OSPAR COMMISSION

Protecting and conserving the North-East Atlantic and its resources

Dutch Implementation Report of PARCOM Recommendation 91/4 on radioactive discharges

Radioactive Substances Series

2018

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998.
Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

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Contents

Executive Summary

PARCOM Recommendation 91/4 concerns the use of Best Available Technologies (BAT) to minimise and, as appropriate, eliminate any pollution caused by radioactive discharges from all nuclear industries, including research reactors and reprocessing plants, into the marine environment. The guidelines for the implementation of this Recommendation request that Contracting Parties to the OSPAR Convention report on a four-year basis on progress in the implementation of BAT in such facilities. This is the report of the Netherlands for the seventh round of implementation reporting (2016 - 2019). The information is submitted according to the OSPAR "Guidelines for the submission of information about, and assessment of, the application of BAT in nuclear facilities" (OSPAR Agreement 2004-03).

The information presented in this report indicates that BAT/BEP has been applied to all nuclear installations in the Netherlands: the only operational nuclear power plant in the Netherlands, the nuclear fuel enrichment plant, two research reactors, and the nuclear waste treatment and storage plant. For completeness, we mention that the Low Flux Reactor in Petten is since 2010 no longer in use, and is presently in decommissioning: the fuel has been removed in 2012. The nuclear power plant Dodewaard, which ceased operations in 1997 and is presently in the state of Safe Enclosure, has discharged no radionuclides to water since July 2005.

1. Abstract

This report presents the discharges of radioactive substances to sea by nuclear installations in the Netherlands between 2012 and 2015. The preceding ten-year period 1998-2007 is covered by the previous report [OSPAR09, also available as RIVM09], so this report focuses on the changes and additional information since the year 2007. The techniques used to reduce these discharges and details on the nuclear installations are described in the previous report over the period 1998-2007. This report fulfills the recommendation of the OSPAR Convention to report regularly on these discharges and techniques.

The Netherlands has ratified the OSPAR Convention, which entered into force in 1998. The aim of the OSPAR Convention is to prevent and eliminate pollution and to protect the marine environment of the North-East Atlantic (including the North Sea) against the adverse effects of human activities. The agreement is to prevent pollution as much as possible and to terminate discharges where possible.

The highest radiation dose resulting from the discharges to sea has been assessed for each of the nuclear installations. Each dose is less than one thousandth of the average radiation dose for individuals in the Netherlands.

Key words:
OSPAR, radioactive substances, nuclear power plant, nuclear installation, discharges, water, marine environment, North Sea, the Netherlands

1. Introduction

PARCOM Recommendation 91/4 states that Contracting Parties agree "to respect the relevant recommendations of the competent international organisations and to apply the Best Available Technology (BAT) to minimise and, as appropriate, eliminate any pollution caused by radioactive discharges from all nuclear industries, including research reactors and reprocessing plants, into the marine environment. Contracting Parties shall present a statement on progress made in applying such technology every four years in accordance with the guidelines annexed to this recommendation".

After the third round of implementation reporting on PARCOM Recommendation 91/4, OSPAR agreed revised guidelines for the submission of information about, and the assessment of, the application of BAT in nuclear facilities (OSPAR Agreement 2004-03 [OSPAR04]). This document has been written according to these guidelines, focusing on the changes which have occurred since the previous round of reporting.

This document reviews the situation in the Netherlands over the period 2012 – 2015, and is part of the 7th round of implementation reporting. Information over the years 2008-2011, which is covered by a previous report [OSPAR13] , is also added here, for convenience. Information pertaining to the years 1998 – 2007 is given in [OSPAR09].

The Low Flux Reactor in Petten stopped operations in 2010, and is present in decommissioning: the fuel has been removed in 2012. The nuclear power plant Dodewaard, which ceased operations in 1997 and is presently in the state of Safe Enclosure, has discharged no radionuclides to water since July 2005.

Annex A to this report provides additional information on the location of the nuclear installations and specific sampling locations of the national monitoring programme. Figures showing the discharges and emissions normalized to the granted limits and annual production figures can be found in Annex B. The environmental impact is illustrated in Annex C, and Annex D reports a selection of the environmental measurements in the vicinity of the nuclear power plant of Borssele. In Annex E the specific references for the discharge data since 2008 are given for each year and for each installation.

2. General information

2.1 Implementation of BAT/BEP in terms of the OSPAR convention in national legislation/regulation

The notable change in legislation since the previous report [OSPAR13] is the creation of the Authority for Nuclear Safety and Radiation Protection (ANVS) on January 1st, 2015. The ANVS combines expertise in the fields of nuclear safety and radiation protection, as well as security and safeguards. Being an independent administrative body, the ANVS performs government tasks, but is not directly subject to ministerial authority. The ANVS carries out regulatory activities and can implement any measures that are required in the interests of nuclear safety, security and safeguards, or radiation protection. The ANVS issues licences and records notifications. It also registers and accredits experts and radiation practitioners. Working with its partners, the ANVS ensures that the Netherlands is as well prepared as possible for radiation safety and security accidents. The Authority is also tasked with developing nuclear safety, security and safeguards, and radiation protection policies, including radioactive waste and decommissioning policy. In this connection, it prepares legislation and regulations or provides advice. At international level, the ANVS coordinates with various foreign agencies, authorities and organizations, such as the IAEA and OSPAR as far as radioactive substances and nuclear installations are involved.

2.2 Dose limits/constraints for nuclear installations

There have not been any relevant changes in legislation since the previous reports [OSPAR13].

2.3 Discharge limits

There have not been any relevant changes in legislation regarding discharge limits since the previous reports [OSPAR13].

2.4 Monitoring programmes of environmental concentrations of radionuclides

Rijkswaterstaat monitors the activity concentrations of radionuclides in inland waters and the marine environment. It is the executive arm of the Dutch Ministry of Infrastructure and Water Management.

There have not been any relevant changes in legislation since the previous report [OSPAR13].

2.5 National authority responsible for supervision of discharges

The ANVS ("Authority for Nuclear Safety and Radiation Protection") is the national authority responsible for the supervision of discharges of radionuclides into air and water. The ANVS was formed in 2015 by bringing together the knowledge and expertise necessary to perform those activities at a high level. The ANVS became an Independent Administrative Body ("ZBO" in Dutch) on August 1st, 2017. An independent administrative body performs government tasks, but is not directly subject to ministerial authority. This legal form guarantees the independence of the ANVS. The duties and responsibilities of the Nuclear Safety Service ("Kernfysische Dienst", KFD), which was previously the national authority responsible for the supervision of discharges of radionuclides into air and water, have been transferred to the ANVS.

2.6 Nature of inspection and surveillance programmes

There have not been any relevant changes in legislation since the previous report [OSPAR13], with the exception of the establishment of the ANVS (see paragraph 2.1).

3. The Nuclear Power Plant in Borssele

The information on discharges over the years 2007-2015, together with other changes since 2011 (the last year reported in the previous report [OSPAR13]), is given here. The discharges over the years 2007-2011 have been previously reported [OSPAR13] and are added here for convenience.

In June 2011 the plant has been licensed to use other fuels in addition to enriched Uranium (to a maximum of 2.5% in weight of U-235), namely MOX (to a maximum of 5.41% in weight of fissile Pu, with a maximum allowed number of MOX fuel elements in the reactor of 48, which corresponds to 40% of the total), and compensated enriched reprocessed uranium (c-ERU, enriched to a maximum of 4.6% in weight of U-235 to compensate for U-236 content), and to burn a nuclear fuel element up to a maximum of 68 MWd/kgU (pin average).

Table 3.1: *Annual electric output of net produced electricity*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
GWh	3994	3934	4019	3755	3917	3707	2738	3874	3862
GWa	0.455	0.450	0.459	0.429	0.447	0.423	0.313	0.442	0.441

Table 3.2*: Liquid discharges of gamma and beta emitters of the Borssele NPP, excluding tritium (in TBq/GWa)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cr-51	2.2E-06	3.1E-06	<DL	4.2E-06	6.7E-07	<DL	5.8E-06	6.4E-07	2.3E-06
Mn-54	2.0E-06	4.0E-06	5.5E-07	1.4E-06	<DL	<DL	1.9E-06	2.7E-07	2.3E-07
Fe-55	8.9E-05	2.4E-05	3.2E-05	2.8E-05	6.3E-06	8.0E-06	7.2E-05	<DL	<DL
Co-58	6.0E-06	9.2E-06	2.5E-06	3.8E-06	2.7E-07	4.1E-07	3.3E-06	2.7E-07	1.4E-06
Co-60	1.4E-04	1.5E-04	1.2E-04	1.4E-04	9.1E-05	7.3E-05	9.9E-05	3.0E-05	3.4E-05
Ni-63	1.7E-04	1.4E-04	1.4E-04	8.8E-05	4.5E-05	4.1E-05	7.3E-05	1.3E-05	1.5E-05
Zr-95	2.3E-05	1.2E-05	1.4E-06	8.4E-06	1.0E-06	1.4E-06	1.1E-05	1.0E-06	1.1E-05
Nb-95	3.7E-05	2.0E-05	3.2E-06	1.5E-05	2.6E-06	3.6E-06	2.4E-05	2.3E-06	1.8E-05
Ag-110m	5.8E-06	1.5E-05	1.7E-05	3.0E-05	7.0E-06	1.5E-06	1.7E-05	5.0E-09	1.9E-06
Te-123m	2.2E-07	2.1E-07	1.4E-07	1.5E-06	3.1E-08	6.1E-08	7.0E-07	1.1E-07	4.8E-07
Sb-124	1.3E-06	5.5E-06	1.7E-07	3.5E-08	1.1E-06	1.1E-06	2.4E-06	1.0E-06	1.0E-06
I-131	1.4E-05	3.1E-05	<DL	1.9E-05	5.5E-06	1.5E-05	3.8E-05	1.0E-05	<DL
Cs-134	6.0E-06	2.2E-06	1.8E-06	3.1E-06	<DL	<DL	<DL	<DL	<DL
Cs-137	2.6E-05	2.8E-05	2.4E-05	3.0E-05	1.6E-05	2.0E-05	2.0E-05	1.2E-05	9.8E-06

<DL is below detection limit

Table 3.3*: Liquid discharges of H-3 of Borssele NPP (in TBq/GWa)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	13	15	16	15	15	18	22	7	15

Table 3.4: *Liquid discharges of alpha emitters of Borssele NPP (in TBq/GWa)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Alpha	2.0E-07	2.0E-07	7.4E-07	<DL	<DL	<DL	<DL	<DL	<DL

<DL is below detection limit

Comparison with similar reactors

UNSCEAR [UNSC08] reports for the years 1998-2002 an average value of 20 TBq/GWa of H-3 in liquid discharges for PWRs in the world. The reported discharges of tritium in liquid effluents of the PWR reactor Borssele are below this value since 2007, with the exception of the year 2013 when the discharge was 22 TBq/GWa. The liquid discharge of H-3 in 2014 of 7 TBq/GWa, the lowest of the time series, is due to a revision period taking place in the last months of 2013 (the tritium concentration in the primary system is reduced before a revision period).

Emissions to air relevant for the marine compartment

***Table 3.5**: Emissions to air of Borssele NPP (in TBq/GWa)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	5.7E-01	7.1E-01	5.8E-01	5.8E-01	6.6E-01	6.3E-01	8.6E-01	6.8E-01	6.9E-01
C-14	3.1E-01	2.7E-01	3.4E-01	3.8E-01	4.0E-01	3.7E-01	5.2E-01	2.4E-01	2.9E-01

Emissions of I-129 to air are not measured.

***Table 3.6:** Effective dose per year caused by liquid discharges of the Borssele NPP (in μSv)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
E (μSv)	6.8E-06	6.7E-06	5.6E-06	6.3E-06	4.2E-06	4.2E-06	4.8E-06	1.5E-06	2.5E-06

Site specific target discharge data

Tabel *3.7: The discharge limits for liquid discharges per year of the Borssele NPP (in TBq)*

	Discharge limit
Total gamma and rest beta emitters	0.2
Tritium	30
Total alpha emitters	0.0002

The tritium discharge in waste water shows little variation. The tritium emissions to air also show little variation. In Annex B figures are given which show the discharges normalized to these permitted limits and to the annual electric output. The liquid discharges of beta/gamma emitters vary in the period 1998-2011 between 0.01% and 0.29% of the discharge limit and show since 2007 a downward trend.

3.1 Summary evaluation

According to the OSPAR guidelines [OSPAR04], an indication that BAT/BEP has been applied is a downward trend in the liquid discharges and dose estimates. In the case of the NPP in Borssele the emissions to air and water, normalized to the production in GWa, have been reduced where technologically possible. A downward trend is apparent for discharges of total gamma and residual beta to water, and the emissions remain constant at a relatively low level. The calculated dose is consistently below 7E-06 microSv/a over the years 2007 to 2015. It follows that, according to these indicators, BAT/BEP has been applied in NPP Borssele.
Also, in the Netherlands, compliance with the ALARA principle is considered sufficient evidence that the requirements of BAT/BEP in terms of the OSPAR Convention have been met. At present, the NPP in Borssele is judged to be compliant with the ALARA principle. Furthermore, the discharges are low compared to the licensed discharge limits in the license and largely fulfill the site internal discharge targets. The normalized tritium discharges are equal or less than the reference data for the same type of reactor in the UNSCEAR report [UNSC08].
The information presented above is in accordance with the OSPAR guidelines [OSPAR04] and includes indicators that BAT/BEP has been applied in the NPP in Borssele.

4. The Fuel Enrichment Plant in Almelo

The information on discharges over the years 2007-2015, together with other changes since the previous report [OSPAR13], which covers the period 2007-2011, is given here. The discharges over the years 2007-2011 have already been given in the previous report [OSPAR13] and they are also added here, for convenience.

The licensed production capacity was increased from 4500 tSW/y in 2007 to 4950 tSW/y in 2010, to 6200 tSw/y since 15 December 2011 (tSW stands for tonnes of Separative Work).

Table 4.1: *The fuel enrichment production (in tSW/y)*

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
tSW/y	3554	3644	4078	4550	4659	5268	5425	5426	5027

Table 4.2: *Liquid discharges of Almelo facility (in TBq/tSW)*

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
total alpha	1.7E-10	1.7E-10	1.5E-10	1.6E-10	1.5E-10	2.7E-10	1.3E-10	1.5E-10	2.0E-10
beta/gamma	6.4E-10	8.2E-10*	7.7E-10	3.0E-10	3.8E-10	5.7E-10	7.6E-10	3.1E-10	3.2E-10

* Mistakenly reported as 8.1E10 in report report OSPAR13

The figures in Annex B show the discharges normalized to the limits and to production.

4.1 Summary evaluation

According to the Guidelines an indication that BAT/BEP has been applied is a downward trend in the liquid discharges [OSPAR04]. A reduction can be observed in the normalized discharges of radionuclides since the year 2007. This is mainly due to do the closing of separation plant SP3 and the expansion of the modern separation plant SP5.
Moreover, in the Netherlands compliance with the ALARA principle is deemed sufficient to meet the requirements of BAT/BEP in terms of the OSPAR Convention. At present, the fuel enrichment plant in Almelo is considered to comply with the ALARA principle.
The discharges are low compared to the discharge limits in the license. Also, the estimated dose for the critical group due to liquid discharges is very low, less than 1 µSv/year.
The information presented above is in accordance with the OSPAR Agreement 2004-03 and includes indicators that BAT/BEP has been applied in the fuel enrichment plant in Almelo.

5. The Research Facility in Petten

The information on discharges over the years 2007-2015, together with other changes since the previous report [OSPAR13], which covers the period 2007-2011, is given here. The discharges over the years 2007-2011 have already been reported in the previous report [OSPAR13] and they are also added here, for convenience.

The LFR ("Low Flux Reactor") is currently in decommissioning. It stopped operations in December 2010 and the fuel has been removed in 2012. Since 2011, the only operational reactor on the Petten site is the HFR ("High Flux Reactor") research reactor owned by the European Commission. The reactor type is a swimming pool reactor, with an installed capacity of 50 MW (th).

