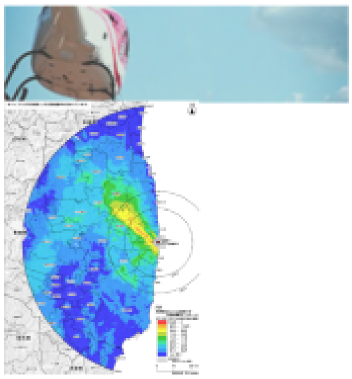
Spatiotemporal Distribution of Ambient Dose Rates

Comprehensive Radiation Monitoring Plan and Information Disclosure

Radiation dose measurement map
Results of radiation monitoring nationwide are shown in a map.



Airborne monitoring
Monitoring using airplanes is conducted on a regular basis, centered on Fukushima Prefecture. The results are compiled into ambient dose rate maps and released.

Sea area monitoring
Relevant ministries and agencies conduct monitoring of seawater, marine soil and marine organisms and release measurement results.

Prepared based on Nuclear Regulation Authority; Monitoring information of environmental radioactivity level: https://radioactivity.nsr.go.jp/ja/ (in Japanese)
Comprehensive Monitoring Plan: https://radioactivity.nsr.go.jp/ja/list/204/list-1.html (in Japanese)

The Monitoring Coordination Meeting established in the Nuclear Emergency Response Headquarters formulated Comprehensive Radiation Monitoring Plan to ensure detailed monitoring of a large amount of radioactive materials released into the environment due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. Based on this plan, relevant organizations and nuclear operators are collaboratively conducting monitoring, respectively focusing on the following.

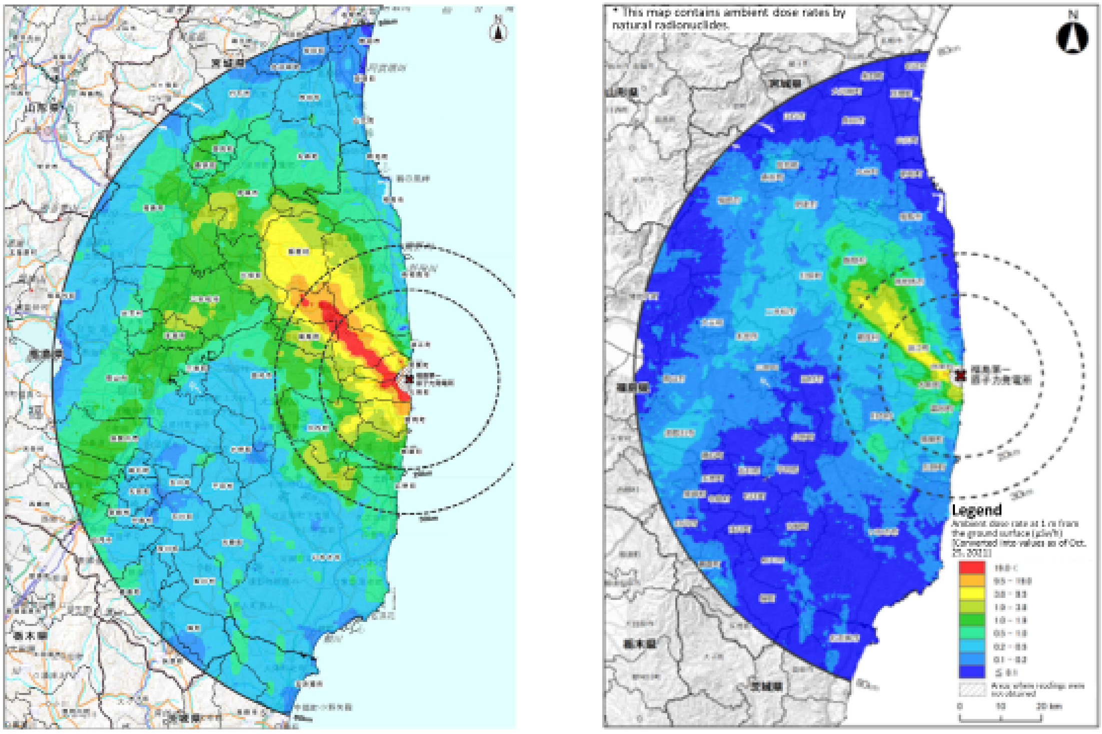
1) General environment (soil, water, and atmosphere, etc.), water environment, sea areas, etc.
2) Schools, etc.
3) Ports, airports, and sewage, etc.
4) Wild fauna and flora, and waste
5) Cultivated soil, forests, and pasture grass, etc.
6) Tap water
7) Foodstuffs (agricultural products, forestry products, livestock products, and fishery products)

Monitoring results are released on the websites of the respective organizations and are updated as needed.

Included in this reference material on February 28, 2018
Updated on March 31, 2019

Spatiotemporal Distribution of Ambient Dose Rates

Distribution of Ambient Dose Rates within the 80-km Zone of TEPCO's Fukushima Daiichi NPS



Released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) on Dec. 16, 2011

* Converted into values as of October 25, 2021
Released by the Nuclear Regulation Authority on Mar. 4, 2022

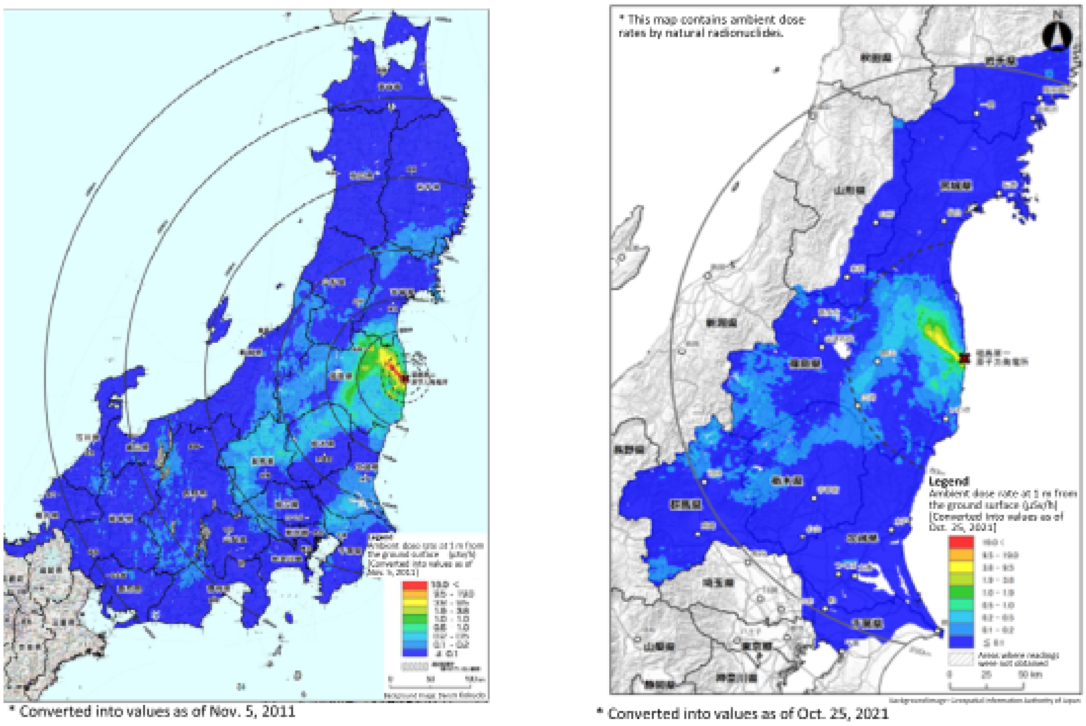
In order to ascertain the changes in the effect of radioactive materials, the airborne monitoring survey has been conducted continuously within the 80-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, and the distribution of ambient dose rates and deposition of radioactive cesium have been surveyed. Additionally, the effect of radioactive materials outside the 80-km zone has also been ascertained through the airborne monitoring survey.

It was confirmed that ambient dose rates within the 80-km zone decreased over time both in areas showing higher dose rates (areas extending to the northwest of the NPS) and areas showing lower dose rates.

Included in this reference material on March 31, 2014
Updated on March 31, 2023

Spatiotemporal Distribution of Ambient Dose Rates

Distribution of Ambient Dose Rates in Fukushima Prefecture and Neighboring Prefectures



* Converted into values as of Nov. 5, 2011

Released by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) on Dec. 16, 2011

* Converted into values as of Oct. 25, 2021

Released by the Nuclear Regulation Authority on Mar. 4, 2022

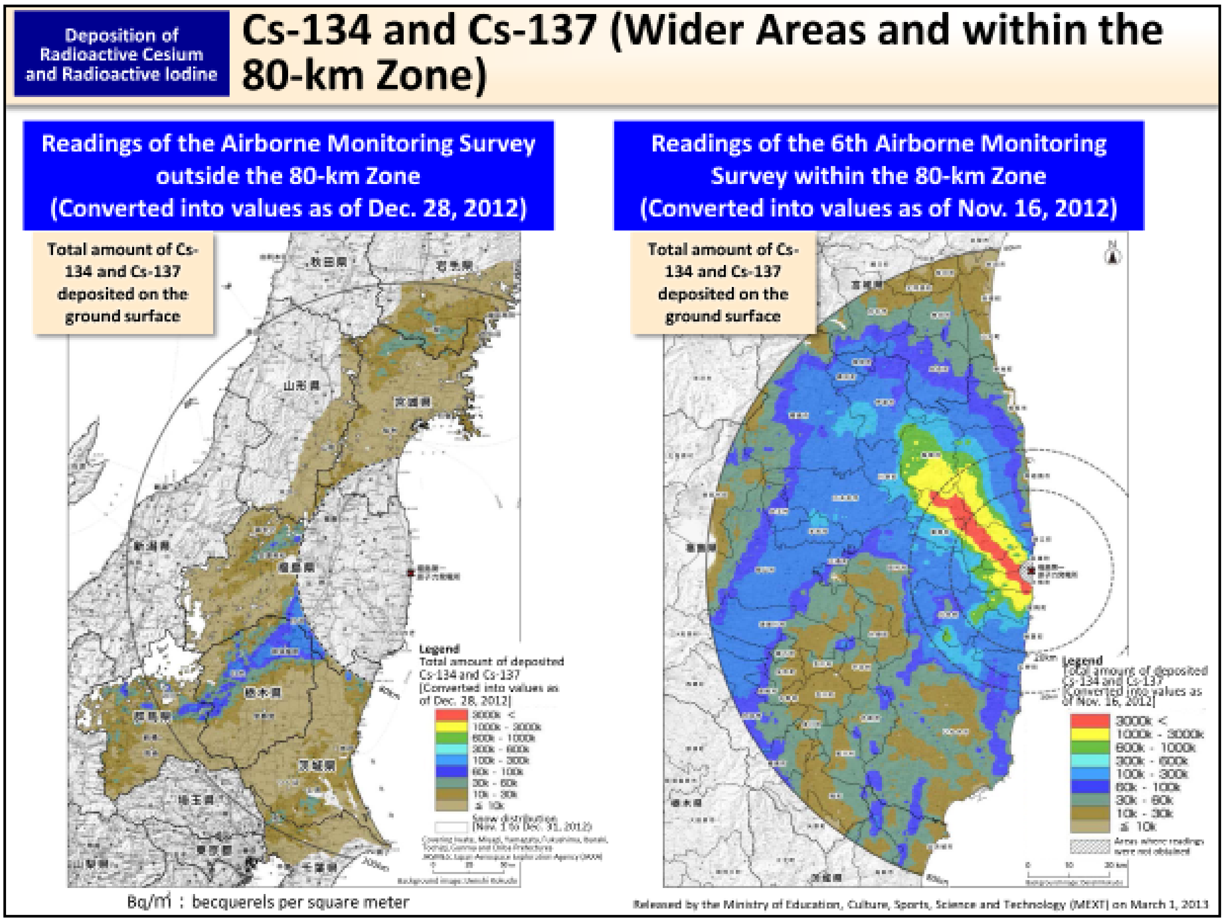
An airborne monitoring survey was conducted within the 80-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and outside this zone, mainly in the western area of Fukushima Prefecture, and in Ibaraki, Gunma, Tochigi and Miyagi Prefectures.

