

Fukushima Radioactive Monitoring in Scotland

Summary of Monitoring Data



1st September 2011

Scottish Environment Protection Agency

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1. Summary/Acknowledgements

This report provides a single reference for the additional analysis work undertaken in Scotland following the positive detection of trace levels of ^{131}I from the Fukushima nuclear incident in Japan. Data is provided from SEPA's routine monitoring network, Dounreay Site Restoration Limited and University of Lancaster.

SEPA gratefully appreciates the co-operative and constructive manner in which data was supplied to SEPA by contractors, operators and academia, which allowed SEPA to make an informed decision of the magnitude of the impact on a timely basis.

2. Scope

The aim of this report is to provide a single comprehensive list of data generated by additional sampling and to demonstrate the volume of data provided to SEPA by its contractors and third parties.

SEPA expects that a UK wide report will be produced later in 2011 to include SEPA's data together with data from the Environment Agency and the Health Protection Agency.

3. Public Health Implications

The concentrations of ^{131}I detected around Scotland from the Fukushima nuclear incident in Japan did not pose a significant risk to human health and no special precautions were necessary. The concentrations detected were consistent with those found further afield e.g. across Europe and demonstrate that the monitoring programme in Scotland is capable of detecting even trace levels of radioactive contamination present in the air.

4. SEPA Data Tables

The following data tables provide results from SEPA's additional environmental monitoring conducted in response to the elevated ¹³¹I measurement from the routine network on 25 March 2011.

- Results below the limit of detection are depicted as "N/D"
- Sample locations are limited to the geographical region of Scotland

Table 1: High and Medium Volume Air Sampling Results (micro Becquerel/cubic metre – $\mu\text{Bq}/\text{m}^3$)

Region	Date on	Date off	Duration (days)	Sample Volume (m^3)	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Ayrshire 1	29/03/2011	05/04/2011	07	563	242 ± 53	N/D	29 ± 15	59 ± 20
Ayrshire 2	29/03/2011	05/04/2011	07	577	380 ± 120	N/D	N/D	N/D
Ayrshire 3	29/03/2011	05/04/2011	07	644	220 ± 110	N/D	N/D	N/D
Caithness 1	30/03/2011	06/04/2011	07	553	297 ± 110	N/D	N/D	N/D
Caithness 2	30/03/2011	06/04/2011	07	632	199 ± 80	N/D	N/D	N/D
Caithness 3	30/03/2011	06/04/2011	07	616	255 ± 76	N/D	N/D	N/D
Dumfries & Galloway 1	28/03/2011	04/04/2011	07	23600	368 ± 35	13.4 ± 6.3	46.4 ± 4.5	55.2 ± 5.5
Shetland	28/03/2011	04/04/2011	07	18600	312 ± 32	N/D	64.9 ± 6.3	65.7 ± 6.8
Lothian 1	01/04/2011	08/04/2011	07	1152	198 ± 27	N/D	30 ± 5.7	37 ± 12
Lothian 2	01/04/2011	08/04/2011	07	1083	184 ± 76	N/D	29.9 ± 7.1	44 ± 16
Dumfries & Galloway 2	04/04/2011	11/04/2011	07	1240	76 ± 24	N/D	32 ± 17	27 ± 15
Dumfries & Galloway 3	04/04/2011	11/04/2011	07	1200	105 ± 35	N/D	51 ± 17	37 ± 26
Dumfries & Galloway 4	04/04/2011	11/04/2011	07	1350	65 ± 26	N/D	36.4 ± 8.7	50 ± 19
Ayrshire 2	05/04/2011	12/04/2011	07	604	137 ± 55	N/D	47 ± 18	71 ± 46
Ayrshire 3	05/04/2011	12/04/2011	07	672	122 ± 57	N/D	N/D	N/D
Shetland	04/04/2011	11/04/2011	07	17700	144 ± 16	N/D	53.3 ± 5.3	56.1 ± 6.2
Ayrshire 1	05/04/2011	12/04/2011	07	594	109 ± 45	N/D	44 ± 20	60 ± 34
Caithness 1	06/04/2011	13/04/2011	07	598	74 ± 45	N/D	40 ± 18	61 ± 41