The liquid discharges of the HFR and, until 2010, LFR are presented as a total of the Petten site. The Petten site includes research laboratories and auxiliary industry like Mallinckrodt, and the discharges cannot easily be separated. Therefore, the data presented here are an overestimation of the actual discharges of the HFR (and – until 2010 – of the LFR).

Table 5.1: *Liquid discharges of Petten site (in GBq: i.e. not normalized)*

(GBq)	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	2.7E+02	2.0E+02	6.7E+01	2.6E+02	1.5E+02	1.6E+02	2.7E+02	7.6E+01	1.0E+02
Na-22	5.1E-02	5.2E-02	4.3E-02	6.9E-02	7.7E-02	7.7E-02	6.4E-02	2.0E-02	3.0E-02
Cr-51	7.8E-02	1.5E-03	<DL	7.2E-04	5.5E-03	5.2E-03	NI	NI	NI
Mn-54	8.2E-02	1.3E-02	1.2E-02	1.5E-02	<DL	4.2E-02	7.4E-02	NI	NI
Co-57	1.8E-02	3.2E-02	3.4E-03	2.4E-02	1.5E-01	9.0E-02	2.0E-01	NI	NI
Co-58	5.2E-02	6.9E-03	2.9E-03	3.1E-03	1.4E-02	2.0E-02	4.0E-02	NI	NI
Co-60	1.2E+00	3.8E-01	5.3E-01	2.7E-01	5.4E-01	7.1E-01	1.8E+00	1.1E+00	4.2E-01
Zn-65	5.0E-01	2.3E-01	5.8E-01	2.6E-01	1.8E-01	1.6E-01	3.9E-01	3.4E-02	1.8E-02
Mo-99	3.0E+00	3.5E-01	3.8E-01	2.3E-01	9.7E-02	9.9E-02	3.7E-01	NI	NI
Ru-103	5.5E-03	3.5E-03	6.7E-04	5.4E-04	3.5E-03	4.0E-03	5.4E-04	NI	NI
Cd-109	2.1E+01	1.6E+00	1.3E+00	1.3E-01	7.1E-02	2.1E-02	2.7E-02	1.8E-03	7.3E-05
Sb-124	4.1E-01	3.3E-01	5.5E-02	1.9E-01	1.8E-01	6.0E-02	9.8E-03	1.6E-02	2.9E-02
Sb-125	3.1E-01	2.0E-01	5.7E-02	1.9E-01	1.8E-01	2.6E-01	1.5E-01	7.4E-02	1.0E-01
I-131	4.6E-01	2.3E-01	2.6E-01	1.3E+01	3.5E+00	1.6E+00	7.5E-01	1.1E-01	4.6E-03
Cs-134	5.5E-01	1.0E-01	7.5E-02	5.0E-02	3.3E-02	1.7E-02	1.4E-02	1.4E-02	5.5E-03
Cs-137	1.4E+00	6.3E-01	4.8E-01	7.0E-01	8.3E-01	6.7E-01	7.8E-01	4.8E-01	3.1E-01
W-181	1.3E-01	2.8E-01	8.6E-03	8.2E-03	8.9E-02	3.7E-01	3.7E-02	NI	NI
W-188	2.5E-02	6.4E-02	<DL	6.3E-04	7.6E-03	5.3E-02	1.1E-03	NI	NI
Re-186	<DL	9.0E-03	<DL	<DL	2.8E-03	NI	NI	NI	NI
Tl-202	1.4E-03	2.9E-03	1.1E-02	5.4E-03	2.8E-03	3.6E-03	1.2E-03	NI	NI
Alpha	2.4E-03	4.9E-03	2.4E-03	9.1E-04	1.9E-03	2.1E-03	1.7E-03	2.6E-03	5.1E-03
Beta	9.8E+01	6.0E+01	1.5E+01	1.4E+01	1.4E+01	2.4E+01	1.6E+01	1.1E+01	8.2E+00

<DL is below detection limit

Table 5.2: *Tritium emissions to air from all facilities combined on the Petten site (in TBq: i.e. not normalized)*

(TBq)	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	0.3	0.3	0.4	0.3	0.4	0.3	0.2	0.2	0.3

Table 5.4*: Effective dose per year caused by the liquid discharges of the Petten site (in µSv)*

	2007	2008	2009	2010	2011	2012	2013	2014	2015
E (?Sv)	9E-03	1E-03	7E-04	5E-04	6E-04	6E-04	1E-03	7E-04	3E-04

5.1 Summary evaluation

According to the Guidelines, an indication that BAT/BEP has been applied is a downward trend in the liquid discharges [OSPAR04]. The annual liquid discharges of the Petten site do not show such a downward trend, but vary from year to year. The effective dose due to the liquid discharges shows the same variation. Also the estimated dose for the critical group due to liquid discharges is very low, much less than 1 µSv/y.
In the Netherlands, the requirements of BAT/BEP in terms of the OSPAR Convention are met when the ALARA principle is applied. At present the Petten site is considered to comply with the ALARA principle.
The information presented above is in accordance with the OSPAR Agreement 2004-03 [OSPAR04] and includes indicators that BAT/BEP has been applied in the Petten site.

6. The Research Facility in Delft

This section gives information on discharges over the years 2007-2015. Information since the previous report [OSPAR13], which covers the period 2007-2011, is also added here, for convenience.

Table 6.1: *Liquid discharges of Delft facility (in GBq: i.e. not normalized)*

(GBq)	2007	2008	2009	2010	2011	2012	2013	2014	2015
Alpha	< 0.59E-03	< 0.1E-03	< 0.1E-03	< 0.3E-03	< 0.1E-03	< 0.1E-03	< 0.1E-03	< 0.1E-03	< 0.1E-03
Beta	4.67E-03	4.92E-03	2.0E-03	1.06E-02	6.0E-03	6.2E-02	4.3E-03	2.4E-03	2.4E-03
Gamma	< 2.89E-03	< 2.58E-03	1.0E-03	5.51E-03	3.6E-03	4.0E-02	4.3E-03	3.9E-03	4.9E-03

6.1 Summary Evaluation

According to the Guidelines, an indication that BAT/BEP has been applied is a downward trend in the liquid discharges [OSPAR04]. The annual liquid discharges of the research facility in Delft do not show such a downward trend but vary from year to year. However, the question whether or not BAT/BEP has been applied, is not only a matter of downward trends.
In the Netherlands, the requirements of BAT/BEP in terms of the OSPAR Convention are met when the ALARA principle is applied. At present, the research facility in Delft is considered to comply with the ALARA principle. The discharges are low compared to the discharge limits in the license. Also the estimated dose for the critical group due to liquid discharges is very low, less than 0.009 Sv/y.
The information presented above is in accordance with the OSPAR Agreement 2004-03 [OSPAR04] and includes indicators that BAT/BEP has been applied in the research facility in Delft.

7. Waste Treatment Plant COVRA in Vlissingen

The information on discharges over the years 2007-2015, together with other changes since the previous report [OSPAR13], which covers the period 2007-2011, is given here. The discharges over the years 2007-2011 have already been given in the previous report [OSPAR13] and they are also added here, for convenience.

The efficiency of the waste water treatment system is given in the following table. For each nuclide in this table the activity concentration after the treatment is divided by the activity concentration before. A "slip-through" factor of 0.3 therefore means a wastewater cleaning efficiency of 70%.
A report of 2006 [VL06] shows that BAT/BEP are applied to the wastewater treatment systems.

Table 7.1: *Slip-through factors for the wastewater treatment system*

nuclide	2007	2008	2009	2010	2011	2012	2013	2014	2015
Co-60	0.2	0.3	0.2	0.1	0.1	0.15	0.12	0.06	0.17
Cs-137	0.8	0.7	0.9	0.73	0.83	0.51	0.74	0.74	0.88
I-125	0	0	< 0.1	0.17	< 0.01	0.04	0.0	0.0	*
H-3	0.9	1.0	1.0	0.75	0.86	0.84	0.61	0.77	0.81
C-14	1.0	0.2	0.4	0.23	0.32	0.22	0.31	0.26	0.84
Alpha	0.1	0.2	0.1	0.03	0.1	0.05	0.02	0.03	0.14
Gross	0.8	0.7	0.9	0.73	0.83	NI	NI	NI	NI

NI No Information
* In 2015 no I-125 has been detected neither upstream or downstream of the wastewater treatment systems

Table 7.2: *Liquid discharges of COVRA (in GBq: i.e. not normalized)*

(GBq)	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	6.0E-01	4.0E-01	7.1E+00	6.4E+01	4.6E+00	1.7E+01	4.9E+01	6.3E+00	2.8E-01
C-14	2.5E-02	6.0E-03	3.2E-02	8.4E-03	1.1E-03	0.1E-02	7.9E-03	1.4E-02	1.4E-03
gross-alpha	2.6E-03	6.9E-04	1.4E-03	1.4E-04	1.2E-04	9.2E-05	8.0E-05	4.2E-05	1.8E-05
residual beta	5.0E-02	2.9E-02	9.4E-01	2.2E-01	9.5E-02	1.1E-01	2.4E-01	8.6E-02	7.3E-03
gamma	5.2E-02	2.9E-02	1.0E+00	2.0E-01	8.9E-02	7.7E-02	1.7E-01	6.8E-02	5.6E-03

Table 7.3: *Emissions to air of COVRA (in GBq: i.e. not normalized).*
MDA is Minimum Detectable Activity

(GBq)	2007	2008	2009	2010	2011	2012	2013	2014	2015
H-3	3.8E+02	4.0E+02	7.5E+00	8.3E+01	4.0E+01	1.4E+02	1.8E+02	5.8E+01	2.3E+00
C-14	7.6E-01	3.0E-01	2.0E-01	1.4E+01	3.7E+00	2.0E-01	6.5E+00	0.1E-01	0.3E-01
gross-alpha	1.0E-05	3.7E-06	3.4E-06	3.2E-06	4.4E-06	4.1E-06	< MDA	< MDA	0.3E-06
residual beta	1.4E-04	5.9E-05	2.5E-04	1.1E-04	7.3E-05	7.5E-05	8.0E-05	2.9E-05	4.5E-05
gamma	9.5E-04	1.9E-04	1.5E-03	8.2E-04	1.9E-04	3.8E-04	7.9E-05	< MDA	1.6E-04

7.1 Summary Evaluation

According to the Guidelines, an indication that BAT/BEP has been applied is a downward trend in the liquid discharges [OSPAR04]. The annual liquid discharges of COVRA do not show such a downward trend but vary from year to year. However, the question whether or not BAT/BEP has been applied, is not only a matter of downward trends.
In the Netherlands, the requirements of BAT/BEP in terms of the OSPAR Convention are met when the ALARA principle is applied. At present, COVRA is considered to comply with the ALARA principle.
The discharges are low compared to the discharge limits in the license. Also the estimated dose for the critical group due to liquid discharges is very low, much less than 0.001 Sv/y.
The information presented above is in accordance with the OSPAR Agreement 2004-03 [OSPAR04] and includes indicators that BAT/BEP has been applied in the research facility in the COVRA facility.

8. The Nuclear Power Plant in Dodewaard (in decommissioning)

From June 2005 onwards (Safe Enclosure) no liquid discharges have taken place. Since the final transport of the last spent fuel elements to a reprocessing facility in 2003, there are no longer emissions to air.

8.1 Summary Evaluation

The last discharge of waste water took place in the first half of 2005. From July 2005 onwards, the plant is in a state of Safe Enclosure. Liquid discharges no longer take place and neither H-3 nor C-14 can be measured in ventilation air.
The information presented above is in accordance with the OSPAR-guidelines 2004-03 [OSPAR04] and includes indicators that BAT/BEP has been applied in NPP Dodewaard in its present state of Safe Enclosure.

References

[KCB93] Safety Report, Nuclear Power Plant Borssele 1993. Moddoc.no. 063-000 Rev. 1. 1996 (in Dutch).

[OSPAR04] Guidelines for the Submission of Information about, and the Assessment of, the Application of BAT in Nuclear Facilities. OSPAR Convention for the protection of the marine environment of the North-East Atlantic. Reference number 2004-03.

[OSPAR09] Report on Information about, and the Assessment of, the Application of BAT in Nuclear Facilities, OSPAR Publication 2009/391 Report from the Netherlands. ISBN 978-1-906840-31-0.

[OSPAR13] Report on implementation of PARCOM Recommendation 91/4 on radioactive discharges by the Netherlands 2008-2011. OSPAR Publication 590/2013. Report from the Netherlands. ISBN 978-1-909159-23-5.

[RIVM09] Report on implementation of PARCOM Recommendation 91/4 on radioactive discharges by the Netherlands. OSPAR: nuclear installations, CP Tanzi, PJM Kwakman, RIVM Rapport 610790005, 2009.

[UNSC08] UNSCEAR 2008 report: Sources and effects of ionizing radiation: volume I: Sources - Report to the General Assembly Scientific Annexes A and B. UN, United Nations Office at Vienna, 2008.

[VL06] Efficiency of water treatment systems, COVRA report no. 06.037, 2006 (in Dutch).

Annex A: Locations of Sites

Location of nuclear sites in the Netherlands, including the Dodewaard Nuclear Power Plant, which is in Safe Enclosure since July 2005.

Map of nine measurement points for which measurements are reported in Tables C1 to C4..

Annex B: normalized discharges

The normalized discharges of the Nuclear Power Plant and of the fuel enrichment facility are shown here (a logarithmic scale is used for the y-axis).

NPP Borssele

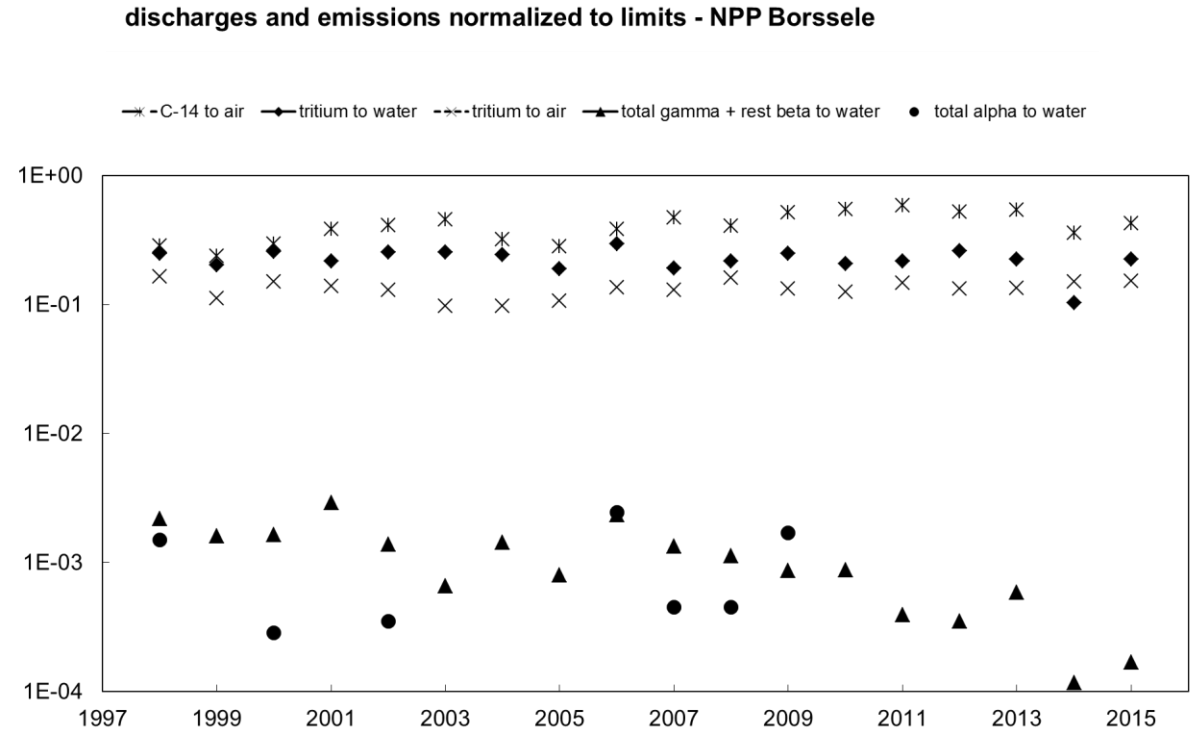


Figure B1: *Discharges and emissions normalized to limits, NPP Borssele (logarithmic scale).*

