Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

UNRESTRICTED

2018 August

SUMMARY OF ENVIRONMENTAL PERFORMANCE AT THE NUCLEAR POWER DEMONSTRATION WASTE FACILITY.

This summary describes the results of the effluent and environmental monitoring activities at the Nuclear Power Demonstration Waste Facility (NPDWF) for calendar year 2017.

The NPDWF contains the decommissioned NPD Nuclear Generating Station located just east of Rolphton, Ontario. Under a target cost agreement with Atomic Energy of Canada Limited (AECL) and subject to approval by the Canadian Nuclear Safety Commission (CNSC), Canadian Nuclear Laboratories (CNL) is planning the decommissioning of the NPDWF and is targeting to complete the decommissioning activities required to close the site by 2020. Activities to support planning for decommissioning took place during the 2017 reporting period. The preferred means of decommissioning is in-situ decommissioning; as such the proposed end state of NPDWF is a nuclear waste disposal facility, thus triggering the decommissioning of NPDWF to be a designated project under the Canadian Environmental Assessment Act (CEAA). During 2017, CNL submitted a draft Environmental Impact Statement (EIS) to the CNSC, who is the Responsible Authority for the proposed project.

Until an environmental assessment and licencing decision is issued by the CNSC, CNL continues to maintain the NPDWF in a safe and secure shut down state during Storage with Surveillance (SWS) until such time that final decommissioning is undertaken.

In terms of environmental performance, there were no abrupt changes in the nature or magnitude of releases to the environment during 2017. All radiological environmental releases were a small fraction of their respective Derived Release Limits (DRLs) thus had little impact on the public or the environment. Non-radiological concentrations discharged were assessed to determine calculated maximum discharged concentrations in the Ottawa River, and these were well below the relevant guidelines, thus also indicating little impact on the environment.

CNL is committed to achieving high standards of operational safety. The information and data presented in this report support the conclusion that safe performance is being achieved at the NPDWF.

ACRONYMS

AECL	Atomic Energy of Canada Limited
CEAA	Canadian Environmental Assessment Act
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CO_2e	CO_2 equivalent
CPT	Condenser Pipe Trench
DRL	Derived Release Limit
EIS	Environmental Impact Statement
HEPA	High-Efficiency Particulate Air
MDA	Minimum Detectable Activity
NPDWF	Nuclear Power Demonstration Waste Facility
NPRI	National Pollutant Release Inventory
OCM	Operational Control Monitoring
SWS	Storage With Surveillance
WAS	Wells Area Sump
VKT	Vehicle Kilometers Travelled

EFFLUENT MONITORING PROGRAM

The Effluent Monitoring Program at the NPDWF consists of:

- An annual check against the National Pollutant Release Inventory (NPRI) reporting requirements;
- An annual check against the Greenhouse Gas Emissions reporting requirements;
- Monitoring and reporting any losses of halocarbon refrigerants and fire suppressants over 10 kg, in compliance with the Federal Halocarbon Regulations;
- Airborne release monitoring through tritium and gross beta-gamma analysis of the ventilation stack emissions (Table 1); and
- Waterborne release monitoring through tritium, gross beta-gamma, and non-radiological parameter monitoring of the Wells Area Sump (WAS), as well as tritium and gross beta-gamma monitoring of Manhole #2 (Table 2).

National Pollutant Release Inventory

Additional work was completed at NPDWF during the 2017 reporting period, in comparison with previous reporting periods, with over 20,000 hours worked during the calendar year, thereby meeting the requirement to consider activities and emissions against NPRI reporting thresholds. Despite this increased work, the sources of NPRI emissions were virtually unchanged for the 2017 reporting period and included:

- The intermittent burning of diesel fuel in the emergency generator.
- Unpaved road dust.
- Solvent use.

All three sources were minimal such that formal calculations were not deemed to be warranted as no reporting thresholds were met for the 2017 reporting period. More specifically, there is a minor amount of diesel fuel burned on site in contractors equipment and in the emergency diesel generator (routinely tested and used during emergencies); virtually no unpaved road travel (does not meet the 10,000 VKT reporting limit); and there is a small volume of chemicals containing solvent in storage.

Greenhouse Gas Emissions

The NPDWF would be required to report releases under the *Greenhouse Gas Emissions Notice* provided that the facility emitted over the 10 000 tons of CO_2 equivalent (CO_2e) or more in 2017 (a lower reporting threshold than the 50 000 tons of CO_2 equivalent (CO_2e) in previous years). The source of greenhouse gas emissions at NPDWF was minimal and included on-site transportation with approximately 8,000 kilometers travelled, minor emissions from a former landfill and intermittent use of the diesel generator. Thus NPDWF did not exceed the greenhouse gas emissions threshold limits which require reporting.

