable

Table 7.4 Primary data for non-waste wood: PAHs (USEPA 16) (μg/kg DW)

(a)

Sample ID	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo(a)anthracene**	**Benzo(a)pyrene**	**Benzo(b)fluoranthene**	**Benzo(ghi)perylene**	**Benzo(k)fluoranthene**
Wood 01	4.440	<8	<200	<200	<200	<200	<50	<200
Wood 02	<2.000	<20	<400	<400	<30	<400	<100	<400
Wood 03	<2.000	<20	<400	<400	<400	<400	<100	<400
Wood 04	<2.000	<20	<400	<400	<20	<20	<6	<20
Wood 05	<30.000	30	<50	<50	<30	<20	<100	<20
Wood 06	<0.900	<9	<200	<200	<200	<200	<50	<200
Wood 07	6.670	<9	<200	<200	<200	<200	<50	<200
Wood 08	1.300	<8	<200	<200	<200	<200	<50	<200
Wood 09	<0.800	<8	<200	<200	<200	<200	<50	<200
Wood 10	8.600	<10	<200	<200	<200	<200	<70	<200
Wood 11	<0.700	<7	<100	<100	<100	<100	<40	<100
Wood 12	0.296	<2	<40	<40	<40	<40	<10	<40
Mean	4.976	13	216	216	152	182	56	182
Median	2.000	9	200	200	200	200	50	200
Minimum	0.296	2	40	40	20	20	6	20
Maximum	30.000	30	400	400	400	400	100	400
No. of samples	12	12	12	12	12	12	12	12
90^{th} percentile	8.407	20	40	40	20	20	6	20
LOD	0.1	1	20	20	20	20	6	20

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(b)

Sample ID	Chrysene	Dibenzo(ah)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Wood 01	<200	<20	<200	<80	<200	<80	<200	<200
Wood 02	<600	<60	<400	<200	<600	<200	<400	<400
Wood 03	<600	<60	<400	<200	<600	<200	<400	<400
Wood 04	<700	<70	<20	<200	<700	<200	<400	<400
Wood 05	<500	<50	<400	<400	<500	<200	<400	<30
Wood 06	<300	<30	<200	<90	<300	<90	<200	<200
Wood 07	<300	<30	<200	<90	<300	<90	<200	<200
Wood 08	<200	<20	<200	<80	<200	<80	<200	<200
Wood 09	<200	<20	<200	<80	<200	<80	<200	<200
Wood 10	<300	<30	<200	<100	<300	<100	<200	<200
Wood 11	<200	<20	<100	<70	<200	<70	<100	<100
Wood 12	<60	<6	<40	<20	<60	<20	<40	<40
Mean	347	35	213	134	347	118	245	214
Median	300	30	200	90	300	90	200	200
Minimum	60	6	20	20	60	20	40	30
Maximum	700	70	400	400	700	200	400	400
No. of samples	12	12	12	12	12	12	12	12
90^{th} percentile	60	6	20	20	60	20	40	30
LOD	30	3	20	10	30	10	20	20

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

Table 7.5 Primary data for non-waste wood: organochlorine pesticides (OCPs) (µg/kg DW)

(a)

Sample ID	Aldrin	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,3,5-Trichlorobenzene	2,3,5,6-Tetrachloroaniline	2,3,5,6-Tetrachlorothioanisole	Chlordane -cis [Chlordane – alpha]	Chlordane -trans [Chlordane - gamma]
Wood 01	<20	<6	<6	<8	<20	<8	<20	<20
Wood 02	<40	<20	<20	<20	<40	<20	<40	<40
Wood 03	<40	<20	<20	<20	<40	<20	<40	<40
Wood 04	<40	<20	<20	<20	<40	<20	<40	<40
Wood 05	<40	<10	<10	<20	<40	<20	<40	<40
Wood 06	<20	<7	<7	<9	<20	<9	<20	<20
Wood 07	<20	<7	<7	<9	<20	<9	<20	<20
Wood 08	<20	<6	<6	<8	<20	<8	<20	<20
Wood 09	<10	<6	<6	<7	<10	<7	<10	<10
Wood 10	<20	<7	<7	<8	<20	<8	<20	<20
Wood 11	<20	<9	<9	<10	<20	<10	<20	<20
Wood 12	<10	<6	<6	<7	<10	<7	<10	<10
Mean	25	10	10	12	25	12	25	25
Median	20	7	7	9	20	9	20	20
Minimum	10	6	6	7	10	7	10	10
Maximum	40	20	20	20	40	20	40	40
No. of samples	12	12	12	12	12	12	12	12
90th percentile	10	6	6	7	10	7	10	10
LOD	2	0.8	0.8	1	2	1	2	2