Region	Date on	Date off	Duration (days)	Sample Volume (m ³)	¹³¹ I		¹³² Te		¹³⁴ Cs		¹³⁷ Cs	
Caithness 2	06/04/2011	13/04/2011	07	685	116	± 39	N/D		N/D		N/D	
Caithness 3	06/04/2011	13/04/2011	07	629	76	± 44	N/D		N/D		N/D	
Lothian 1	08/04/2011	15/04/2011	07	601	96	± 36	N/D		29.6	± 6.9	25	± 21
Lothian 2	08/04/2011	15/04/2011	07	563	70	± 31	N/D		23.9	± 8.6	57	± 22
Central	11/04/2011	14/04/2011	03	15100	63.8	± 7.5	N/D		18.7	± 2.3	18.8	± 3.2
Dumfries & Galloway 1	04/04/2011	11/04/2011	07	24300	123	± 14	N/D		61.8	± 6.0	61.9	± 6.6
Central	14/04/2011	18/04/2011	04	20000	35.5	± 5.2	N/D		11.5	± 1.7	12	± 1.9
Lothian 1	01/04/2011	08/04/2011	07	585	389	± 53	N/D		60	± 12	67	± 23
Lothian 2	01/04/2011	08/04/2011	07	552	362	± 64	N/D		59	± 14	87	± 31
Dumfries & Galloway 2	04/04/2011	11/04/2011	07	621	152	± 48	N/D		64	± 33	53	± 29
Dumfries & Galloway 3	04/04/2011	11/04/2011	07	603	208	± 68	N/D		101	± 33	73	± 50
Dumfries & Galloway 4	04/04/2011	11/04/2011	07	684	128	± 50	N/D		90	± 22	99	± 37
Dumfries & Galloway 2	11/04/2011	18/04/2011	07	626	N/D		N/D		N/D		N/D	
Dumfries & Galloway 3	11/04/2011	18/04/2011	07	606	N/D		N/D		N/D		N/D	
Dumfries & Galloway 4	11/04/2011	18/04/2011	07	689	N/D		N/D		N/D		N/D	
Ayrshire 1	12/04/2011	19/04/2011	07	568	N/D		N/D		N/D		N/D	
Ayrshire 3	12/04/2011	19/04/2011	07	658	N/D		N/D		N/D		N/D	
Ayrshire 2	12/04/2011	19/04/2011	07	583	N/D		N/D		N/D		N/D	
Central	11/04/2011	14/04/2011	03	15100	63.8	± 7.5	N/D		18.7	± 2.3	18.8	± 3.2
Central	18/04/2011	21/04/2011	03	15200	26.2	± 6.2	N/D		5.8	± 1.6	3.4	± 1.5
Central	21/04/2011	26/04/2011	05	25200	21.8	± 4.2	N/D		16.3	± 1.9	14.5	± 1.9
Dumfries & Galloway 1	11/04/2011	18/04/2011	07	23300	20.3	± 2.5	N/D		11.8	± 1.2	11.4	± 1.3
Shetland	11/04/2011	18/04/2011	07	19000	19.4	± 2.8	N/D		11	± 1.2	12	± 1.7
Caithness 1	13/04/2011	20/04/2011	07	589	N/D		N/D		N/D		N/D	
Caithness 2	13/04/2011	20/04/2011	07	665	N/D		N/D		N/D		N/D	
Caithness 3	13/04/2011	20/04/2011	07	611	N/D		N/D		N/D		N/D	
Lothian 1	15/04/2011	22/04/2011	07	588	N/D		N/D		N/D		N/D	
Lothian 2	15/04/2011	22/04/2011	07	545	N/D		N/D		N/D		N/D	