Halocarbons

All of the halocarbon-containing equipment at the NPD site contains far below 10 kg charging capacity of halocarbons, thus the reporting requirements as per sections 32 and 33 of the *Federal Halocarbon Regulations* do not apply.

Radiological Airborne Releases

Airborne emissions are reported as increased this year. This is directly attributable to the six month long intrusive asbestos abatement campaign in the Boiler Room of the NPDWF in an effort to reduce asbestos hazards within the facility.

The High-Efficiency Particulate Air (HEPA filtered) ventilation system was operated for a total of 319.3 hours in 2017. This is a reduced fan run time from the 2016 reporting period since the Boiler Room was on separate temporary ventilation for asbestos abatement.

Airborne effluent monitoring results are presented in Table 1 and include tritium and gross beta as described above, as well as tritium and gross beta as measured from the ventilation stack monitoring station. It should be noted that the gross beta estimated release from the Boiler Room asbestos abatement activities is very conservative since it does not take into consideration the HEPA filter efficiency of 99.00% removal of particulate.

Table 1
NPDWF Annual Airborne Effluent Monitoring Report for 2017

Radionuclide	Release for Period (Bq)	DRL (Bq/a)	% DRL	Average (Bq) 2012-2016
Tritium	1.48E+12[1]	4.52E+16	<0.01	1.70E+11
Gross Beta[2]	1.84E+05[1][3]	3.83E+12[4]	<0.01	<4.51E+04

[1] Includes releases estimated from Boiler Room asbestos abatement as well as via the ventilation stack.
[2] Gross Beta results were determined using Canberra Packard Gross Alpha-Beta counter and the radioactivity is based on Cesium-137.
[3] Based on two months data, for all other months Gross Beta was not detectable.
[4] Gross Beta DRL is based on Cesium-137, the most restrictive radionuclide.

The total airborne tritium release in 2017 was 1.48E+12 Bq compared with a DRL of 4.52E+16 Bq/a (<0.01% of the DRL). The average airborne release for 2012 to 2016 for tritium is 1.7E+11 Bq. The 2017 minor increase is directly attributable to the six month long intrusive asbestos abatement campaign, and there is no abnormal or adverse trend shown in Figure 1.

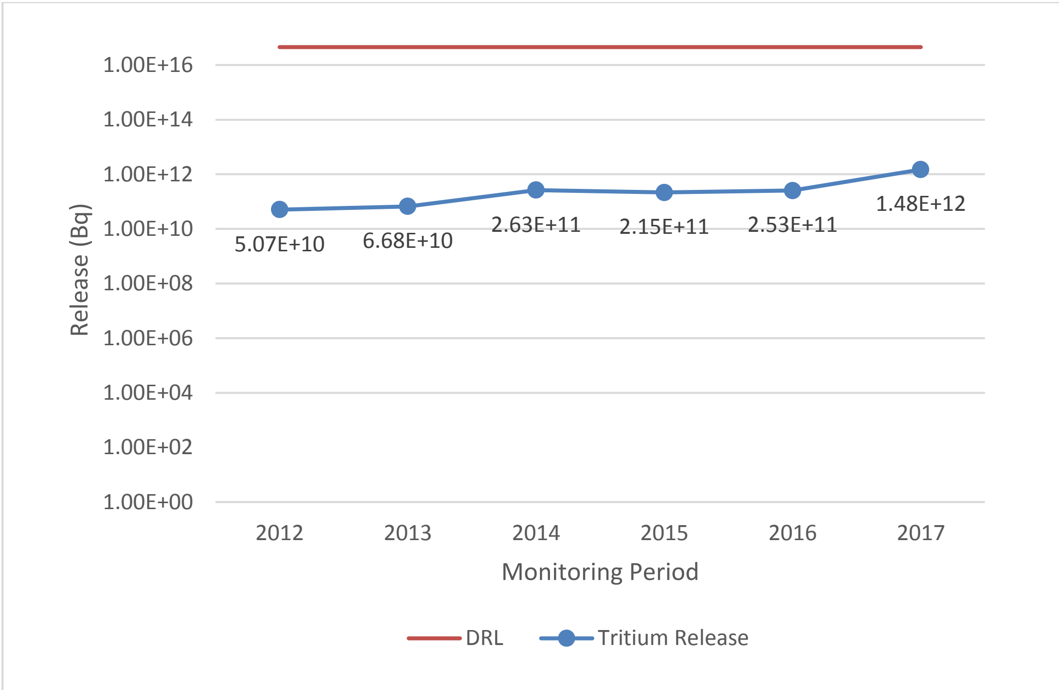
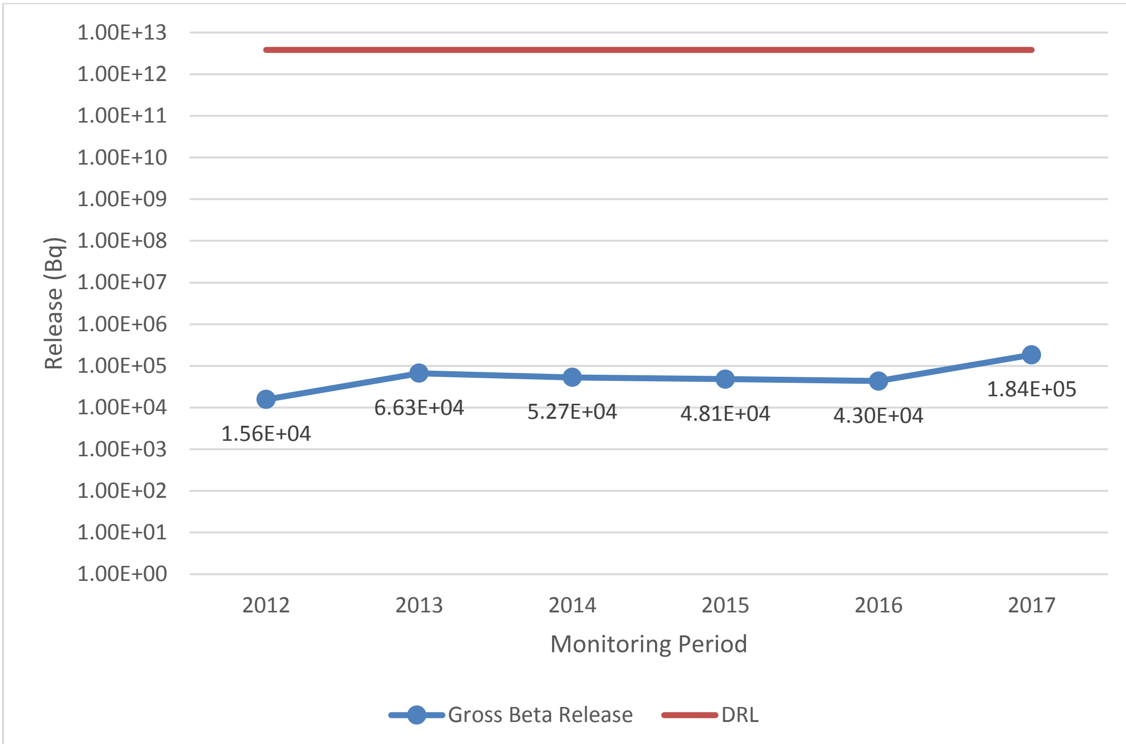