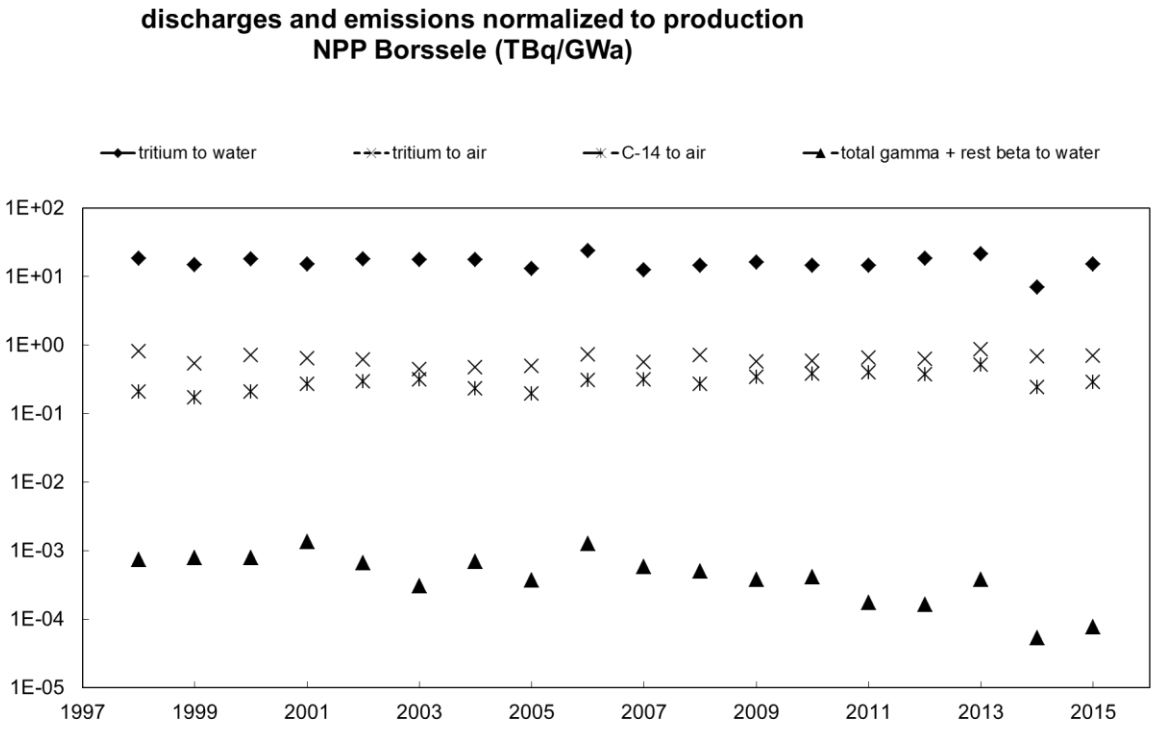


Figure B2: *Discharges and emissions normalized to production, NPP Borssele (logarithmic scale).*

Fuel enrichment facility URENCO

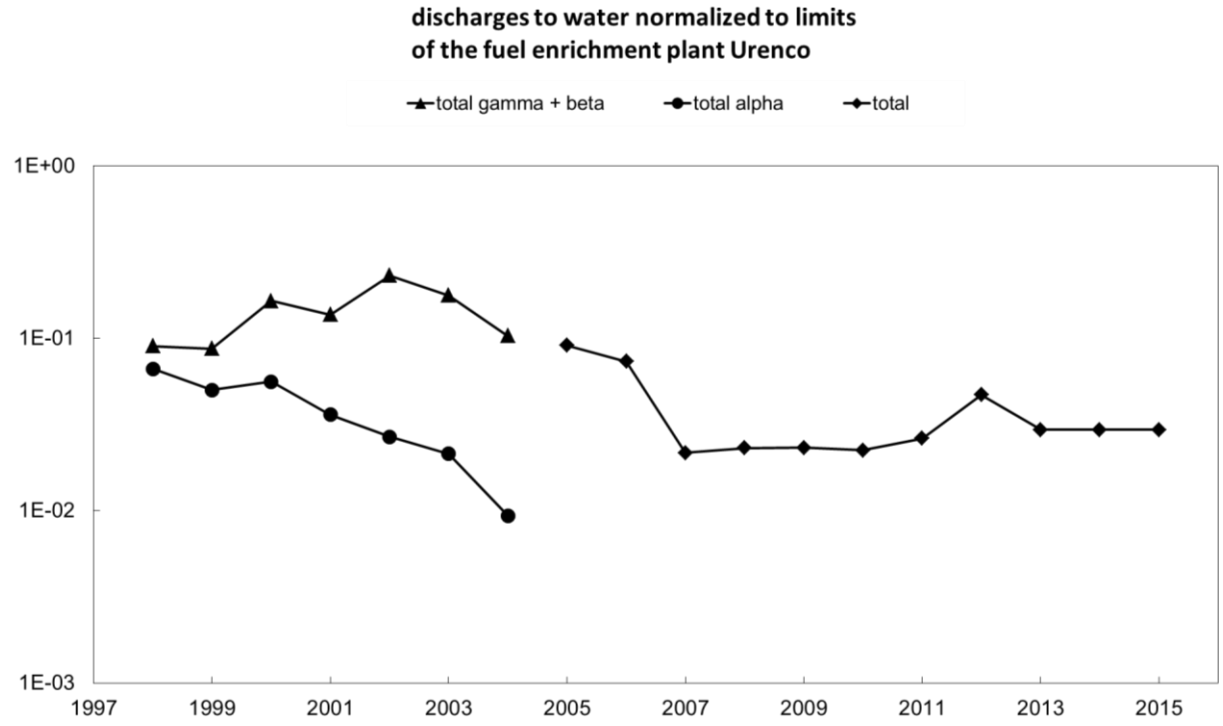


Figure B3: *Discharges to water normalized to limits of the fuel enrichment plant Urenco (logarithmic scale).*

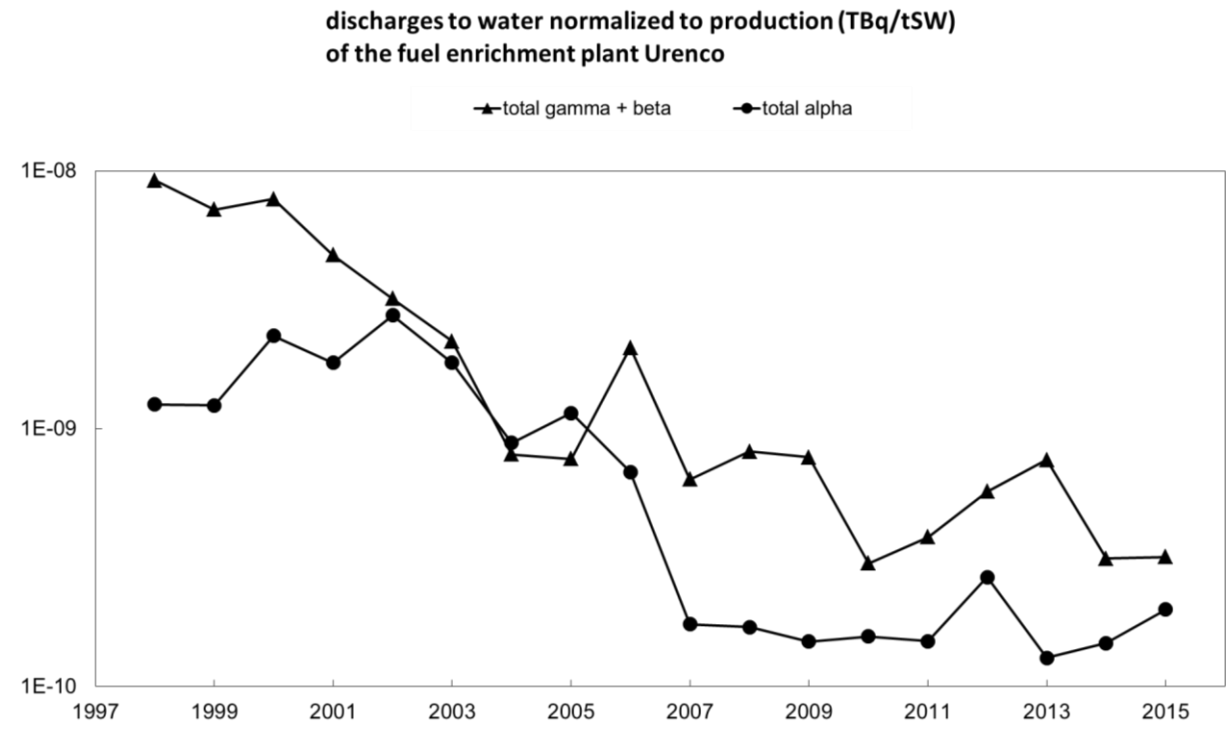


Figure B4: *Discharges to water normalized to production (TBq/tSW) at Urenco (logarithmic scale).*

Annex C: Environmental Impact in the Netherlands

Although discharges of Dutch and foreign nuclear installations lead to an increase of the activity concentrations in the environment, it cannot be expected that the environmental monitoring data are associated to a unique discharge source. For this reason the environmental impact is presented in this appendix and not in the main text.

Concentrations of radionuclides in samples

Activity concentrations are frequently measured in environmental samples from several locations in waters of the Netherlands. In this report data from nine specific locations, for which an increase of the activity concentration in the environment may be expected, are presented. A map of these nine locations is given in Annex A. The median value for the measured activity concentrations in a year is given. The data are extracted from http://www.waterbase.nl.

Table C1: *Alpha activity concentration (in Bq.m^{-3})*

	Dantzig gat	Eijsden ponton	Vrouwe zand	Haring-vlietsluis	Lobith ponton	Maas-sluis	Marsdiep noord	Sas van Gent	Wester-scheldt
1998	NI	3.8E+01	4.6E+01	5.3E+01	7.1E+01	1.2E+02	4.2E+02	8.7E+01	4.5E+02
1999	6.1E+02	5.0E+01	5.0E+01	5.1E+01	7.8E+01	1.0E+02	5.1E+02	1.5E+02	6.6E+02
2000	3.0E+02	3.1E+01	5.2E+01	3.7E+01	5.6E+01	4.8E+01	2.1E+02	4.9E+01	2.0E+02
2001	5.4E+02	3.9E+01	4.0E+01	4.4E+01	6.0E+01	8.5E+01	3.6E+02	7.1E+01	4.0E+02
2002	4.2E+02	3.7E+01	3.6E+01	4.6E+01	6.0E+01	8.3E+01	3.6E+02	7.5E+01	3.2E+02
2003	5.2E+02	2.5E+01	3.4E+01	3.3E+01	4.6E+01	9.8E+01	3.4E+02	1.0E+02	4.8E+02
2004	4.4E+02	3.8E+01	4.6E+01	3.7E+01	5.3E+01	8.8E+01	3.3E+02	1.2E+02	5.1E+02
2005	5.4E+02	3.8E+01	3.3E+01	3.4E+01	5.9E+01	1.0E+02	7.0E+02	1.2E+02	7.0E+02
2006	8.0E+02	3.7E+01	4.7E+01	3.9E+01	5.9E+01	1.2E+02	7.3E+02	1.3E+02	6.1E+02
2007	3.6E+02	4.4E+01	4.1E+01	3.8E+01	5.5E+01	9.2E+01	4.4E+02	9.3E+01*	4.1E+02
2008	3.9E+02	4.8E+01	4.7E+01	4.1E+01	5.3E+01	9.7E+01	5.2E+02	1.2E+02	5.6E+02
2009	9.8E+02	3.3E+01	3.9E+01	3.5E+01	6.0E+01	9.2E+01	7.6E+02	1.1E+02	7.0E+02
2010	3.1E+02	3.0E+01	3.3E+01	2.9E+01	5.5E+01	6.1E+01	2.9E+02	7.5E+02	4.5E+02
2011	2.1E+02	2.9E+01	4.8E+01	3.6E+01	5.4E+01	1.2E+02	2.5E+02	1.8E+02	3.0E+02
2012	3.1E+02	2.9E+01	2.8E+01	2.8E+01	4.1E+01	8.8E+01	3.8E+02	1.0E+02	3.5E+02
2013	5.2E+02	3.0E+01	3.4E+01	3.4E+01	5.5E+01	1.4E+02	8.7E+02	9.4E+01	5.7E+02
2014	4.9E+02	3.0E+01	3.5E+01	3.7E+01	5.5E+01	8.0E+01	3.9E+02	8.2E+01	4.9E+02
2015	5.4E+02	4.3E+01	4.8E+01	3.9E+01	5.9E+01	1.1E+02	8.5E+02	1.0E+02	5.5E+02

NI: No Information * Mistakenly reported as 9.3E02 in report OSPAR09 and corrected in report OSPAR13

Table C2: *Residual beta activity concentration (in Bq.m^{-3})*

	Dantzig gat	Eijsden ponton	Vrouwe zand	Haring-vlietsluis	Lobith ponton	Maas-sluis	Mars-diep noord	Sas van Gent	Wester-scheldt
1998	NI	3.2E+01	2.7E+01	2.7E+01	3.8E+01	4.8E+01	8.1E+01	2.9E+01	8.6E+01
1999	9.4E+01	2.5E+01	3.1E+01	2.1E+01	4.2E+01	5.7E+01	4.8E+01	2.9E+01	6.2E+01
2000	1.2E+02	1.7E+01	3.6E+01	1.9E+01	3.6E+01	3.6E+01	4.5E+01	2.3E+01	6.4E+01
2001	1.3E+02	2.2E+01	3.2E+01	2.9E+01	4.6E+01	7.4E+01	6.2E+01	4.1E+01	8.9E+01
2002	1.4E+02	2.0E+01	2.0E+01	1.8E+01	3.0E+01	7.3E+01	8.7E+01	4.6E+01	1.1E+02
2003	1.1E+02	1.3E+01	1.8E+01	8.0E+00	2.9E+01	2.5E+01	4.3E+01	3.0E+01	6.8E+01
2004	1.4E+02	1.7E+01	2.2E+01	1.3E+01	2.5E+01	5.2E+01	5.9E+01	3.2E+01	7.8E+01
2005	1.5E+02	1.8E+01	3.8E+01	8.0E+00	3.5E+01	4.2E+01	5.0E+01	2.8E+01	7.5E+01
2006	1.0E+02	3.4E+01	3.1E+01	1.5E+01	4.3E+01	4.1E+01	6.3E+01	2.3E+01	6.8E+01
2007	1.3E+02	2.7E+01	2.6E+01	1.5E+01	3.0E+01	5.4E+01	8.1E+01	3.1E+01	5.8E+01
2008	2.0E+02	3.2E+01	4.8E+01	2.4E+01	4.9E+01	4.3E+01	8.1E+01	2.9E+01	8.3E+01

2009	1.4E+02	2.7E+01	3.6E+01	2.7E+01	5.3E+01	4.4E+01	9.5E+01	3.6E+01	1.3E+02
2010	1.5E+02	1.8E+01	1.7E+01	1.1E+01	3.6E+01	4.3E+01	7.9E+01	2.8E+01	1.1E+02
2011	1.4E+02	1.6E+01	3.0E+01	9.0E+00	2.8E+01	4.5E+01	8.3E+01	3.8E+01	1.1E+02
2012	1.7E+02	2.0E+01	2.2E+01	7.0E+00	3.1E+01	3.5E+01	5.1E+01	2.5E+01	9.2E+01
2013	1.7E+02	2.3E+01	3.2E+01	1.4E+01	3.6E+01	4.2E+01	3.9E+01	3.7E+01	9.7E+01
2014	1.5E+02	2.3E+01	2.4E+01	2.0E+01	3.1E+01	3.1E+01	3.9E+01	2.6E+01	3.8E+01
2015	1.5E+02	1.5E+01	2.0E+01	2.0E+01	3.5E+01	3.0E+01	4.8E+01	2.5E+01	9.0E+01