The left figure shows the airborne monitoring survey results as of November 2011, seven months after the accident, and the right figure shows those as of October 2021.

Readings of the Airborne Monitoring Survey in Fukushima Prefecture and Neighboring Prefectures (March 4, 2022)

https://radioactivity.nra.go.jp/ja/contents/17000/16384/24/2021_16thAirborne_monitoring_press_JPN(2).pdf (in Japanese)

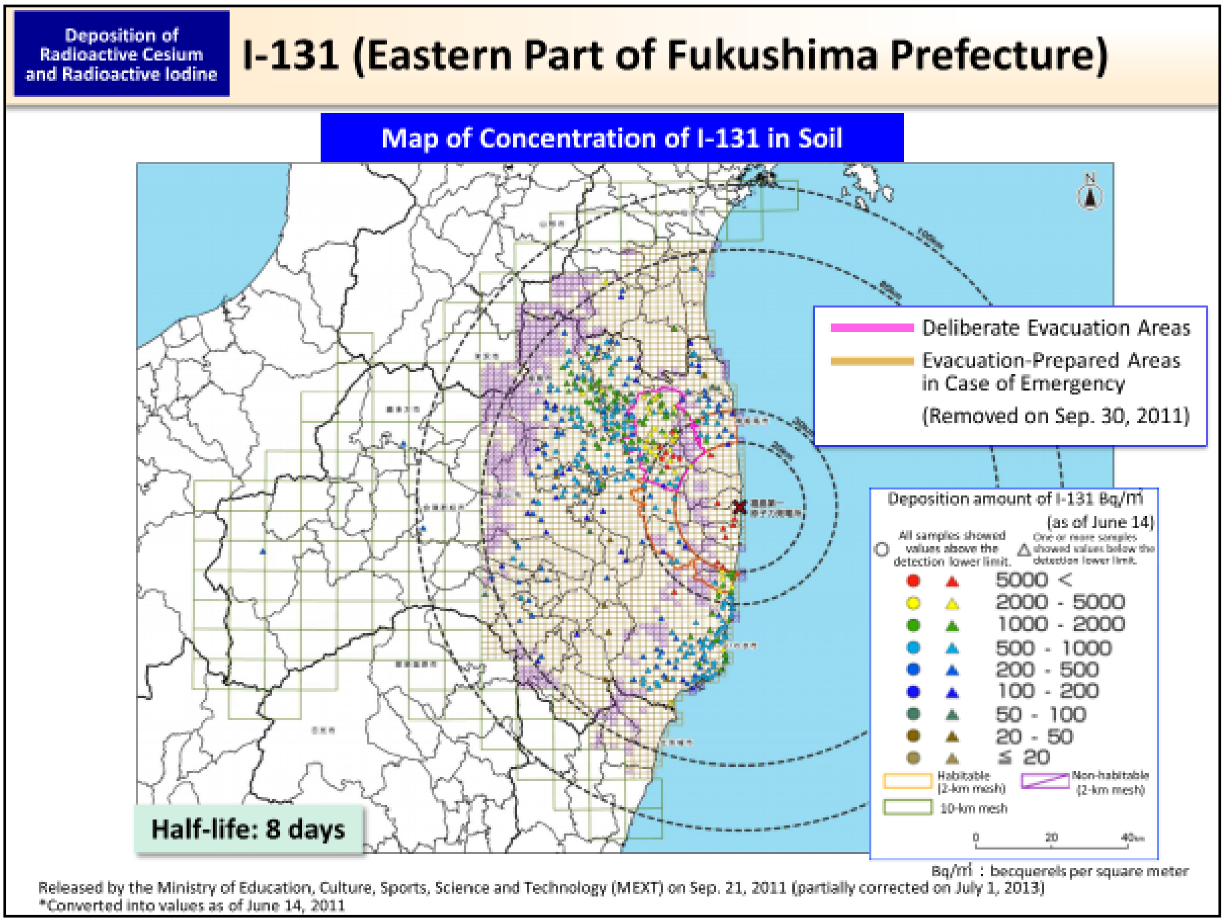
Included in this reference material on March 31, 2013
Updated on March 31, 2023



These maps show deposition of radioactive cesium on the soil surface in Fukushima and neighboring prefectures based on the readings of the airborne monitoring survey.

The survey was conducted in October to December 2012 for the purpose of ascertaining the changes in the situation regarding the effect of radioactive materials including influence of rainfall or other natural environments. When creating these maps, values were all converted into those as of the last day of the relevant airborne monitoring survey, November 16, 2012, and December 28, 2012, respectively.

Included in this reference material on March 31, 2013
Updated on March 31, 2019



In the soil survey conducted by the national government in June 2011, three months after the accident, analysis of I-131 was conducted for soil samples collected within the 100-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS.

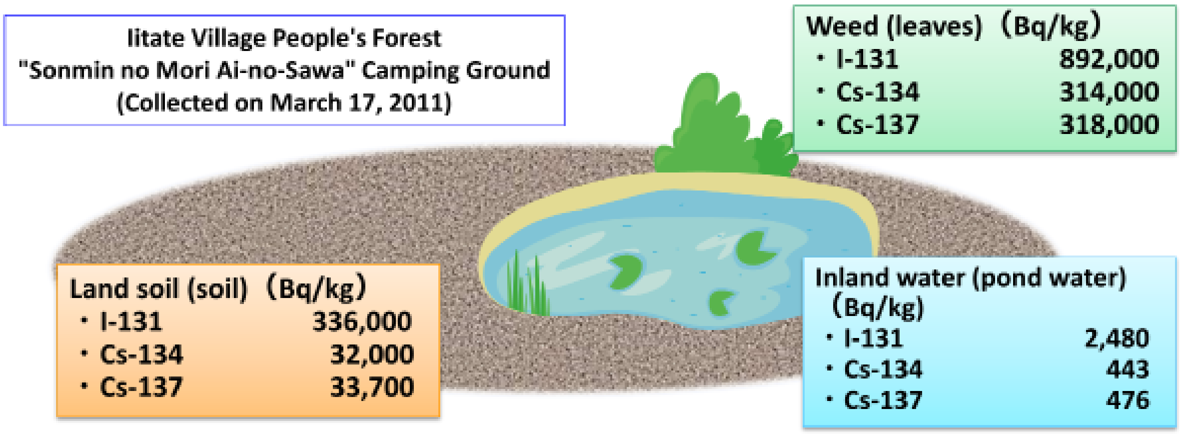
Areas showing high deposition amounts of iodine extended to the northwest of the NPS, in the same manner as in the case of cesium, and there are areas where the ratio of iodine against cesium is large in the southern areas of the NPS. I-131 and Cs-137 were thus deposited at different ratios in different areas probably because the ratio between I-131 and Cs-137 in radioactive plumes differed depending on the time when they were discharged. There is also the possibility that the ratio of I-131 against Cs-137 was relatively larger in plumes that flowed down to the south or that deposition was not even and a larger amount of Cs-137 was deposited in the north due to rainfall, resulting in increased concentrations of Cs-137 in soil in the north.[1]

1. "Concerning the Preparation of Distribution Map of Radiation Doses, etc. (Part 1)" (2012) by the Emergency Operation Center, Ministry of Education, Culture, Sports, Science and Technology

Included in this reference material on March 31, 2013
Updated on March 31, 2020

Deposition of Radioactive Cesium and Radioactive Iodine

Environmental Samples Collected in Fukushima Prefecture (Immediately after the TEPCO's Fukushima Daiichi NPS Accident)



Sampling location	Date	Weed (leaves) Bq/kg			Land soil (soil) Bq/kg		
		I-131	Cs-134	Cs-137	I-131	Cs-134	Cs-137
Towa branch municipal office, Nihonmatsu City	March 17	152,000	107,000	110,000	35,800	5,440	6,230
Swordsmanship dojo, Iitate Village	March 16	1,150,000	546,000	549,000	151,000	22,600	25,100
Ruins of Onami castle, Fukushima City	March 17	429,000	283,000	292,000	156,000	16,700	18,000

Bq/kg : becquerels per kilogram

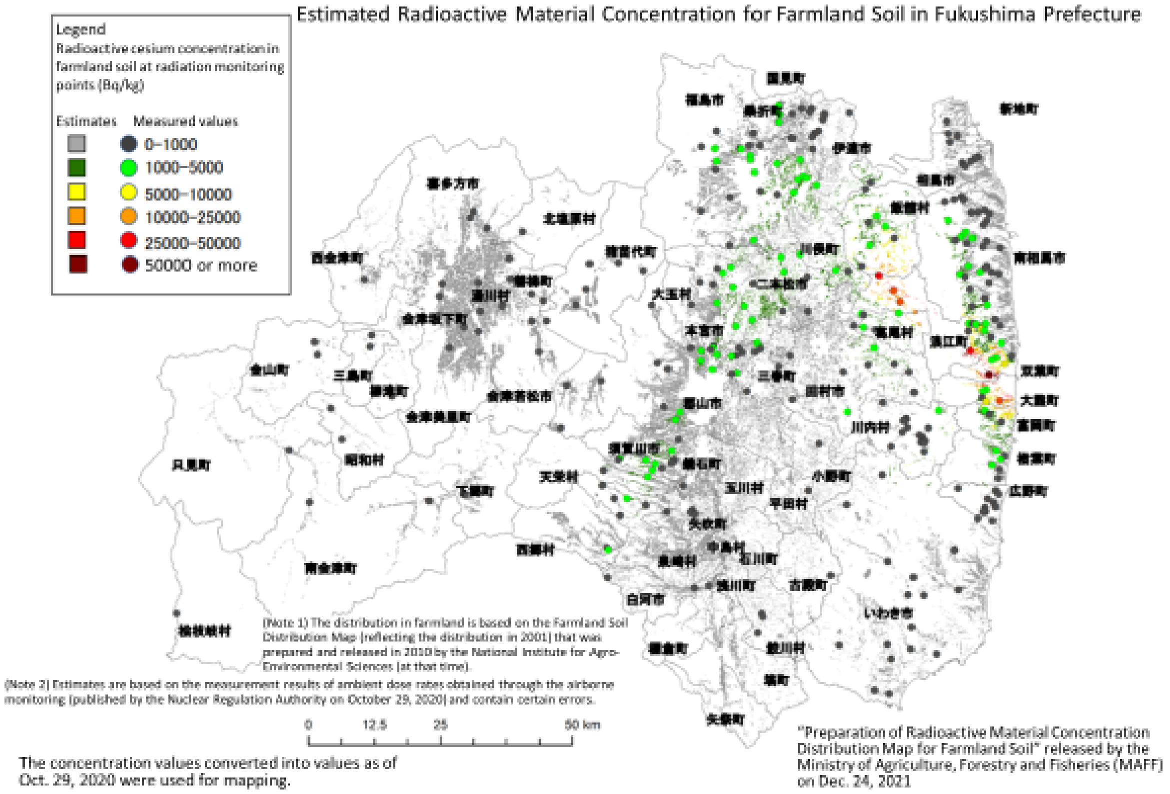
Prepared based on "Measurement Readings for Environmental Samples" on June 7, 2011, by the Ministry of Education, Culture, Sports, Science and Technology (MEXT)

Through radiation monitoring of environmental samples conducted immediately after the accident, high level concentrations of radioactive iodine and radioactive cesium were detected from soil and plants.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radiation Monitoring of Farmland

Radioactive Cesium (Fukushima Prefecture)



In order to promote future agricultural activities at farmland in Fukushima Prefecture, which was severely affected by radioactive materials due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, measurements of radioactive materials in farmland soil have been conducted continuously. The above map shows estimated radioactive cesium concentrations in farmland soil based on the results of the measurement conducted at 329 locations in Fukushima Prefecture in FY2020 (values are converted into those as of October 29, 2020).