Figure 1: NPDWF Airborne Release Trend for Tritium

The total airborne gross beta release was 1.84E+05 Bq compared with a DRL of 3.83E+12 Bq/a (<0.01% of the DRL). Average airborne release for 2012 to 2016 for gross beta was <4.51E+04 Bq. The 2017 minor increase is directly attributable to the six month long intrusive asbestos abatement campaign, and there is no abnormal or adverse trend shown in Figure 2.



Note: 2012, 2015, and 2016 results were based on values that were at the Minimum Detectable Activity.

Figure 2 NPDWF Airborne Release Trend for Gross Beta

Liquid Releases

Figure 3 shows the internal and external facility drainage systems around the NPDWF. Internal liquids are collected via the WAS and Condenser Pipe Trench (CPT) sump and discharged after sampling to the Ottawa River via the process drain. The contents of the CPT sump were discharged to the Ottawa River in 2017 June, and from the WAS in 2017 December, both following sampling and verification that content was below the DRLs. The total release volume in 2017 from the CPT was 4,500 L and 8,000 L from the WAS.

Manhole #2 has been monitored as of 2016. It collects water diverted from around the Main Building (groundwater and precipitation) and has a continuous release to the Ottawa River. The volumetric flowrate from the manhole was measured four times in 2017, once in June and three times in October, while tritium and gross beta are measured semi-annually in May and November. An estimated 559,550,000 L of groundwater was diverted via Manhole #2 in 2017. This volume of flow may be artificially high as some flow measurements were taken subsequent to heavy rain events. In comparison the 2016 estimate of groundwater diverted through Manhole #2 was 191,260,000 L (measured once in October 2016).

Manhole #3 has no measurable flow through it, and as such it was not sampled since it had no corresponding release.

