FY2017
Results of the Radioactive Material Monitoring in the Water Environment

March 2019
Ministry of the Environment

Contents

Note: ND stands for “Not detectable” in this report.

Outline

Following is an outline of the results of monitoring for radioactive material carried out in FY2017 based on the Water Pollution Control Act. Monitoring locations are as shown in Figure 1 and Figure 2.

1. National Radioactive Material Monitoring in Water Environment throughout Japan (FY2017)

○ Monitoring commenced in FY2014 at 110 public water areas and groundwater locations in 47 prefectures in Japan for the purpose of clarifying the distribution of radioactive materials in those areas nationwide (hereinafter referred to as "Nationwide Monitoring").

○ A summary of the results for the FY2017 is as follows.

<Overall outline>

○ The total β radioactivity and the detected γ-ray emitting nuclides were within the past measurement trends[1]. Detection limits differ by nuclide and sampling location, but overall were around 0.001 to 0.1 Bq/L in water and around 1 to 100 Bq/kg in sediment[2]. ("Bq/kg" of sediment indicates "dried sediment" in this report, and the same shall apply to Radioactive Material Monitoring performed in Fukushima prefecture and the surrounding areas, and other national radioactive material monitoring.).

<Naturally occurring radionuclides>

○ There were some locations where the value of K-40 and total β radioactivity were elevated in water samples from public water areas, but these levels were thought to have been influenced by seawater.

○ As for other naturally occurring radionuclides, Ac-228, Bi-214, Pb-212 and Pb-214 were detected at higher concentrations at some locations for public water areas than in past results. They are in the thorium series or uranium series radionuclides, and generally occur naturally in soils / rocks.

<Artificial radionuclides>

○ At some public water area monitoring locations, the artificial radionuclides Cs-134 and Cs-137 were detected exceeding their detection limits, but their values were within the past measurement trends.

○ It is appropriate to continue this monitoring from the following fiscal year onwards in order to clarify the distribution of radioactive materials in water environments.

2. Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture (FY2017)

○ In response to the accident at the Tokyo Electric Power Company's Fukushima Daiichi NPS (hereinafter referred to as the "Fukushima NPS Accident"), monitoring has been conducted continuously since August 2011 at around 600 public water area locations and around 400 groundwater locations in and around Fukushima prefecture for the purpose of clarifying the distribution of the accident-derived radioactive materials in water environment

1 "Within the past measurement trends" means that the results of the latest monitoring survey are evaluated from a technical perspective as not displaying extreme deviation from the results of past similar monitoring surveys.
2 See Table 3.1-1, Table 3.1-2, and Table 3.1-3 in Part 1 of this report for the details of the detection limits.

(hereinafter referred to as "Post-Earthquake Monitoring").

○ A summary of the results for the FY2017 is as follows.

1) Radioactive cesium

<Public water areas>

1) Water (detection limit: 1 Bq/L for both Cs-134 and Cs-137)

・At most locations, radioactive cesium was not detectable, although several locations showed a positive result for these radionuclide.

2) Sediment (detection limit: 10 Bq/kg for both Cs-134 and Cs-137)

[Rivers]

• Out of all monitoring locations, the levels of both Cs-134 and Cs-137 were less than 200 Bq/kg at most locations, though they were detected at relatively higher levels at some limited locations, such as those within 20 km of Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant (hereinafter referred to as the "Within 20km"). Changes in activity concentrations were observed as a decreasing trend at most locations.

[Lakes]

• Out of all monitoring locations, the levels of both Cs-134 and Cs-137 were less than 3,000 Bq/kg at most locations, though they were detected at relatively high levels at some limited locations, such as those within 20 km of the power plant. Activity concentrations were observed to be decreasing or unchanged, except for some locations which showed fluctuations.

[Coastal areas]

• Out of all monitoring locations, the levels of both Cs-134 and Cs-137 were less than 200 Bq/kg at most locations. Changes in activity concentrations were observed to be generally decreasing or unchanged, except for some locations which showed fluctuations.

< Groundwater >

• Radioactive cesium was not detected in groundwater at any surveyed locations in FY2017 (detection limit: 1 Bq/L for both Cs-134 and Cs-137).

(2) Radionuclides other than radioactive cesium

•Sr-89: Was not detected at any surveyed groundwater locations.

•Sr-90: Was detected in collected sediment at several public water area locations, but remained at relatively low levels; was not detectable at any surveyed public water areas and at groundwater locations.

○ Measured activity concentrations have fluctuated at some locations. There is a possibility that this is due to the effects of the Fukushima nuclear accident, but the fluctuations could also be due to slight differences in sampling locations and the properties of individual samples. Therefore, it is appropriate to continue this monitoring on an ongoing basis over the following fiscal years.

3. Other Radioactive Material Monitoring Conducted Nationwide (FY2017)

○ The results of the Monitoring of Environmental Radioactivity Levels (hereinafter referred to as "Monitoring of

Levels"), which has been conducted by the Nuclear Regulation Authority for the purpose of clarifying the existence or nonexistence of the influence of nuclear facilities, etc., nationwide, were all within the past measurement trends.

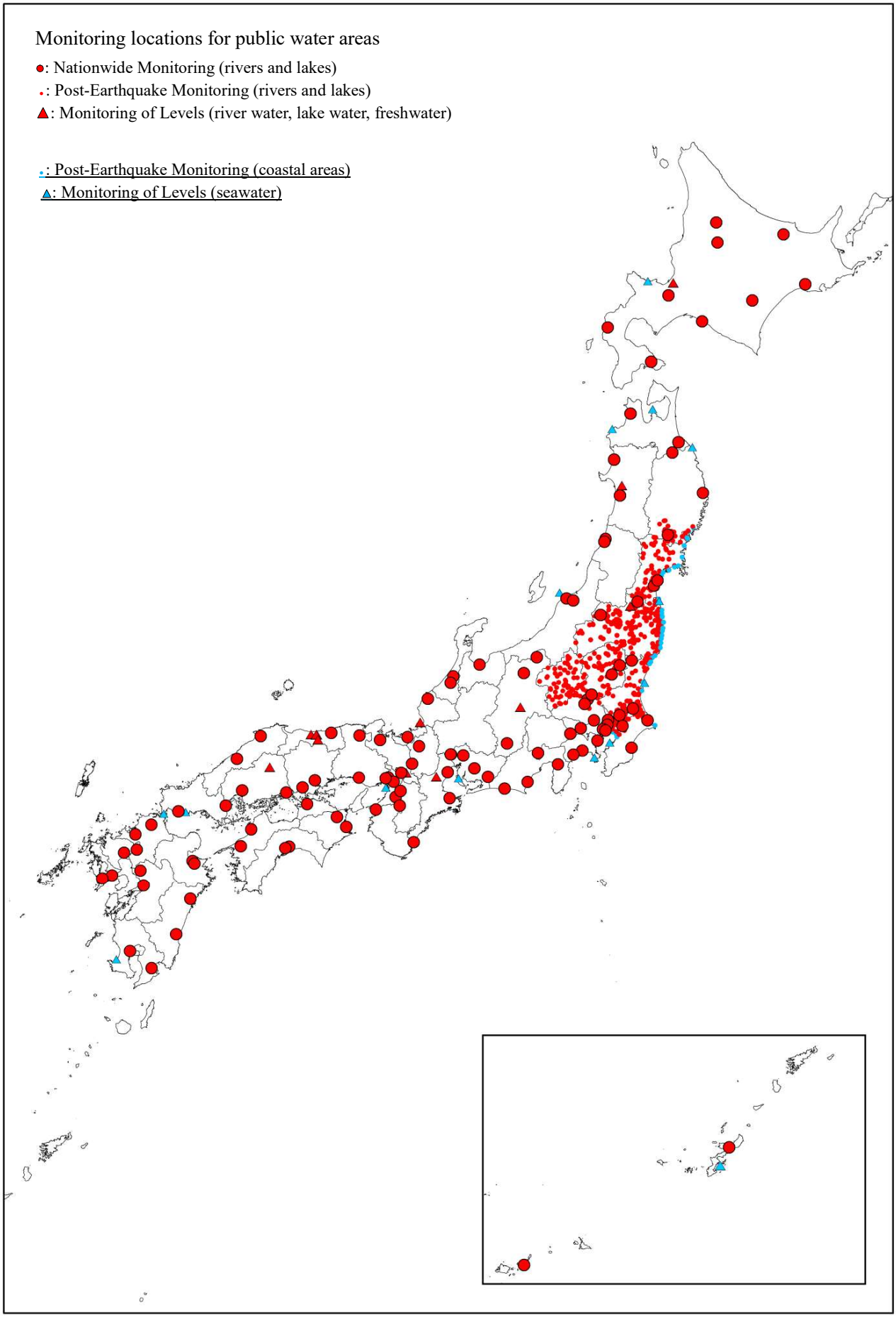


Figure 1 Locations for monitoring radioactive materials (public water areas)

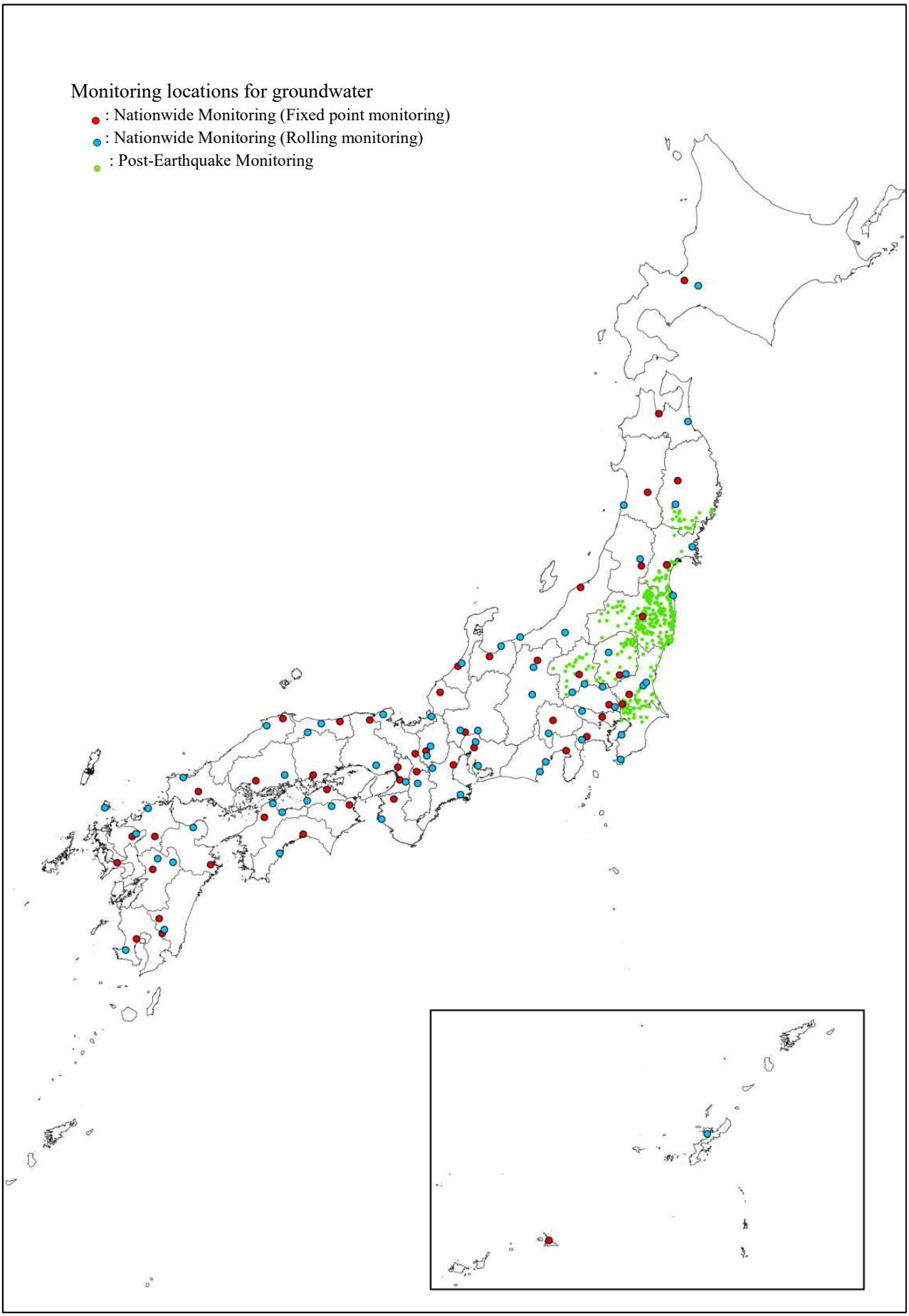


Figure 2 Locations for monitoring radioactive materials (groundwater)

Part 1: National Radioactive Material Monitoring in the Water Environment throughout Japan (FY2017)

1 Objective and Details

1.1 Objective

In response to the Fukushima NPS Accident, during which radioactive materials were discharged causing environmental pollution, the Water Pollution Control Act was amended. It was decided that the Minister of the Environment should monitor pollution caused by radioactive materials in public water areas and groundwater and release the results from the perspective of preserving the health and living environment of the people.