In this farmland soil survey, soil to a depth of approx. 15 cm from the ground surface or a depth to be plowed was collected as samples in consideration of the depth of soil wherein radioactive materials are turned over in cultivation and in which crops take root.

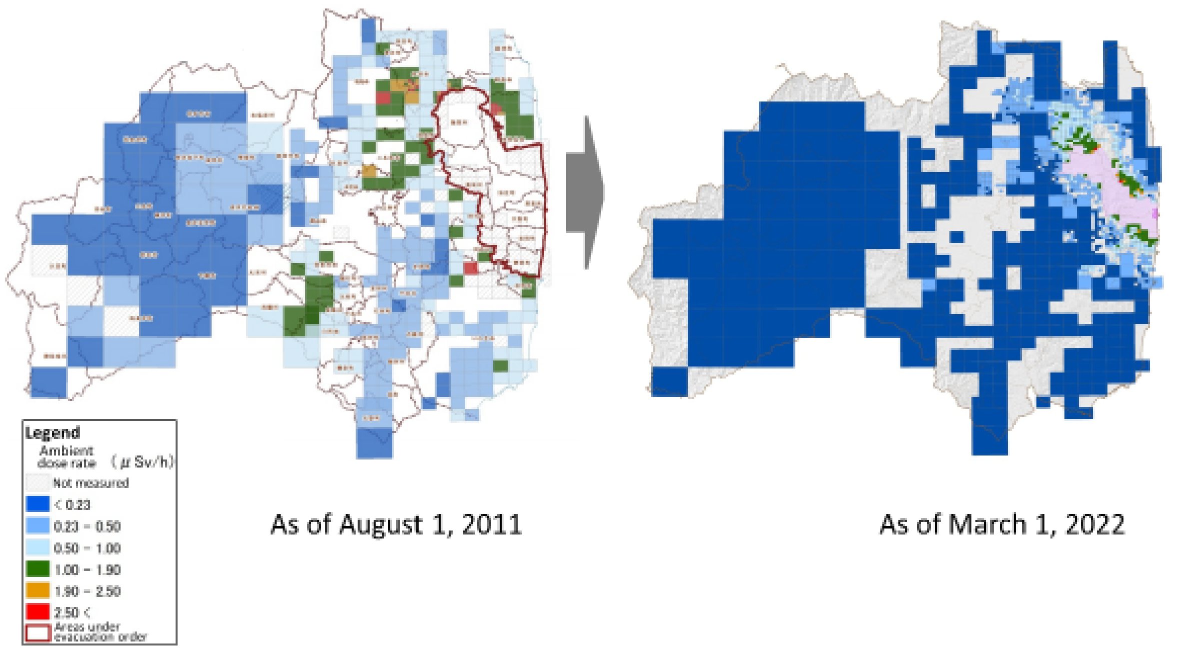
Comparing the measured values of radioactive cesium concentration in targeted farmland soil in the previous survey (converted into values as of November 2, 2019) and the measured values for the same locations obtained in the most recent survey, it was confirmed that in around one year, radioactive cesium concentration decreased by 1% in paddies, by 7% in fields, and by 9% in pastures and orchards outside the Areas under Evacuation Orders. The decline in radioactive cesium concentration in soil due to physical attenuation during the same period was 4%.

Included in this reference material on March 31, 2013
Updated on March 31, 2022

Radiation Monitoring of Forest

Changes in Ambient Dose Rates in Forests

The average ambient dose rate for 362 locations as of March 2022 is approximately 19% of the average as of August 2011.



Prepared based on "Current State and Forecast of Radioactive Materials in Forests" by Fukushima Prefecture

Fukushima Prefecture has been conducting monitoring of ambient dose rates in forests within the prefecture every year since FY2011. The monitoring targeted 362 locations in FY2011 but gradually expanded the coverage to target 1,300 locations in FY2021.

For the 362 locations, where monitoring has been continued from the beginning, the average ambient dose rate was 0.17 μSv/h as of March 2022, approximately 19% of the average as of August 2011 (0.91 μSv/h). The ambient dose rate in forests has decreased almost the same as the decrease in dose rate due to physical attenuation.

Measurement results by region as of March 2022 (minimum value - maximum value) are as follows.

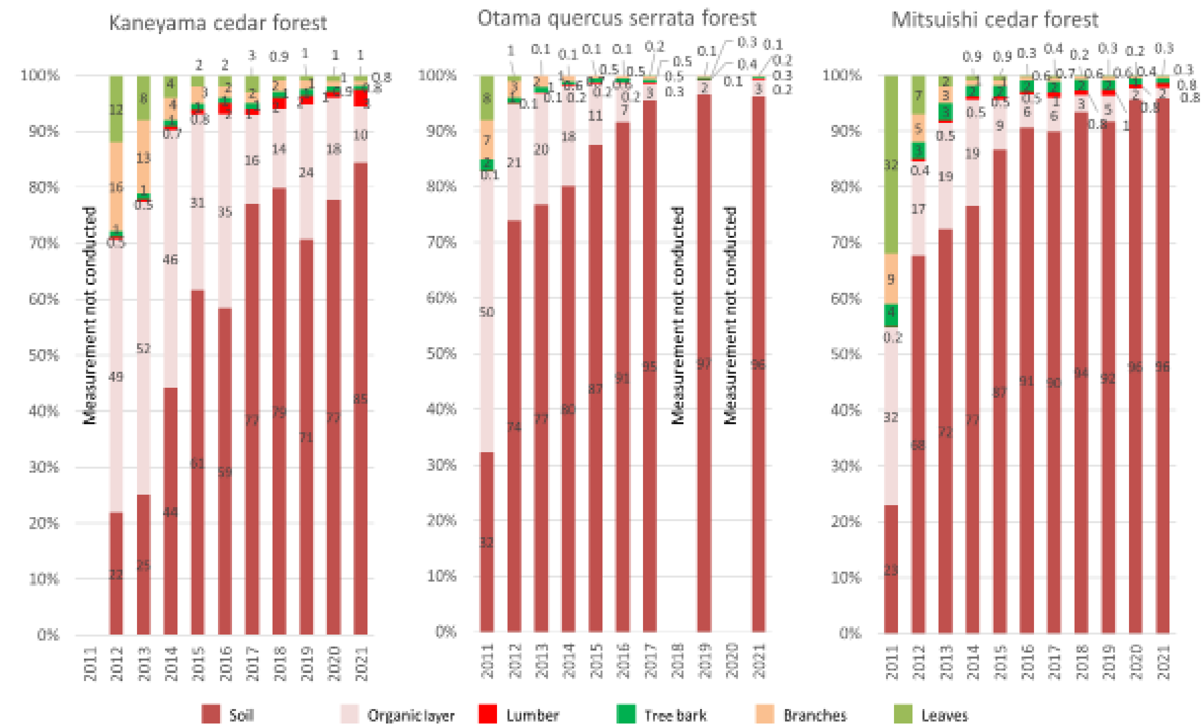
- Ken-poku (northern pref.) (361 locations): 0.04 - 1.15 μSv/h
- Ken-chu (central pref.) (122 locations): 0.04 - 0.37 μSv/h
- Ken-nan (southern pref.) (38 locations): 0.04 - 0.19 μSv/h
- Aizu (33 locations): 0.03 - 0.08 μSv/h
- Minamiaizu (22 locations): 0.02 - 0.07 μSv/h
- Soso (653 locations): 0.09 - 2.82 μSv/h
- Iwaki (71 locations): 0.05 - 0.91 μSv/h

(Related to p.184 of Vol. 1, "Distribution of Radioactive Materials in Forests")

Included in this reference material on March 31, 2019
Updated on March 31, 2023

Radiation Monitoring of Forest

Changes in Radioactive Cesium Distribution in Forests



Prepared based on the "Result of FY2021 Survey on Radioactive Cesium Distribution in Forests" (Forestry Agency)

Regarding radioactive cesium in the surveyed forests, in the first one year after the accident from 2011 to 2012, the percentage of radioactive cesium found in leaves, branches and litter layers decreased significantly, while that found in soil increased significantly. This is considered to be because radioactive cesium deposited on leaves and branches, etc. of trees gradually transferred to the litter layer on the ground due to rain or leaf fall and then transferred to soil due to the decomposition of the litter layer. The percentage of radioactive cesium in soil is continuously increasing, and over 90% of the radioactive cesium in forests is found in soil or the litter layer as of 2021, mostly found in the soil surface layer at a depth between 0 cm and 5 cm.

The percentage of radioactive cesium found in the litter layer is high in the Kaneyama cedar forest and is low in other forests. Each forest thus shows different tendencies. The survey will be continued into the future.

(Related to p.184 of Vol. 1, “Distribution of Radioactive Materials in Forests”)

Included in this reference material on January 18, 2016
Updated on March 31, 2023

Radiation Monitoring of Forest

Readings of the Monitoring of Radioactive Cesium in Mountain Streams (2012)

Category	Snowmelt season (March 1 - April 30)		Rainy season (May 1 - July 31)		Autumn season (Aug. 1 - Oct. 31)
Total number of samples	118	(342)	184	(264)	175
Samples wherein Cs was not detected[1]	111	(333)	181	(260)	169
Samples wherein Cs was detected[2]	7	(9)	3	(4)	6
Concentration of Cs in samples wherein Cs was detected[3]: (minimum - maximum) (Bq/L)	1.1 - 5.9	(1.0 - 5.9)	1.0 - 13.1	(1.0 - 13.1)	1.1 - 6.8
Percentage of samples wherein Cs was not detected	94.4%	(97.4%)	98.4%	(98.5%)	96.6%

Source: Prepared based on the Readings of the Monitoring of Radioactive Cesium in Mountain Streams (press releases by the Forestry and Forest Products Research Institute on June 12, Sep. 21 and Dec. 20, 2012)

Forestry Agency

Water samples collected from streams from forests in Fukushima Prefecture were inspected but radioactive cesium was not detected in most of them. Radioactive cesium was detected only in some of the samples, such as those collected on days with rainfall. These samples contained suspended solids with insoluble particles. Measurement was conducted again after filtering them and radioactive cesium was not detected in any of those filtered samples.