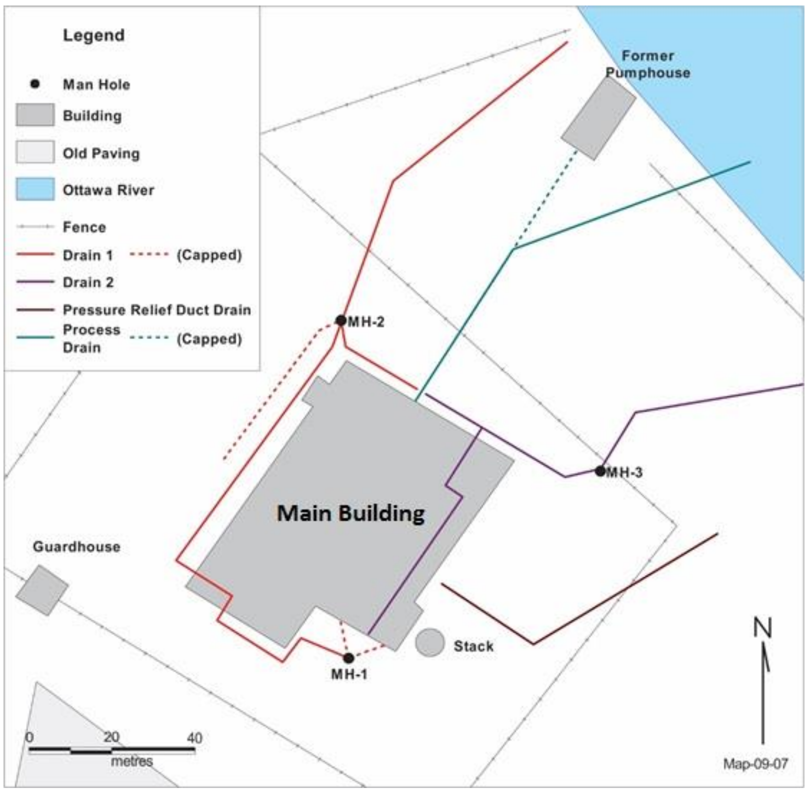


Figure 3: Internal and external facility drainage systems around the NPDWF

Liquid Radiological Releases

Figure 2 shows the liquid radiological releases from the building sumps (WAS and CPT Sump), as well as from Manhole #2.

Table 2
NPDWF Annual Liquid Effluent Monitoring Report for 2017

Location	Radionuclide	Release for Period (Bq)	DRL (Bq/a)	% DRL	Average (Bq) 2012-2016
Wells Area Sump/Condenser Pipe Trench Sump	Tritium	7.21E+10	4.33E+17	<0.01	9.92E+10
	Gross Beta	9.69E+05	2.56E+13[1]	<0.01	3.44E+06
Manhole #2	Tritium	3.57E+13[2]	4.33E+17	<0.01	3.57E+13[3]
	Gross Beta	1.80E+08[2]	2.56E+13[1]	<0.01	1.07E+08 (2016-2017)

[1] Gross Beta DRL is based on Cesium-137, the most restrictive radionuclide

[2] Based on values that were at the Lower Detection Limit.

[3] Based on 2017 data only, 2016 was "Not Detected".

The total liquid tritium release from the WAS and CPT in 2017 was 7.21E+10 Bq compared with a DRL of 4.33E+17 Bq/a (<0.01%). The average liquid release from the WAS and CPT for 2012 to 2016 for tritium was 9.92E+10 Bq. There is no evidence of an abnormal or unexplained trend in the liquid tritium releases from building sumps as shown in Figure 4.