Region	Date on	Date off	Duration (days)	Sample Volume (m ³)	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Ayrshire 1	19/04/2011	26/04/2011	07	582	N/D	N/D	N/D	N/D
Ayrshire 2	19/04/2011	26/04/2011	07	593	N/D	N/D	N/D	N/D
Ayrshire 3	19/04/2011	26/04/2011	07	672	N/D	N/D	N/D	N/D
Dumfries & Galloway 2	18/04/2011	26/04/2011	08	697	N/D	N/D	N/D	N/D
Dumfries & Galloway 3	18/04/2011	26/04/2011	08	684	N/D	N/D	N/D	N/D
Dumfries & Galloway 4	18/04/2011	26/04/2011	08	780	N/D	N/D	N/D	N/D
Caithness 1	20/04/2011	27/04/2011	07	590	N/D	N/D	N/D	N/D
Caithness 2	20/04/2011	27/04/2011	07	678	N/D	N/D	N/D	N/D
Caithness 3	20/04/2011	27/04/2011	07	619	N/D	N/D	N/D	N/D
Lothian 2	22/04/2011	28/04/2011	06	473	N/D	N/D	N/D	N/D
Lothian 1	22/04/2011	28/04/2011	06	506	N/D	N/D	N/D	N/D
Ayrshire 1	26/04/2011	03/05/2011	07	583	N/D	N/D	N/D	N/D
Ayrshire 2	26/04/2011	03/05/2011	07	592	N/D	N/D	N/D	N/D
Ayrshire 3	26/04/2011	03/05/2011	07	674	N/D	N/D	N/D	N/D
Central	26/04/2011	28/04/2011	02	10100	23.6 ± 3.6	N/D	27.6 ± 2.8	26.9 ± 3.2
Dumfries & Galloway 1	18/04/2011	25/04/2011	07	23,000	10.5 ± 5.1	N/D	6.3 ± 1.1	6 ± 1.9
Shetland	18/04/2011	25/04/2011	07	17,900	21.6 ± 6.4	N/D	10.5 ± 1.5	11.9 ± 2.2
Dumfries & Galloway 1	25/04/2011	02/05/2011	07	23,200	6.5 ± 3.5	N/D	22.8 ± 2.4	22.3 ± 2.9
Dumfries & Galloway 2	26/04/2011	03/05/2011	07	629	N/D	N/D	N/D	N/D
Dumfries & Galloway 3	26/04/2011	03/05/2011	07	605	N/D	N/D	N/D	N/D
Dumfries & Galloway 4	26/04/2011	03/05/2011	07	687	N/D	N/D	N/D	N/D
Caithness 1	27/04/2011	04/05/2011	07	599	N/D	N/D	N/D	N/D
Caithness 2	27/04/2011	04/05/2011	07	696	N/D	N/D	N/D	N/D
Caithness 3	27/04/2011	04/05/2011	07	631	N/D	N/D	N/D	N/D
Lothian 1	28/04/2011	06/05/2011	08	674	N/D	N/D	N/D	N/D
Lothian 2	28/04/2011	06/05/2011	08	625	N/D	N/D	N/D	N/D
Central	05/05/2011	12/05/2011	07	28700	N/D	N/D	N/D	N/D
Shetland	25/04/2011	02/05/2011	07	18,700	N/D	N/D	13.7 ± 1.9	15.2 ± 2.1

Region	Date on	Date off	Duration (days)	Sample Volume (m ³)	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Dumfries & Galloway 1	02/05/2011	09/05/2011	07	22,000	N/D	N/D	4.95 ± 0.64	5.4 ± 1.2

Table 2: Rainwater monitoring (Bq/l)

Region	Date on	Date off	Duration (days)	Rainfall (mm)	¹³¹ I	¹³² Te	¹³⁴ Cs
Central 2	31/03/2011	04/04/2011	04	0.94 * litres	0.69	± 0.30	
Dumfries & Galloway 5	31/03/2011	11/04/2011	11	62.9	N/D	N/D	N/D
Central 2	07/04/2011	26/04/2011	19	7.8	N/D	N/D	N/D
Dumfries & Galloway 5	11/04/2011	18/04/2011	07	10.1	N/D	N/D	N/D
Central 2	26/04/2011	12/05/2011	16	44.5	N/D	N/D	N/D
Dumfries & Galloway 5	25/04/2011	09/05/2011	14	59.1	N/D	N/D	N/D

Table 3: Surface Water monitoring (Bq/l)

Region	Date	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Lothian 3	01/04/2011	N/D	N/D	N/D	N/D
Lothian 4	01/04/2011	N/D	N/D	N/D	N/D
Dumfries & Galloway 6	04/04/2011	N/D	N/D	N/D	N/D
Dumfries & Galloway 7	04/04/2011	N/D	N/D	N/D	N/D
Dumfries & Galloway 8	04/04/2011	N/D	N/D	N/D	N/D
Ayrshire 4	29/03/2011	N/D			
Ayrshire 5	29/03/2011	N/D			
Ayrshire 6	29/03/2011	N/D			
Caithness 4	30/03/2011	N/D			N/D
Caithness 5	30/03/2011	N/D			N/D
Caithness 6	30/03/2011	0.20 ± 0.13			N/D
Lothian 5	01/04/2011	N/D			N/D