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(b)

Sample ID	Chlorpropham	DDD -op	DDE -op	DDE -pp	DDT -op + DDD pp	DDT -pp	Dichlobenil	Dieldrin
Wood 01	<20	<20	<20	<20	<2	<20	<7	<20
Wood 02	<40	<40	<40	<40	<40	<40	<20	<40
Wood 03	<40	<40	<40	<40	<40	<40	<20	<40
Wood 04	<40	<40	<40	<40	<2	<40	<20	<40
Wood 05	<40	<40	<40	<40	<2	<40	<20	<40
Wood 06	<20	<20	<20	<20	<2	<20	<8	<20
Wood 07	<20	<20	<20	<20	<2	<20	<8	<20
Wood 08	<20	<20	<20	<20	<2	<20	<7	<20
Wood 09	<10	<10	<10	<10	<2	<10	<6	<10
Wood 10	<20	<20	<20	<20	<2	<20	<7	<20
Wood 11	<20	<20	<20	<20	<2	<20	<10	<20
Wood 12	<10	<10	<10	<10	<2	<10	<7	<10
Mean	25	25	25	25	8	25	12	25
Median	20	20	20	20	2	20	8	20
Minimum	10	10	10	10	2	10	6	10
Maximum	40	40	40	40	40	40	20	40
No. of samples	12	12	12	12	12	12	12	12
90th percentile	10	10	10	10	2	10	6	10
LOD	2	2	2	2	2	2	0.9	2

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(c)

Sample ID	Endosulfan A	Endosulfan B	Endrin	HCH -alpha	HCH -beta	HCH -delta	HCH -epsilon	HCH -gamma [lindane]
Wood 01	<20	<20	<20	<20	<20	<20	<20	<20
Wood 02	<40	<40	<40	<40	<40	<40	<40	<40
Wood 03	<40	<40	<40	<40	<40	<40	<40	<40
Wood 04	<40	<40	<40	<40	<40	<40	<40	<40
Wood 05	<40	<40	<40	<40	<40	<40	<40	<40
Wood 06	<20	<20	<20	<20	<20	<20	<20	<20
Wood 07	<20	<20	<20	<20	<20	<20	<20	<20
Wood 08	<20	<20	<20	<20	<20	<20	<20	<20
Wood 09	<10	<10	<10	<10	<10	<10	<10	<10
Wood 10	<20	<20	<20	<20	<20	<20	<20	<20
Wood 11	<20	<20	<20	<20	<20	<20	<20	<20
Wood 12	<10	<10	<10	<10	<10	<10	<10	<10
Mean	25	25	25	25	25	25	25	25
Median	20	20	20	20	20	20	20	20
Minimum	10	10	10	10	10	10	10	10
Maximum	40	40	40	40	40	40	40	40
No. of samples	12	12	12	12	12	12	12	12
90^{th} percentile	10	10	10	10	10	10	10	10
LOD	2	2	2	2	2	2	2	2

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(d)