Table C3: *Tritium activity concentration (in Bq.m^{-3})*

	Dantzig gat	**Eijsden ponton**	**Vrouwe zand**	**Haring-vlietsluis**	**Lobith ponton**	**Maas-sluis**	**Mars-diep noord**	**Sas van Gent**	**Wester-scheldt**
1998	NI	2.8E+03	3.4E+03	5.5E+03	4.6E+03	4.7E+03	4.3E+03	1.7E+03	5.4E+03
1999	3.5E+03	2.4E+04	3.6E+03	5.3E+03	4.6E+03	5.1E+03	5.2E+03	2.0E+03	5.4E+03
2000	3.7E+03	3.4E+03	2.5E+03	6.1E+03	4.3E+03	5.1E+03	5.5E+03	1.5E+03	5.2E+03
2001	2.4E+03	3.5E+03	2.6E+03	3.3E+03	3.4E+03	3.7E+03	2.6E+03	1.1E+03	3.9E+03
2002	2.7E+03	1.5E+04	2.7E+03	4.1E+03	3.3E+03	4.4E+03	3.1E+03	1.7E+03	4.5E+03
2003	3.7E+03	2.0E+04	3.7E+03	5.3E+03	5.1E+03	6.0E+03	3.5E+03	2.0E+03	5.2E+03
2004	4.7E+03	1.2E+04	3.2E+03	5.0E+03	4.1E+03	5.5E+03	4.7E+03	1.7E+03	6.5E+03
2005	4.8E+03	9.2E+03	3.3E+03	4.6E+03	4.8E+03	4.7E+03	4.9E+03	1.4E+03	6.2E+03
2006	5.2E+03	1.5E+04	4.2E+03	4.1E+03	5.9E+03	4.2E+03	5.4E+03	1.3E+03	6.6E+03
2007	3.7E+03	1.5E+04	3.2E+03	4.2E+03	3.3E+03	4.1E+03	3.4E+03	5.6E+02	4.8E+03
2008	4.5E+03	2.8E+04	3.1E+03	4.5E+03	4.0E+03	4.2E+03	4.0E+03	1.1E+03	5.2E+03
2009	2.7E+03	2.4E+03	3.3E+03	4.8E+03	3.4E+03	4.9E+03	3.5E+03	1.4E+03	4.2E+03
2010	3.1E+03	2.0E+04	3.3E+03	4.8E+03	4.1E+03	5.1E+03	3.1E+03	1.6E+03	4.8E+03
2011	3.7E+03	3.0E+04	2.5E+03*	5.4E+03	4.3E+03	4.9E+03	3.8E+03	2.1E+03	5.0E+03
2012	3.2E+03	9.1E+03	3.1E+03	6.6E+03	5.1E+03	5.4E+03	3.5E+03	1.4E+03	4.7E+03
2010	3.5E+03	8.4E+03	2.7E+03	3.4E+03	2.3E+03	4.3E+03	3.4E+03	1.3E+03	4.6E+03
2010	3.1E+03	2.0E+04	2.6E+03	5.6E+03	2.5E+03	4.6E+03	4.4E+03	1.3E+03	4.9E+03
2010	3.5E+03	1.8E+04	2.5E+03	4.0E+03	3.8E+03	4.5E+03	4.1E+03	1.1E+03	4.5E+03

NI: No Information * Mistakenly reported as 2.6E+03 in report OSPAR13

Table C4: *Ra-226 activity concentration (in Bq.m^{-3})*

	Dantzig gat	**Eijsden ponton**	**Vrouwe zand**	**Haring-vlietsluis**	**Lobith ponton**	**Maas-sluis**	**Mars-diep noord**	**Sas van Gent**	**Wester-scheldt**
1998	NI	7E+00	NI	NI	9E+00	2E+01	7E+00	1.3E+01	9E+00
1999	6E+00	6E+00	NI	NI	8E+00	8E+00	6E+00	1.1E+01	9E+00
2000	6E+00	4E+00	NI	NI	5E+00	7E+00	6E+00	7E+00	6E+00
2001	5E+00	3E+00	NI	NI	4E+00	4E+00	4E+00	5.5E+00	5E+00
2002	5E+00	3E+00	NI	NI	4E+00	5E+00	4E+00	7E+00	5E+00
2003	4E+00	4E+00	NI	NI	5E+00	4E+00	4E+00	7E+00	5E+00
2004	4E+00	4E+00	NI	NI	4E+00	4E+00	3E+00	8E+00	6E+00
2005	4E+00	4E+00	NI	NI	4E+00	4E+00	3E+00	7E+00	5E+00
2006	3E+00	3E+00	NI	NI	4E+00	5E+00	4E+00	6E+00	5E+00
2007	4E+00	2E+00	NI	NI	3E+00	4E+00	3E+00	6E+00	5E+00
2008	4E+00	3E+00	NI	NI	4E+00	4E+00	3E+00	7E+00	4E+00
2009	4E+00	3E+00	NI	NI	4E+00	4E+00	4E+00	5E+00	4E+00
2010	5E+00	3E+00	NI	NI	4E+00	4E+00	4E+00	5E+00	5E+00
2011	4E+00	3E+00	NI	NI	3E+00	2E+00	2E+00	6E+00	5E+00
2012	3E+00	2E+00	NI	NI	3E+00	3E+00	4E+00	5E+00	4E+00
2013	4E+00	2E+00	NI	NI	3E+00	3E+00	3E+00	6E+00	3E+00
2014	5E+00	4E+00	NI	NI	8E+00	1.6E+01	1E+01	6E+00	7E+00

2015	8E+00	3E+00	NI	NI	4E+00	9E+00	6E+00	8E+00	7E+00

NI: No Information

Nuclide libraries

The reported activity concentrations are total alpha, total and residual beta, H-3, Pb-210/Po-210, Sr-90 and Ra-226. Residual beta is the total beta activity excluding K-40, H-3 and short-lived radon daughters.
The nuclide library Nuchart, a product of Canberra, is used to identify gamma emitting radionuclides in environmental samples. However, only Co-58, Co-60, Cs-134, Cs-137, I-131 and Mn-54, are reported, if the radionuclides are detected. The library is based on NUDAT (produced by the National Nuclear Data Center, Brookhaven National Laboratory).

Environmental monitoring program

The environmental monitoring programme consists of measuring water samples and suspended particles. The frequency of sampling is variable per year per nuclide and per location. For each of the alpha, residual beta and tritium activity measurements an average sampling frequency of 12 times per year per location is kept. Ra-226, Sr-90, Sr-89, Po-210 and gamma (Cs-137, etc.) activity is measured with a sampling frequency between 4 and 13 times per year per location. Rijkswaterstaat monitors the activity concentrations at 10 locations in inland waters and at 11 locations at sea.

National target levels of radioactive substances

National target levels of activity of radionuclides in the environment are defined for inland waters, as mentioned in section 2.4. Compliance is assessed by comparing the 90th percentile of the measured data, which is not given in this report, with the target levels.

Table C5*: National target levels (in Bq.m^{-3}) [TPW98].*

Total alpha	1.0E+02
Residual beta	2.0E+02
Tritium	1.0E+04

Quality assurance of systems for environmental monitoring

The methodology of environmental monitoring is according to NEN 5622[1], NEN 5623[2], and NEN 6421[3] for the determination of alpha, gamma and beta activities respectively. NEN is a Dutch quality assurance standard. Beta and alpha emitters are monitored according to KTA 1504[4].

Relevant information not covered by previous sections

There is no relevant information not covered by the previous sections.

1 NEN5622: Radioactivity measurements - Determination of massic gross-alpha activity of a solid counting sample by the thick source method. Date of most recent version: 2006.

2 NEN5623: Radioactivity measurements - Determination of the activity of gamma ray emitting nuclides in a counting sample by semiconductor gammaspectrometry. Date of most recent version: 2002.

3 NEN6421: Water - Determination of volumic gross-beta activity and volumic residual beta activity of non-volatile compounds. Date of most recent version: 2006.

4 Kerntechnischer Asschuss (KTA 1504) Überwachung der Ableitung radioaktiver Stoffe mit wasser. Kerntechnischer Ausschuss 1504, Fassung 6/94. Carl Heymans Verlag KG, Luxemburger Strasse 449, 50939 Köln, Germany. 1994 (In German).

Annex D: Environmental Measurements in the Vicinity of NPP Borssele and the Waste Treatment Plant COVRA in Vlissingen

Since the year 2007, the results of the monitoring programme around NPP Borssele are made available through the reports on environmental radioactivity that are compiled by the Netherlands within the framework of the EURATOM Treaty. This is a collation of data from those reports:

Environmental radioactivity in the Netherlands.
Results in 2007, G.J. Knetsch (editor), RIVM Report 610791002/2008
Results in 2008, G.J. Knetsch (editor), RIVM, RIVM Report 610791003/2010
Results in 2009, M.C.E. Groot and G.J. Knetsch (editors), RIVM Report 610891002/2011
Results in 2010, G.J. Knetsch (editor), RIVM Report 610891003/2012
Results in 2011, G.J. Knetsch (editor), RIVM report 610891004/2013
Results in 2012, G.J. Knetsch (editor), RIVM Report 610891005/2014
Results in 2013, G.J. Knetsch (editor), RIVM Report 2015-0040
Results in 2014, G.J. Knetsch (editor), RIVM Report 2016-0182
Results in 2015, G.J. Knetsch (editor), RIVM Report 2016-0183 (in preparation)

The Nuclear Research & consultancy Group (NRG) is commissioned by Elektriciteits-Productiemaatschappij Zuid-Nederland (N.V. EPZ) to perform monthly measurements on environmental samples taken in the vicinity of the nuclear power plant at Borssele (owned by N.V. EPZ). NPP Borssele and the waste treatment plant COVRA make use of the same wastewater outlet into the Westerscheldt. Samples are taken to monitor the compartments air (not shown here), water and soil. The monitoring program presented here [Donk, 2008, Delorme, 2009 and Donk, 2011] forms only part of the total monitoring program performed near the nuclear power plant. A more detailed description of the monitoring program and underlying strategy is reported in KEMA, 1994. The monitoring programme over the years 2007 to 2015 is shown in Table D.1, with the locations given in Figure D.1. The measurements of radionuclides in water (Tables D.2 and D.3, Figures D.2 and D.3), suspended solids (Table D.4 and Figure D.4), seaweed and sediment (Tables D.5 and D.6) are reported here.

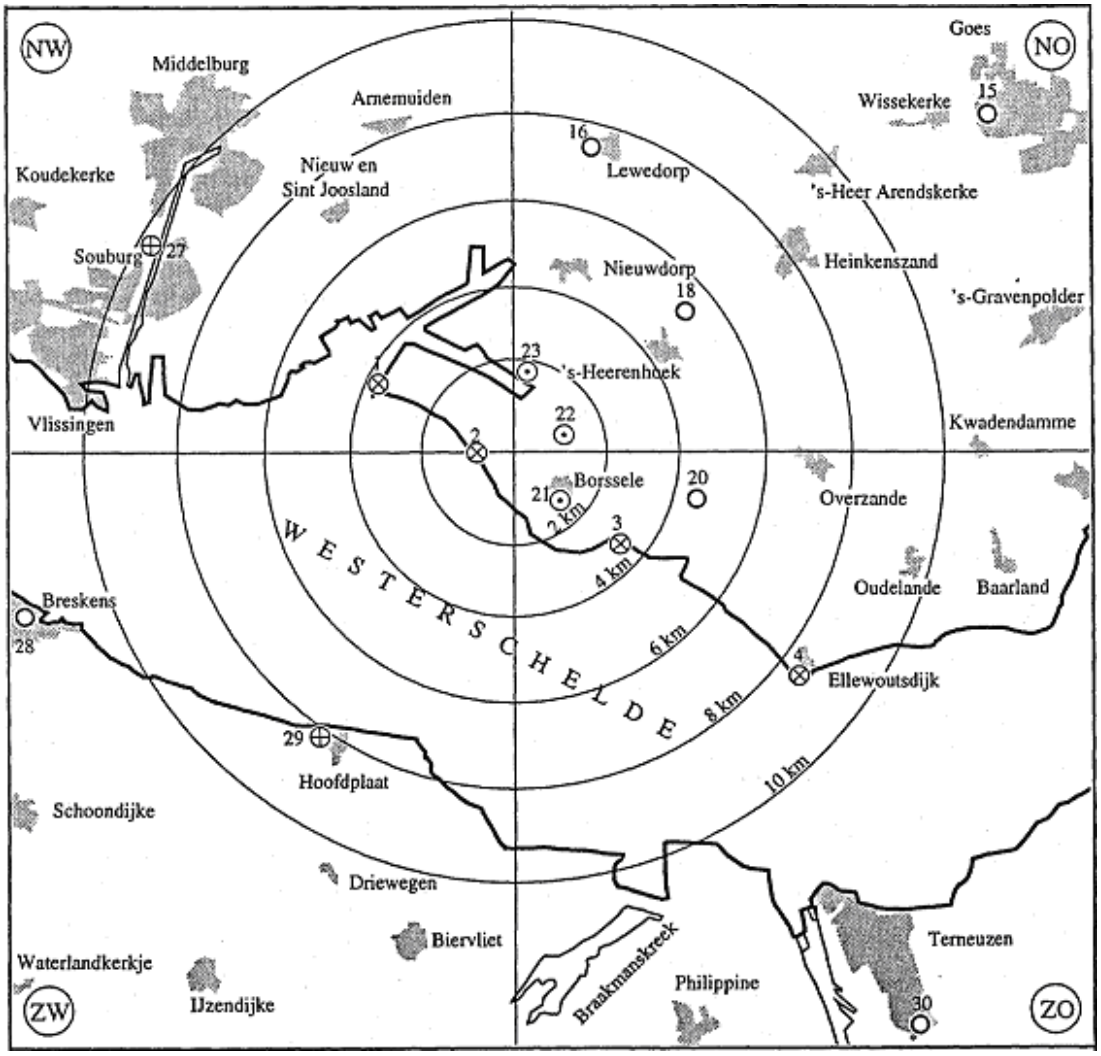
Table D.1: Monitoring program for environmental samples in the vicinity of the nuclear power plant at Borssele. The location numbers correspond with the location numbers given in Figure D.1.

Matrix	Location	Parameter	Monitoring frequency (per year)
Water	1, 2, 3 and 4	residual β, ^{3}H	12
Suspended solids	1, 2, 3 and 4	gross β	12
Seaweed	1, 2, 3 and 4	γ-emitters [(1)]	12 [(2)]
Sediment	1, 2, 3 and 4	γ-emitters [(1)]	12 [(2)]

[(1)] *γ-spectroscopic analysis of specific γ-emitting nuclides: ^{60}Co, ^{131}I and ^{137}Cs.*

[(2)] *Analysis is performed on a combined sample of monthly samples of all four or five locations.*

Figure D.1: *Monitoring program for environmental samples in the vicinity of the nuclear power plant at Borssele (centre of the map) and the waste treatment plant COVRA in Vlissingen located at approximately 1 km in North-West direction.*



The residual β and H-3 activity concentrations in water and gross β-activity concentrations in suspended solids from the Westerscheldt are presented in Tables D.2, D.3 and D.4. The respective yearly averages are shown in Figure D.2, D.3 and D.4.

Since 2012, the ^{3}H activity concentrations in water are significantly lower than those in previous years. Since 2012, the gross β activity concentrations in suspended solids have been somewhat higher than those in previous years. These changes in ^{3}H and gross β activity concentrations were investigated. The change in gross β activity coincides with a change in counting efficiency. For ^{3}H no significant changes in analysis procedures have been identified so far, while an investigation into the background correction is ongoing.

The results for the nuclides considered in the gammaspectroscopic analysis (Co-60, I-131 and Cs-137) in seaweed and sediment are given in Tables D.5 and D.6.