This suggests that radioactive cesium was detected mainly due to temporary increases in suspended solids, which are often observed when forest streams increase after rainfall.

1. Detection lower limits for both Cs-134 and Cs-137 are 1 Bq/L.
2. Samples wherein radioactive cesium was detected all contained suspended solids. As a result of the second measurement of those samples after filtering, radioactive cesium was not detected in any of them.
3. Concentration of radioactive cesium is the total of Cs-134 and Cs-137 concentrations.
4. Monitoring points were as follows:
   - Snowmelt season: Date City, Iitate Village, (Nihonmatsu City, Aizuwakamatsu City, Koriyama City and Hirono Town)
   - Rainy season: Date City, Iitate Village, (Nihonmatsu City)
   - Autumn season: Date City, Iitate Village
5. Values in the table are the readings for Date City and Iitate Village throughout these seasons. Values in the parentheses for the snowmelt season and rainy season contain the readings for the cities and the town in the parentheses indicated in 4. above.

Included in this reference material on January 18, 2016

Radiation Monitoring in Well Water

Results of Well Water Inspection in Fukushima Prefecture

	Aizu District (western part of Fukushima Prefecture)	Nakadori District (central part of Fukushima Prefecture)	Hamadori District (eastern part of Fukushima Prefecture)
	Aizuwakamatsu City, Kitakata City, Nishiaizu Town, Bandai Town, Inawashiro Town, Aizubange Town, Yanaizu Town, Mishima Town, Kaneyama Town, Aizumisato Town, Kitashiobara Village, Showa Village, Shimogo Town, Tadami Town, Hinoemata Village	Fukushima City, Nihonmatsu City, Date City, Motomiya City, Koori Town, Kunimi Town, Kawamata Town, Otama Village, Sukagawa City, Tamura City, Ishikawa Town, Asakawa Town, Furudono Town, Miharu Town, Ono Town, Tenei Village, Tamakawa Village, Hirata Village, Shirakawa City, Yabuki Town, Tanagura Town, Yamatsuri Town, Hanawa Town, Nishigo Village, Izumizaki Village, Nakajima Village, Samegawa Village	Soma City, Minamisoma City, Hirono Town, Naraha Town, Kawauchi Village, Katsurao Village, Iitate Village, Iwaki City
2011	All ND	All ND	All ND
2012	All ND	All ND	All ND
2013	All ND	All ND	All ND
2014	All ND	All ND	All ND
2015	All ND	All ND	All ND
2016	All ND	All ND	All ND
2017	All ND	All ND	All ND
2018	All ND	All ND	All ND
2019	All ND	All ND	All ND
2020	All ND	All ND	All ND
2021	All ND	All ND	All ND
2022 (up to Dec.27)	All ND	All ND	All ND

Measurement readings of radioactive materials in well water

ND (not detected; below the detection lower limit): The detection lower limits for radioactive cesium and radioactive iodine were both 5 Bq/kg in 2011 and have been 1 Bq/kg since 2012.

* All municipalities indicated above participate in the Fukushima Prefecture Monitoring Program for Radioactive Materials in Drinking Water. Some of the other municipalities conduct their own inspection.

Source: Prepared based on the "Results of Drinking Well Water Inspection (Dec. 27, 2022)," of the Fukushima Revitalization Station

Fukushima Prefecture's reconstruction information portal site, "Fukushima Revitalization Station," publicizes the results of the drinking well water inspection, which has been conducted since 2011, the year when the nuclear accident occurred. Based on the inspection system established under the Fukushima Prefecture Monitoring Program for Radioactive Materials in Drinking Water, the inspection has been conducted for municipalities upon their requests.

Fukushima Revitalization Information Portal Site: "Results of monitoring of drinking water and related information"

https://www.pref.fukushima.lg.jp/site/portal/ps-drinkingwater-monitoring.html (in Japanese)

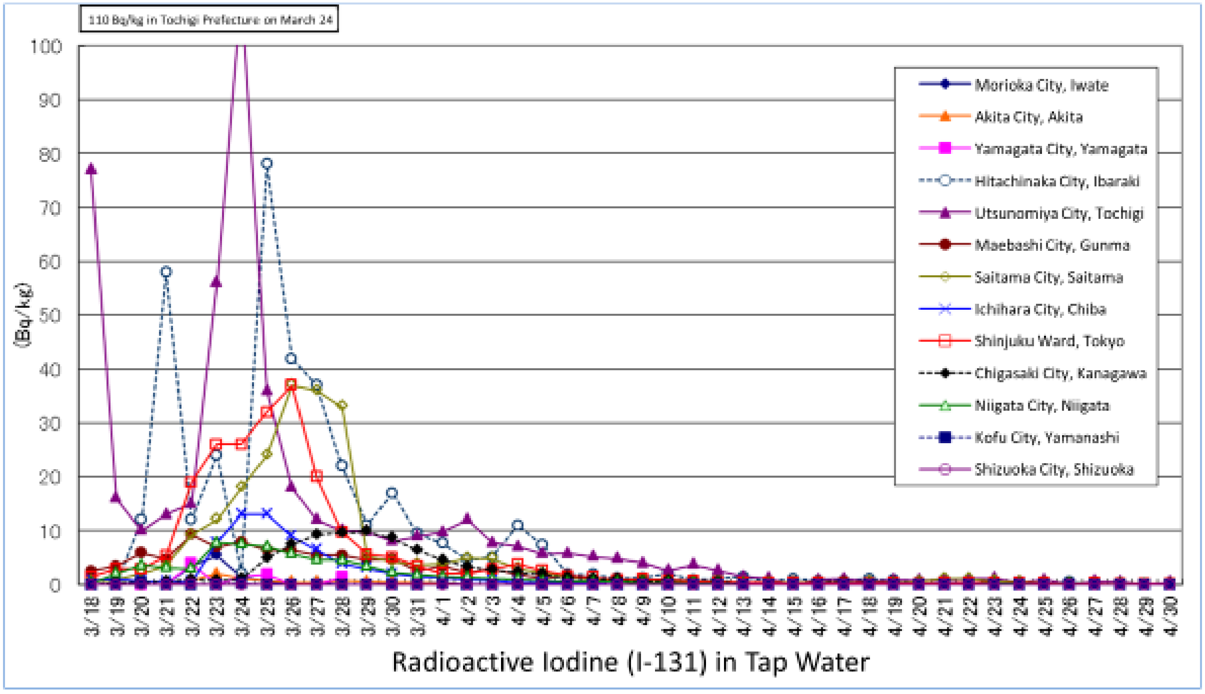
The national standard for drinking water including well water is 10 Bq/kg, but radioactive materials have never been detected from well water in the inspection conducted so far. Inspection results have been all "ND" (not detected; below the detection limit).

The detection lower limits for radioactive cesium and radioactive iodine were both 5 Bq/kg or lower in 2011 and are 1 Bq/kg or lower at present.

Included in this reference material on March 31, 2017
Updated on March 31, 2024

Radiation Monitoring of Clean Water

Radioactive Iodine (I-131) (the Tokyo Metropolis and 12 Prefectures)



Bq/kg: becquerels per kilogram

* In the figure above, values below the detection lower limit are treated as 0 for convenience.
* Only prefectures where radioactive iodine was detected in the measurement are indicated in the figure.

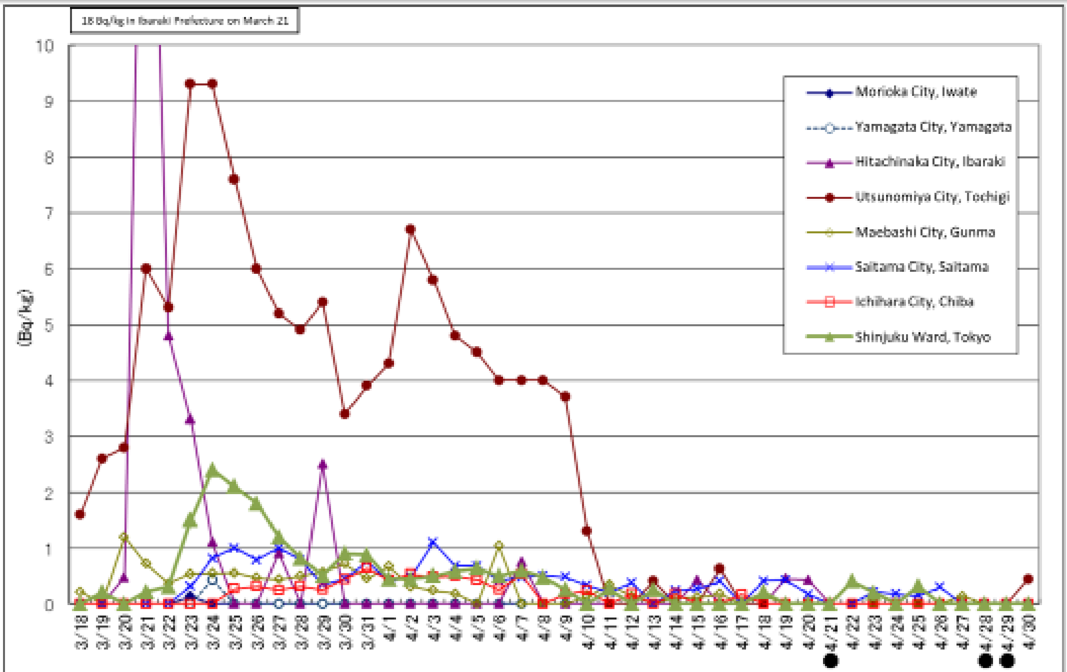
Interim Report on Measures for Radioactive Materials in Tap Water
Prepared based on the reference material for the Ministry of Health, Labour and Welfare (MHLW)'s Study Meeting on Measures for Radioactive Materials in Tap Water (June 2011)

As a result of the inspection of radioactive materials in tap water conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), radioactive iodine was detected in the Tokyo Metropolis and 12 prefectures out of 47 prefectures nationwide. Highest concentrations were detected at the respective locations from March 18 to 29, 2011, but I-131 concentrations turned to decrease in many locations in the latter half of March 2011. In and after April 2011, only small amounts of I-131 were detected at some of these locations.

Included in this reference material on March 31, 2013
Updated on January 18, 2016

Radiation Monitoring of Clean Water

Radioactive Cesium (Cs-134 + Cs-137) (the Tokyo Metropolis and 7 Prefectures)



Radioactive Cesium (Cs-134 + Cs-137) in Tap Water

* In the figure above, values below the detection lower limit are treated as 0 for convenience.
* Only prefectures where radioactive cesium was detected in the measurement are indicated in the figure.
* ● is marked on dates when the readings were ND (not detected; below the detection lower limit).