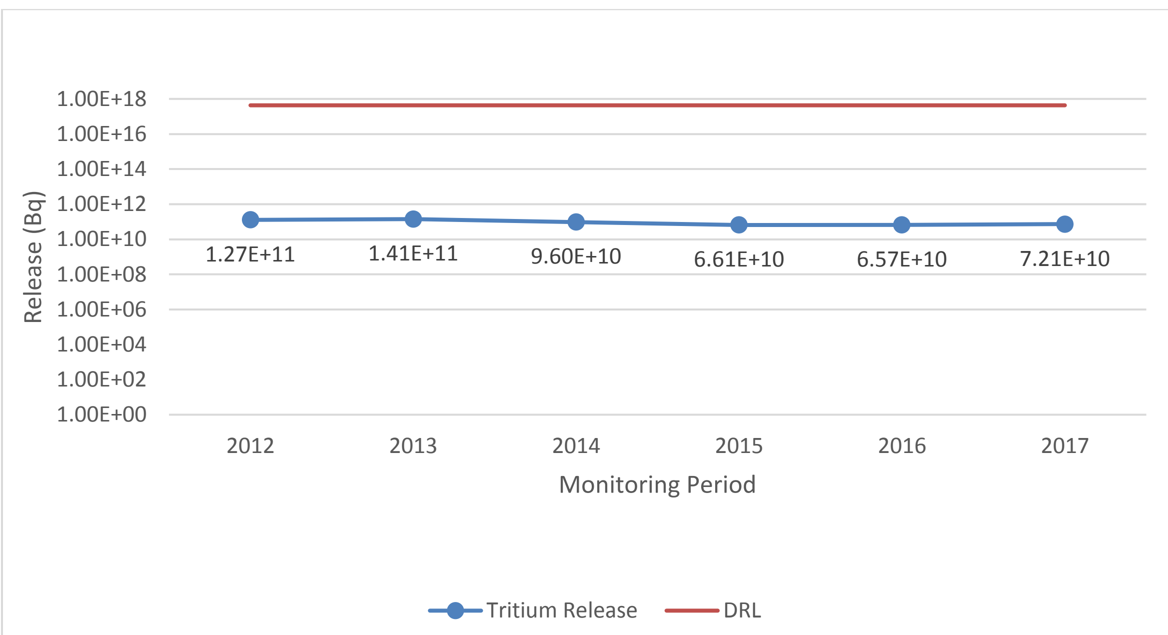


Figure 4: NPDWF Liquid Release Trend for Tritium from Sumps

The total liquid gross beta release from the building sumps in 2017 was 9.69E+05 Bq compared with a DRL of 2.56E+13 Bq/a (<0.01%). The average liquid release from the WAS and CPT for 2012 to 2016 for gross beta was 3.44E+06 Bq. There is no evidence of an abnormal or unexplained trend in the liquid gross beta releases from the building sumps as shown in Figure 5.

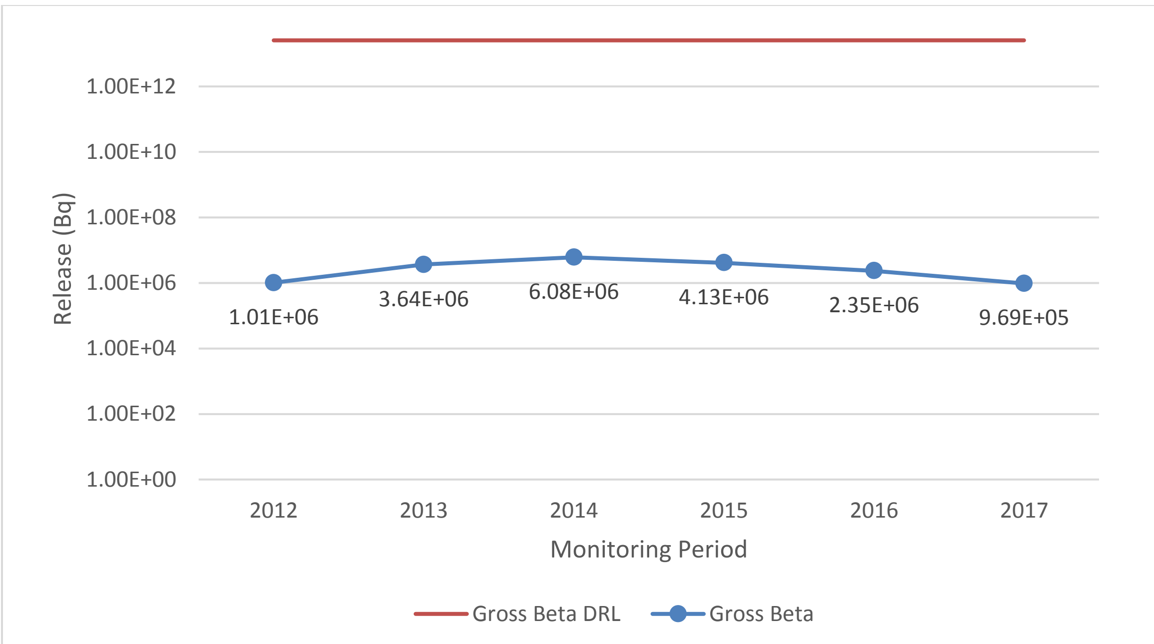


Figure 5: Liquid Release Trend for Gross Beta from Sumps

The total liquid tritium release in the effluent from Manhole #2, as a result of the external groundwater diversion system is reported in Table 2 as 3.57E+13 Bq, however, this is based on the test laboratory lower limit of detection. Tritium data in 2016 is not presented because it was below the laboratories' lower limit of detection.

The total liquid gross beta release in the effluent from Manhole #2 presented in Table 2, which is reflective of the external groundwater diversion system, was 1.80E+08 Bq compared with a DRL of 2.56E+13 Bq/a (<0.01%).

Since Manhole #2 has only been measured for radiological parameters since 2016, there is insufficient data to provide a trend. Canadian Nuclear Laboratories will continue to monitor these parameters during future monitoring periods in order to further evaluate environmental performance.

Liquid Non-Radiological Releases

There is only one liquid effluent monitoring point at NPDWF, which requires the reporting of non-radiological parameters as part of the transient discharges to the Ottawa River. During the

2017 reporting period, the potential for metals, mercury, dioxins/furans and PCBs were all monitored in the facility sumps. For the 2017 reporting period, dioxins/furans analysis services were not available.