Based on the above, this monitoring aims to clarify the distribution of radioactive materials in public water areas and groundwater nationwide.

1.2 Details

(1) Monitoring locations

- Public water areas: 110 locations (rivers: 107 locations; lakes: three locations)
- Groundwater: 110 locations

Monitoring locations were selected based on the following policy with a view to ensuring balanced nationwide monitoring (specific locations are as shown in Tables 1.2-2 and 1.2-3 and Figures 1.2-1 and 1.2-2).

1) Public water areas

- At least one sampling location was selected in each prefecture, and additional locations were added according to the area and population of each prefecture.
- Locations within each prefecture were selected based on the following policy:
  a) Select representative rivers (including lakes) within each prefecture using the same numbers listed above, taking into account the area and population in their basins.
  b) Regarding rivers selected as explained in a), select locations from among those monitored for hazardous materials, etc., conducted under the Water Pollution Control Act, selected of consideration of water utilization points. Within a single river, give priority to a location in the lower reaches (including lakes located downstream).
  c) As this monitoring does not aim to clarify the influence of specific sources, exclude locations close to those subject to Environmental Monitoring around Nuclear Facilities, etc. (Radiation Monitoring Grants) in principle.

2) Groundwater

- Two sampling locations were chosen in each prefecture, and one more location was added for each prefecture in which the amount of groundwater utilized had been large over the past several years.
- Sampling locations for continuous monitoring of environmental standard items were selected based on the following policy:
  a) Select regional representative wells (such as wells built for monitoring or major wells with an especially large amount of water yield) taking into consideration the amount of utilization of groundwater from

each groundwater basin and water vein (hereinafter referred to as "groundwater basins, etc.").

b) Prioritize wells owned or managed by local governments, etc., in consideration of the convenience of coordination in case any additional survey is required.

c) Select one location for continuous fixed-point monitoring from among the locations selected in the manner above, taking into account that location's level of utilization and the representativeness of that groundwater basin in the wider area. Perform rolling monitoring at the remaining locations (for five years in principle).

d) As this monitoring does not aim to clarify the influence of specific sources, exclude locations close to those subject to Environmental Monitoring around Nuclear Facilities, etc. (Radiation Monitoring Grants), in principle.

(2) Targets

・Public water areas: Water and sediment (for lakes, survey water both at the surface layer and bottom layers)
(Additionally, as a reference, radioactive concentrations in soil and ambient dose rates at riverbeds, etc., in the environment surrounding the sampling locations are to be measured.)

・Groundwater: Water
(Additionally, as a reference, ambient dose rates near the sampling locations are to be measured.)

(3) Frequencies and periods

・Public water areas : Once a year
However, monitoring was conducted four times a year at two locations (one location in eastern and western Japan, respectively) in order to check any annual variation.

・Groundwater : Fixed point monitoring was conducted once a year, and rolling monitoring was conducted once every five years for each location in principle.

FY2017 monitoring periods are as shown in Table 1.2-4.

(4) Conducted analyses

The following analyses were conducted for collected samples:

・Measurement of total β radioactivity concentrations.

・γ-ray spectrometry measurement using a germanium semiconductor detector (In principal, all detectable radionuclides, including artificial radionuclides and major naturally occurring radionuclides, were analyzed).

(5) Evaluation of measurement results

The measurement results were evaluated upon the guidance/advice of "Evaluation Committee on the Radioactive Material Monitoring in the Water Environment" (Table 1.2-1) comprised of professionals.

1) Comparison with the past measurement trends

Obtained values were compared with the past measurement trends, and if any deviation was suspected, the

validity of the measured values was rechecked (potential number transcription errors, incorrect calibration of equipment, etc.).

Because this monitoring has just commenced, there are no accumulated data for some locations. Therefore, results from similar environmental monitoring surveys conducted so far will be used for comparison for the time being. Specifically, results from the Monitoring of Environmental Radioactivity Levels and Monitoring of the Surrounding Environment conducted by the Nuclear Regulation Authority, as well as the results from the Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture conducted by the Ministry of the Environment were utilized. When making comparisons, due consideration was given to the possibility that the values of Cs-137 and other accident-derived radionuclides would have increased after the Fukushima NPS Accident.

Essentially, nationwide data for the past two decades were used for comparison. Considering the influence of the Fukushima NPS Accident and informed by actual measurements, “three years after the accident” was assumed to be a steady state, and therefore, data of artificial radionuclides from between Mar 11, 2011 to Mar 10, 2014 were excluded.

2) Measures to be taken when a value deviating from the past measurement trends was detected

The following measures were taken when a value deviating from the past measurement trends was detected (see Figure 1.2-3).

2)-1 Release of preliminary values

Any value that is suspected of deviating from the past measurement trends should be immediately evaluated professionally by the chair and the deputy chair, and if it is judged highly urgent (when it has been confirmed that the value is highly likely to deviate from the past measurement trends, and additional detailed analyses are considered to be necessary), a preliminary report should be released as promptly as possible.

In such a case, the following related data should be compiled as basic data for professional evaluation. Members of the Evaluation Committee other than the chair and the deputy chair should be informed of the relevant information together with the professional evaluation by the chair and the deputy chair (see Table 1.2-1 for the chair and other committee members).

(i) Results of the measurement concerning water and sediment (γ-ray spectrometry and total β radioactivity concentrations), and ambient dose rates

(ii) Sampling dates, sampling locations (maps, water depth, river width, etc.), sampling methods, and sampling circumstances (photos)

(iii) Weather data for about one week close to the measurement date (the amount of precipitation, in particular)

(iv) Ambient dose rates measured for the last month or so at neighboring points

(v) Changes in detected values of a relevant radionuclide compared to the past

2)-2 Detailed analyses and release of the results

For data for which the preliminary report was released as explained in 2)-1 above, the following detailed analyses are to be conducted and the results are to be released.

・Specific analyses to identify radionuclides (including measurement of individual radionuclides through radiochemical analyses)

・Additional measurements in the surrounding areas of the relevant surveyed location

(6) Disclosure of measurement results

The measurement results data are made publicly available on the following Ministry of the Environment website:

http://www.env.go.jp/en/water/rmms/surveys.html

Table 1.2-1 List of members of the Evaluation Committee on Radioactive Material Monitoring in the Water Environment

IIMOTO Takeshi (Deputy chair)	Professor, Division for Environment, Health and Safety, the University of Tokyo
ISHII Nobuyoshi	Principal Researcher, Environmental Transfer Parameter Research Team, The Fukushima Project Headquarters, National Institute of Radiological Sciences, National Institutes for Quantum and Radiological Science and Technology
TOKUNAGA Tomochika	Professor, Department of Environment Systems, Graduate School of Frontier Sciences, the University of Tokyo
HAYASHI Seiji	Research Group Manager & Head of Environmental Assessment Section, Fukushima Branch, National Institute for Environmental Studies
FUKUSHIMA Takehiko (Chair)	Director of the Center, Ibaraki Kasumigaura Environmental Science Center

Table 1.2-2 List of locations for the FY2017 Nationwide Monitoring (public water areas) (No. 1)

No.	Prefecture	Property	Sampling location		
			Water area	Location	Municipality
1	Hokkaido Prefecture	River	Ishikari River	Domestic water intake at Ishikari River in Asahikawa City	Asahikawa City
2		River	Ishikari River	Intake at the Shirakawa water purification plant in Sapporo City	Sapporo City
3		River	Teshio River	Nakashibetsu Bridge (Intake at the Higashiyama water purification plant in Shibetsu City)	Shibetsu City
4		River	Tokoro River	Tadashi Bridge	Kitami City
5		River	Kushiro River	Intake at the Aikoku water purification plant in Kushiro City	Kushiro City
6		River	Tokachi River	Nantai Bridge	Obihiro City
7		River	Sarugawa River	Sarugawa Bridge (Tomigawa)	Hidaka Town
8		River	Matsukura River	Mitsumori Bridge (Before the confluence with Torasawa River)	Hakodate City
9		River	Shiribeshi-toshibetsu River	Intake at the Kitahiyama simple water plant in Kitahiyama Town	Setana Town
10	Aomori Prefecture	River	Iwaki River	Tsugaru-ohashi Bridge	Nakadomari Town
11		River	Mabechi River	Shiriuchi Bridge	Hachinohe City
12	Iwate Prefecture	River	Mabechi River	Fugane Bridge	Ninohe City
13		River	Heigawa River	Miyako Bridge	Miyako City
14		River	Kitakami River	Chitose Bridge	Ichinoseki City
15	Miyagi Prefecture	River	Abukuma River	Iwanuma (Abukuma Bridge)	Iwanuma City
16		River	Natori River	Yuriage-ohashi Bridge	Natori City
17	Akita Prefecture	River	Yoneshiro River	Noshiro Bridge	Noshiro City
18		River	Omono River	Kurose Bridge	Akita City
19	Yamagata Prefecture	River	Mogami River	Ryou Bridge	Sakata City
20		River	Akagawa River	Shinkawa Bridge	Sakata City
21	Fukushima Prefecture	River	Agano River	Shingo Dam	Kitakata City
22		River	Abukuma River	Taisho Bridge (Fushiguro)	Date City
23		River	Kujigawa River	Takachihara Bridge	Yamatsuri Town
24	Ibaraki Prefecture	Lake	Lake Kasumigaura	Center of the lake	Miho Village
25		River	Kokai River	Fumimaki Bridge	Toride City
26	Tochigi Prefecture	River	Nakagawa River	Shinnaka Bridge	Nakagawa Town
27		River	Kinugawa River	Kinugawa Bridge (Hoshakuji Temple)	Utsunomiya City
28	Gunma Prefecture	River	Tonegawa River	Toneozeki Weir	Chiyoda Town/Gyoda City (Saitama Prefecture)
29		River	Watarase River	Watarase-ohashi Bridge	Tatebayashi City
30	Saitama Prefecture	River	Arakawa River	Kuge Bridge	Kumagaya City
31		River	Arakawa River	Akigase Intake Weir	Saitama City/ Shiki City
32		River	Edogawa River	Nagareyama Bridge	Nagareyama City (Chiba Prefecture) / Misato City
33	Chiba Prefecture	River	Tonegawa River	Kakozeki Weir	Tonosho Town
34		River	Ichinomiya River	Nakano Bridge	Ichinomiya Town
35		Lake	Lake Inbanuma	Lower area of water supply intake	Sakura City
36	Tokyo Metoropolis	River	Edogawa River	Shinkatsushika Bridge	Katsushika City
37		River	Tamagawa River	Haijima raw water supply point	Akishima City
38		River	Sumida River	Ryogoku Bridge	Chuo City / Sumida City
39		River	Arakawa River	Kasai Bridge	Koto City / Edogawa City
40	Kanagawa Prefecture	River	Tsurumi River	Rinko Tsurumigawa Bridge	Yokohama City
41		River	Sagami River	Banyu Bridge	Hiratsuka City
42		River	Sakawa River	Sakawa Bridge	Odawara City
43	Niigata Prefecture	River	Shinano River	Heisei-ohashi Bridge	Niigata City
44		River	Agano River	Oun Bridge	Niigata City
45	Toyama Prefecture	River	Jinzu River	Hagiura Bridge	Toyama City
46	Ishikawa Prefecture	River	Saigawa River	Okuwa Bridge	Kanazawa City
47		River	Tedori River	Hakusangoguchi Dike	Hakusan City
48	Fukui Prefecture	River	Kuzuryu River	Fuseda Bridge	Fukui City
49		River	Kitagawa River	Takatsuka Bridge	Obama City
50	Yamanashi Prefecture	River	Sagami River	Katsuragawa Bridge	Uenohara City
51		River	Fujikawa River	Nanbu Bridge	Nanbu Town
52	Nagano Prefecture	River	Shinano River	Ozeki Bridge	Iiyama City
53		River	Saigawa River	Koichi Bridge	Nagano City
54		River	Tenryu River	Tsutsuji Bridge	Iida City