Table 4: Milk monitoring (Bq/l)

Region	Date	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Dumfries & Galloway 9	28/03/2011	N/D			
Dumfries & Galloway 10	28/03/2011	N/D			
Dumfries & Galloway 11	28/03/2011	N/D			
Ayrshire 7	29/03/2011	N/D			
Ayrshire 8	29/03/2011	N/D			
Ayrshire 9	29/03/2011	N/D			
Ayrshire 10	31/03/2011	N/D			N/D
Caithness 7	30/03/2011	N/D			N/D
Caithness 8	30/03/2011	N/D			N/D
Lothian 6	01/04/2011	N/D			N/D

Table 5: Grass monitoring (Bq/kg wet)

Site	Date	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Caithness 9	30/03/2011	2.38 ± 0.71			N/D
Caithness 10	30/03/2011	2.76 ± 0.81			0.53 ± 0.24
Caithness 11	30/03/2011	2.08 ± 0.73			N/D

Table 6: Soil monitoring (Bq/kg wet)

Site	Date	¹³¹ I	¹³² Te	¹³⁴ Cs	¹³⁷ Cs
Caithness 12	30/03/2011	N/D			22.8 ± 6.2
Caithness 13	30/03/2011	N/D			25.2 ± 6.9
Caithness 14	30/03/2011	N/D			2.91 ± 0.81