For non-radiological parameters, comparison to environmental-based quality guidelines are not directly applicable to effluent concentrations, which are typically subject to dispersion and dilution processes in a receiving water body. In order to complete a meaningful assessment, the assimilative capacity of the receiving waters must be taken into account to determine the actual discharge concentrations, which reach the surface water environment. As such, Table 3 provides the measured effluent parameter concentrations as well as the calculated maximum discharged concentrations in the Ottawa River, which occurs just beyond the NPD discharge pipe. All discharged concentrations were well below the relevant guidelines, thus indicating little impact on the environment.

Table 3
Liquid Effluent Concentrations, Calculated Maximum Discharged Concentrations and Water Quality Guidelines

Effluent Parameter	2016		2017		Water Quality Guideline[1]
	Effluent Concentration	Calculated Maximum Discharged Concentration	Effluent Concentration	Calculated Maximum Discharged Concentration	
Iron	320 µg/L	8.47E-03 µg/L	230 µg/L	6.09E-03 µg/L	300 µg/L[1]
Lead	46 µg/L	1.22E-03 µg/L	102 µg/L	2.70E-03 µg/L	1 µg/L[1][2]
Mercury	0.31 µg/L	8.21E-06 µg/L	0.36 µg/L	9.53E-06 µg/L	0.026 µg/L[1]
Total PCBs	0.2 µg/L	5.30E-06 µg/L	0.2 µg/L	5.30E-06 µg/L	0.001 µg/L[3]
Total Dioxins/Furans	5.85 pg/L	1.55E-04 pg/L	5.85 pg/L[4]	1.55E-04 pg/L[4]	ncl[5]

[1] Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life: Freshwater.

[2] The CWQG for lead is hardness related and the value shown is the most stringent, for hardness ≤60 mg/L.

[3] Provincial Water Quality Objectives for the Protection of Aquatic Life (MOEE 1994).

[4] Due to laboratory unavailability, dioxins/furans were not measured; data is from 2016.

[5] no criterion listed.

As non-radiological parameters have only been measured in 2016 and 2017, insufficient data is yet available in order to provide a trend. Canadian Nuclear Laboratories will continue to monitor these parameters during future monitoring periods in order to further evaluate the environmental performance.

NPD SITE MONITORING

Additional monitoring at the NPD site consists of tritium, gross beta, gross alpha, total strontium and cesium-137 analyses of the Ottawa River as well as tritium analysis of water from surface soil and vegetation.

Results of monitoring of radioactivity in the Ottawa River upstream (Rolphton) and downstream (Deep River) of NPDWF from 2012 to 2017 is shown in Table 4, and the sampling locations are shown in Figure 6. The observed concentrations are at natural background levels, and far below the Maximum Acceptable Concentrations specified by Health Canada.

Table 4: Radioactivity (Bq/L in Ottawa River Water – 2012-2017)

Location & Parameter	2012	2013	2014	2015	2016	5-Year Average	2017 Average	2017 Maximum
Rolphton (ORR) [1]								
Tritium (Bq/L)	< 4	V 1	< 1.2 ± 0.6	V 1.7 ± 0.1	2.1 ± 0.1	2.2 ± 1.3	3.5 ± 0.2	6.1 ± 1.1 (Feb)
Gross Beta (Bq/L)	0.056 ± 0.006	V 0.039 ± 0.002	0.042 ± 0.001	0.04 ± 0.001	0.046 ± 0.012	0.044 ± 0.007	0.046 ± 0.012	0.1 ± 0 (Aug)
Gross Alpha (Bq/L)	0.0056 ± 0.0005	0.0046 ± 0.0001	0.0115 ± 0.0004	0.0091 ± 0.0003	0.0072 ± 0.0006	0.0074 ± 0.0028	0.0074 ± 0.0006	0.013 ± 0.0029 (Mar)
Total Strontium (Bq/L)	< 0.0037	V 0.0017 ± 0.0005	0.0048 ± 0.0006	0.0019 ± 0.0017	NA	0.0031 ± 0.0013	NA	NA
Cesium-137 (Bq/L)	< 0.0009	V 0.0010 ± 0.0003	V 0.0016 ± 0.0005	V 0.0012 ± 0.0008	V 0.0006 ± 0.0001	0.001 ± 0.0001	V 0.0003 ± 0.0001	0.0005 ± 0.0001 (Q2)
Deep River (ORD) [1]								
Tritium (Bq/L)	< 3	V 1 ± 1	< 1 ± 1	V 1.4 ± 0.1	2.2 ± 0.1	V 2 ± 1.2	3.6 ± 0.2	6.3 ± 1.1 (Feb)
Gross Beta (Bq/L)	0.061 ± 0.007	0.042 ± 0.002	0.046 ± 0.001	0.039 ± 0.001	0.052 ± 0.013	0.046 ± 0.009	0.054 ± 0.013	0.1 ± 0.1 (Sep)
Gross Alpha (Bq/L)	0.0056 ± 0.0005	0.0045 ± 0.0001	0.0095 ± 0.0003	0.0079 ± 0.0003	0.0065 ± 0.0006	0.0064 ± 0.0022	0.007 ± 0.0006	0.01 ± 0.0026 (Dec)
Total Strontium (Bq/L)	< 0.0027	0.0026 ± 0.0005	V 0.0052 ± 0.0007	V 0.0027 ± 0.0012	NA	V 0.0034 ± 0.0012	NA	NA
Cesium-137 (Bq/L)	0.0011 ± 0.0003	V 0.0009 ± 0.0003	V 0.0007	V 0.002	V 0.0006 ± 0.0001	V 0.0015 ± 0.0009	< 0.0004	< 0.001 (Oct)