Table 1.2-2 List of locations for the FY2017 Nationwide Monitoring (public water areas) (No. 2)

No.	Prefecture	Property	Sampling location		
			Water area	Location	Municipality
55	Gifu Prefecture	River	Kisogawa River	Tokai-ohashi Bridge (Naruto)	Kaizu City
56		River	Nagara River	Tokai-ohashi Bridge	Kaizu City
57	Shizuoka Prefecture	River	Kanogawa River	Kurose Bridge	Numazu City
58		River	Ooi River	Fujimi Bridge	Yaizu City / Yoshida Town
59		River	Tenryu River	Kaketsuka Bridge	Iwata City / Hamamatsu City
60	Aichi Prefecture	River	Shonai River	Mizuwake Bridge	Nagoya City
61		River	Yahagi River	Iwazutenjin Bridge	Okazaki City / Toyota City
62		River	Toyogawa River	Eshima Bridge	Toyokawa City
63	Mie Prefecture	River	Suzuka River	Ogura Bridge	Yokkaichi City
64		River	Miyakawa River	Watarai Bridge	Ise City
65	Shiga Prefecture	River	Adogawa River	Joan Bridge	Takashima City
66		Lake	Lake Biwako	Karasakioki-Chuo	—
67	Kyoto Prefecture	River	Yuragawa River	Yuragawa Bridge	Maizuru City
68		River	Katsura River	Before the confluence of three tributaries of Katsura River	Oyamazaki Town
69	Osaka Prefecture	River	Inagawa River	Gunko Bridge	Itami City (Hyogo prefecture)
70		River	Yodogawa River	Sugaharashirokita-ohashi Bridge	Osaka City
71		River	Ishikawa River	Takahashi	Tondabayashi City
72	Hyogo Prefecture	River	Kakogawa River	Kakogawa Bridge	Kakogawa City
73		River	Mukogawa River	Hyakkenbi	Takarazuka City
74		River	Maruyama River	Kaminogo Bridge	Toyooka City
75	Nara Prefecture	River	Yamato River	Fujii	Oji Town
76		River	Kinokawa River	Okura Bridge	Gojo City
77	Wakayama Prefecture	River	Kinokawa River	Shinrokkaizeki Weir	Wakayama City
78		River	Kumano River	Kumano-ohashi Bridge	Shingu City
79	Tottori Prefecture	River	Sendai River	Gyotoku	Tottori City
80	Shimane Prefecture	River	Hiikawa River	Kandatsu Bridge	Izumo City
81		River	Gonokawa River	Sakurae-ohashi Bridge	Gotsu City
82	Okayama Prefecture	River	Asahikawa River	Otoite Weir	Okayama City
83		River	Takahashi River	Kasumi Bridg	Kurashiki City
84	Hiroshima Prefecture	River	Ota River	Water supply intake in Hesaka	Hiroshima City
85		River	Ashida River	Kominomi Bridge	Fukuyama City
86	Yamaguchi Prefecture	River	Nishiki River	Domestic water intake for the city	Iwakuni City
87		River	Koto River	Suenobu Bridge	Ube City
88	Tokushima Prefecture	River	Yoshino River	Takase Bridge	Ishii Town
89		River	Nakagawa River	Nakagawa Bridge	Anan City
90	Kagawa Prefecture	River	Dokigawa River	Marugame Bridge	Marugame City
91	Ehime Prefecture	River	Shigenobu River	Deai Bridge	Matsuyama City
92		River	Hijikawa River	Hijikawa Bridge	Ozu City
93	Kochi Prefecture	River	Kagami River	Kachuzeki Weir	Kochi City
94		River	Niyodo River	Hatazeki Weir (1) Center of flow	Ino Town
95	Fukuoka Prefecture	River	Onga River	Hinode Bridge	Nogata City
96		River	Nakagawa River	Shiobara Bridge	Fukuoka City
97		River	Chikugo River	Senoshita	Kurume City
98	Saga Prefecture	River	Kasegawa River	Kase Bridge	Saga City
99	Nagasaki Prefecture	River	Honmyo River	In front of Tenma Park	Isahaya City
100		River	Uragami River	Ohashizeki Weir	Nagasaki City
101	Kumamoto Prefecture	River	Kikuchi River	Shiroishi	Nagomi Town
102		River	Midori River	Uesugizeki Weir	Kumamoto City
103	Oita Prefecture	River	Oita River	Funaichi-ohashi Bridge	Oita City
104		River	Oono River	Shirataki Bridge	Oita City
105	Miyazaki Prefecture	River	Gokase River	Miwa	Nobeoka City
106		River	Oyodo River	Shinaioi Bridge	Miyazaki City
107	Kagoshima Prefecture	River	Kotsuki River	Iwasaki Bridge	Kagoshima City
108		River	Kimotsuki River	Matase Bridge	Kanoya City
109	Okinawa Prefecture	River	Genka River	Water intake	Nago City
110		River	Miyara River	Omoto water intake	Ishigaki City

Table 1.2-3 List of locations for the FY2017 Nationwide Monitoring (groundwater) (No. 1)

No.	Prefecture	Property	Municipality	District	Monitoring method
1	Hokkaido Prefecture	Groundwater	Sapporo City	Kitasanjonishi, Chuo Ward	Fixed point monitoring
2		Groundwater	Naganuma Town	Nishiichisenminami	Rolling monitoring
3	Aomori Prefecture	Groundwater	Aomori City	Shinmachi	Fixed point monitoring
4		Groundwater	Misawa City	Sakuracho	Rolling monitoring
5	Iwate Prefecture	Groundwater	Morioka City	Motomiya	Fixed point monitoring
6		Groundwater	Kitakami City	Shimoezuriko	Rolling monitoring
7	Miyagi Prefecture	Groundwater	Sendai City	Honcho, Aoba Ward	Fixed point monitoring
8		Groundwater	Ishinomaki City	Onagawa, kitakamicho	Rolling monitoring
9	Akita Prefecture	Groundwater	Daisen City	Niiyaji	Fixed point monitoring
10		Groundwater	Nikaho City	Hirasawa	Rolling monitoring
11	Yamagata Prefecture	Groundwater	Yamagata City	Hatagomachi	Fixed point monitoring
12		Groundwater	Sagae City	Nitta	Rolling monitoring
13	Fukushima Prefecture	Groundwater	Koriyama City	Asahi	Fixed point monitoring
14		Groundwater	Soma City	Isobe	Rolling monitoring
15	Ibaraki Prefecture	Groundwater	Tsukuba City	Kenkyugakuen	Fixed point monitoring
16		Groundwater	Omitama City	Katakura	Rolling monitoring
17		Groundwater	Ibaraki Town	Ozutsumi	Rolling monitoring
18	Tochigi Prefecture	Groundwater	Shimotsuke City	Machida	Fixed point monitoring
19		Groundwater	Nikko City	Kobyaku	Rolling monitoring
20		Groundwater	Mooka City	Tamachi	Rolling monitoring
21	Gunma Prefecture	Groundwater	Maebashi City	Shikishimacho	Fixed point monitoring
22		Groundwater	Kanna Town	Manba	Rolling monitoring
23		Groundwater	Meiwa Town	Minamioshima	Rolling monitoring
24	Saitama Prefecture	Groundwater	Saitama City	Mikura, Minuma Ward	Fixed point monitoring
25		Groundwater	Koshigaya City	Shichizacho	Rolling monitoring
26		Groundwater	Honjo City	Sugiyama	Rolling monitoring
27	Chiba Prefecture	Groundwater	Kashiwa City	Funato	Fixed point monitoring
28		Groundwater	Tateyama City	Yamamoto	Rolling monitoring
29		Groundwater	Kisarazu City	Egawa	Rolling monitoring
30	Tokyo Metoropolis	Groundwater	Koganei City	Kajinocho	Fixed point monitoring
31		Groundwater	Okutama Town	Unazawa	Rolling monitoring
32	Kanagawa Prefecture	Groundwater	Hadano City	Imaizumi	Fixed point monitoring
33		Groundwater	Minamiashigara City	Wadagahara	Rolling monitoring
34	Niigata Prefecture	Groundwater	Niigata City	Nagata, Chuo Ward	Fixed point monitoring
35		Groundwater	Tokamachi City	Kawauchicho	Rolling monitoring
36		Groundwater	Itoigawa City	Suzawa	Rolling monitoring
37	Toyama Prefecture	Groundwater	Toyama City	Funahashikitamachi	Fixed point monitoring
38		Groundwater	Kurobe City	Horikirishin	Rolling monitoring
39	Ishikawa Prefecture	Groundwater	Hakusan City	Kuramitsu	Fixed point monitoring
40		Groundwater	Kanazawa City	Daiwamachi	Rolling monitoring
41	Fukui Prefecture	Groundwater	Fukui City	Ote	Fixed point monitoring
42		Groundwater	Tsuruga City	Mishimacho	Rolling monitoring
43	Yamanashi Prefecture	Groundwater	Showa Town	Saijyoshinden	Fixed point monitoring
44		Groundwater	Minobu Town	Shimoyama	Rolling monitoring
45	Nagano Prefecture	Groundwater	Nagano City	Tsurugamidoricho	Fixed point monitoring
46		Groundwater	Chikuma City	Kuiseke	Rolling monitoring
47		Groundwater	Shimosuwa Town	Shimosuwa Town	Rolling monitoring
48	Gifu Prefecture	Groundwater	Gifu City	Kanoshimizucho	Fixed point monitoring
49		Groundwater	Motosu City	Shimomakuwa	Rolling monitoring
50		Groundwater	Minokamo City	Otacho	Rolling monitoring
51	Shizuoka Prefecture	Groundwater	Numazu City	Hara	Fixed point monitoring
52		Groundwater	Shizuoka City	Nakajima, Suruga Ward	Rolling monitoring
53		Groundwater	Yoshida Town	Kawashiri	Rolling monitoring
54	Aichi Prefectur	Groundwater	Nagoya City	Kawaharatori, Showa Ward	Fixed point monitoring
55		Groundwater	Kasugai City	Toriimatsucho	Rolling monitoring
56		Groundwater	Nishio City	Naganawacho Inomoto	Rolling monitoring

Table 1.2-3 List of locations for the FY2017 Nationwide Monitoring (groundwater) (No. 2)