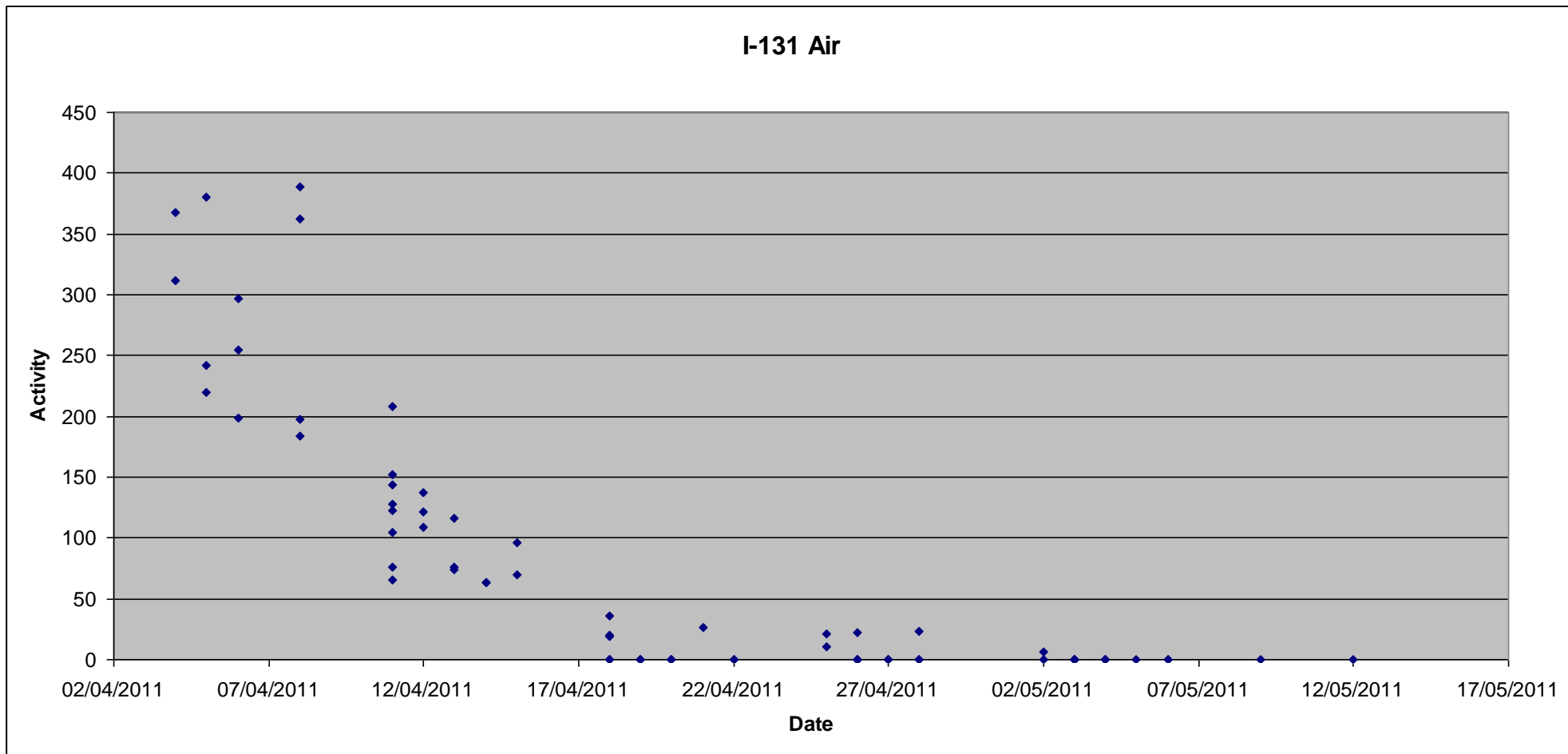


Figure 1: I-131 in Air across Scotland, April – May 2011

5. Operator Data Tables

This series of data tables presents monitoring results that were provided to SEPA by Dounreay Site Restoration Limited.

Table 7: High Volume Air Sampling (Bq/kg)

Location	Date	¹³¹ I	Error	¹³⁴ Cs	Error	¹³⁷ Cs	Error
Caithness Operator 1	01/04/2011	7.49E-05	5.22E-06	2.31E-05	1.64E-06	2.19E-05	2.19E-05
Caithness Operator 2	02/04/2011	5.82E-05	4.36E-06	8.61E-06	9.72E-07	7.93E-06	7.93E-06
Caithness Operator 3	03/04/2011	9.18E-05	6.16E-06	9.72E-06	1.05E-06	9.61E-06	9.61E-06
Caithness Operator 4	04/04/2011	7.24E-05	4.96E-06	8.31E-06	1.12E-06	8.36E-06	8.36E-06
Caithness Operator 5	05/04/2011	5.50E-05	4.11E-06	1.01E-05	1.07E-06	9.32E-06	9.32E-06
Caithness Operator 6	06/04/2011	5.89E-05	3.75E-06	1.02E-05	9.40E-07	9.44E-06	9.44E-06

Note: Filters had been in place for approximately 1 month

Table 8: Grass sampling (Bq/kg dry)

Location	Date	¹³¹ I	Error
Caithness Operator 7	22/03/2011	4.60E-01	5.96E-01
Caithness Operator 8	28/03/2011	5.31E+00	1.11E+00
Caithness Operator 9	28/03/2011	3.65E+00	7.97E-01
Caithness Operator 10	29/03/2011	7.00E+00	1.49E+00
Caithness Operator 11	29/03/2011	5.60E+00	1.59E+00
Caithness Operator 12	30/03/2011	6.47E+00	1.24E+00
Caithness Operator 13	04/04/2011	8.90E+00	1.40E+00
Caithness Operator 14	04/04/2011	6.00E+00	1.00E+00
Caithness Operator 7	05/04/2011	1.70E+01	1.90E+00
Caithness Operator 15	05/04/2011	1.50E+01	2.20E+00
Caithness Operator 16	05/04/2011	1.30E+01	3.80E+00
Caithness Operator 10	11/04/2011	1.50E+01	2.70E+00
Caithness Operator 11	11/04/2011	8.10E+00	2.10E+00
Caithness Operator 12	12/04/2011	8.23E+00	1.59E+00
Caithness Operator 8	13/04/2011	1.04E+01	1.92E+00
Caithness Operator 9	13/04/2011	1.68E+01	2.10E+00

Table 9: Rainfall monitoring (Bq/l)

Location	¹³¹ I	Error
Caithness Operator 13	2.07E-02	1.16E-02
Caithness Operator 14	4.61E-02	2.10E-02
Caithness Operator 15	8.16E-02	5.45E-02
Caithness Operator 16	7.21E-02	2.43E-02
Caithness Operator 17	1.19E-02	1.29E-02
Caithness Operator 18	4.12E-02	2.54E-02
Caithness Operator 19	3.48E-02	2.76E-02

Note: Taken on 1st April

6. Academia Data Tables

Table 10 provides results of mixed sampling undertaken by academia across the United Kingdom. Data was provided to SEPA through the Centre for Ecology and Hydrology at Lancaster University.