Figure D.2: *Yearly averaged residual β-activity concentrations from Table D.2 in water from the Westerscheldt at four locations in the vicinity of NPP Borssele (see Figure D.1 for locations). Figure from RIVM Report 2016-0183.*

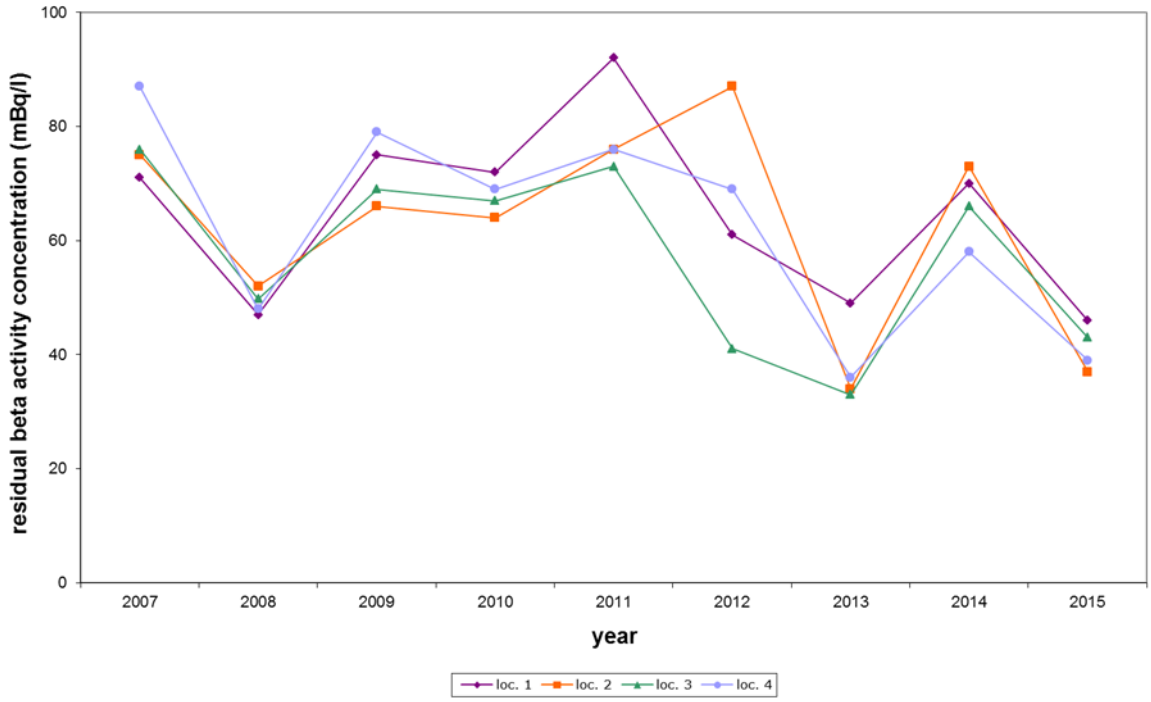


Figure D3: *Yearly averaged H-3 activity concentrations from Table D.3 in water from the Westerscheldt at four locations in the vicinity of NPP Borssele (see Figure D.1 for sampling locations). Figure from RIVM Report 2016-0183.*

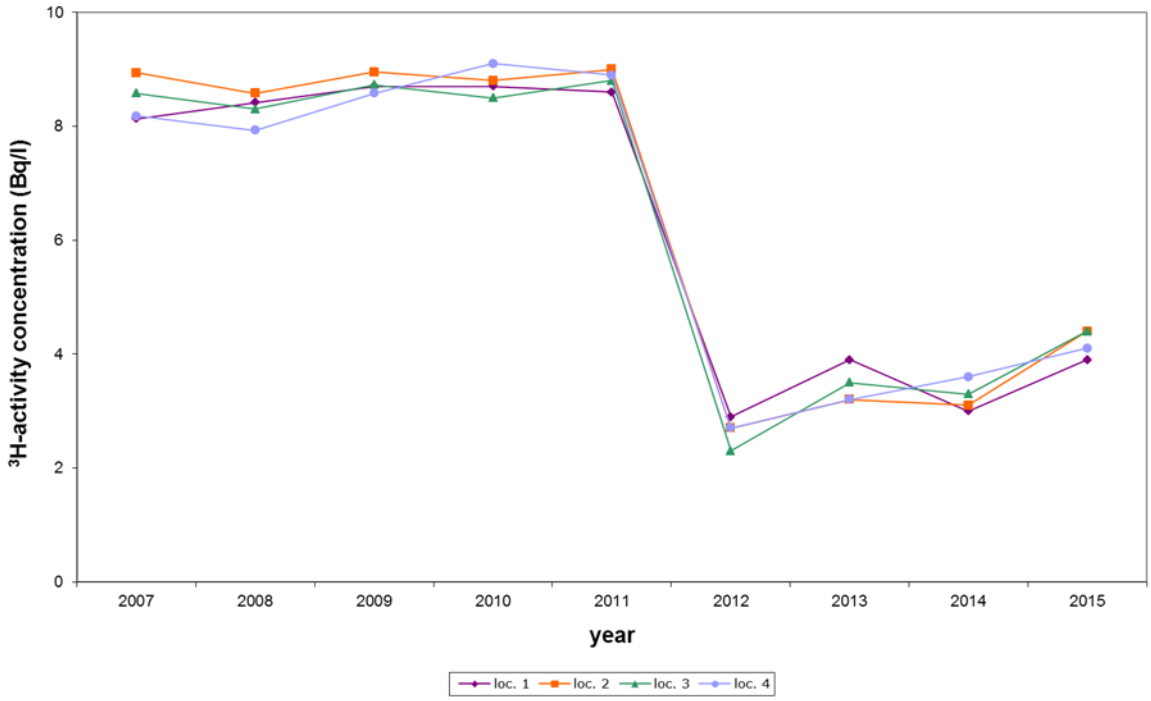


Figure D.4: *Yearly averaged gross β-activity activity concentrations from Table D.4 in suspended solids from the Westerscheldt at four locations in the vicinity of NPP Borssele (see Figure D.1 for sampling locations). Figure from RIVM Report 2016-0183.*

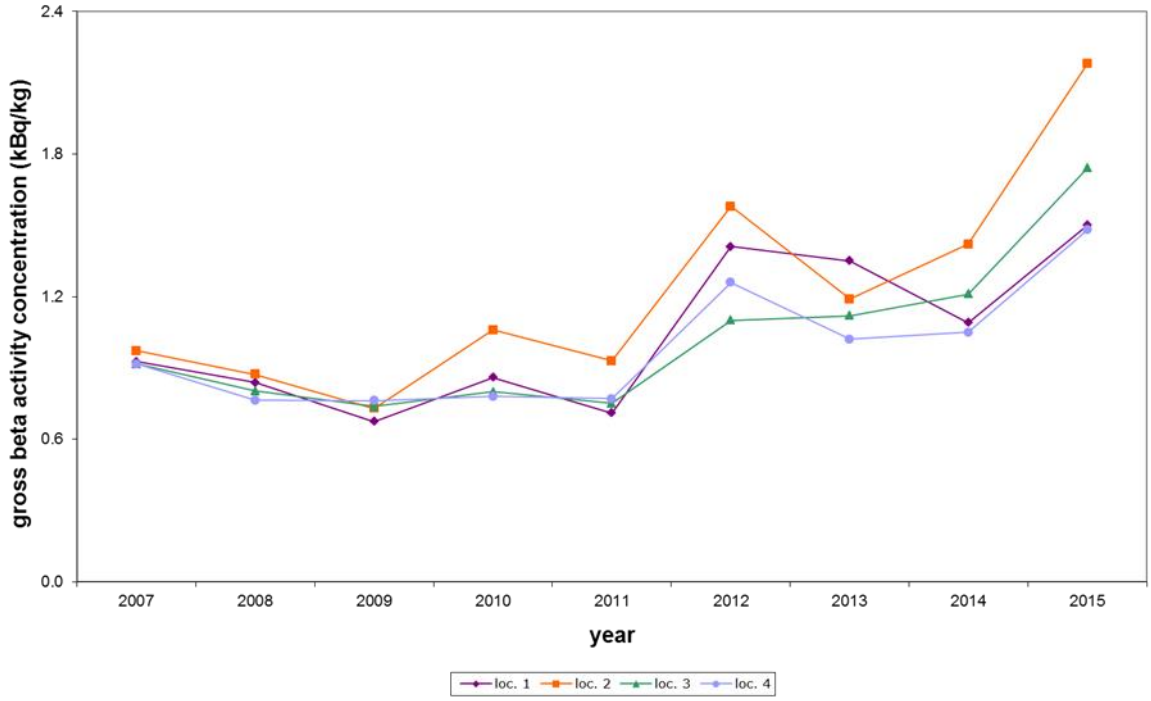


Table D.2 *Residual β-activity concentrations in water from the Westerscheldt (see Figure D.1 for sampling locations).*

Date	Residual β (Bq/l)			
Location	**1**	**2**	**3**	**4**
07/02/07	0.036 ± 0.006	0.033 ± 0.005	0.052 ± 0.006	0.048 ± 0.005
07/03/07	0.093 ± 0.006	0.114 ± 0.006	0.087 ± 0.005	0.042 ± 0.005
05/04/07	0.036 ± 0.006	0.030 ± 0.006	0.062 ± 0.006	0.041 ± 0.006
03/05/07	0.153 ± 0.008	0.114 ± 0.007	0.193 ± 0.007	0.101 ± 0.006
06/06/07	0.070 ± 0.007	0.058 ± 0.006	0.060 ± 0.006	0.085 ± 0.005
05/07/07	0.083 ± 0.007	0.092 ± 0.008	0.059 ± 0.006	0.084 ± 0.007
06/08/07	0.053 ± 0.007	0.069 ± 0.006	0.031 ± 0.006	0.201 ± 0.009
05/09/07	0.073 ± 0.007	0.069 ± 0.007	0.064 ± 0.007	0.097 ± 0.005
03/10/07	0.037 ± 0.006	0.063 ± 0.007	0.061 ± 0.006	0.113 ± 0.006
07/11/07	0.129 ± 0.008	0.125 ± 0.007	0.130 ± 0.007	0.066 ± 0.006
06/12/07	0.048 ± 0.006	0.082 ± 0.006	0.065 ± 0.006	0.132 ± 0.006
07/01/08	0.043 ± 0.005	0.053 ± 0.006	0.042 ± 0.005	0.031 ± 0.004
07/02/08	0.030 ± 0.007	0.025 ± 0.006	0.046 ± 0.007	0.029 ± 0.004
04/03/08	0.051 ± 0.008	0.106 ± 0.007	0.069 ± 0.008	0.070 ± 0.008
02/04/08	0.038 ± 0.006	0.022 ± 0.005	0.025 ± 0.006	0.026 ± 0.004
08/05/08	0.033 ± 0.008	0.035 ± 0.006	0.064 ± 0.006	0.038 ± 0.006
04/06/08	0.051 ± 0.008	0.037 ± 0.007	0.035 ± 0.007	0.047 ± 0.005
03/07/08	0.063 ± 0.011	0.030 ± 0.008	0.029 ± 0.007	0.043 ± 0.007
06/08/08	0.060 ± 0.006	0.047 ± 0.006	0.043 ± 0.006	0.134 ± 0.008
08/09/08	0.064 ± 0.007	0.057 ± 0.006	0.067 ± 0.007	0.031 ± 0.006
01/10/08	0.053 ± 0.007	0.094 ± 0.006	0.061 ± 0.006	0.021 ± 0.006
06/11/08	0.051 ± 0.007	0.050 ± 0.006	0.070 ± 0.006	0.061 ± 0.006
04/12/08	0.042 ± 0.006	0.050 ± 0.006	0.031 ± 0.006	0.029 ± 0.005
08/01/09	0.030 ± 0.005	0.073 ± 0.006	0.057 ± 0.006	0.043 ± 0.005
06/02/09	0.080 ± 0.008	0.062 ± 0.006	0.073 ± 0.006	0.058 ± 0.005
05/03/09	0.052 ± 0.006	0.079 ± 0.008	0.055 ± 0.005	0.046 ± 0.005
02/04/09	0.040 ± 0.013	0.031 ± 0.005	0.055 ± 0.006	0.036 ± 0.004
06/05/09	0.083 ± 0.014	0.073 ± 0.006	0.047 ± 0.008	0.057 ± 0.005
04/06/09	0.084 ± 0.008	0.064 ± 0.006	0.054 ± 0.006	0.057 ± 0.006
08/07/09	0.077 ± 0.005	0.071 ± 0.006	0.046 ± 0.005	0.041 ± 0.008
06/08/09	0.067 ± 0.007	0.075 ± 0.011	0.073 ± 0.006	0.115 ± 0.006
07/09/09	0.134 ± 0.008	0.078 ± 0.007	0.077 ± 0.007	0.178 ± 0.008
08/10/09	0.090 ± 0.009	0.085 ± 0.012	0.102 ± 0.008	0.092 ± 0.007
05/11/09	0.056 ± 0.012	0.061 ± 0.007	0.110 ± 0.007	0.086 ± 0.007
03/12/09	0.086 ± 0.007	0.061 ± 0.007	0.087 ± 0.009	0.065 ± 0.005
07/01/10	0.051 ± 0.007	0.056 ± 0.006	0.046 ± 0.005	0.116 ± 0.006
04/02/10	0.046 ± 0.006	0.038 ± 0.006	0.061 ± 0.006	0.053 ± 0.007
03/03/10	0.047 ± 0.006	0.043 ± 0.006	0.032 ± 0.005	0.083 ± 0.006
01/04/10	0.051 ± 0.005	0.049 ± 0.006	0.034 ± 0.005	0.042 ± 0.005
07/05/10	0.039 ± 0.004	0.042 ± 0.005	0.055 ± 0.012	0.045 ± 0.004
03/06/10	0.083 ± 0.007	0.047 ± 0.007	0.068 ± 0.006	0.091 ± 0.008
08/07/10	0.048 ± 0.006	0.060 ± 0.006	0.063 ± 0.006	0.059 ± 0.007
05/08/10	0.078 ± 0.006	0.062 ± 0.007	0.048 ± 0.006	0.051 ± 0.006