Sample ID	Heptachlor	Heptachlor epoxide -cis	Heptachlor epoxide - trans	Hexachlorobenzene	Hexachlorobutadiene	Isodrin	Metazachlor	Methoxychlor
Wood 01	<20	<20	<20	<7	<7	<20	<20	<20
Wood 02	<40	<40	<40	<20	<20	<40	<40	<40
Wood 03	<40	<40	<40	<20	<20	<40	<40	<40
Wood 04	<40	<40	<40	<20	<20	<40	<40	<40
Wood 05	<40	<40	<40	<20	<20	<40	<40	<40
Wood 06	<20	<20	<20	<8	<8	<20	<20	<20
Wood 07	<20	<20	<20	<8	<8	<20	<20	<20
Wood 08	<20	<20	<20	<7	<7	<20	<20	<20
Wood 09	<10	<10	<10	<6	<6	<10	<10	<10
Wood 10	<20	<20	<20	<7	<7	<20	<20	<20
Wood 11	<20	<20	<20	<10	<10	<20	<20	<20
Wood 12	<10	<10	<10	<7	<7	<10	<10	<10
Mean	25	25	25	12	12	25	25	25
Median	20	20	20	8	8	20	20	20
Minimum	10	10	10	6	6	10	10	10
Maximum	40	40	40	20	20	40	40	40
No. of samples	12	12	12	12	12	12	12	12
90^{th} percentile	10	10	10	6	6	10	10	10
LOD	2	2	2	0.9	0.9	2	2	2

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(e)

Sample ID	Pendimethalin	Permethrin -cis	Permethrin -trans	Propachlor	Tecnazene	Trifluralin	Vinclozolin
Wood 01	<20	<20	<20	<20	<20	<7	<20
Wood 02	<40	<40	<40	<40	<40	<20	<40
Wood 03	<40	<40	<40	<40	<40	<20	<40
Wood 04	<40	<40	<40	<40	<40	<20	<40
Wood 05	<40	<40	<40	<40	<40	<20	<40
Wood 06	<20	<20	<20	<20	<20	<8	<20
Wood 07	<20	<20	<20	<20	<20	<8	<20
Wood 08	<20	<20	<20	<20	<20	<7	<20
Wood 09	<10	<10	<10	<10	<10	<6	<10
Wood 10	<20	<20	<20	<20	<20	<7	<20
Wood 11	<20	<20	<20	<20	<20	<10	<20
Wood 12	<10	<10	<10	<10	<10	<7	<10
Mean	25	25	25	25	25	12	25
Median	20	20	20	20	20	8	20
Minimum	10	10	10	10	10	6	10
Maximum	40	40	40	40	40	20	40
No. of samples	12	12	12	12	12	12	12
90th percentile	10	10	10	10	10	6	10
LOD	2	2	2	2	2	0.9	2

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

Table 7.6 Primary data for non-waste wood: phenols (μg/kg DW)

(a)

Sample ID	**2,3,4,6-Tetrachlorophenol**	**2,4,5-Trichlorophenol**	**2,4-Dichlorophenol**	**2,4-Dinitrophenol**	**2-Nitrophenol**	**3,4-Dimethylphenol [3,4-Xylenol]**	**3,5-Dimethylphenol [3,5-Xylenol]**
Wood 01	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 02	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 03	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 04	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 05	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 06	<6000	<6000	<6000	<6000	<6000	<6000	<6000
Wood 07	<5000	<5000	<5000	<5000	<5000	<5000	<5000
Wood 08	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 09	<7000	<7000	<7000	<7000	<7000	<7000	<7000
Wood 10	<10000	<10000	<10000	<10000	<10000	39800	<10000
Wood 11	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 12	<8000	<8000	<8000	<8000	<8000	<8000	<8000
Mean	11333	11333	11333	11333	11333	13817	11333
Median	10000	10000	10000	10000	10000	10000	10000
Minimum	5000	5000	5000	5000	5000	5000	5000
Maximum	20000	20000	20000	20000	20000	39800	20000
No. of samples	12	12	12	12	12	12	12
90th percentile	5000	5000	5000	5000	5000	20000	5000
LOD	1000	1000	1000	1000	1000	1000	1000

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

(b)