Bq/kg: becquerels per kilogram

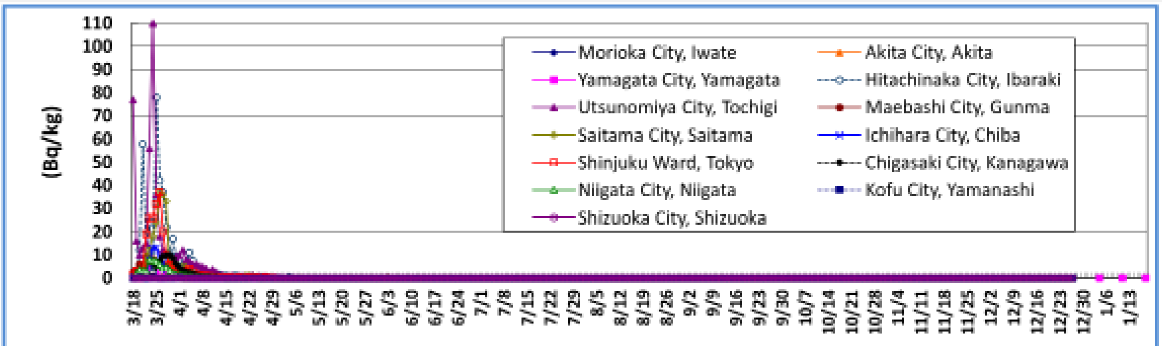
Interim Report on Measures for Radioactive Materials in Tap Water
Prepared based on the reference material for the Ministry of Health, Labour and Welfare (MHLW)'s Study Meeting on Measures for Radioactive Materials in Tap Water (June 2011)

As a result of the inspection of radioactive materials in tap water conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), radioactive cesium was detected in the Tokyo Metropolis and 7 prefectures out of 47 prefectures nationwide. Highest concentrations were detected at the respective locations from March 20 to early April 2011, but radioactive cesium concentrations were relatively smaller than radioactive iodine concentrations. In and after April 2011, only small amounts of radioactive cesium were detected at some of these locations.

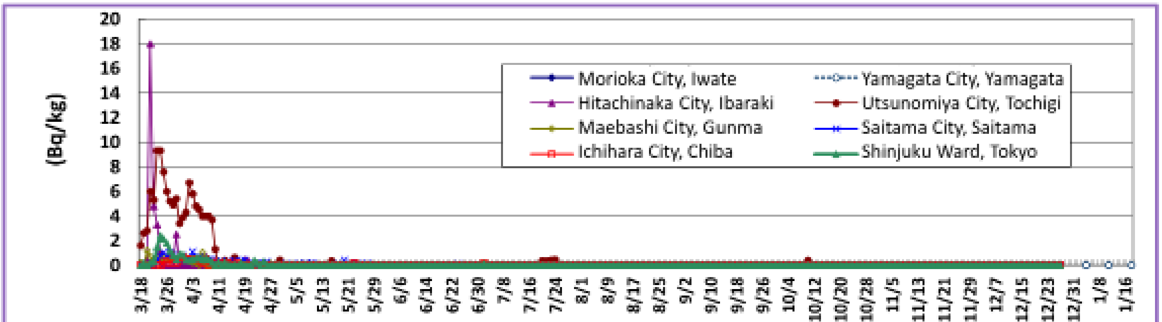
Included in this reference material on March 31, 2013
Updated on January 18, 2016

Radiation Monitoring of Clean Water

Results of Radiation Monitoring of Tap Water (until Jan. 2012)



Radioactive Iodine (I-131) in Tap Water



Radioactive Cesium (Cs-134 + Cs-137) in Tap Water

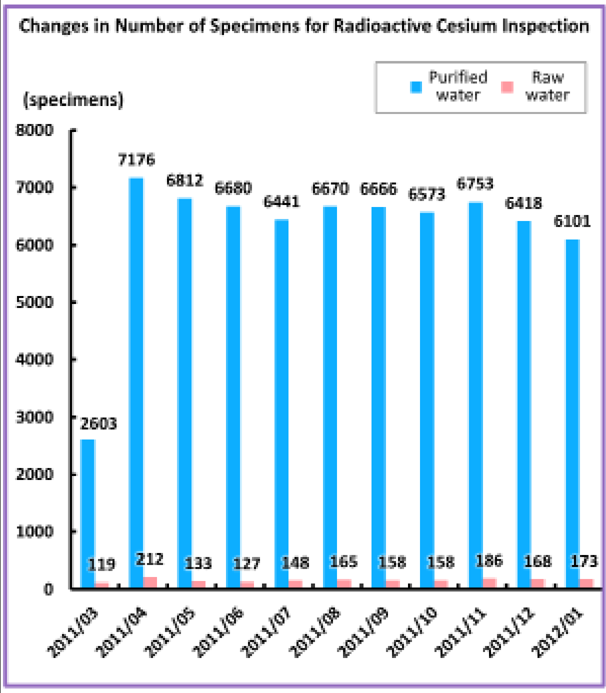
Prepared based on 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

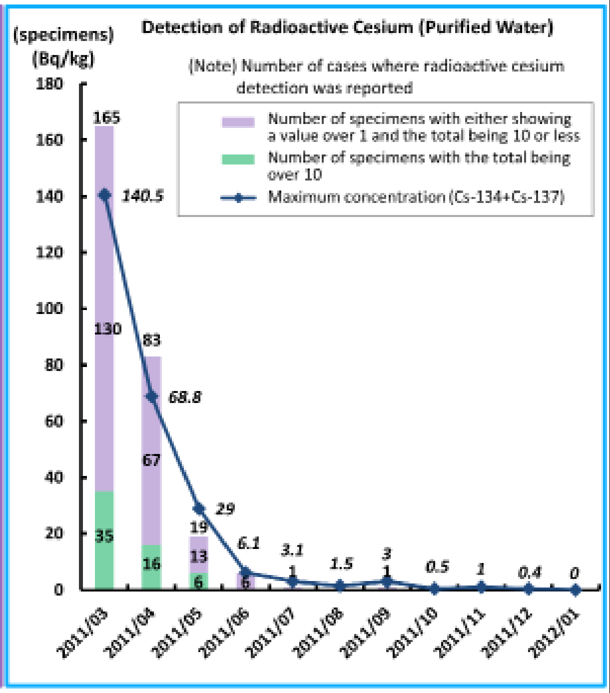
The tap water monitoring showed that radioactive cesium has seldom been detected since May 2011, not to mention short-half-life radioactive iodine.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radiation Monitoring of Clean Water

Inspections by Water Suppliers





Bq/kg: becquerels per kilogram

Prepared based on 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

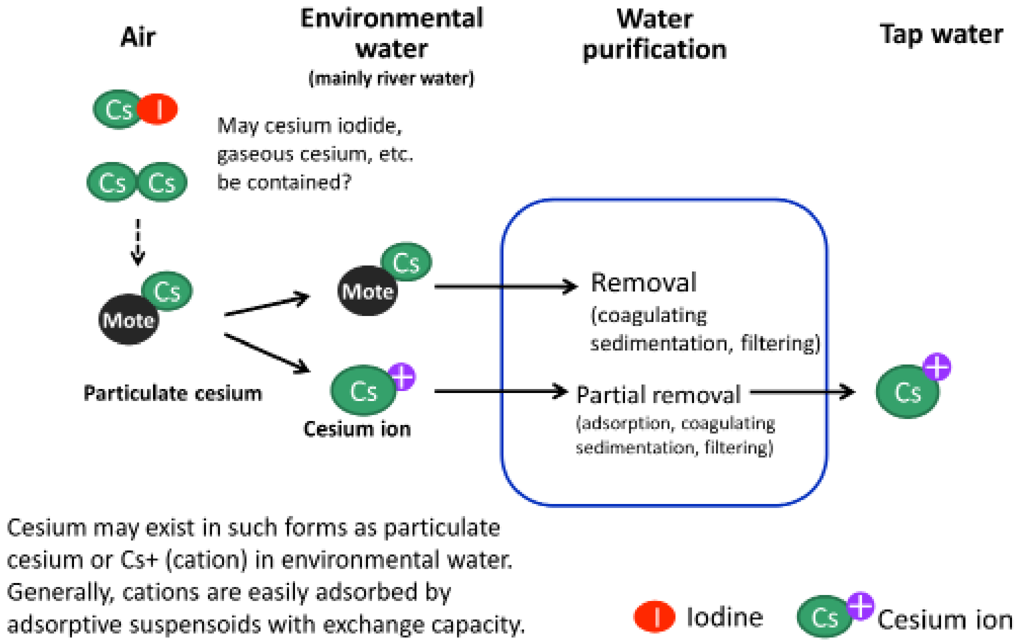
Water suppliers conduct inspections of radioactive cesium for approx. 6,000 to 7,000 specimens of purified water and over 100 specimens of raw water per month. The maximum monthly value of radioactive cesium concentration was 140.5 Bq/kg detected in March 2011, but the value declined gradually thereafter and there has been no report of radioactive cesium detection at a level exceeding 10 Bq/kg since June 2011.

Included in this reference material on March 31, 2013

Radiation Monitoring of Clean Water

Behavior of Radioactive Cesium

Conceptual Diagram of Behavior of Radioactive Cesium



Prepared based on the reference material for the 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

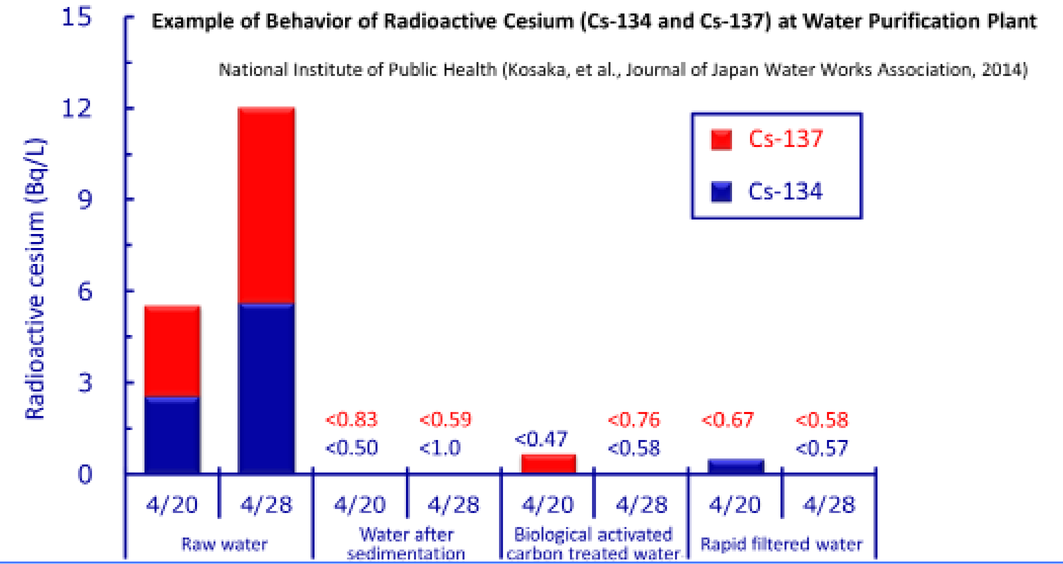
Radioactive cesium discharged due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS consists of Cs-134 and Cs-137 in equal proportion (1:1) and has also been detected at the same rate in the environment immediately after the accident. Radioactive cesium was in the form of particles or gas immediately after discharge from the NPS, but it is considered to have fallen down onto the ground surface and to have been adsorbed into soil and dust, etc. In water, radioactive cesium is adsorbed into dust and tends to behave in the same manner as soil or other suspensoids, and therefore, is highly likely to be reduced by removing suspensoids in water.