No.	Prefecture	Property	Municipality	District	Monitoring method
57	Mie Prefecture	Groundwater	Suzuka City	Inoucho	Fixed point monitoring
58		Groundwater	Iga City	Otacho	Rolling monitoring
59		Groundwater	Minamiise Town	Goshogaura	Rolling monitoring
60	Shiga Prefecture	Groundwater	Moriyama City	Miyakecho	Fixed point monitoring
61		Groundwater	Ritto City	Arahari	Rolling monitoring
62		Groundwater	Omihachiman City	Tsudacho	Rolling monitoring
63	Kyoto Prefecture	Groundwater	Kyoto City	Toraishicho, Nakagyo Ward	Fixed point monitoring
64		Groundwater	Kyotango City	Yasakacho	Rolling monitoring
65	Osaka Prefecture	Groundwater	Sakai City	Daisennakamachi, Sakai Ward	Fixed point monitoring
66		Groundwater	Habkino City	Shakudo	Rolling monitoring
67	Hyogo Prefecture	Groundwater	Itami City	Kuchisakai	Fixed point monitoring
68		Groundwater	Toyooka City	Saiwaicho	Fixed point monitoring
69		Groundwater	Miki City	Fukui	Rolling monitoring
70	Nara Prefecture	Groundwater	Nara City	Sakyo	Fixed point monitoring
71		Groundwater	Sakurai City	Kawai	Rolling monitoring
72	Wakayama Prefecture	Groundwater	Kinokawa City	Takano	Fixed point monitoring
73		Groundwater	Gobo City	Sono	Rolling monitoring
74	Tottori Prefecture	Groundwater	Tottori City	Saiwaicho	Fixed point monitoring
75		Groundwater	Kurayoshi City	Yatsuya	Rolling monitoring
76	Shimane Prefecture	Groundwater	Matsue City	Nishikawatsucho	Fixed point monitoring
77		Groundwater	Izumo City	Enyacho	Rolling monitoring
78	Okayama Prefecture	Groundwater	Kurashiki City	Fukui	Fixed point monitoring
79		Groundwater	Maniwa City	Hiruzenkamitokuyama	Rolling monitoring
80	Hiroshima Prefecture	Groundwater	Hiroshima City	Kamisenocho, Aki Ward	Fixed point monitoring
81		Groundwater	Onomichi City	Mitsugicho Saburomaru	Rolling monitoring
82	Yamaguchi Prefecture	Groundwater	Yamaguchi City	Ouchimihori	Fixed point monitoring
83		Groundwater	Nagato City	Higashifukawa	Rolling monitoring
84	Tokushima Prefecture	Groundwater	Tokushima City	Fudohoncho	Fixed point monitoring
85		Groundwater	Mima City	Wakimachi	Rolling monitoring
86	Kagawa Prefecture	Groundwater	Takamatsu City	Bancho	Fixed point monitoring
87		Groundwater	Kanonji City	Shigekicho	Rolling monitoring
88	Ehime Prefecture	Groundwater	Matsuyama City	Hiraimachi	Fixed point monitoring
89		Groundwater	Saijo City	Kanbaiko	Rolling monitoring
90		Groundwater	Imabari City	Katayama	Rolling monitoring
91	Kochi Prefecture	Groundwater	Kochi City	Kerako	Fixed point monitoring
92		Groundwater	Shimanto Town	Hondo	Rolling monitoring
93	Fukuoka Prefecture	Groundwater	Kurume City	Tanushimarumachi Akinari	Fixed point monitoring
94		Groundwater	Munakata City	Togo	Rolling monitoring
95	Saga Prefecture	Groundwater	Saga City	Yamatochoniiji	Fixed point monitoring
96		Groundwater	Kanzaki City	Sefurimachi Hirotaki	Rolling monitoring
97	Nagasaki Prefecure	Groundwater	Isahaya City	Eidamachi	Fixed point monitoring
98		Groundwater	Iki City	Gonouracho Katabarufure	Rolling monitoring
99	Kumamoto Prefecture	Groundwater	Kumamoto City	Suizenji, Chuo Ward	Fixed point monitoring
100		Groundwater	Kikuchi City	Wataru	Rolling monitoring
101		Groundwater	Aso City	Ichinomiyamachi Miyaji	Rolling monitoring
102	Oita Prefecure	Groundwater	Saiki City	Kamioka	Fixed point monitoring
103		Groundwater	Bungotakada City	Miwaenomoto	Rolling monitoring
104	Miyazaki Prefecture	Groundwater	Miyakonojo City	Minamiyokoichicho	Fixed point monitoring
105		Groundwater	Kobayashi City	Minaminishikata	Fixed point monitoring
106		Groundwater	Miyakonojo City	Marutanicho	Rolling monitoring
107	Kagoshima Prefecture	Groundwater	Kagoshima City	Tamazatocho	Fixed point monitoring
108		Groundwater	Minamisatsuma City	Manose	Rolling monitoring
109	Okinawa Prefecture	Groundwater	Miyakojima City	Hirarahigashinakasonezoe	Fixed point monitoring
110		Groundwater	Nago City	Yabu	Rolling monitoring

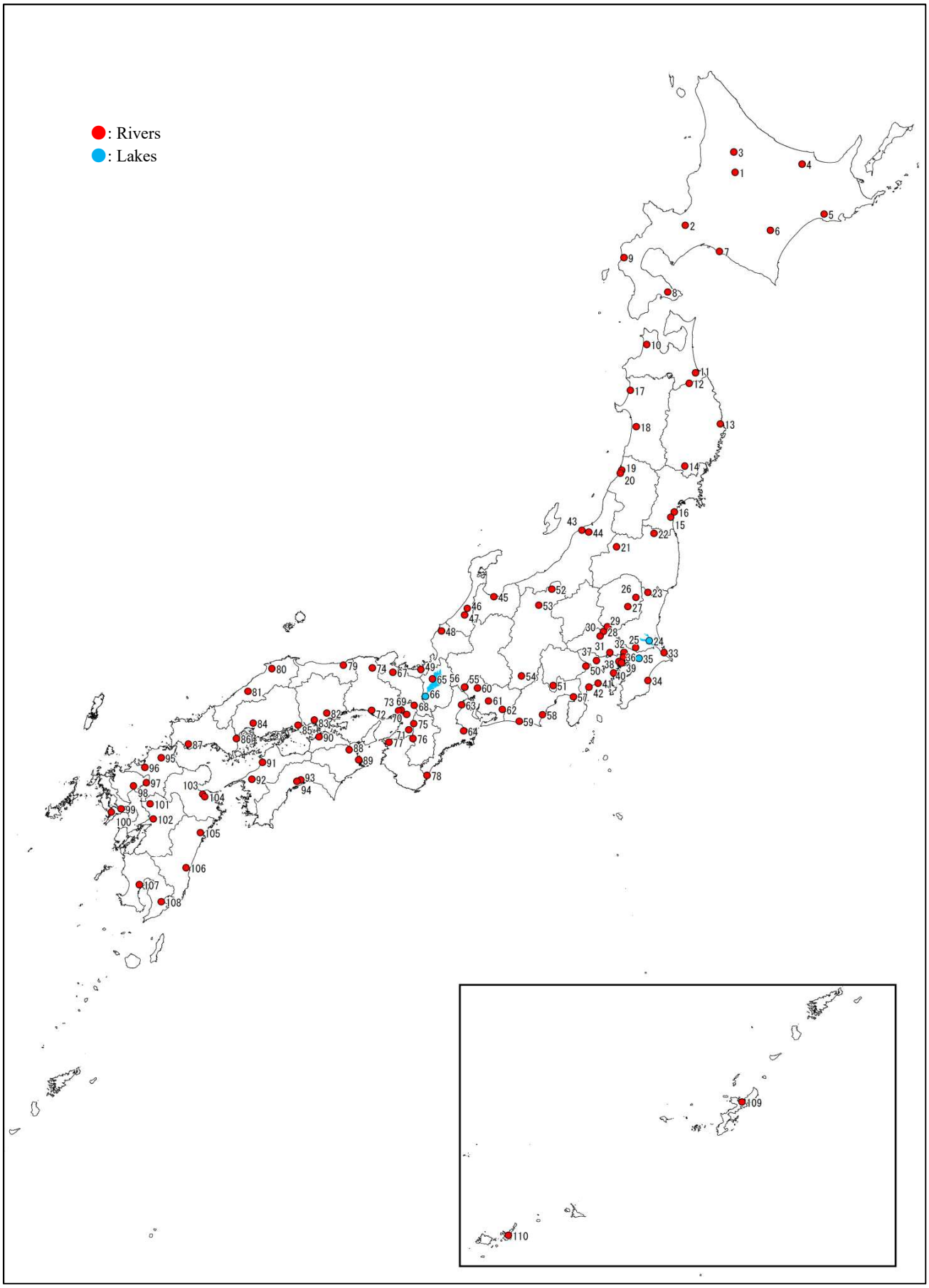


Figure 1.2-1 Map showing locations for FY2017 Nationwide Monitoring (public water areas)

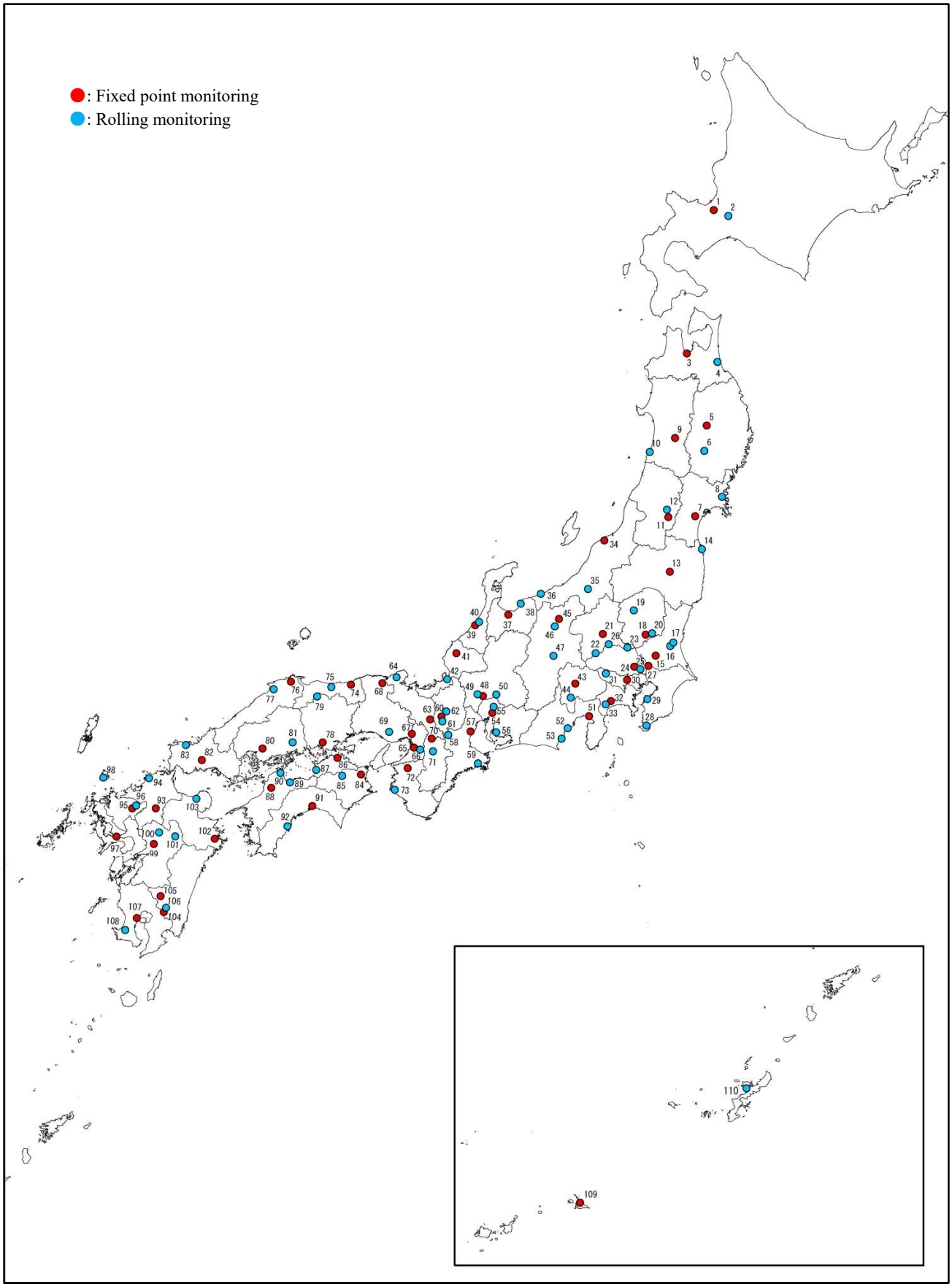


Figure 1.2-2 Map showing locations for FY2017 Nationwide Monitoring (groundwater)