02/09/10	0.099 ± 0.007	0.082 ± 0.006	0.095 ± 0.007	0.080 ± 0.006
04/10/10	0.088 ± 0.006	0.081 ± 0.010	0.097 ± 0.006	0.093 ± 0.010
03/11/10	0.096 ± 0.015	0.101 ± 0.012	0.065 ± 0.005	0.076 ± 0.011
09/12/10	0.099 ± 0.008	0.093 ± 0.009	0.089 ± 0.006	0.093 ± 0.006
05/01/11	0.086 ± 0.008	0.070 ± 0.006	0.096 ± 0.006	0.067 ± 0.005
01/02/11	0.135 ± 0.006	0.099 ± 0.004	0.089 ± 0.004	0.078 ± 0.005
01/03/11	0.102 ± 0.004	0.084 ± 0.005	0.064 ± 0.007	0.085 ± 0.005
06/04/11	0.096 ± 0.004	0.057 ± 0.006	0.081 ± 0.006	0.061 ± 0.007
02/05/11	0.071 ± 0.008	0.102 ± 0.007	0.069 ± 0.006	0.082 ± 0.007
07/06/11	0.078 ± 0.007	0.056 ± 0.007	0.061 ± 0.006	0.069 ± 0.006
06/07/11	0.059 ± 0.007	0.063 ± 0.009	0.091 ± 0.007	0.070 ± 0.006
03/08/11	0.141 ± 0.007	0.086 ± 0.006	0.056 ± 0.005	0.067 ± 0.006
08/09/11	0.121 ± 0.018	0.103 ± 0.007	0.107 ± 0.007	0.138 ± 0.010
04/10/11	0.108 ± 0.007	0.081 ± 0.006	0.062 ± 0.007	0.072 ± 0.007
03/11/11	0.051 ± 0.006	0.048 ± 0.006	0.043 ± 0.006	0.036 ± 0.006
08/12/11	0.100 ± 0.007	0.077 ± 0.010	0.085 ± 0.006	0.108 ± 0.008
09/01/12	0.043 ± 0.005	0.051 ± 0.005	0.065 ± 0.005	0.047 ± 0.004
08/02/12	0.045 ± 0.006	0.058 ± 0.006	0.065 ± 0.005	0.072 ± 0.005
08/03/12	0.049 ± 0.016	0.147 ± 0.016	0.024 ± 0.016	0.064 ± 0.015
03/04/12	0.043 ± 0.015	0.108 ± 0.015	0.026 ± 0.015	0.102 ± 0.015
03/05/12	0.169 ± 0.017	0.161 ± 0.017	0.052 ± 0.015	0.060 ± 0.010
11/06/12	0.045 ± 0.019	0.060 ± 0.019	0.034 ± 0.018	0.064 ± 0.016
03/07/12	0.047 ± 0.018	0.065 ± 0.017	0.023 ± 0.016	0.065 ± 0.017
08/08/12	0.064 ± 0.017	0.120 ± 0.016	0.072 ± 0.015	0.087 ± 0.015
04/09/12	0.07 ± 0.02	0.056 ± 0.015	0.035 ± 0.018	0.036 ± 0.020
03/10/12	0.065 ± 0.019	0.076 ± 0.018	0.060 ± 0.015	0.107 ± 0.016
07/11/12	0.061 ± 0.016	0.076 ± 0.018	0.047 ± 0.014	0.070 ± 0.015
05/12/12	0.034 ± 0.012	0.046 ± 0.016	0.017 ± 0.015	0.054 ± 0.014
02/01/13	0.045 ± 0.013	0.068 ± 0.012	0.042 ± 0.013	0.042 ± 0.011
05/02/13	0.102 ± 0.010	0.044 ± 0.007	0.042 ± 0.009	0.050 ± 0.008
06/03/13	0.074 ± 0.009	0.036 ± 0.008	0.040 ± 0.008	0.021 ± 0.008
03/04/13	0.027 ± 0.008	0.018 ± 0.007	0.019 ± 0.008	0.024 ± 0.008
01/05/13	0.003 ± 0.008	0.028 ± 0.008	0.018 ± 0.007	0.028 ± 0.006
05/06/13	0.020 ± 0.008	0.029 ± 0.007	0.031 ± 0.007	0.020 ± 0.006
03/07/13	0.045 ± 0.008	0.026 ± 0.005	0.017 ± 0.007	0.045 ± 0.007
08/08/13	0.095 ± 0.011	0.024 ± 0.008	0.083 ± 0.008	0.053 ± 0.008
05/09/13	0.041 ± 0.009	0.031 ± 0.009	0.022 ± 0.009	0.067 ± 0.009
07/10/13	0.029 ± 0.010	0.047 ± 0.009	0.047 ± 0.009	0.037 ± 0.009
05/11/13	0.079 ± 0.009	0.060 ± 0.010	0.015 ± 0.007	0.035 ± 0.006
04/12/13	0.047 ± 0.007	0.046 ± 0.007	0.036 ± 0.008	0.037 ± 0.007
02/01/14	0.022 ± 0.009	0.023 ± 0.007	0.030 ± 0.008	0.017 ± 0.005
05/02/14	0.058 ± 0.008	0.054 ± 0.008	0.059 ± 0.007	0.052 ± 0.007
05/03/14	0.076 ± 0.008	0.061 ± 0.009	0.075 ± 0.008	0.043 ± 0.007
02/04/14	0.037 ± 0.009	0.033 ± 0.007	0.028 ± 0.006	0.048 ± 0.007
07/05/14	0.081 ± 0.010	0.083 ± 0.015	0.098 ± 0.012	0.059 ± 0.008
05/06/14	0.049 ± 0.011	0.042 ± 0.012	0.055 ± 0.009	0.041 ± 0.009
08/07/14	0.102 ± 0.010	0.092 ± 0.011	0.091 ± 0.010	0.064 ± 0.009

07/08/14	0.088 ± 0.013	0.078 ± 0.009	0.090 ± 0.008	0.076 ± 0.009
03/09/14	0.058 ± 0.009	0.084 ± 0.009	0.073 ± 0.008	0.078 ± 0.011
09/10/14	0.082 ± 0.009	0.106 ± 0.009	0.061 ± 0.008	0.062 ± 0.007
05/11/14	0.088 ± 0.009	0.16 ± 0.02	0.050 ± 0.008	0.071 ± 0.007
04/12/14	0.061 ± 0.009	0.027 ± 0.008	0.037 ± 0.007	0.046 ± 0.008
07/01/15	0.059 ± 0.011	0.050 ± 0.007	0.070 ± 0.007	0.061 ± 0.007
04/02/15	0.028 ± 0.005	0.032 ± 0.006	0.076 ± 0.007	0.032 ± 0.005
05/03/15	0.081 ± 0.007	0.058 ± 0.007	0.048 ± 0.006	0.059 ± 0.006
02/04/15	0.069 ± 0.009	0.043 ± 0.008	0.032 ± 0.007	0.082 ± 0.009
06/05/15	0.066 ± 0.009	0.038 ± 0.007	0.060 ± 0.008	0.025 ± 0.004
03/06/15	0.032 ± 0.007	0.024 ± 0.007	0.032 ± 0.008	0.021 ± 0.007
08/07/15	0.056 ± 0.006	0.016 ± 0.008	0.035 ± 0.008	0.023 ± 0.007
05/08/15	0.041 ± 0.009	0.023 ± 0.009	0.037 ± 0.009	0.058 ± 0.009
02/09/15	0.030 ± 0.009	0.080 ± 0.014	0.034 ± 0.009	0.046 ± 0.008
07/10/15	0.057 ± 0.007	0.054 ± 0.008	0.041 ± 0.008	0.034 ± 0.007
04/11/15	0.035 ± 0.009	0.038 ± 0.011	0.055 ± 0.009	0.024 ± 0.008
09/12/15	0.018 ± 0.009	0.011 ± 0.008	0.033 ± 0.008	0.030 ± 0.007
06/01/16	0.033 ± 0.007	0.030 ± 0.008	0.034 ± 0.007	0.029 ± 0.008

Table D.3 *^{3}H-activity concentrations in water from the Westerscheldt (see Figure D.1 for sampling locations).*

Date	**H-3 (Bq/l)**			
Location	**1**	**2**	**3**	**4**
07/02/07	7.8 ± 1.3	8.9 ± 1.3	10.4 ± 1.4	9.0 ± 1.4
07/03/07	7.9 ± 1.3	9.9 ± 1.4	8.3 ± 1.3	7.1 ± 1.3
05/04/07	7.3 ± 1.4	8.1 ± 1.4	7.6 ± 1.4	8.0 ± 1.3
03/05/07	8.1 ± 1.4	8.7 ± 1.4	8.4 ± 1.4	7.1 ± 1.4
06/06/07	6.6 ± 1.4	8.5 ± 1.4	9.1 ± 1.4	6.8 ± 1.4
05/07/07	7.5 ± 1.4	9.2 ± 1.4	7.8 ± 1.4	8.1 ± 1.4
06/08/07	8.8 ± 1.4	9.6 ± 1.4	9.7 ± 1.4	8.9 ± 1.4
05/09/07	8.8 ± 1.4	9.8 ± 1.5	9.0 ± 1.4	8.7 ± 1.4
03/10/07	9.1 ± 1.4	9.3 ± 1.4	8.3 ± 1.4	8.6 ± 1.4
07/11/07	8.6 ± 1.4	8.9 ± 1.4	9.1 ± 1.4	8.0 ± 1.4
06/12/07	9.0 ± 1.4	9.0 ± 1.4	8.1 ± 1.4	8.7 ± 1.4
07/01/08	8.1 ± 1.4	7.4 ± 1.4	7.1 ± 1.4	9.1 ± 1.4
07/02/08	7.8 ± 1.4	8.7 ± 1.4	8.8 ± 1.4	7.5 ± 1.4
04/03/08	7.8 ± 1.5	8.2 ± 1.5	7.0 ± 1.5	7.2 ± 1.5
02/04/08	9.9 ± 1.6	8.5 ± 1.5	7.7 ± 1.5	8.3 ± 1.5
08/05/08	9.2 ± 1.5	8.9 ± 1.5	8.7 ± 1.5	7.3 ± 1.4
04/06/08	7.3 ± 1.5	8.2 ± 1.5	8.3 ± 1.5	7.6 ± 1.5
03/07/08	8.4 ± 1.3	8.3 ± 1.3	9.8 ± 1.5	7.8 ± 1.3
06/08/08	8.3 ± 1.3	8.6 ± 1.3	7.7 ± 1.3	7.5 ± 1.3
08/09/08	8.0 ± 1.3	8.8 ± 1.3	8.5 ± 1.3	9.1 ± 1.3
01/10/08	9.1 ± 1.3	8.6 ± 1.3	8.0 ± 1.3	7.9 ± 1.3
06/11/08	8.7 ± 1.3	9.4 ± 1.3	9.1 ± 1.3	8.4 ± 1.3
04/12/08	8.3 ± 1.3	9.3 ± 1.3	8.4 ± 1.3	8.1 ± 1.3
08/01/09	8.2 ± 1.3	7.5 ± 1.2	7.6 ± 1.2	8.5 ± 1.3
06/02/09	8.2 ± 1.3	8.7 ± 1.3	9.3 ± 1.4	8.4 ± 1.4

05/03/09	9.2 ± 1.4	8.6 ± 1.4	7.8 ± 1.3	9.3 ± 1.4
02/04/09	9.5 ± 1.4	9.6 ± 1.4	8.5 ± 1.4	8.9 ± 1.4
06/05/09	8.4 ± 1.4	8.0 ± 1.4	7.6 ± 1.3	9.2 ± 1.4
04/06/09	7.3 ± 1.4	9.1 ± 1.5	8.7 ± 1.4	7.2 ± 1.4
08/07/09	9.3 ± 1.4	8.0 ± 1.4	9.1 ± 1.4	8.9 ± 1.4
06/08/09	7.2 ± 1.4	9.3 ± 1.4	8.8 ± 1.4	9.4 ± 1.4
07/09/09	8.7 ± 1.3	9.0 ± 1.3	8.6 ± 1.4	7.6 ± 1.4
08/10/09	8.4 ± 1.4	9.4 ± 1.4	8.8 ± 1.4	7.6 ± 1.3
05/11/09	8.7 ± 1.4	9.3 ± 1.4	8.8 ± 1.4	9.1 ± 1.4
03/12/09	9.1 ± 1.3	9.4 ± 1.3	8.9 ± 1.3	7.8 ± 1.3
07/01/10	10.4 ± 1.4	9.0 ± 1.4	9.8 ± 1.4	9.6 ± 1.4
04/02/10	8.5 ± 1.4	9.2 ± 1.4	8.9 ± 1.4	9.9 ± 1.4
03/03/10	9.2 ± 1.4	8.4 ± 1.4	8.3 ± 1.4	7.2 ± 1.4
01/04/10	7.4 ± 1.4	7.9 ± 1.4	7.7 ± 1.4	8.8 ± 1.4
07/05/10	8.9 ± 1.4	9.1 ± 1.4	8.0 ± 1.4	9.4 ± 1.4
03/06/10	8.6 ± 1.4	9.1 ± 1.4	8.5 ± 1.4	10.3 ± 1.4
08/07/10	8.7 ± 1.4	8.0 ± 1.4	9.1 ± 1.4	9.9 ± 1.2
05/08/10	7.9 ± 1.4	9.2 ± 1.4	8.2 ± 1.5	10.1 ± 1.2
02/09/10	8.7 ± 1.5	8.0 ± 1.5	8.1 ± 1.5	7.9 ± 1.3
04/10/10	8.9 ± 1.5	8.8 ± 1.5	9.2 ± 1.5	8.1 ± 1.3
03/11/10	8.3 ± 1.3	9.3 ± 1.4	8.8 ± 1.3	8.7 ± 1.1
09/12/10	9.5 ± 1.3	9.2 ± 1.4	8.9 ± 1.3	10.1 ± 1.2
05/01/11	9.6 ± 1.4	9.2 ± 1.3	8.6 ± 1.3	8.7 ± 1.1
01/02/11	8.3 ± 1.3	9.9 ± 1.3	9.4 ± 1.3	7.1 ± 1.1
01/03/11	8.3 ± 1.3	8.5 ± 1.3	8.6 ± 1.3	9.0 ± 1.1
06/04/11	8.9 ± 1.3	9.2 ± 1.3	9.8 ± 1.4	8.8 ± 1.1
02/05/11	7.4 ± 1.3	8.4 ± 1.3	7.2 ± 1.3	8.3 ± 1.1
07/06/11	9.8 ± 1.3	8.1 ± 1.3	8.3 ± 1.2	8.8 ± 1.1
06/07/11	8.9 ± 1.3	8.1 ± 1.3	7.8 ± 1.3	9.1 ± 1.1
03/08/11	8.9 ± 1.5	9.4 ± 1.5	9.1 ± 1.5	8.8 ± 1.3
08/09/11	8.3 ± 1.5	9.2 ± 1.5	8.6 ± 1.5	9.4 ± 1.3
04/10/11	8.8 ± 1.5	9.8 ± 1.5	9.1 ± 1.5	9.4 ± 1.3
03/11/11	8.3 ± 1.4	9.3 ± 1.4	9.5 ± 1.6	9.1 ± 1.2
08/12/11	8.5 ± 1.5	8.8 ± 1.5	9.6 ± 1.5	9.5 ± 1.3
09/01/12	8.3 ± 1.5	9.2 ± 1.5	8.6 ± 1.5	9.2 ± 1.3
08/02/12	3.5 ± 0.3	2.8 ± 0.3	3.0 ± 0.3	3.2 ± 0.3
08/03/12	3.5 ± 0.3	3.4 ± 0.3	3.3 ± 0.3	5.0 ± 0.4
03/04/12	1.6 ± 0.2	2.6 ± 0.3	1.5 ± 0.2	1.2 ± 0.3
03/05/12	0.80 ± 0.15	3.0 ± 0.3	4.6 ± 0.5	< 1
11/06/12	3.9 ± 0.3	4.8 ± 0.4	3.1 ± 0.3	7.9 ± 0.5
03/07/12	1.07 ± 0.18	2.2 ± 0.3	0.53 ± 0.13	2.8 ± 0.4
08/08/12	2.5 ± 0.3	2.9 ± 0.4	2.8 ± 0.3	1.8 ± 0.2
04/09/12	4.9 ± 0.4	3.8 ± 0.4	2.5 ± 0.3	3.9 ± 0.4
03/10/12	3.1 ± 0.4	0.68 ± 0.14	1.4 ± 0.3	1.3 ± 0.3
07/11/12	2.3 ± 0.4	0.91 ± 0.17	0.62 ± 0.20	0.44 ± 0.12
05/12/12	2.9 ± 0.3	2.4 ± 0.3	1.0 ± 0.3	1.6 ± 0.2
02/01/13	4.7 ± 0.4	2.9 ± 0.3	3.3 ± 0.3	2.6 ± 0.3