Included in this reference material on March 31, 2013
Updated on March 31, 2019

Radiation Monitoring of Clean Water

Control of Radioactive Cesium

Most of the radioactive cesium that reaches sources of tap water is adsorbed into suspensoids such as soil and flows out. Therefore, radioactive cesium can be controlled through strict turbidity management.



Zeolite, ion exchangers, nanofiltration membranes and reverse osmosis membranes are professionally used for removing radioactive materials, but these cannot be used for ordinary water purification due to high cost, required facilities and inefficiency (in particular, the use of nanofiltration membranes and reverse osmosis membranes is power consuming).

Bq/L: becquerels per liter

Prepared based on the reference material for the 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

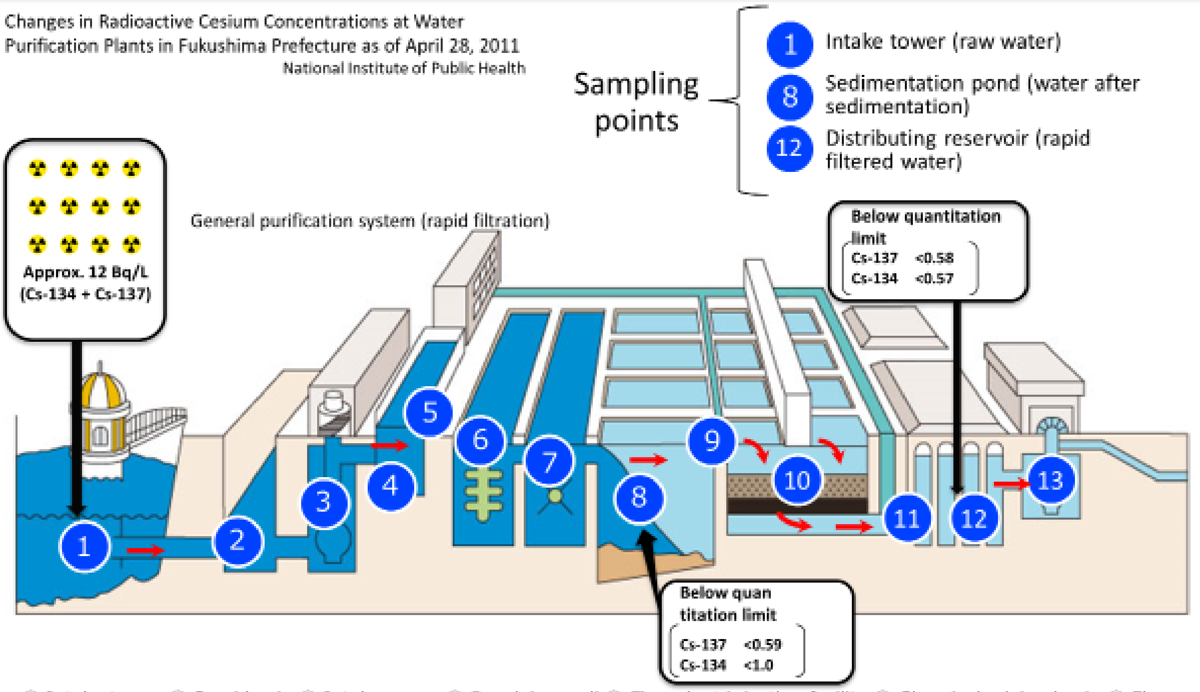
As of April 2011, radioactive cesium concentrations in raw water, water after sedimentation, biological activated carbon treated water, and rapid filtered water were measured at water purification plants in Fukushima Prefecture. As a result, it was confirmed that low-concentrated radioactive cesium detected in raw water had decreased through adsorption into soil in the process of sedimentation.

A survey of water purification processes revealed that radioactive cesium had been almost entirely removed together with suspensoids through coagulating sedimentation, sand filtration and the use of powdered activated carbon. At present, radioactive cesium is not detected in almost all purified water. These results showed that radioactive cesium can be controlled through strict turbidity management.

Included in this reference material on March 31, 2013

Radiation Monitoring of Clean Water

Waterworks System



① Intake tower ② Sand basin ③ Intake pump ④ Receiving well ⑤ Flocculant injection facility ⑥ Chemical mixing basin ⑦ Floc forming basin ⑧ Sedimentation pond ⑨, ⑪ Chlorine injection facility ⑩ Filter basin ⑫ Distributing reservoir ⑬ Water pump

Bq/L: becquerels per liter

Prepared based on the reference material for the 12th Health Sciences Council's Committee on Living Environment and Water Supply in March 2012

This figure shows the rapid filtration method, which is generally used in Japan. In this method, chemicals are injected into raw water taken from a river or dam to cause sedimentation of mud and small particles and make them into big chunks called "floc." Tap water is created by filtering the clear upper portion of such water.

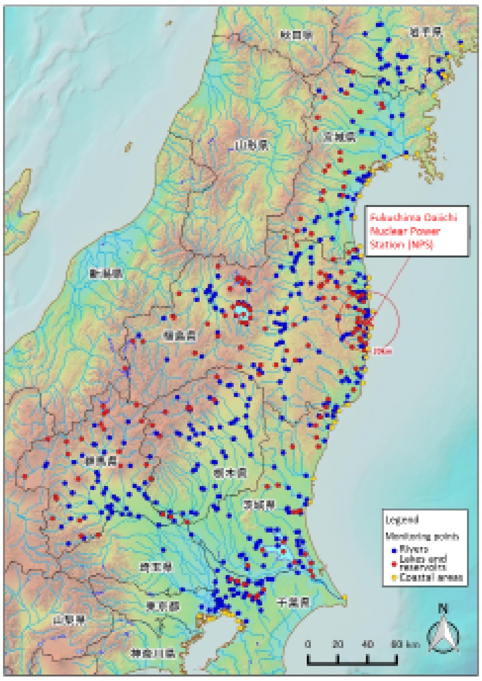
Cesium has the property to be easily adsorbed into soil and mud (p.40 of Vol. 2, "Behavior of Radioactive Cesium"). Therefore, when water is separated from floc, cesium tends to gather around the floc, which is a chunk of soil and mud. Additionally, tap water is created using the clear upper portion of the water in plant basins. Therefore, this mechanism leaves little chance for cesium to be mixed into tap water.

In the pattern diagram above, radioactive cesium concentrations (Bq/L) actually measured at a water purification plant in Fukushima Prefecture as of April 28, 2011, are indicated at points where measurement was conducted. Radioactive cesium concentration, which was initially approx. 12 Bq/L at the intake tower, decreased to below the quantitation limit in the end when being pumped out from the distribution reservoir. As 1 liter of water weighs approx. 1 kg, it can be found that the concentration was far below 200 Bq/kg, which was the allowable limit for radioactive cesium in tap water publicized by the Ministry of Health, Labour and Welfare (MHLW) in March 2011, and also far below 10 Bq/kg, which is specified in the new standards for radioactive materials in tap water publicized in March 2012 (p.55 of Vol. 2, "Standard Limits Applied from April 2012").

Included in this reference material on March 31, 2015
Updated on March 31, 2019

Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in and around Fukushima Prefecture (Public Water Areas)



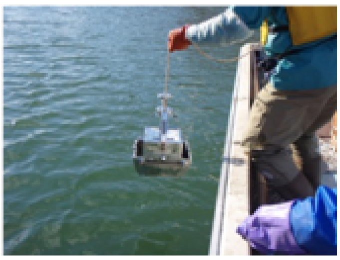
[Coverage]
Whole Area of Fukushima, Miyagi, Ibaraki, Tochigi and Gunma Prefectures, and part of Iwate and Chiba Prefectures, etc.

[Monitoring points]
602 locations

[Radionuclide analyses]
- Samples
  Water, sediments and Surrounding environment (soil)
- Analyzed radionuclides
  Radioactive cesium, Radioactive strontium (only for some water and sediment samples), etc.

[Frequencies]
Twice to 10 times a year depending on the contamination status, etc.

(River: water sampling)



(Lake: sediments sampling)

Prepared based on the Results of the FY2021 Radioactive Material Monitoring in the Water Environment (Public Water Areas) (Summary) by the Ministry of the Environment
http://www.env.go.jp/jishin/monitoring/results_r-pw-r03.html (in Japanese)

Radioactive material monitoring was conducted at rivers, lakes and coastal areas in Miyagi, Ibaraki and other Prefectures, centered on Fukushima Prefecture, where contamination with radioactive materials was suspected.

In FY2021, monitoring covered 602 locations and analysis was conducted for radioactive cesium and strontium in water, etc.

Monitoring results of radioactive cesium concentrations in water are as follows. Monitoring results for sediments (mud of the bottom of rivers, lakes, etc.) are shown in p.44 of Vol. 2, "Radioactive Material Monitoring in the Water Environment (River Sediments)" through to p.46 of Vol. 2, "Radioactive Material Monitoring in the Water Environment (Coastal Area Sediments)."

[Monitoring results of radioactive cesium concentrations in water]

River water samples (2,014 samples): Radioactive cesium concentrations were all below the detection limit.

Lake/reservoir water samples (1,409 samples): Radioactive cesium concentrations were all below the detection limit except for those in 8 samples collected at 2 locations in the Hamadori District and 1 sample collected at 1 location in the Nakadori District, Fukushima Prefecture.

Coastal samples (534 samples): Radioactive cesium concentrations were all below the detection limit.

- At all locations where radioactive cesium or strontium was detected, amounts of suspended solids (SS) and turbidity were relatively large.

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Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in the Water Environment (River Sediments)

Distribution of Radioactive Cesium Concentrations in River Sediments (FY2021)

[Number of collected samples]

Radioactive cesium concentrations [Bq/kg(dry)]	Iwate Prefecture	Miyagi Prefecture	Fukushima Prefecture, Hamadori District	Fukushima Prefecture, Nakadori District	Fukushima Prefecture, Aizu District	Ibaraki Prefecture	Tochigi Prefecture	Gunma Prefecture	Chiba Prefecture	Saitama Prefecture	Tokyo Metropolis	Total	Percentage
Less than 1,000	80	195	313	324	167	212	278	214	196	8	8	1,995	99.1%
1,000 or more but less than 2,000	0	0	13	0	1	0	0	0	4	0	0	18	0.9%
2,000 or more but less than 3,000	0	1	0	0	0	0	0	0	0	0	0	1	0.0%
3,000 or more but less than 4,000	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
4,000 or more but less than 5,000	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
5,000 or more but less than 10,000	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
10,000 or more	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Total	80	196	326	324	168	212	278	214	200	8	8	2,014	100.0%

Prepared based on the FY2021 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in river sediments were measured in FY2021 as in the previous year.

A total of 2,014 samples, including 818 samples collected in Fukushima Prefecture and others collected in Iwate, Miyagi, Ibaraki, Tochigi, Gunma, Chiba and Saitama Prefectures and the Tokyo Metropolis, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in approx. 99% of these samples were less than 1,000 Bq/kg (dry).