Table 1.2-4 Monitoring points and period by block (FY2017)

Blocks	Prefectures	Public water areas		Groundwater	
		Number of Locations (*1)	Period	Number of locations	Period
Hokkaido block	Hokkaido	9	Aug 23 to Oct 6	2	Aug 22 to Aug 23
Tohoku block	Aomori, Iwate, Miyagi, Akita, Yamagata and Fukushima	14	Aug 22 to Sep 11	12	Aug 23 to Sep 12
Kanto block	Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Niigata, Yamanashi and Shizuoka	26 (2)	Aug 23 to Oct 3	27	Aug 21 to Oct 3
Chubu block	Toyama, Ishikawa, Fukui, Nagano, Gifu, Aichi and Mie	15	Sep 11 to Sep 26	18	Sep 11 to Sep 21
Kinki block	Shiga, Kyoto, Osaka, Hyogo, Nara and Wakayama	14 (1)	Aug 29 to Oct 3	14	Aug 28 to Sep 21
Chugoku-Shikoku block	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime and Kochi	16	Aug 21 to Sep 15	19	Aug 21 to Sep 13, Nov 20 (*2)
Kyushu and Okinawa block	Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima and Okinawa	16	Aug 21 to Sep 22	18	Aug 22 to Sep 22
Survey to check annual variation	Gunma and Okayama	2	May 29 to Jan 16	-	-

(*1) Numbers in parentheses designate monitoring locations for lakes; plain numbers are for rivers.

(*2) The groundwater at No. 91 was collected on November 20, and collection from other locations was completed by September 13.

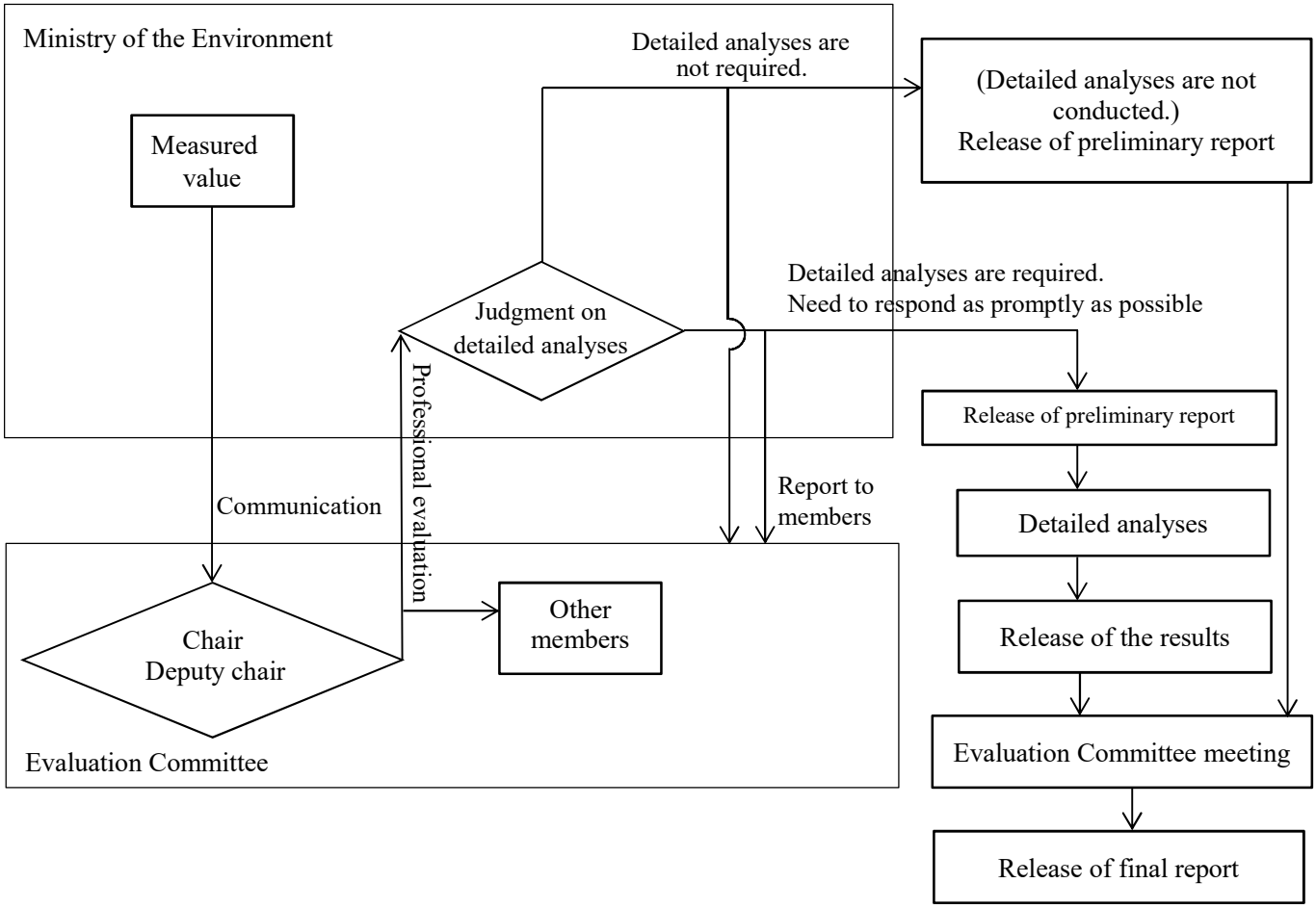


Figure 1.2-3 Procedures for professional evaluation of the results of the Nationwide Monitoring

2 Survey Methods and Analysis Methods

2.1 Survey methods

Samples were collected based on the following guidelines in principle, as outlined below.

- Water Quality Survey Method (Sep 30, 1971; Notice Kansuikan No. 30 issued by the Director General of the Water Quality Preservation Bureau, Ministry of the Environment)
- Sediment Survey Method (Aug 8, 2012; Notice Kansuitaisuihatsu No. 120725002 issued by the Director General of the Environmental Management Bureau, Ministry of the Environment)
- Groundwater Quality Survey Method (Sep 14, 1989; Notice Kansuikan No. 189 issued by the Director General of the Water Quality Preservation Bureau, Ministry of the Environment)
- Environmental Sample Collection Method (1983, Ministry of Education, Culture, Sports Science and Technology (hereinafter referred to as "MEXT")'s Radioactivity Measurement Method Series)
- Sample Pretreatment for Instrumental Analysis Using Germanium Semiconductor Detectors (1982, MEXT's Radioactivity Measurement Method Series)

(1) Public water areas

• Water:

Water samples of around 160 L (hydrochloric acid added) and around 2 L (nitric acid added) were collected at the predetermined points. From the 160 L sample (hydrochloric acid added), 80 L was used for γ-ray spectrometry analyses and the remaining 80 L was preserved for possible detailed analyses. From the 2 L sample (nitric acid added), 1 L was used to measure total β radioactivity concentrations.

Additionally, the transparency (or Secchi disk depth) was measured when collecting water samples, and in the case that transparency was thought to have been affected by rainwater based on comparison to prior measurements, or if there was no past data to compare, the measured transparency was 50 cm or less and it was suspected that rainwater may have influenced transparency, the water was not used as samples.

• Sediment:

Bottom sediment samples of around 6 L were collected at the predetermined points at a depth of around 10 cm from the surface layer by using an Ekman-Birge grab sampler etc., and 3 L out of the 6 L was used for γ-ray spectrometry analyses.

• Soil:

Soil samples (around 5 cm in diameter) were collected at a depth of around 5 cm at five points within a 3 to 5 meter square (four vertexes and the diagonal intersection point), or, when it was difficult to find an appropriate square to determine five such sampling locations, soil from five points in 3 to 5 meter intervals along a river was collected and was brought back separately. Samples thus collected at the five points were mixed in equal amounts respectively and were used for analyses.

• Ambient dose rates (soil sampling locations):

Ambient dose rates were measured by installing NaI (Tl) scintillation survey meters at a height of 1 m from the ground surface on both banks of a river (or in the case of a lake, installing a NaI (Tl) scintillation survey meter at one point on lake side) so that the meters would face the sampling location of river water (or lake

water).

(2) Groundwater

• Water:

Groundwater samples of around 160 L (hydrochloric acid added) and 2 L (nitric acid added) were collected at the predetermined wells, etc., 80 L of the 160 L sample (hydrochloric acid added) was used for γ-ray spectrometry analyses and the remaining 80 L was preserved for possible detailed analyses. 1 L of the 2 L sample (nitric acid added) was used for to measure total β radioactivity concentrations.

When collecting water samples, it was confirmed that water temperature, transparency, pH, and electrical conductivity remained constant by allowing the water to pass for several minutes, and changes in the transparency, etc., thereafter were recorded as notes.

・Ambient dose rates:

Ambient dose rates were measured by installing NaI (Tl) scintillation survey meters at a height of 1 m from the ground surface near the relevant wells, etc., so that they would face the sampling location of groundwater (or the groundwater layer).

2.2 Analysis methods

For public water areas (water and sediment) and groundwater (water), total β radioactivity concentrations and γ-ray spectrometry with a germanium semiconductor detector were conducted using the methods below. As a general rule, the γ-ray spectrometry measurement covered all detectable radionuclides (including artificial radionuclides and naturally occurring radionuclides). Measurements were described to two significant digits, and the unit of measures were "Bq/L" for water samples from public water areas and groundwater samples, and "Bq/kg" for sediment samples from public water areas, respectively.

The adopted analysis methods were essentially in line with the MEXT's Radioactivity Measurement Method Series, and detection limits were set around 0.001 to 0.01 Bq/L for water samples and around 1 to 30 Bq/kg for sediment samples. (However, these detection limits did not apply to radionuclides with short half-lives or those with extremely low γ-ray emission rates.)

・Measurement of total β radioactivity concentrations: The samples were concentrated and dried, and then measurements were taken using a low-background gas-flow proportional counter.

・γ-ray spectrometry measurement: After proper pretreatment, the samples were placed in a U-8 container or a 2L Marinelli beaker and measured using a germanium semiconductor detector. The following 62 types of γ-ray emitting radionuclides (18 naturally occurring radionuclides and 44 artificial radionuclides) were surveyed. The measured results of γ-ray emitting radionuclides were corrected for attenuation, and figures were reported as activity concentration after sampling.