05/02/13	1.8 ± 1.1	2.6 ± 1.2	0.7 ± 1.1	2.9 ± 1.3
06/03/13	3.5 ± 1.2	2.6 ± 1.2	4.3 ± 1.2	2.6 ± 1.2
03/04/13	5.0 ± 1.2	2.0 ± 1.3	4.9 ± 1.2	2.5 ± 1.3
01/05/13	7.7 ± 1.2	6.8 ± 1.2	8.5 ± 1.2	4.0 ± 1.2
05/06/13	5.2 ± 1.2	2.3 ± 1.2	3.2 ± 1.2	3.7 ± 1.2
03/07/13	2.6 ± 1.3	2.4 ± 1.7	1.9 ± 1.7	6.7 ± 1.3
08/08/13	4.0 ± 1.7	2.2 ± 1.2	1.8 ± 1.2	4.9 ± 1.7
05/09/13	2.8 ± 1.2	2.5 ± 1.2	5.0 ± 1.2	5.3 ± 1.2
07/10/13	<1	2.1 ± 1.2	0.4 ± 1.2	2.4 ± 1.3
05/11/13	5.0 ± 1.1	5.3 ± 1.2	5.0 ± 1.1	4.5 ± 1.2
04/12/13	3.3 ± 1.2	3.4 ± 1.2	3.4 ± 1.2	4.4 ± 1.3
02/01/14	2.3 ± 1.1	4.5 ± 1.2	3.1 ± 1.2	5.6 ± 1.2
05/02/14	3.1 ± 1.4	3.5 ± 1.3	2.0 ± 1.3	2.6 ± 1.3
05/03/14	0.9 ± 1.8	1.9 ± 1.2	1.7 ± 1.2	3.0 ± 1.3
02/04/14	3.3 ± 1.2	6.3 ± 1.2	4.8 ± 1.2	5.3 ± 1.2
07/05/14	3.5 ± 1.2	1.5 ± 1.2	4.7 ± 1.2	5.6 ± 1.2
05/06/14	0.2 ± 1.6	1.1 ± 1.2	1.1 ± 1.2	< LLD[(2)]
08/07/14	1.2 ± 1.8	1.6 ± 1.6	0.8 ± 1.6	0.8 ± 1.3
07/08/14	2.6 ± 1.2	0.4 ± 2.0	2.6 ± 1.2	4.3 ± 1.2
03/09/14	1.1 ± 1.6	< LLD[(2)]	2.6 ± 1.2	1.7 ± 1.2
09/10/14	5.3 ± 1.1	4.7 ± 1.1	4.8 ± 1.1	5.6 ± 1.1
05/11/14	1.4 ± 1.6	2.6 ± 1.2	2.2 ± 1.2	1.5 ± 1.2
04/12/14	6.3 ± 1.2	2.8 ± 1.2	3.7 ± 1.3	1.9 ± 1.2
07/01/15	6.8 ± 1.1	8.0 ± 1.2	8.0 ± 1.2	6.9 ± 1.1
04/02/15	5.5 ± 1.1	6.7 ± 1.2	4.8 ± 1.1	5.3 ± 1.1
05/03/15	4.9 ± 1.1	5.0 ± 1.1	6.5 ± 1.1	5.1 ± 1.1
02/04/15	3.7 ± 1.1	4.4 ± 1.1	4.4 ± 1.1	3.6 ± 1.2
06/05/15	4.1 ± 1.1	6.5 ± 1.1	4.6 ± 1.1	3.0 ± 1.1
03/06/15	3.1 ± 1.1	3.5 ± 1.1	3.4 ± 1.1	3.2 ± 1.1
08/07/15	4.3 ± 1.1	3.6 ± 1.1	5.4 ± 1.1	5.9 ± 1.3
05/08/15	3.5 ± 1.1	4.9 ± 1.1	6.2 ± 1.1	4.4 ± 1.1
02/09/15	2.0 ± 1.2	1.6 ± 1.1	1.4 ± 1.1	3.4 ± 1.2
07/10/15	3.0 ± 1.1	6.1 ± 1.7	3.3 ± 1.1	4.4 ± 1.1
04/11/15	4.5 ± 1.3	4.5 ± 1.2	2.0 ± 1.1	2.7 ± 1.1
09/12/15	4.8 ± 1.1	5.0 ± 1.6	5.0 ± 1.1	5.6 ± 1.1
06/01/16	3.0 ± 1.1	1.3 ± 1.2	5.4 ± 1.2	3.1 ± 1.0

[(2)]LLD is Lower Limit of Detection

Table D.4 *Gross β-activity concentrations in suspended solids from the Westerscheldt (see Figure D.1 for sampling locations).*

Date	**Gross β (kBq/kg)**			
Location	**1**	**2**	**3**	**4**
07/02/07	0.71 ± 0.03	0.85 ± 0.04	0.85 ± 0.03	0.65 ± 0.02
07/03/07	0.81 ± 0.06	0.90 ± 0.07	0.69 ± 0.06	0.90 ± 0.06
05/04/07	1.2 ± 0.2	1.08 ± 0.10	0.87 ± 0.06	0.96 ± 0.08
03/05/07	0.93 ± 0.09	1.40 ± 0.11	1.77 ± 0.11	1.24 ± 0.05
06/06/07	1.16 ± 0.16	0.68 ± 0.06	0.83 ± 0.03	0.78 ± 0.04

05/07/07	0.80 ± 0.05	0.96 ± 0.05	0.64 ± 0.02	0.66 ± 0.03
06/08/07	0.82 ± 0.05	0.95 ± 0.06	0.73 ± 0.03	0.88 ± 0.06
05/09/07	0.647 ± 0.16	0.75 ± 0.03	0.88 ± 0.04	1.04 ± 0.10
03/10/07	0.69 ± 0.05	0.96 ± 0.07	0.68 ± 0.08	0.95 ± 0.06
07/11/07	0.99 ± 0.06	1.49 ± 0.08	1.31 ± 0.09	1.19 ± 0.06
06/12/07	1.22 ± 0.05	0.74 ± 0.11	0.80 ± 0.04	0.95 ± 0.05
07/01/08	1.15 ± 0.06	0.90 ± 0.06	0.95 ± 0.06	0.79 ± 0.05
07/02/08	0.46 ± 0.10	0.68 ± 0.12	0.75 ± 0.03	0.45 ± 0.05
04/03/08	0.60 ± 0.09	0.78 ± 0.04	0.71 ± 0.02	0.61 ± 0.14
02/04/08	0.71 ± 0.14	0.80 ± 0.12	0.71 ± 0.11	0.49 ± 0.14
08/05/08	1.06 ± 0.14	0.60 ± 0.06	0.89 ± 0.06	0.79 ± 0.11
04/06/08	1.05 ± 0.07	1.29 ± 0.11	0.86 ± 0.06	1.01 ± 0.11
03/07/08	0.77 ± 0.07	0.66 ± 0.05	0.79 ± 0.08	0.76 ± 0.03
06/08/08	1.26 ± 0.12	0.80 ± 0.05	0.62 ± 0.05	1.59 ± 0.13
08/09/08	0.77 ± 0.03	0.79 ± 0.06	0.89 ± 0.08	0.55 ± 0.04
01/10/08	0.74 ± 0.04	1.32 ± 0.05	0.74 ± 0.04	0.42 ± 0.13
06/11/08	0.90 ± 0.04	0.81 ± 0.04	1.01 ± 0.05	0.77 ± 0.05
04/12/08	0.81 ± 0.07	0.73 ± 0.05	0.59 ± 0.03	0.61 ± 0.05
06/02/09	0.94 ± 0.06	0.75 ± 0.04	0.58 ± 0.02	0.291 ± 0.018
05/03/09	0.44 ± 0.03	0.49 ± 0.03	0.61 ± 0.03	0.42 ± 0.03
02/04/09	0.61 ± 0.05	0.61 ± 0.07	0.66 ± 0.04	1.33 ± 0.13
06/05/09	0.31 ± 0.05	0.63 ± 0.07	0.96 ± 0.06	0.66 ± 0.05
04/06/09	0.89 ± 0.19	0.75 ± 0.15	0.91 ± 0.04	0.92 ± 0.05
08/07/09	0.94 ± 0.08	0.96 ± 0.08	0.64 ± 0.06	0.72 ± 0.03
06/08/09	0.41 ± 0.07	0.66 ± 0.02	0.66 ± 0.02	0.617 ± 0.019
07/09/09	0.22 ± 0.03	0.20 ± 0.03	0.95 ± 0.05	0.89 ± 0.06
08/10/09	0.69 ± 0.03	0.79 ± 0.05	0.70 ± 0.04	0.77 ± 0.04
05/11/09	0.83 ± 0.05	1.15 ± 0.12	0.78 ± 0.05	0.73 ± 0.11
03/12/09	1.02 ± 0.07	1.00 ± 0.04	0.84 ± 0.04	1.20 ± 0.07
07/01/10	0.79 ± 0.03	0.76 ± 0.03	0.55 ± 0.02	0.60 ± 0.03
04/02/10	0.71 ± 0.05	0.64 ± 0.03	0.161 ± 0.017	0.56 ± 0.03
03/03/10	0.74 ± 0.08	0.79 ± 0.09	0.71 ± 0.08	0.10 ± 0.02
01/04/10	0.54 ± 0.04	0.75 ± 0.04	0.73 ± 0.04	0.57 ± 0.03
07/05/10	0.81 ± 0.16	1.18 ± 0.09	0.92 ± 0.13	0.61 ± 0.12
03/06/10	1.05 ± 0.06	0.84 ± 0.03	0.78 ± 0.03	0.81 ± 0.08
08/07/10	1.62 ± 0.10	0.74 ± 0.05	0.58 ± 0.17	0.33 ± 0.05
05/08/10	0.35 ± 0.10	0.94 ± 0.16	0.74 ± 0.09	0.65 ± 0.05
02/09/10	0.98 ± 0.08	0.95 ± 0.15	0.76 ± 0.08	0.99 ± 0.08
04/10/10	0.86 ± 0.14	1.76 ± 0.16	0.91 ± 0.07	1.01 ± 0.08
03/11/10	0.95 ± 0.09	1.58 ± 0.10	1.03 ± 0.07	1.68 ± 0.07
09/12/10	0.70 ± 0.03	1.11 ± 0.05	0.90 ± 0.04	0.98 ± 0.03
05/01/11	0.97 ± 0.05	1.47 ± 0.05	1.32 ± 0.05	1.11 ± 0.05
01/02/11	1.07 ± 0.06	1.44 ± 0.09	0.81 ± 0.07	1.57 ± 0.08
01/03/11	0.81 ± 0.03	1.33 ± 0.09	1.64 ± 0.08	1.35 ± 0.08
06/04/11	0.59 ± 0.12	1.39 ± 0.13	0.74 ± 0.07	0.45 ± 0.05
02/05/11	0.49 ± 0.07	0.41 ± 0.09	0.51 ± 0.06	0.59 ± 0.05
07/06/11	0.30 ± 0.06	0.61 ± 0.13	0.59 ± 0.04	0.43 ± 0.07

06/07/11	0.80 ± 0.07	0.76 ± 0.03	0.56 ± 0.03	0.64 ± 0.03
03/08/11	0.70 ± 0.03	0.72 ± 0.08	0.58 ± 0.04	0.61 ± 0.03
08/09/11	0.77 ± 0.13	0.77 ± 0.10	0.67 ± 0.07	0.72 ± 0.08
04/10/11	0.67 ± 0.05	0.75 ± 0.08	0.72 ± 0.03	0.73 ± 0.04
03/11/11	0.71 ± 0.04	0.98 ± 0.07	0.70 ± 0.04	0.67 ± 0.04
08/12/11	0.73 ± 0.08	0.87 ± 0.07	0.63 ± 0.04	0.59 ± 0.06
09/01/12	0.86 ± 0.08	1.11 ± 0.07	0.85 ± 0.09	0.84 ± 0.04
08/02/12	0.78 ± 0.07	0.91 ± 0.06	0.87 ± 0.09	1.12 ± 0.06
08/03/12	1.27 ± 0.13	2.10 ± 0.09	1.32 ± 0.08	2.39 ± 0.10
03/04/12	1.98 ± 0.12	2.8 ± 0.3	1.14 ± 0.04	2.1 ± 0.2
03/05/12	1.1 ± 0.3	1.8 ± 0.3	1.20 ± 0.12	1.15 ± 0.09
11/06/12	1.41 ± 0.08	1.54 ± 0.19	0.755 ± 0.014	1.14 ± 0.10
03/07/12	1.6 ± 0.4	1.24 ± 0.12	1.38 ± 0.11	1.11 ± 0.05
08/08/12	1.49 ± 0.11	2.2 ± 0.5	0.78 ± 0.02	0.93 ± 0.05
04/09/12	0.87 ± 0.02	1.2 ± 0.3	0.828 ± 0.018	0.97 ± 0.05
03/10/12	3.1 ± 1.4	1.20 ± 0.06	1.30 ± 0.14	1.18 ± 0.08
07/11/12	1.10 ± 0.03	1.27 ± 0.06	1.5 ± 0.2	0.84 ± 0.05
05/12/12	0.98 ± 0.03	1.24 ± 0.06	0.876 ± 0.019	0.93 ± 0.07
02/01/13	1.28 ± 0.10	1.5 ± 0.2	1.24 ± 0.06	1.28 ± 0.10
05/02/13	1.31 ± 0.08	1.01 ± 0.06	1.16 ± 0.06	0.79 ± 0.02
06/03/13	1.53 ± 0.11	1.52 ± 0.09	1.01 ± 0.02	0.530 ± 0.007
03/04/13	0.769 ± 0.014	0.88 ± 0.03	1.22 ± 0.03	1.07 ± 0.02
01/05/13	1.24 ± 0.16	0.648 ± 0.011	0.84 ± 0.03	1.17 ± 0.19
05/06/13	1.32 ± 0.08	1.53 ± 0.12	1.7 ± 0.3	1.33 ± 0.09
03/07/13	1.65 ± 0.17	1.19 ± 0.12	1.17 ± 0.06	0.92 ± 0.03
08/08/13	0.83 ± 0.04	0.62 ± 0.09	0.69 ± 0.04	1.05 ± 0.05
05/09/13	1.46 ± 0.19	2.6 ± 0.5	1.7 ± 0.3	0.97 ± 0.03
07/10/13	2.2 ± 0.4	1.08 ± 0.12	0.832 ± 0.017	1.14 ± 0.05
05/11/13	1.56 ± 0.09	0.71 ± 0.06	1.10 ± 0.05	1.17 ± 0.05
04/12/13	1.12 ± 0.04	1.27 ± 0.09	1.03 ± 0.04	0.92 ± 0.04
02/01/14	1.21 ± 0.06	1.28 ± 0.08	1.01 ± 0.02	1.21 ± 0.04
05/02/14	1.0 ± 0.4	1.19 ± 0.07	1.25 ± 0.09	1.53 ± 0.12
05/03/14	0.93 ± 0.04	1.13 ± 0.05	0.91 ± 0.03	0.536 ± 0.008
02/04/14	0.32 ± 0.03	2.83 ± 0.10	1.74 ± 0.11	1.31 ± 0.03
07/05/14	1.09 ± 0.19	0.93 ± 0.07	0.86 ± 0.02	1.1 ± 0.2
05/06/14	0.8 ± 0.4	0.99 ± 0.07	0.93 ± 0.03	1.00 ± 0.04
08/07/14	1.63 ± 0.20	2.2 ± 0.4	2.06 ± 0.14	0.95 ± 0.04
07/08/14	0.9 ± 0.3	1.6 ± 0.7	1.20 ± 0.14	0.701 ± 0.019
03/09/14	0.898 ± 0.017	1.09 ± 0.06	0.78 ± 0.02	1.33 ± 0.13
09/10/14	1.28 ± 0.08	0.84 ± 0.07	1.30 ± 0.17	0.566 ± 0.013
05/11/14	1.02 ± 0.07	1.03 ± 0.06	0.91 ± 0.02	1.40 ± 0.13
04/12/14	1.20 ± 0.08	1.9 ± 0.3	1.10 ± 0.08	1.07 ± 0.08
07/01/15	2.0 ± 0.2	1.3 ± 0.2	1.52 ± 0.17	1.1 ± 0.3
04/02/15	1.8 ± 0.2	2.1 ± 0.3	1.38 ± 0.06	1.24 ± 0.12
05/03/15	1.5 ± 0.2	1.3 ± 0.3	1.3 ± 0.2	1.2 ± 0.3
02/04/15	3.1 ± 0.5	2.7 ± 0.4	2.8 ± 0.7	2.8 ± 0.5
06/05/15	1.1 ± 0.7	1.9 ± 0.5	1.2 ± 0.7	1.70 ± 0.15