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Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in the Water Environment (Lake and Reservoir Sediments)

Distribution of Radioactive Cesium Concentrations in Lake and Reservoir Sediments (FY2021)

[Number of collected samples]

Radioactive cesium concentrations [Bq/kg(dry)]	Miyagi Prefecture	Fukushima Prefecture, Hamadori District	Fukushima Prefecture, Nakadori District	Fukushima Prefecture, Aizu District	Ibaraki Prefecture	Tochigi Prefecture	Gunma Prefecture	Chiba Prefecture	Total	Percentage
Less than 1,000	74	113	50	158	76	29	82	28	610	73.0%
1,000 or more but less than 2,000	1	30	11	16	0	3	10	4	75	9.0%
2,000 or more but less than 3,000	0	13	4	10	0	0	2	0	29	3.5%
3,000 or more but less than 4,000	1	17	7	8	0	0	0	0	33	3.9%
4,000 or more but less than 5,000	0	7	1	2	0	0	0	0	10	1.2%
5,000 or more but less than 10,000	0	34	1	3	0	0	2	0	40	4.8%
10,000 or more	0	38	1	0	0	0	0	0	39	4.7%
Total	76	252	75	197	76	32	96	32	836	100.0%

Prepared based on the FY2021 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in lake and reservoir sediments were measured in FY2021 as in the previous year.

A total of 836 samples, including 524 samples collected in Fukushima Prefecture and others collected in Miyagi, Ibaraki, Tochigi, Gunma and Chiba Prefectures, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in approx. 73% of these samples were less than 1,000 Bq/kg (dry).

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Radiation Monitoring of Public Water Areas

Radioactive Material Monitoring in the Water Environment (Coastal Area Sediments)

Distribution of Radioactive Cesium Concentrations in Coastal Area Sediments (FY2021)

[Number of collected samples]

Radioactive cesium concentrations [Bq/kg(dry)]	Iwate Prefecture	Miyagi Prefecture	Fukushima Prefecture	Ibaraki Prefecture	Chiba Prefecture	Tokyo Metropolis	Total	Percentage
Less than 1,000	4	52	150	20	23	18	267	100.0%
1,000 or more but less than 2,000	0	0	0	0	0	0	0	0.0%
2,000 or more but less than 3,000	0	0	0	0	0	0	0	0.0%
3,000 or more but less than 4,000	0	0	0	0	0	0	0	0.0%
4,000 or more but less than 5,000	0	0	0	0	0	0	0	0.0%
5,000 or more but less than 10,000	0	0	0	0	0	0	0	0.0%
10,000 or more	0	0	0	0	0	0	0	0.0%
Total	4	52	150	20	23	18	267	100.0%

Prepared based on the FY2021 Radioactive Material Monitoring in the Water Environment (Environmental Management Bureau, Ministry of the Environment)

Radioactive cesium concentrations in sediments in coastal areas were measured in FY2021 as in the previous year.

A total of 267 sediment samples collected in coastal areas, including 150 samples collected in Fukushima Prefecture and others collected in Iwate, Miyagi, Ibaraki, Chiba Prefectures and the Tokyo Metropolis, were surveyed.

The survey results showed that concentrations of radioactive cesium detected in all of these samples were less than 1,000 Bq/kg (dry).

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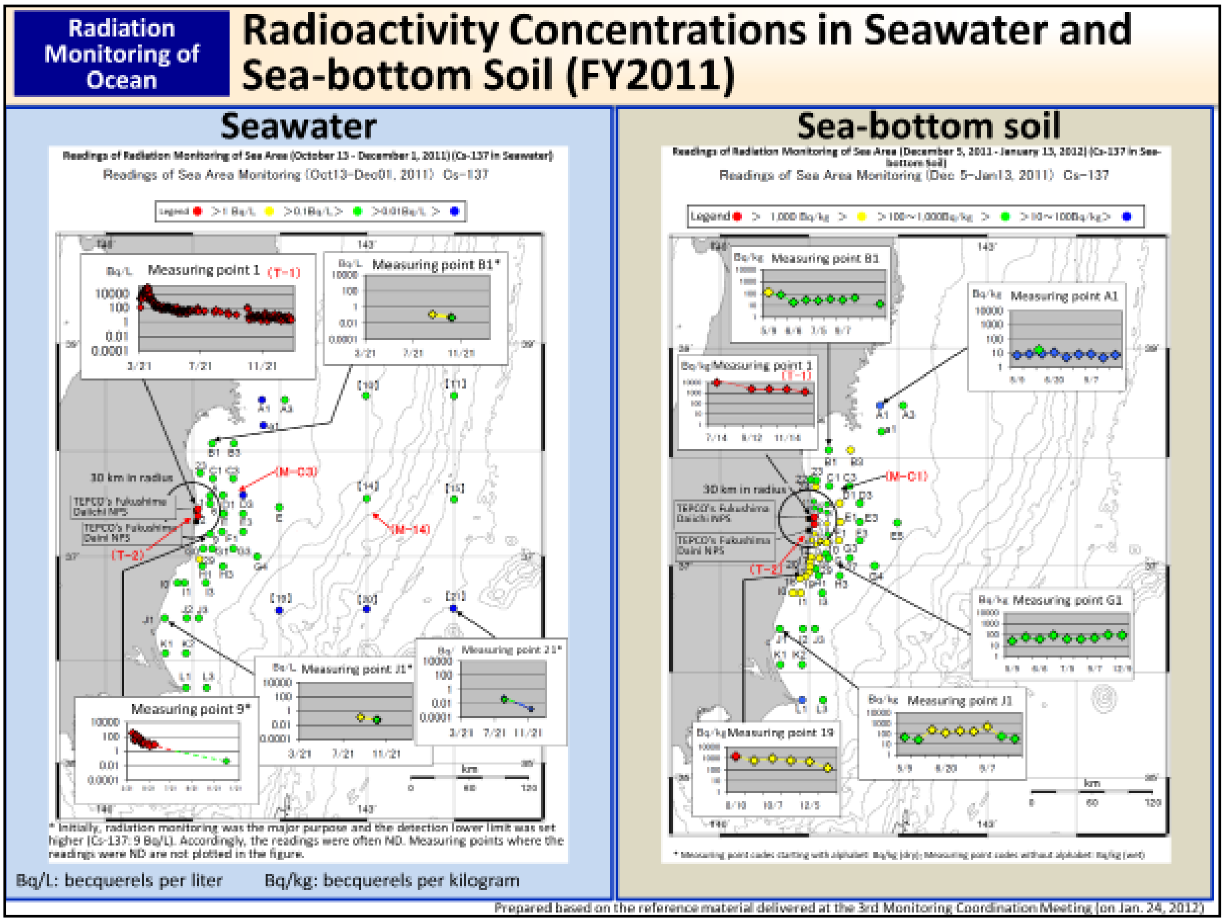

Since October 2011, radiation monitoring of radioactive cesium (Cs-137) in seawater and sea-bottom soil has been conducted jointly by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (until the establishment of the Secretariat of the Nuclear Regulation Authority), Secretariat of the Nuclear Regulation Authority, Fisheries Agency, Japan Coast Guard, Ministry of the Environment (MOE), Fukushima Prefecture and Tokyo Electric Power Company (TEPCO). With regard to samples collected near outlets (at Measuring Points T-1 and T-2), analysis has been conducted not only for radioactive cesium, but also for radioactive iodine (only for seawater samples), radioactive strontium, plutonium, and tritium (only for seawater samples).

The figures show the results of radiation monitoring of the sea area immediately after the accident.

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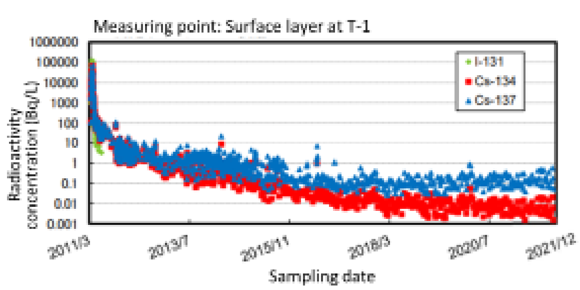
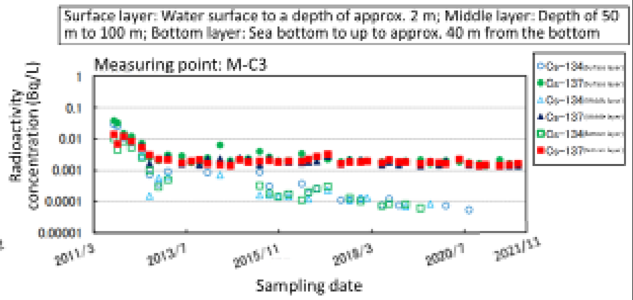
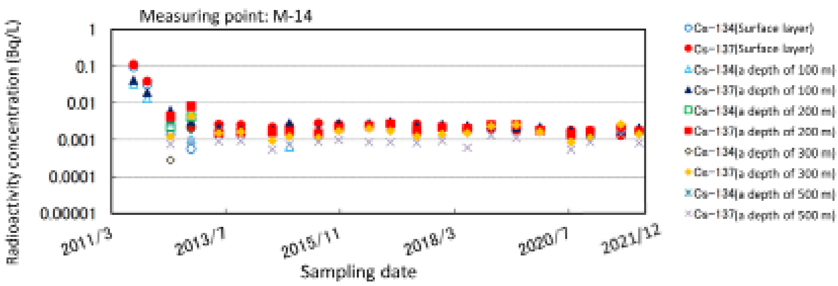
Radiation Monitoring of Ocean

Changes in Radioactivity Concentrations in Seawater







* For measuring points, see p. 47 of Vol. 2, "Radioactivity Concentrations in Seawater and Sea-bottom Soil (FY2011)."

Results of the Sea Area Monitoring by the Nuclear Regulation Authority: https://radioactivity.nsr.go.jp/ja/list/428/list-1.html (in Japanese)

Soil with radioactive cesium is transported to coastal areas via rivers.

Radioactivity concentrations in seawater samples collected near Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS rose to 100,000 Bq/L immediately after the accident, but dropped to one-thousandth (100 Bq/L) in one and a half months as a result of dilution and dispersion. The concentrations further decreased to 10 Bq/L in one and a half years and are 1 Bq/L or less at present.

In six months after the accident, soil containing radioactive cesium was transported from the coastal areas to 30 km offshore, but the concentration detected at Measuring Point M-C3 was 0.05 Bq/L or one-200th of the concentrations detected in the coastal areas. Generally it is considered that radioactivity concentrations become higher at the sea bottom due to settling of part of radioactive cesium, but in 2012, radioactivity concentrations were as low as 0.008 Bq/L in samples collected from bottom layers, and radioactivity concentrations detected in samples collected from surface layers and middle layers also decreased.