Table 2.2-1 Surveyed γ-ray emitting radionuclides

Naturally occurring radionuclides (18 radionuclides)		Artificial radionuclides (44 radionuclides)				
Ac-228	Ra-224	Ag-108m	Co-58	I-131	Np-239	Te-129m
Be-7	Ra-226	Ag-110m	Co-60	I-132	Ru-103	Te-132
Bi-212	Th-227	Am-241	Cr-51	La-140	Ru-106	Y-91
Bi-214	Th-228	As-74	Cs-134	Mn-54	Sb-124	Y-93
K-40	Th-231	Ba-140	Cs-136	Mn-56	Sb-125	Zn-63
Pa-234m	Th-234	Bi-207	Cs-137	Mo-99	Sb-127	Zn-65
Pb-210	Tl-206	Ce-141	Fe-59	Nb-95	Sr-91	Zr-95
Pb-212	Tl-208	Ce-143	Ga-74	Nb-97	Tc-99m	Zr-97
Pb-214	U-235	Ce-144	Ge-75	Nd-147	Te-129	

3 Results

The outline of detectable radioactive materials at each monitoring location is as follows.

3.1 Detection of total β radioactivity and γ-ray emitting radionuclides

(1) Public water areas

1) Water

The results of the measurements of total β radioactivity and γ-ray emitting radionuclides in water samples from public water areas are as shown in Table 3.1-1 and Figure 3.1-1.

a) Total β radioactivity

The detection rate for total radioactivity was 85.0% with detected values ranging from not detectable to 5.2 Bq/L: some of which exceeded the range of the past measurement, however, they were all attributable to k-40 in seawater and considered to be within the past measurement trends.

b) γ-ray emitting radionuclides

As shown in Table 3.1-1 and Figure 3.1-1, eight types of γ-ray emitting radionuclides (six naturally occurring radionuclides and two artificial radionuclides) were detected, while other types of γ-ray emitting radionuclides were not detectable at any of the locations surveyed.

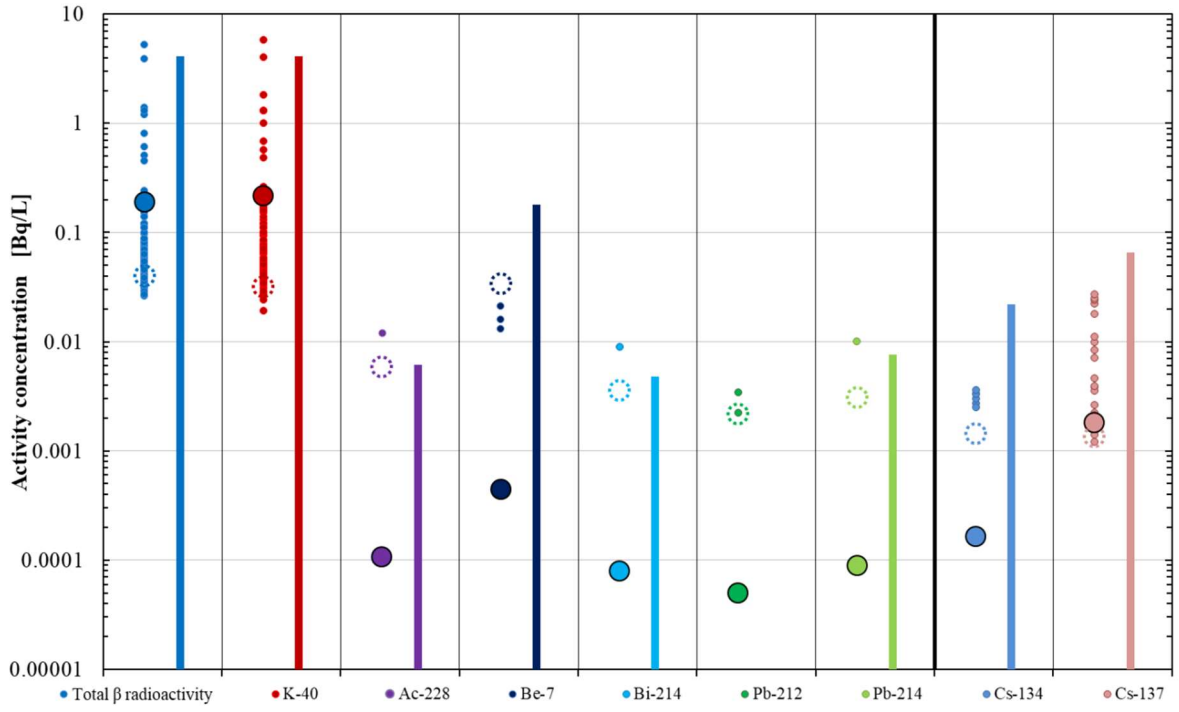
The detection rates of naturally occurring radionuclides were 3% or less, except for K-40, for which the detection rate was 96.5%. K-40 exceeded the range of past measurements, which was considered to be due to seawater (described later). In addition, the detected concentrations of Ac-228, Bi-214, Pb-212 and Pb-214 exceeded the range of the past measured values at some locations; they are naturally occurring thorium or uranium series radionuclides and generally contained in natural soils and rocks. Considering that the past detections were based on the results of surveys at only a few locations (Nationwide monitoring results of the past three years: three times for Ac-228, eight times for Bi-214, ND for Pb-212 and 17 times for Pb-214, respectively), all of the measured values of naturally occurring radionuclides were within the past measurement trends.

Regarding artificial radionuclides, the detection rate for Cs-134 was 5.3% and for Cs-137 it was 17.7%, while the nuclide concentration of Cs-134 was 0.0036 Bq/L or less, Cs-137 was 0.027 Bq/L or less: all of which were within the past measurement trends.

Table 3.1-1 Detection of total β radioactivity and γ-ray emitting radionuclides in water samples from public water areas

Radionuclides			Number of samples	Number of detections	Detection rate[%]	Measured values [Bq/L]		Maximum records [Bq/L]	
						Range	Detection limits	FY2014 - FY2016 Nationwide monitoring	Monitoring of Levels (*1)
Total β radioactivity			113	96	85.0	ND - 5.2	0.024 - 0.69	4.1	0.24
γ-ray emitting radionuclides	Naturally occurring	K-40	113	109	96.5	ND - 5.8	0.017 - 0.090	4.1	2.3
		Ac-228	113	1	0.9	ND - 0.012	0.0033 - 0.019	0.0061	0.0037
		Be-7	113	3	2.7	ND - 0.021	0.0090 - 0.096	0.057	0.18
		Bi-214	113	1	0.9	ND - 0.0089	0.0021 - 0.011	0.0037	0.0048
		Pb-212	113	2	1.8	ND - 0.0034	0.0012 - 0.0080	ND	No data
		Pb-214	113	1	0.9	ND - 0.010	0.0018 - 0.0093	0.0076	No data
	Artificial	Cs-134	113	6	5.3	ND - 0.0036	0.00085 - 0.0046	0.022	0.015
		Cs-137	113	20	17.7	ND - 0.027	0.00077 - 0.0042	0.065	0.041

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1998 to FY2017 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014)



<Legend> : Detected value
: Mean value (arithmetic mean calculated assuming ND = 0)
: Mean value of detection limits (Arithmetic mean)
: Range of past measured values (Nationwide Monitoring from FY2014 to FY2016, and Monitoring Levels, etc., from FY1998 to FY2017 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014))

(*) The vertical axis is logarithmically scaled because the magnitude of detected values varies widely depending on the type of radionuclide.

Figure 3.1-1 Detection of total β radioactivity and γ-ray emitting radionuclides in water samples from public water areas

2) Sediment

The results for total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas are as shown in Table 3.1-2 and Figure 3.1-2.

a) Total β radioactivity

Total β radioactivity was detected at all locations surveyed, with detected values ranging from 160 to 1,200 Bq/kg: all of which were within the past measurement trends.

b) γ-ray emitting radionuclides

As shown in Table 3.1-2 and Figure 3.1-2, 11 types of γ-ray emitting radionuclides (nine naturally occurring radionuclides and two artificial radionuclides) were detected, while no other types of γ-ray emitting radionuclides were detectable.

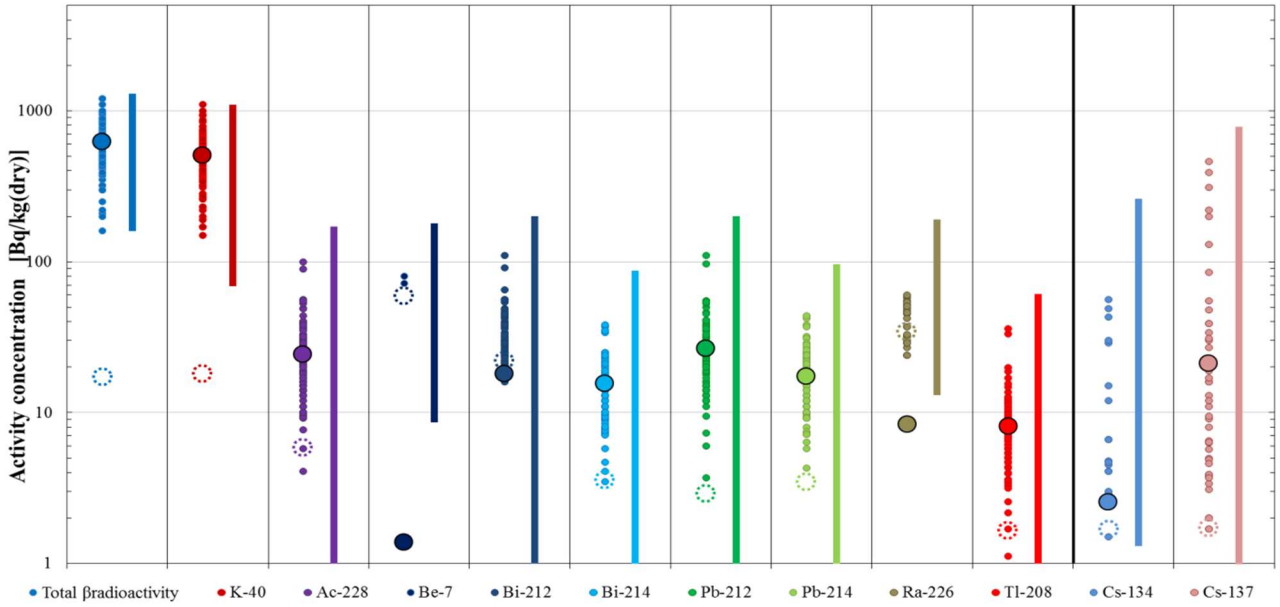
The detection rates of the six naturally occurring radionuclides other than Be-7, Bi-212, and Ra-226 exceeded 95%. All of the detected naturally occurring radionuclides were within the past measurement trends.

As for artificial radionuclides, the detection rates of Cs-134 and Cs-137 were 16.4% and 39.1% respectively, while detected values were 56 Bq/kg or less for Cs-134 and 460 Bq/kg or less for Cs-137: all of which were within the past measurement trends.

Table 3.1-2 Detection of total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas

Radionuclides			Number of samples	Number of detections	Detection rate[%]	Measured values [Bq/kg (dry)] Range	Measured values [Bq/kg (dry)] Detection limits	Maximum records [Bq/kg(dry)] FY2014 - FY2016 Nationwide monitoring	Maximum records [Bq/kg(dry)] Monitoring of Levels (*1)
Total β radioactivity			110	110	100	160 - 1,200	15 - 21	1,300	1,300
γ-ray emitting radionuclides	Naturally occurring	K-40	110	110	100	150 - 1,100	11 - 28	1,100	800
		Ac-228	110	109	99.1	ND - 100	2.6 - 9.7	170	No data
		Be-7	110	2	1.8	ND - 80	13 - 170	180	48
		Bi-212	110	59	53.6	ND - 110	12 - 40	200	No data
		Bi-214	110	110	100	3.5 - 38	1.8 - 9.1	87	ND
		Pb-212	110	110	100	3.7 - 110	1.3 - 6.7	200	No data
		Pb-214	110	110	100	4.3 - 44	1.6 - 10	96	No data
		Ra-226	110	23	20.9	ND - 60	16 - 83	190	122
		Tl-208	110	110	100	1.1 - 36	0.79 - 4.0	61	No data
	Artificial	Cs-134	110	18	16.4	ND - 56	0.85 - 4.3	260	30
		Cs-137	110	43	39.1	ND - 460	0.84 - 4.3	780	110

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment studies conducted in Japan nationwide from FY1998 to FY2017 (excluding data of artificial radionuclides from Mar 11, 2011 to Marc10, 2014)



<Legend> : Detected value
: Mean value (arithmetic mean calculated assuming ND = 0)
: Mean value of detection limits(Arithmetic mean)
: Range of past measured values (Nationwide Monitoring from FY2014 to FY2016, and Monitoring Levels, etc., from FY1998 to FY2017 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014))

(*) Details of the detection of Cs-134 and Cs-137 are explained later.
(*) The vertical axis is logarithmically scaled because the magnitude of detected values varies widely with the type of radionuclide.