03/06/15	1.7 ± 0.4	1.8 ± 0.4	2.7 ± 0.8	1.4 ± 0.2
08/07/15	2.5 ± 0.9	3.6 ± 0.7	2.4 ± 0.8	0.7 ± 0.5
05/08/15	1.22 ± 0.11	1.46 ± 0.17	1.36 ± 0.18	0.91 ± 0.11
02/09/15	0.5 ± 0.2	1.6 ± 0.3	1.28 ± 0.07	1.14 ± 0.09
07/10/15	0.9 ± 0.7	3.4 ± 0.8	1.6 ± 0.3	1.4 ± 0.4
04/11/15	1.1 ± 0.3	2.5 ± 0.7	1.9 ± 1.0	0.9 ± 0.9
09/12/15	0.9 ± 0.5	1.7 ± 0.4	1.9 ± 0.5	2.7 ± 0.4
06/01/16	1.7 ± 0.3	2.1 ± 0.9	1.1 ± 0.3	1.65 ± 0.15

Table D.5 *Activity concentrations of γ-emitters in seaweed from the Westerscheldt. Analysis is performed on a combined sample of the monthly samples of all four locations (1, 2, 3 and 4).*

Date	**Mass**	**^{60}Co**	**^{131}I**	**^{137}Cs**
	kg	**Bq/kg (1)**	**Bq/kg (1)**	**Bq·kg (1)**
07/02/07	0.198	< 2	2.0 ± 0.3	< 2
07/03/07	0.165	< 3	1.7 ± 0.3	0.6 ± 0.3
05/04/07	0.107	< 4	< 3	2.1 ± 0.6
03/05/07	0.186	< 3	< 2	< 2
06/06/07	0.051	< 8	< 7	< 6
05/07/07	0.099	< 4	1.4 ± 0.5	< 3
06/08/07	0.031	< 4	< 3	< 3
05/09/07	0.024	< 8	< 7	< 7
03/10/07	0.026	< 7	< 4	< 5
07/11/07	0.025	< 5	< 3	< 3
06/12/07	0.028	< 5	< 4	< 4
07/02/08	0.08	< 5	< 4	< 3
04/03/08	0.574	< 0.7	< 0.5	1.80 ± 0.18
02/04/08	0.786	< 0.6	< 0.4	1.52 ± 0.11
08/05/08	0.313	< 2	< 1	< 1
04/06/08	0.305	< 1	< 0.9	0.91 ± 0.15
03/07/08	0.208	< 2	< 1	< 1
06/08/08	0.171	< 2	< 2	< 2
08/09/08	0.2	< 2	< 2	< 2
01/10/08	0.207	< 2	< 1	< 1
06/11/08	0.256	< 2	< 1	< 1
04/12/08	0.179	< 2	< 2	< 2
08/01/09	0.031	< 5	< 3	< 3
06/02/09	0.16	< 3	< 0.8	< 2
05/03/09	0.15	< 3	< 2	< 2
02/04/09	0.077	< 5	< 5	< 4
06/05/09	0.069	< 6	< 4	1.6 ± 0.8
04/06/09	0.105	< 4	< 3	< 3
08/07/09	0.116	< 4	< 2	< 3
06/08/09	0.122	< 4	< 3	1.2 ± 0.6
07/09/09	0.091	< 4	< 3	< 3
08/10/09	0.106	< 4	< 2	< 2
05/11/09	0.201	< 2	< 2	< 2
03/12/09	0.046	< 4	< 3	< 4
04/02/10	0.100	< 4	< 4	< 3

03/03/10	0.094	< 4	< 3	< 3
01/04/10	0.128	< 3	3.3 ± 0.4	< 2
07/05/10	0.142	< 3	< 2	< 2
03/06/10	0.116	< 3	< 3	0.9 ± 0.4
08/07/10	0.158	< 2	< 2	< 2
05/08/10	0.156	< 3	< 2	0.8 ± 0.4
02/09/10	0.119	< 4	< 2	< 3
04/10/10	0.206	< 2	< 2	< 2
03/11/10	0.115	< 3	< 2	< 2
09/12/10	0.242	< 2	< 1	< 1
05/01/11	0.109	< 4	< 3	< 3
01/02/11	0.161	< 3	< 2	< 2
01/03/11	0.129	< 3	< 2	< 2
06/04/11	0.191	< 2	< 2	< 2
02/05/11	0.132	< 3	0.9 ± 0.3	< 2
07/06/11	0.162	< 3	< 2	< 2
06/07/11	0.107	< 3	< 3	< 3
03/08/11	0.132	< 3	< 2	< 2
08/09/11	0.119	< 3	< 2	< 2
04/10/11	0.141	< 3	< 2	< 2
03/11/11	0.086	< 4	< 3	< 3
08/12/11	0.097	< 4	< 3	< 3
09/01/12	0.100	< 4	< 3	< 3
08/02/12	0.095	< 4	< 3	< 3
08/03/12	0.103	< 2	< 1	< 1
03/04/12	0.089	< 2	< 2	< 2
03/05/12	0.075	< 3	< 4	< 2
11/06/12	0.086	< 2	< 2	< 2
03/07/12	0.093	< 2	< 2	< 2
08/08/12	0.076	< 2	< 2	< 2
04/09/12	0.125	< 2	< 2	< 1
03/10/12	0.097	< 2	< 3	< 2
07/11/12	0.125	< 1	< 2	< 1
05/12/12	0.097	< 1	< 1	< 1
02/01/13	0.088	< 2	< 3	< 2
05/02/13	0.086	< 2	< 2	< 2
06/03/13	0.096	< 2	< 2	< 2
03/04/13	0.099	< 1	< 1	< 1
01/05/13	0.08	< 2	< 2	< 2
05/06/13	0.057	< 2	< 1	< 2
03/07/13	0.081	< 2	< 2	< 2
08/08/13	0.083	< 2	< 2	< 2
05/09/13	0.095	< 1	< 2	< 1
07/10/13	0.099	< 2	< 2	< 2
05/11/13	0.094	< 2	< 2	< 2
04/12/13	0.095	< 2	< 2	< 2
02/01/14	0.1	< 1	< 2	< 1
05/02/14	0.146	< 2	< 1	< 1

05/03/14	0.100	< 1	< 1	< 1
02/04/14	0.096	< 2	< 2	< 2
07/05/14	0.109	< 2	< 1	< 2
05/06/14	0.078	< 2	< 3	< 2
08/07/14	0.076	< 3	< 2	< 2
07/08/14	0.161	< 1	< 1	< 1
03/09/14	0.144	< 1	< 2	< 1
09/10/14	0.119	< 2	< 2	< 1
05/11/14	0.299	< 0.6	< 0.5	< 0.5
04/12/14	0.296	< 0.8	< 0.8	< 0.6
07/01/15	0.154	< 1	< 0.9	< 1
04/02/15	0.129	< 2	< 0.9	< 1
05/03/15	0.125	< 2	< 1	< 1
02/04/15	0.07	< 3	< 2	< 2
06/05/15	0.093	< 2	< 2	< 2
03/06/15	0.147	< 1.0	< 0.8	< 0.9
08/07/15	0.078	< 3	< 2	< 2
05/08/15	0.167	< 2	< 0.9	< 1
02/09/15	0.121	< 1	< 1	< 1
07/10/15	0.153	< 1	< 1	< 1
04/11/15	0.129	< 2	< 1	< 1
09/12/15	0.147	< 1	< 1	< 1
06/01/16	0.097	< 2	< 3	< 2

(1) Dry weight.

Table D.6 *Activity concentrations of γ-emitters in sediment from the Westerscheldt. Analysis is performed on a combined sample of the monthly samples of all four locations (1, 2, 3 and 4) (see Figure D.1 for sampling locations).*

Date	Mass	^{60}Co	^{131}I	^{137}Cs
	kg·m^{-2}	Bq/kg (1)	Bq/kg (1)	Bq·kg (1)
07/02/07	38.5	< 0.3	< 0.2	0.56 ± 0.07
07/03/07	38.9	< 0.3	< 0.2	0.74 ± 0.06
05/04/07	31.8	< 0.3	< 0.2	0.93 ± 0.08
03/05/07	31.0	< 0.3	< 0.2	1.52 ± 0.08
06/06/07	37.1	< 0.3	< 0.3	1.06 ± 0.06
05/07/07	38.3	< 0.3	< 0.2	1.19 ± 0.07
06/08/07	31.6	< 0.3	< 0.3	1.24 ± 0.07
05/09/07	35.7	< 0.3	< 0.2	1.34 ± 0.07
03/10/07	31.4	< 0.3	< 0.2	1.22 ± 0.12
07/11/07	29.3	< 1	< 0.9	0.9 ± 0.3
06/12/07	30.7	< 0.4	< 0.3	1.19 ± 0.10
07/02/08	35.1	< 0.3	< 0.3	1.30 ± 0.07
04/03/08	34.8	< 0.3	< 0.2	1.01 ± 0.08
02/04/08	33.1	< 0.3	< 0.3	1.25 ± 0.09
08/05/08	36.8	< 0.2	< 0.1	0.70 ± 0.05
04/06/08	31.7	< 0.3	< 0.2	1.24 ± 0.08
03/07/08	43.7	< 0.5	< 0.3	1.43 ± 0.12
06/08/08	37.0	< 0.3	< 0.2	0.99 ± 0.09

08/09/08	34.0	< 0.3	< 0.2	1.03 ± 0.07
01/10/08	37.0	< 0.3	< 0.2	1.05 ± 0.07
06/11/08	34.8	< 0.3	< 0.2	1.20 ± 0.07
04/12/08	32.1	< 0.3	< 0.2	1.03 ± 0.08
06/02/09	35.7	< 0.3	< 0.3	< 0.5
05/03/09	34.5	< 0.4	< 0.3	< 0.3
02/04/09	30.4	< 0.4	< 0.5	< 0.3
06/05/09	26.7	< 0.4	< 0.3	1.04 ± 0.08
04/06/09	29.1	< 0.3	< 0.2	1.19 ± 0.08
08/07/09	23.8	< 0.3	< 0.3	1.11 ± 0.08
06/08/09	29.5	< 0.3	< 0.2	1.13 ± 0.08
07/09/09	35.1	< 0.3	< 0.2	0.84 ± 0.07
08/10/09	56.3	< 0.3	< 0.2	0.95 ± 0.08
05/11/09	60.8	< 0.3	< 0.3	1.31 ± 0.11
03/12/09	66.7	< 0.3	< 0.2	1.33 ± 0.07
07/01/10	62.0	< 0.3	< 0.3	1.24 ± 0.08
04/02/10	47.5	< 0.5	< 0.3	1.08 ± 0.11
03/03/10	58.0	< 0.4	< 0.3	1.27 ± 0.09
01/04/10	60.1	< 0.4	< 0.3	1.02 ± 0.08
07/05/10	48.6	< 0.4	< 0.3	0.85 ± 0.09
03/06/10	52.4	< 0.4	< 0.3	1.27 ± 0.09
08/07/10	50.5	< 0.4	< 0.3	0.96 ± 0.10
05/08/10	47.4	< 0.5	< 0.4	0.64 ± 0.08
02/09/10	63.9	< 0.4	< 0.3	1.29 ± 0.08
04/10/10	55.4	< 0.4	< 0.3	1.17 ± 0.09
03/11/10	52.1	< 0.4	< 0.3	1.06 ± 0.10
09/12/10	54.4	< 0.4	< 0.3	0.97 ± 0.09
05/01/11	43.6	< 0.5	< 0.3	0.85 ± 0.10
01/02/11	65.4	< 0.4	< 0.3	1.36 ± 0.09
01/03/11	71.7	< 0.3	< 0.2	0.89 ± 0.08
06/04/11	67.3	< 0.3	< 0.2	0.97 ± 0.08
02/05/11	52.7	< 0.4	< 0.3	1.37 ± 0.14
07/06/11	50.4	< 0.4	< 0.3	0.70 ± 0.07
06/07/11	57.3	< 0.4	< 0.3	1.21 ± 0.09
03/08/11	59.6	< 0.3	< 0.2	0.75 ± 0.08
08/09/11	60.7	< 0.4	< 0.4	< 0.4
04/10/11	50.1	< 0.4	< 0.3	1.23 ± 0.10
03/11/11	57.5	< 0.3	< 0.2	0.62 ± 0.04
08/12/11	56.4	< 0.4	< 0.3	2.28 ± 0.10
09/01/12	57.7	< 0.3	< 0.3	0.34 ± 0.07
08/02/12	54.5	< 0.4	< 0.3	1.62 ± 0.09
08/03/12	79.6	< 0.3	< 0.2	0.54 ± 0.04
03/04/12	87.8	< 0.2	< 0.2	0.34 ± 0.03
03/05/12	74.4	< 0.3	< 0.4	0.65 ± 0.04
11/06/12	71.5	< 0.2	< 0.2	0.34 ± 0.04
03/07/12	63.4	< 0.3	< 0.3	0.72 ± 0.05
08/08/12	79.8	< 0.3	< 0.2	0.47 ± 0.10
04/09/12	72.7	< 1	< 0.2	0.35 ± 0.03

03/10/12	73.6	< 0.2	< 0.3	< 0.5
07/11/12	69.9	< 0.3	< 0.3	0.56 ± 0.04
05/12/12	68.5	< 0.3	< 0.2	0.39 ± 0.04
02/01/13	60.1	< 0.3	< 0.4	1.21 ± 0.06
05/02/13	74.7	< 0.3	< 0.3	0.73 ± 0.04
06/03/13	71.9	< 0.3	< 0.4	0.83 ± 0.06
03/04/13	77.2	< 0.3	< 0.3	0.46 ± 0.05
01/05/13	66.1	< 0.3	< 0.3	1.17 ± 0.06
05/06/13	65.1	< 0.2	< 0.3	0.50 ± 0.04
03/07/13	64.3	< 0.3	< 0.5	0.31 ± 0.04
08/08/13	68.6	< 0.2	< 0.2	0.44 ± 0.04
05/09/13	65.6	< 0.3	< 0.4	0.90 ± 0.11
07/10/13	76.7	< 0.3	< 0.3	0.72 ± 0.04
05/11/13	65.3	< 0.3	< 0.2	1.06 ± 0.05
04/12/13	69.8	< 0.3	< 0.3	0.40 ± 0.04
02/01/14	72.6	< 0.3	< 0.4	1.03 ± 0.05
05/02/14	69.8	< 0.3	< 0.3	0.84 ± 0.05
05/03/14	66.0	< 0.2	< 0.3	0.72 ± 0.04
02/04/14	70.6	< 0.3	< 0.3	0.59 ± 0.05
07/05/14	76.8	< 0.2	< 0.2	0.55 ± 0.04
05/06/14	50.8	< 0.7	< 0.6	1.61 ± 0.08
08/07/14	61.2	< 0.2	< 0.3	1.19 ± 0.05
07/08/14	68.7	< 0.2	< 0.2	0.67 ± 0.03
03/09/14	69.2	< 0.4	< 0.3	0.96 ± 0.04
09/10/14	71.2	< 0.3	< 0.3	0.39 ± 0.11
05/11/14	75.7	< 0.2	< 0.2	0.68 ± 0.04
04/12/14	58.9	< 0.4	< 0.4	1.37 ± 0.05
07/01/15	76.2	< 0.3	< 0.3	0.37 ± 0.04
04/02/15	70.3	< 0.2	< 0.2	0.48 ± 0.03
05/03/15	76.8	< 0.2	< 0.2	0.35 ± 0.03
02/04/15	58.8	< 0.4	< 0.4	1.35 ± 0.05
06/05/15	71.2	< 0.2	< 0.2	0.36 ± 0.06
03/06/15	73.7	< 0.3	< 0.3	0.48 ± 0.04
08/07/15	74.4	< 0.2	< 0.2	0.56 ± 0.06
05/08/15	76.0	< 0.2	< 0.2	0.60 ± 0.07
02/09/15	77.3	< 0.2	< 0.2	0.42 ± 0.03
07/10/15	67.8	< 0.3	< 0.2	0.51 ± 0.04
04/11/15	56.4	< 0.3	< 0.3	< 0.3
09/12/15	69.9	< 0.2	< 0.2	0.40 ± 0.04
06/01/16	72.4	< 0.2	< 0.3	0.71 ± 0.04

(1) Dry weight.

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