At Measuring Point M-14 in the open sea, 180 km away from the land, radioactivity concentrations detected in surface layers were 0.1 Bq/L, the same level of concentrations detected 30 km offshore, in six months after the accident. The concentrations further showed a two-digit decrease to 0.001 Bq/L in two years after the accident.
(Related to p.186 of Vol. 1, "Distribution of Radioactive Cesium in the Ocean")

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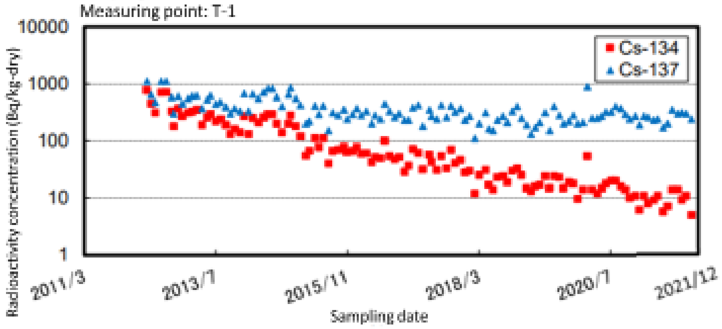
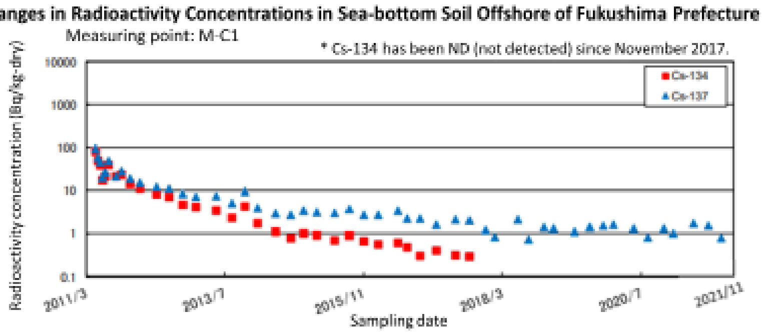
Radiation Monitoring of Ocean

Changes in Radioactivity Concentrations in Sea-bottom Soil

Changes in Radioactivity Concentrations in Sea-bottom Soil in Coastal Areas in and around Fukushima Prefecture



Changes in Radioactivity Concentrations in Sea-bottom Soil Offshore of Fukushima Prefecture



* For measuring points, see p.47 of Vol. 2, "Radioactivity Concentrations in Seawater and Sea-bottom Soil (FY2011)."

Results of the Sea Area Monitoring by the Nuclear Regulation Authority: https://radioactivity.nsr.go.jp/ja/list/428/list-1.html (in Japanese)

As a result of measuring dried sea-bottom soil samples collected in the coastal areas near Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, the concentrations of Cs-134 and Cs-137 were initially 1,000 Bq/kg but decreased in two years after the accident to 200 Bq/kg (down by 80%) and 500 Bq/kg (down by 50%), respectively. (Measuring Point T-1)

Radioactivity concentrations detected from sea-bottom soil samples collected 40 km offshore (Measuring Point M-C1) rose to 100 Bq/kg immediately after the accident but decreased to 10 Bq/kg a year later.

(Related to p.186 of Vol. 1, "Distribution of Radioactive Cesium in the Ocean")

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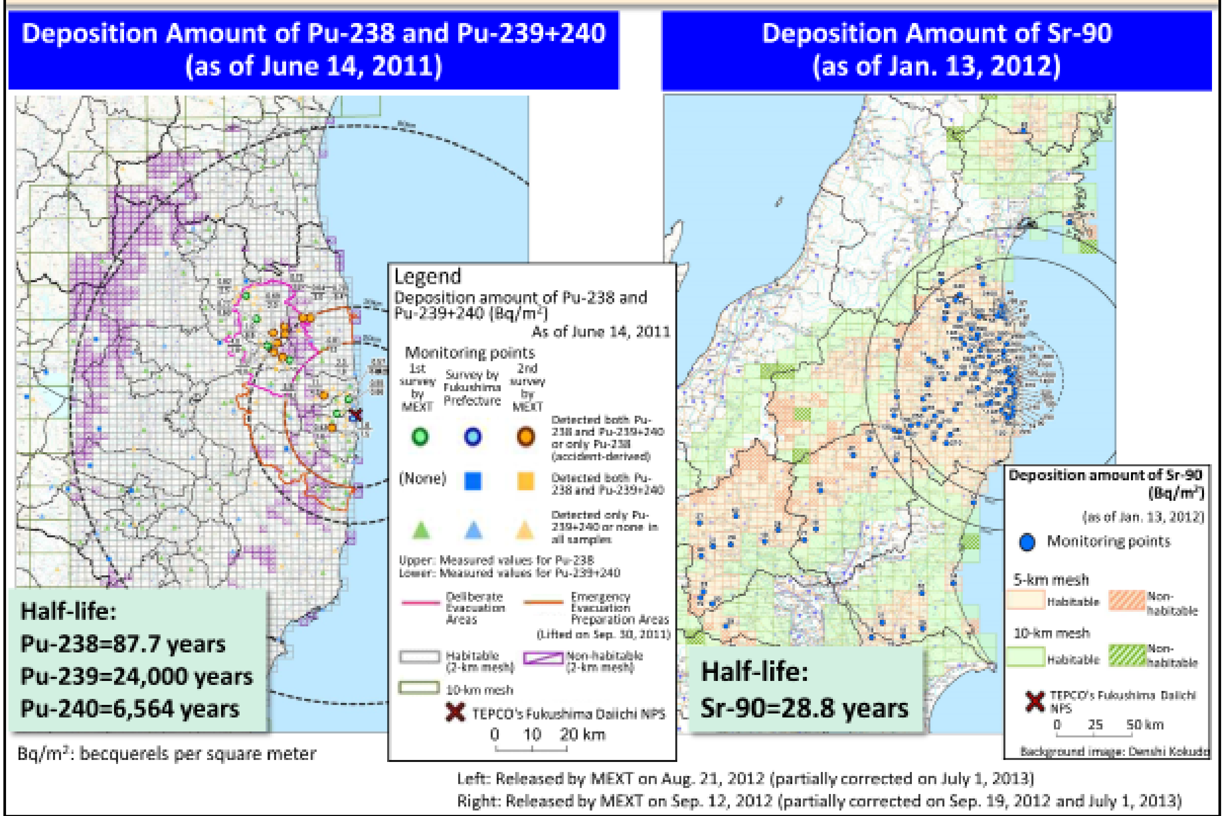
Deposition of Other Radioactive Materials

Plutonium and Strontium (Eastern Part of Fukushima Prefecture, Wider Areas)



In the soil surveys conducted by the national government in June 2011 and January 2012, soil samples were collected within the 100-km zone of Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS and in the western part of Fukushima Prefecture outside this zone.

The amounts of deposited Pu-238 and Pu-239+240 detected in the surveys were found to be within their ranges in past measurements conducted from FY1999 to FY2009, before the accident, covering the whole nation. It means that the amounts were within the fluctuations due to past nuclear bomb tests in the atmosphere, except for the amount of Pu-238 detected in a sample collected at one location (p.183 of Vol. 1, "Effects of Nuclear Test Fallout (Japan)").

In the current surveys, the amount of Pu-238 detected in a sample collected at one location exceeded the maximum deposition amount before the accident, and was around 1.4 times the maximum level before the accident. In order to determine whether the detected plutonium has derived from the TEPCO's Fukushima Daiichi NPS Accident, a comparison was made between the ratios between Pu-238 and Pu-239+240 detected in the current surveys and the ratios between deposited Pu-238 and Pu-239+240 measured nationwide for 11 years from FY1999 to FY2009. Locations where the detected Pu-238 and Pu-239+240 are highly likely to be accident-derived are marked with ◯ on the map.

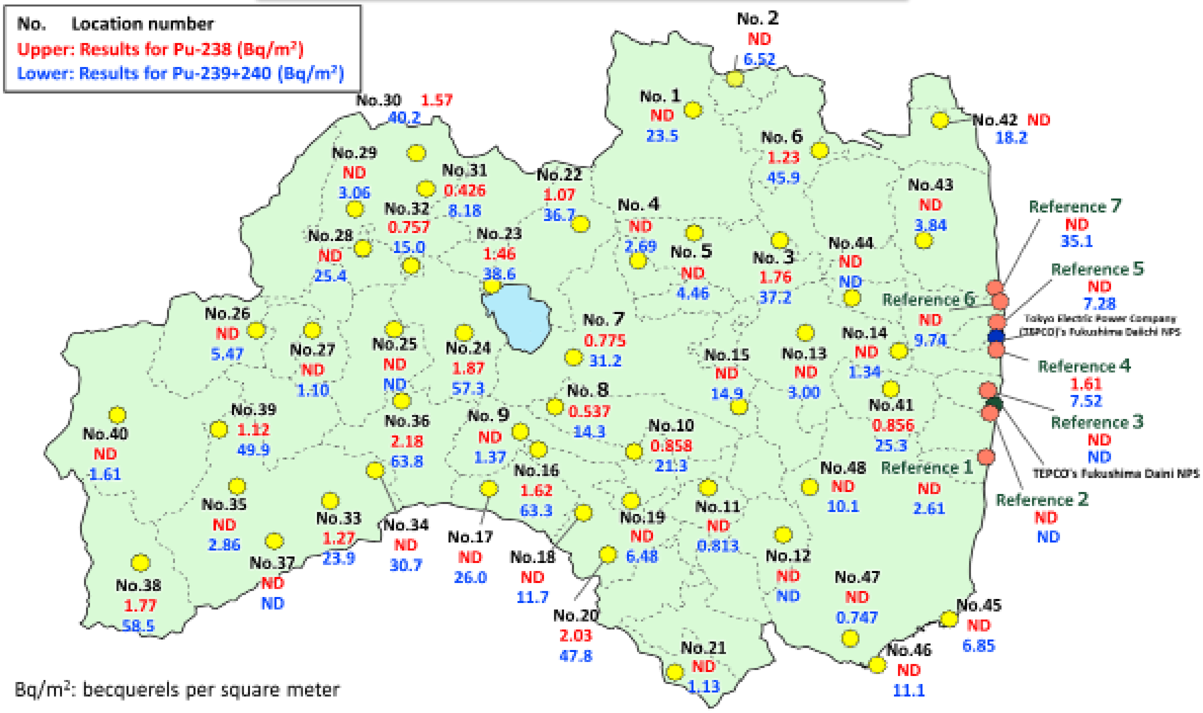
Sr-90 was also detected in the current surveys, but measured values for all samples were within the fluctuations due to past nuclear tests in the atmosphere in comparison with the readings of the nationwide measurements conducted from FY1999 to FY2009 before the accident at TEPCO's Fukushima Daiichi NPS. It was also confirmed that the deposition amounts of detected Sr-90 were around one-thousandth of those of Cs-137 at many of the monitoring points in the current surveys. Only occasionally, the deposition amounts of Sr-90 showed some fluctuations, being around one-tenth of those of Cs-137.

Included in this reference material on March 31, 2013
Updated on March 31, 2021

Deposition of Other Radioactive Materials

Plutonium (Fukushima Prefecture)

Analysis Results for Pu-238 and Pu-239+240 (Soil)



Prepared based on the reference material of the Local Nuclear Emergency Response Headquarters (Radioactivity Team) and the Disaster Provision Main Office of Fukushima Prefecture (Nuclear Power Team) of April 6, 2012

Based on the Plan for the Radiation Monitoring of Soil in Fukushima Prefecture, nuclide analysis for Pu-238 and Pu-239+240 was conducted for soil samples collected in Fukushima Prefecture from August 10 to October 13, 2011.

Deposition amounts of plutonium detected within the prefecture in the current monitoring were all within the ranges in past monitoring in the prefecture for ten years before the Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS Accident. At one location (Ottozawa, Okuma Town; Reference 4) out of seven reference monitoring points around TEPCO's Fukushima Daiichi NPS, the result fell outside the range of values before the accident, suggesting the influence of the accident at TEPCO's Fukushima Daiichi NPS.

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