[1] See Figure 6 for sampling locations.
± Represents the uncertainty in the counting statistics, except for the five-year averages, where it represents the uncertainty in the result population (i.e. one standard deviation of the annual averages).
< Indicates that the result is below the detection level (L_D). Results that fall below the L_D are reported as less than the numerical value of the L_D.
NA Strontium-90 was removed from the monitoring program, with measurements only conducted in the event of abnormal or increasing gross beta results.
V Indicates that one or more of the values used to calculate the result is below the critical level (L_C) and/or the detection level (L_D).
Note: In 2017, the CNL Environmental Monitoring Program moved from reporting a ±1 sigma uncertainty to a method (described in the CSA N288.4) that more accurately represents the uncertainty associated with the measured value. This has, in general, resulted in a higher reported uncertainty than what has been seen in previous years.

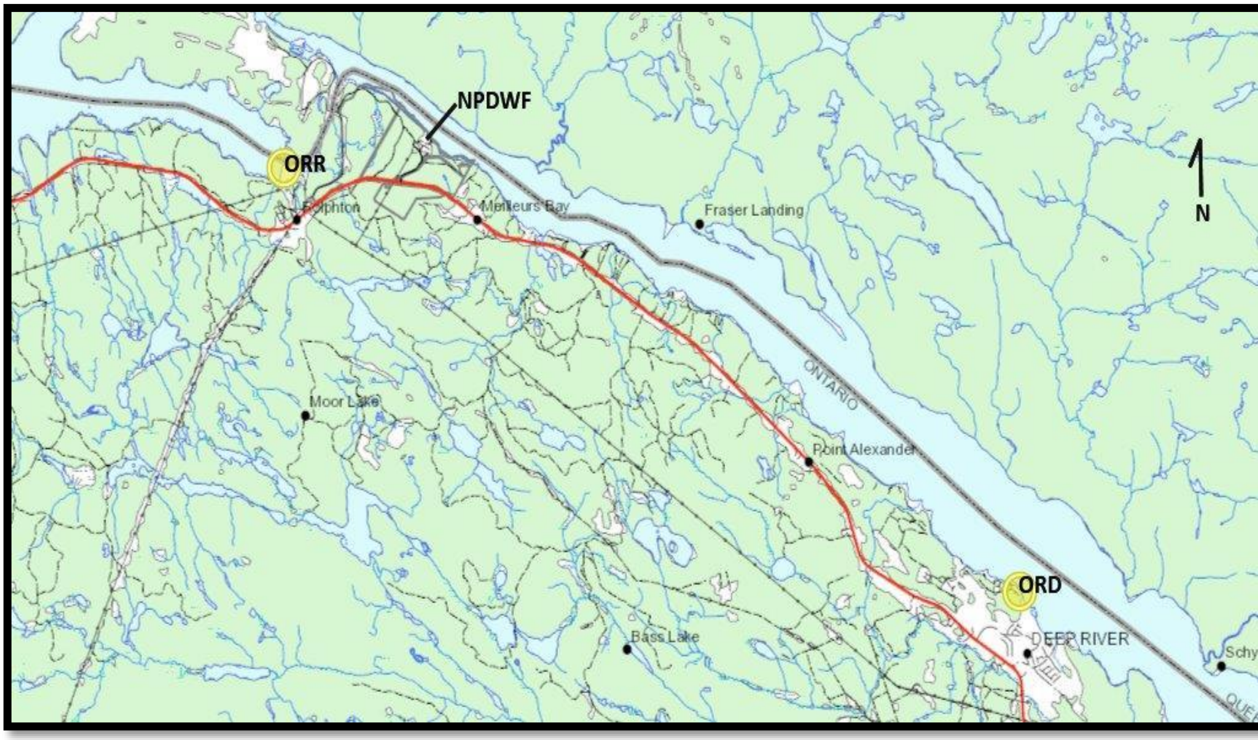


Figure 6: Ottawa River Sampling Locations in the Vicinity of NPDWF

Tritium analysis of water from surface soil and vegetation is shown in Table 5 and sampling locations are shown in Figure 7.