Figure 3.1-2 Detection of total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas

(2) Groundwater

The measurement results for total β radioactivity and γ-ray emitting radionuclides in groundwater samples are as shown in Table 3.1-3 and Figure 3.1-3.

a) Total β radioactivity

The detection rate of total β radioactivity was 84.5%, with detected values ranging from not detectable to 0.40 Bq/L. All values were considered to be within the past measurement trends.

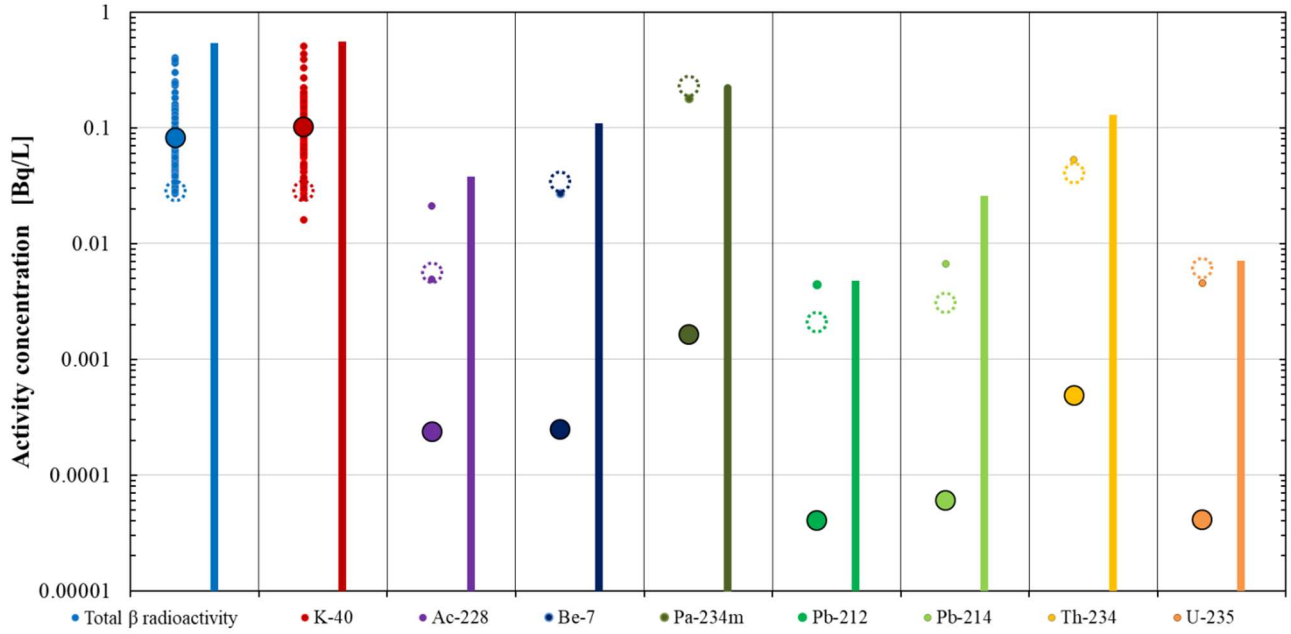
b) γ-ray emitting radionuclides

Eight types of γ-ray emitting radionuclides (all naturally occurring radionuclides), as shown in Table 3.1-3 and Figure 3.1-3, were detected, while no other types of γ-ray emitting radionuclides were detected. The detection rate was less than 2% except for the detection rate of K-40 which was 90.9%. All of these were within the past measurement trends.

Table 3.1-3 Detection of total β radioactivity and γ-ray emitting radionuclides in groundwater samples

Radionuclides			Number of samples	Detection times	Detection rate (%)	Measured values [Bq/L]		Maximum records [Bq/L]	
						Range	Detection limits	FY2014 - FY2016 Nationwide Monitoring	Monitoring of Levels (*1)
Total β radioactivity			110	93	84.5	ND - 0.40	0.024 - 0.13	0.54	0.33
γ-ray emitting radionuclides	Naturally occurring	K-40	110	100	90.9	ND - 0.50	0.016 - 0.052	0.56	0.32
		Ac-228	110	2	1.8	ND - 0.021	0.0032 - 0.0092	0.038	No data
		Be-7	110	1	0.9	ND - 0.027	0.0097 - 0.10	ND	0.11
		Pa-234m	110	1	0.9	ND - 0.18	0.13 - 0.41	0.22	No data
		Pb-212	110	1	0.9	ND - 0.0044	0.0012 - 0.0036	0.0048	No data
		Pb-214	110	1	0.9	ND - 0.0066	0.0018 - 0.0048	0.026	No data
		Th-234	110	1	0.9	ND - 0.053	0.020 - 0.078	0.13	No data
		U-235	110	1	0.9	ND - 0.0045	0.0034 - 0.011	0.0071	No data

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1998 to FY2017



<Legend> : Detected value
: Mean value (arithmetic mean calculated assuming ND = 0)
: Mean value of detection limits (Arithmetic mean)
: Range of past measured values (Nationwide Monitoring from FY2014 to FY2016, and Monitoring of Levels, etc., from FY1998 to FY2017)

(*) The vertical axis is logarithmically scaled because the magnitude of detected values varies widely with the type of radionuclide.

Figure 3.1-3 Detection of total β radioactivity and γ-ray emitting radionuclides in groundwater samples

3.2 Discussion regarding detected radionuclides

(1) Detection of naturally occurring radionuclides

1) Correlation between activity concentrations of K-40 in water samples and seawater

As explained in 3.1 above, in some areas, activity concentrations of K-40 which exceeded the range of the past measurement values (4.1Bq/L at the maximum) were detected in water samples collected in public water areas. All the locations where relatively high concentrations of K-40 were detected were located in the tide zone and the electrical conductivity (EC) was high (2,890 mS/m at the maximum). Therefore, seawater inflow is concerned as a cause of this high concentrations and a comparison was made using all available data to clarify the correlation between activity concentrations of K-40 and EC (see Figure 3.2-1).

As shown in Figure 3.2-1, a positive correlation was found between them.

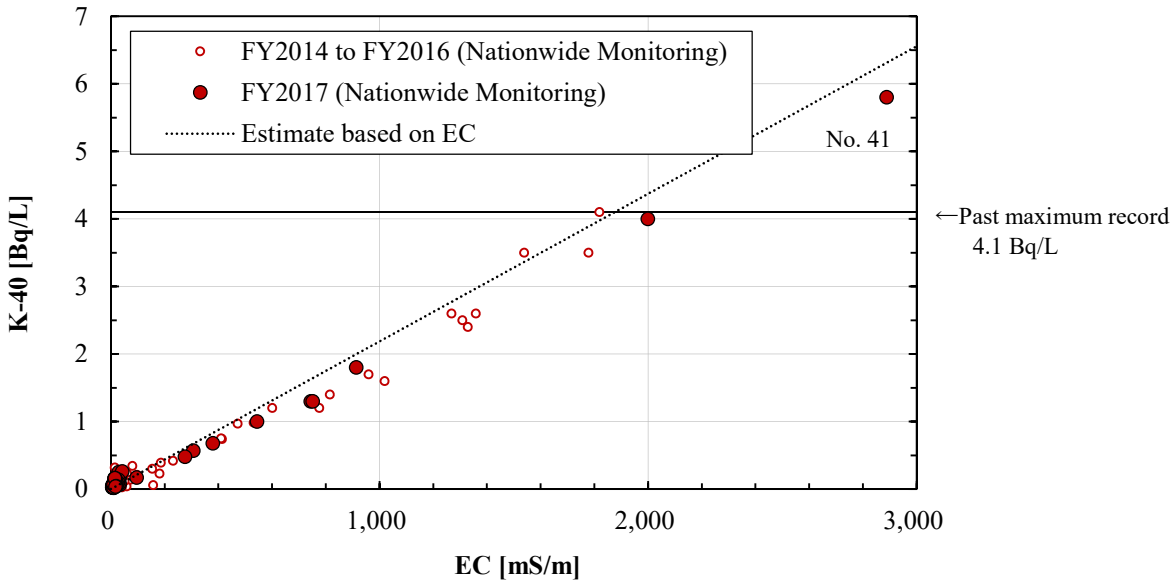


Figure 3.2-1 Correlation between K-40 concentrations and electrical conductivity (EC) in water samples from public water areas

On the other hand, according to the results of the Monitoring of Levels, conducted for 20 years from FY1998 to FY2017 (monitoring of 917 samples collected from 19 prefectures), the average concentration (average) of K-40 was approximately 8.9 Bq/L and the maximum concentration was 15 Bq/L (see Table 3.2-1).

Table 3.2-1 Results of the Monitoring of Levels, etc., concerning K-40 in seawater (*1)

Number of surveys	Detection times	Detection rate [%]	Average [Bq/L]	Maximum [Bq/L]
945	912	96.5	9.8	15

(*1) Results of the Monitoring of Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1998 to FY2017

EC of seawater is generally around 4,500 mS/m, and the estimated activity concentrations of K-40 with possible influence of seawater were obtained by using the following formula based on the measurement results of EC for the relevant river water.

$$\text{(Activity concentration of K-40 in river water)} = \text{(Average activity concentration of K-40 in seawater)} \times \frac{\text{(Measured EC in the river water)}}{\text{(Ordinary values of EC in seawater)}}$$

The estimated activity concentrations of K-40 in the river water are indicated with a dotted line (……) in Figure 3.2-1, and the estimated values agree very well with the measured activity concentrations of K-40. Therefore, the high activity levels of K-40 obtained in the latest measurements are considered to have been caused by the intrusion of seawater and within the past measurement trends.

Although the concentrations of K-40 in groundwater samples fell within the past measurement trends, the correlation between K-40 concentration and EC was found, as in the case of the public water areas (see Figure 3.2-2, scales of the vertical and horizontal axes differ from those for Figure 3.2-1). With regard to groundwater samples, no clear correlation with EC was found.