Sample ID	4-Chloro-3-methylphenol [*p*-chloro-*m*-cresol]	4-Methylphenol [*p*-Cresol]	DNOC	Dinoseb [2-Methyl-n-propyl-4,6-dinitrophenol]	Pentachlorophenol	Phenol	Resorcinol [1,3-Dihydroxybenzene]
Wood 01	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 02	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 03	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 04	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 05	<20000	<20000	<20000	<20000	<20000	<20000	<20000
Wood 06	<6000	<6000	<6000	<6000	<6000	<6000	<6000
Wood 07	<5000	<5000	<5000	<5000	<5000	<5000	<5000
Wood 08	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 09	<7000	<7000	<7000	<7000	<7000	<7000	<7000
Wood 10	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 11	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Wood 12	<8000	<8000	<8000	<8000	<8000	<8000	<8000
Mean	11333	11333	11333	11333	11333	11333	11333
Median	10000	10000	10000	10000	10000	10000	10000
Minimum	5000	5000	5000	5000	5000	5000	5000
Maximum	20000	20000	20000	20000	20000	20000	20000
No. of samples	12	12	12	12	12	12	12
90^{th} percentile	5000	5000	5000	5000	5000	5000	5000
LOD	1000	1000	1000	1000	1000	1000	1000

Numbers in red represent target concentrations, see Section 7.1.1 above for the full explanation

Table 7.7 Primary data for non-waste wood: BTEX (μg/kg DW)

Sample ID	1,2-Dimethylbenzene [*o*-Xylene]	Benzene	Dimethylbenzene sum of (1,3- 1,4-)	Ethylbenzene	Toluene [Methylbenzene]
Wood 01	<5.0	<5.0	<10.0	<2	<10
Wood 02	56.7	23.8	262.0	56.1	511.0
Wood 03	2.0	2.3	12.8	2.7	27.8
Wood 04	11.9	7.1	64.5	15.8	159.0
Wood 05	48.3	13.1	196.0	45.5	341.0
Wood 06	76.6	<5.0	175.0	35.0	194.0
Wood 07	395	41.4	1350.0	244.0	1570.0
Wood 08	37.6	8.4	112.0	21.3	212.0
Wood 09	11.6	<7.0	23.1	<3.0	62.9
Wood 10	19.6	<8.0	45.8	10.1	88.8
Wood 11	43.5	<8.0	143.0	30.6	246.0
Wood 12	61	10.8	160.0	16.8	341.0
Mean	64.1	11.7	212.9	40.2	313.6
Median	40.6	8.0	127.5	19.1	203.0
Minimum	2.0	2.3	10.0	2.0	10.0
Maximum	395.0	41.4	1350.0	244.0	1570.0
No. of samples	12	12	12	12	12
90th percentile	75.0	22.7	255.4	55.0	494.0
LOD	1	1	2	0.5	3

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List of abbreviations

Ag	Silver
Al	Aluminium
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
BTEX	Benzene, toluene, ethylbenzene, xylene
C	Carbon
Ca	Calcium
Cd	Cadmium
Chromium VI	Chromium Hexavalent
Co	Cobalt
Cr	Chromium
Cu	Copper
DCM	dichloromethane
DW	dry weight
EC	electrical conductivity
Fe	Iron
GCMS	gas chromatography–mass spectrometry
Hg	Mercury
HPLC	high performance liquid chromatography
ICP	inductively coupled plasma
HR	high resolution
ICP-OES	inductively coupled plasma optical emission spectrometry
K	Potassium
LE	Leeds laboratory of NLS
Li	Lithium
LOD	limit of detection
LoI	loss on ignition
MCERTS	Environment Agency's Monitoring Certification Scheme
Mg	Magnesium
Mn	Manganese

Mo	Molybdenum
N	Nitrogen
Na	Sodium
Ni	Nickel
NLS	National Laboratory Service [Environment Agency]
OCP	organochlorine pesticide
P	Phosphorus
PAH	polycyclic aromatic hydrocarbon
Pb	Lead
PCP	pentachlorophenol
PSD	particle size distribution
PTEs	Potentially Toxic Elements
SAL	Scientific Analysis Laboratories Limited
Sb	Antimony
Se	Selenium
Sn	Tin
Sr	Strontium
TC	total carbon
Ti	Titanium
Tl	Thallium
TN	total nitrogen
USEPA	United States Environmental Protection Agency
V	Vanadium
WW	wet weight
Zn	Zinc

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