Table 5
NPDWF Tritium Analysis of Water from Surface Soil and Vegetation (2012 – 2017)

	Tritium (Bq/L)						
	Sampling Station Number [1]	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Vegetation-Free Water	NPD-NE	93	103	111	39	37	32
	NPD-SE	151	29	132	35	46	34
	NPD-SW	429	20	12	22	76	11
	NPD-NW	107	39	13	12	42	18
	Stack Base	NM [2]	180	251	102	125	145
	O1B	129	7	<2	< 2	18	<3
	NB-W	220	14	8	7	44	9
	NB-S	73	9	4	< 3	21	2
	NB-E	123	20	15	223	21	40
Soil Water	NPD-NE	68	34	11	24	10	36
	NPD-SE	13	25	21	10	13	14
	NPD-SW	15	26	12	15	15	8
	NPD-NW	28	23	22	25	9	10
	Stack Base	NM [2]	129	19	34	35	138
	O1B	<3	6	<3	7	<3	<2
	NB-W	6	13	13	13	13	8
	NB-S	<3	6	<2	5	<3	4
	NB-E	11	31	14	9	5	4

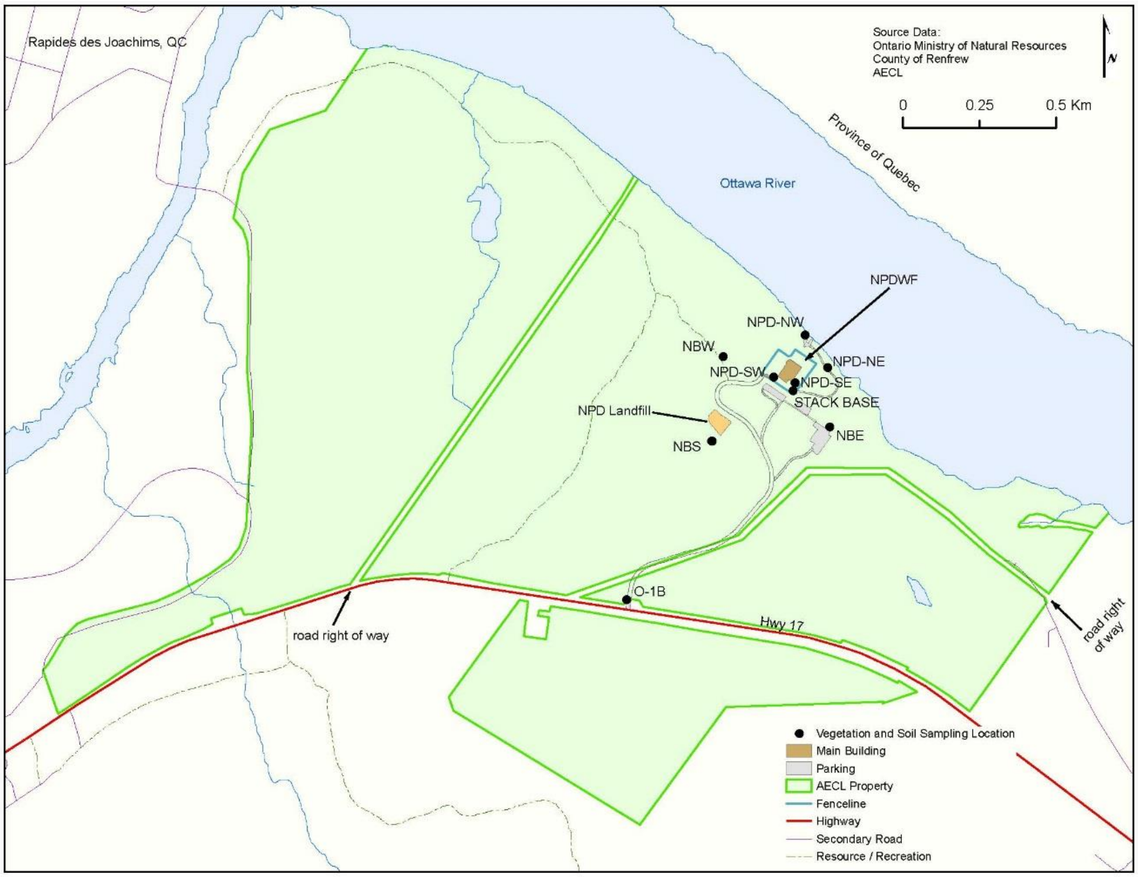


Figure 7: NPDWF Sampling Locations for surface soil and vegetation sampling

MONITORING PROGRAM CHANGES

The frequency at which flowrate measurements were taken at Manhole #2 was increased in 2017, the purpose of which was to better understand the potential for seasonal variability. The only formal monitoring program at NPDWF is the Effluent Verification Monitoring Program which is in compliance with CSA N288.5. There were no changes to this plan during the 2017 reporting period.