Table 10: Academia Data Table (Bq/kg grass/food & Bq/l milk/rainwater)

CEH ID	Location	Date	Notes	Sample	¹³¹ I	Error
RCJ59	Cumbria	01/04/2011		Grass	3.5	0.3
RCJ106	Cumbria	09/04/2011		Grass	3.4	0.6
RCJ68	Gwynedd	01/04/2011		Grass	7.4	0.4
RCJ64	Isle of Wight	01/04/2011		Grass	5.1	0.6
RCJ58	Cumbria	01/04/2011		Grass	4.4	0.5
RCJ97	Cumbria	08/04/2011		Grass	3.3	0.3
RCJ62	Cumbria	01/04/2011		Wild Garlic	N/D	-
RCJ78	Oxfordshire	01/04/2011		Grass	5.4	0.4
RCJ66	Midlothian	01/04/2011		Grass	3.9	0.4
RCJ70	North Yorkshire	02/04/2011		Grass	26.5	1.6
RCJ60	Cumbria	01/04/2011		Grass	6.9	0.4
RCJ107	Cumbria	09/04/2011		Grass	2.8	0.5
RCJ109	Cumbria	08/04/2011		Grass	3.6	0.4
RCJ61	Lancashire	01/04/2011		Grass	5.4	0.4
RCJ79	Lancashire	03/04/2011		Grass	5.1	0.4
RCJ76	Lancashire	04/04/2011		Grass	4.2	0.3
RCJ84	Lancashire	05/04/2011		Grass	3.6	0.2
RCJ90	Lancashire	06/04/2011		Grass	5.3	0.5
RCJ92	Lancashire	07/04/2011		Grass	7.8	0.4
RCJ99	Lancashire	08/04/2011		Grass	5.9	0.3
RCH100	Lancashire	09/04/2011		Grass	6.6	0.3
RCJ105	Lancashire	11/04/2011		Grass	4.4	0.4
RCJ74	Lancashire	02/04/2011	Date on - 01/04/2011	Rainwater	N/D	-
RCJ85	Lancashire	05/04/2011	Date on - 04/04/2011	Rainwater	N/D	-
RCJ82	Caithness	03/04/2011		Grass	4.7	0.6
RCJ102	Caithness	07/04/2011		Grass	4.3	0.4
RCHJ75	Cumbria	02/04/2011		Grass	5.4	0.5
RCJ108	Cumbria	09/04/2011		Grass	3.2	0.5
RCJ57	Cumbria	01/04/2011		Grass	5.2	0.4
RCJ95	Cumbria	08/04/2011		Grass	3.5	0.4
RCJ110	Midlands	08/04/2011		Grass	4.4	1.5
RCJ101	Midlands	08/04/2011		Grass	6.6	0.4
RCJ112	Midlands	06/04/2011		Grass		-
RCJ86	Cumbria	06/04/2011		Grass	21.1	1.8
RCJ88	Cumbria	06/06/2011	Date on 30/3/11	Rainwater	N/D	-
RCJ89	Cumbria	06/06/2011	Date on 30/3/11	Rainwater	N/D	-
RCJ71	Lancashire	07/04/2011		Kale	N/D	-
RCJ67	Devon	01/04/2011		Grass	3.2	0.5
RCJ94	Devon	07/04/2011		Grass	25.9	2.4
RCJ69	Norfolk	01/04/2011		Grass	4.8	0.5
RCJ93	Norfolk	07/04/2011		Grass	7.8	2
RCJ63	Cumbria	30/03/2011		Grass	1.6	0.4
RCJ56	Cumbria	01/04/2011		Grass	5.6	0.4
RCJ83	Cumbria	05/04/2011		Grass	4.1	0.4
RCJ98	Cumbria	08/04/2011		Grass	3.6	0.3
RCJ81	Caithness	01/04/2011		Grass	5.3	0.6
RCJ103	Caithness	02/04/2011		Grass	5.7	0.5
RCJ65	North Yorkshire	01/04/2011		Grass	8.1	0.7

CEH ID	Location	Date	Notes	Sample	¹³¹ I	Error
RCJ77	Oxfordshire	07/04/2011		Grass	3.9	1.3
RCJ96	Oxfordshire	07/04/2011		Grass	4.1	0.4
RCJ73	Cambridgeshire	02/04/2011		Grass	3.5	0.3
RCJ104	Cambridgeshire	08/04/2011		Grass	4	0.3
RCJ72	Cambridgeshire	02/04/2011	including 1/4/11	Goat milk	N/D	-
RCJ87	Cambridgeshire	04/04/2011	including 3/4/11	Goat milk	N/D	-