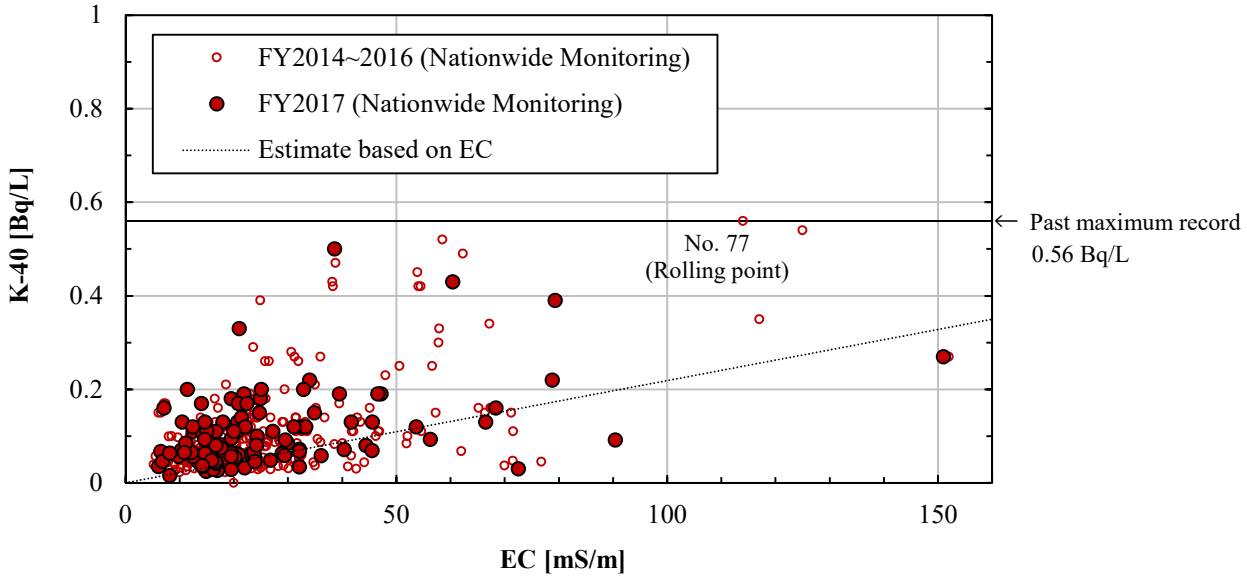
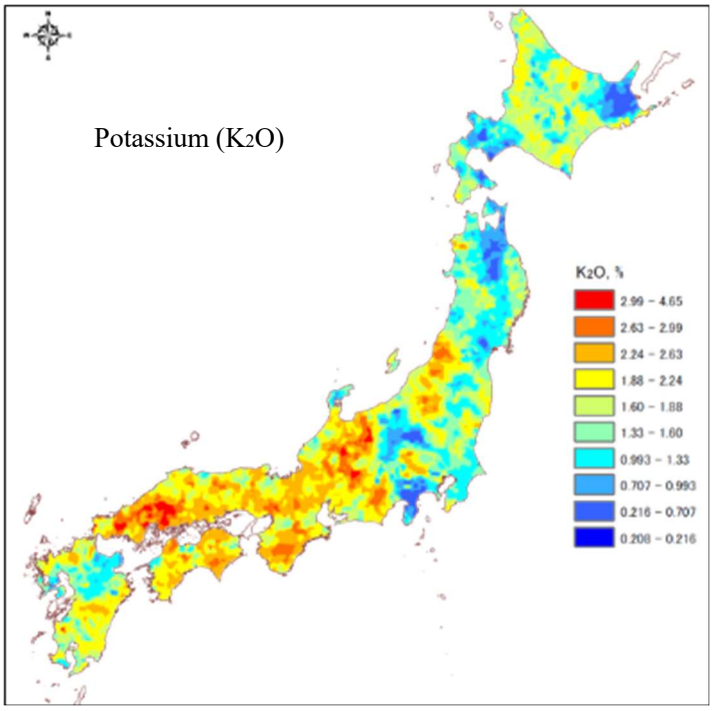


Figure 3.2-2 Correlation between the K-40 concentration and electrical conductivity (EC) in groundwater Sample



Reference: Website of the Geological Survey of Japan, AIST
https://gbank.gsj.jp/geochemmap/setumei/radiation/setumei-radiation.htm

Figure 3.2-3 Distribution of potassium (K_2O) in soil in Japan

2) Uranium and thorium series radionuclides in sediment samples

As explained in 3.1 above, uranium and thorium series radionuclides were detected at relatively high concentration levels in sediment samples from public water areas. The detection status is shown in Table 3.2-2.

Table 3.2-2 Detection of uranium and thorium series naturally occurring radionuclides

Radionuclides			Number of samples [A]	Number of detections [B]	Detection rate (B/A) [%]	Measured value [Bq/kg (dry)]	
						Range	Detection limit
γ-ray emitting radionuclides	Uranium series	Ra-226	110	23	20.9	ND - 60	16 - 83
		Pb-214	110	110	100	4.3 - 44	1.6 - 10
		Bi-214	110	110	100	3.5 - 38	1.8 - 9.1
	Thorium Series	Ac-228	110	109	99.1	ND - 100	2.6 - 9.7
		Pb-212	110	110	100	3.7 - 110	1.3 - 6.7
		Bi-212	110	59	53.6	ND - 110	12 - 40
		Tl-208	110	110	100	1.1 - 36	0.79 - 4.0

These naturally occurring radionuclides exist widely within the earth's crust and the past monitoring has confirmed high correlations among the series.

Figure 3.2-4 and Figure 3.2-5 show the correlation among uranium series radionuclides and among thorium series radionuclides detected at the monitoring for FY2017 (These are plotted out based on radionuclides with high detection rate (uranium series: Pb-214 and thorium series: Pb-212) with instances of non-detection excluded).

Figure 3.2-4 and Figure 3.2-5 reveal high correlations among uranium series or among thorium series radionuclides.

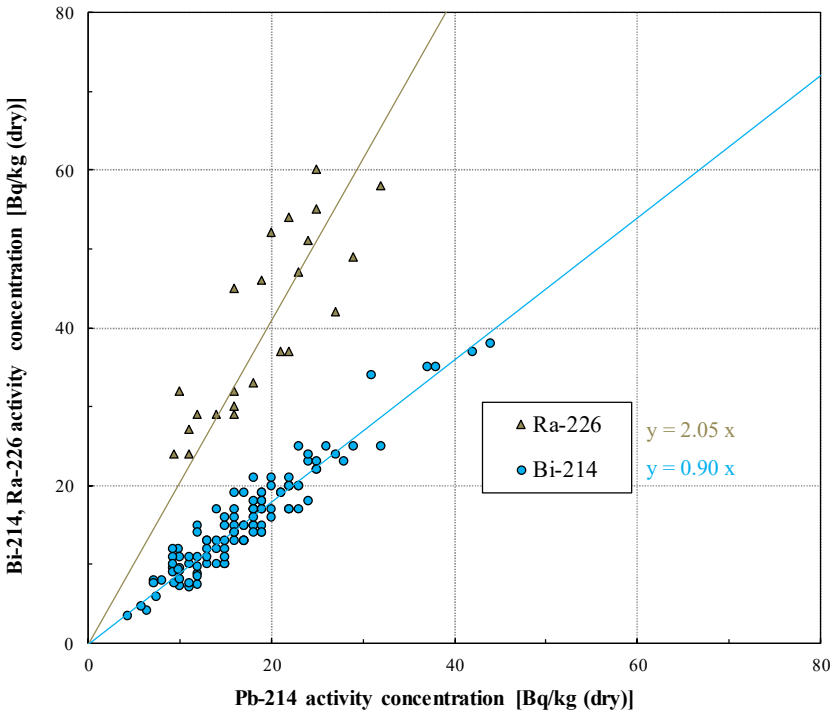
<Note>

The radionuclides of the two series are considered to be reflected in the geology of the locations at which they had been detected.

It is generally accepted that granite contains larger amounts of naturally occurring radionuclides than other kinds of rocks and that natural radiation doses correlate to some extent with uranium and thorium series radionuclides (both according to the Geological Society of Japan[3]).

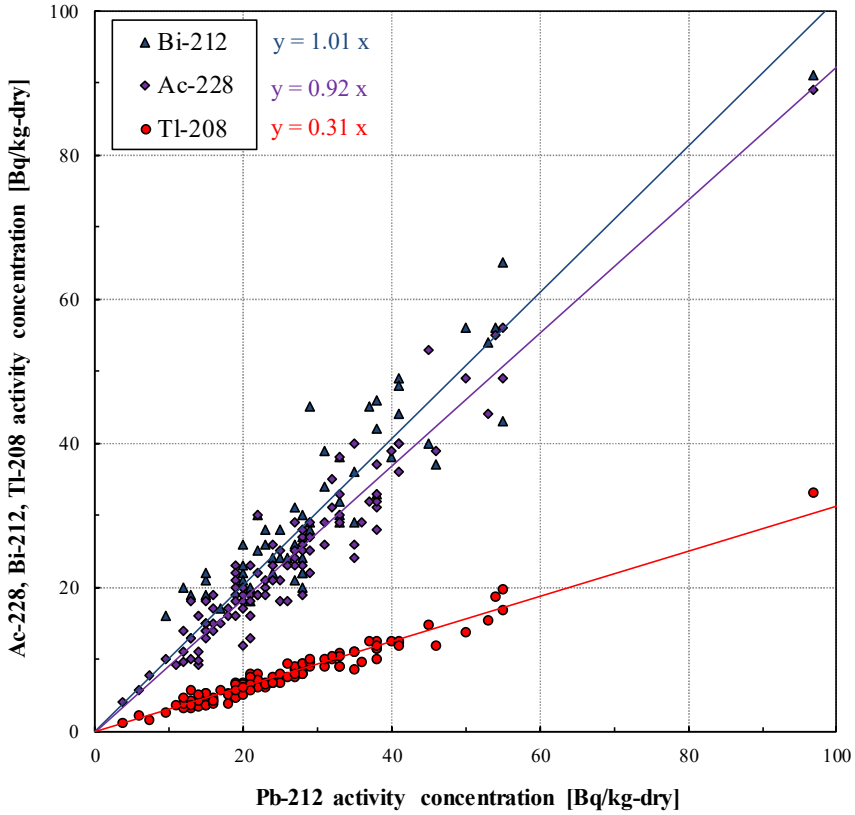
For reference, Figure 3.2-6 shows the distribution map of granite in Japan, while Figure 3.2-7 shows the distribution map of natural radiation doses in Japan.

[3] http://www.geosociety.jp/hazard/content0058.html



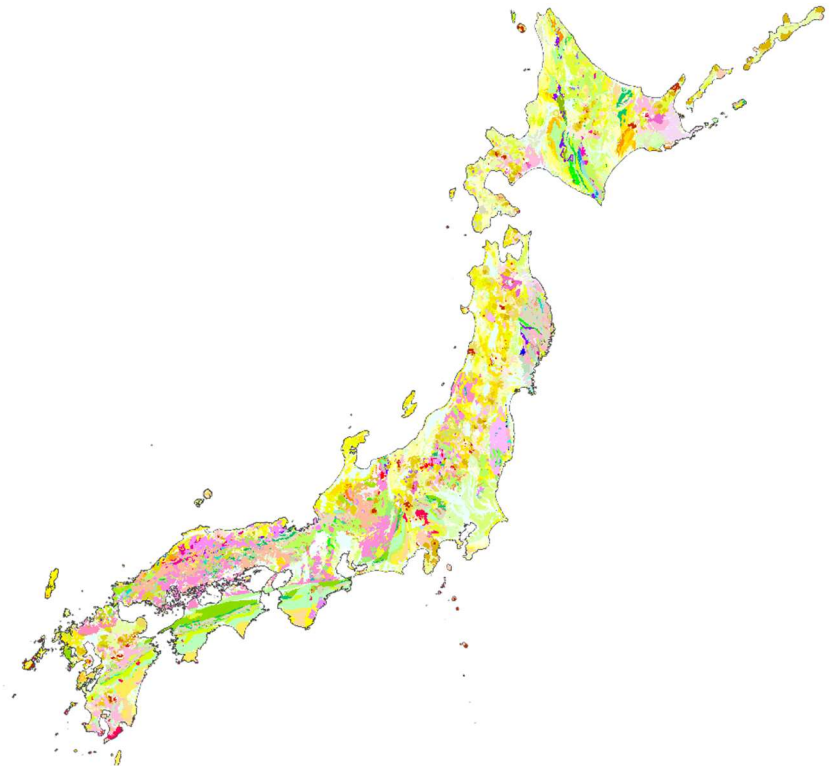
Correlation coefficient	Bi-214	Ra-226
Pb-214	0.95	0.83

Figure 3.2-4 Correlations among uranium series radionuclides



Correlation coefficient	Ac-228	Bi-212	Tl-208
Pb-212	0.97	0.95	0.98

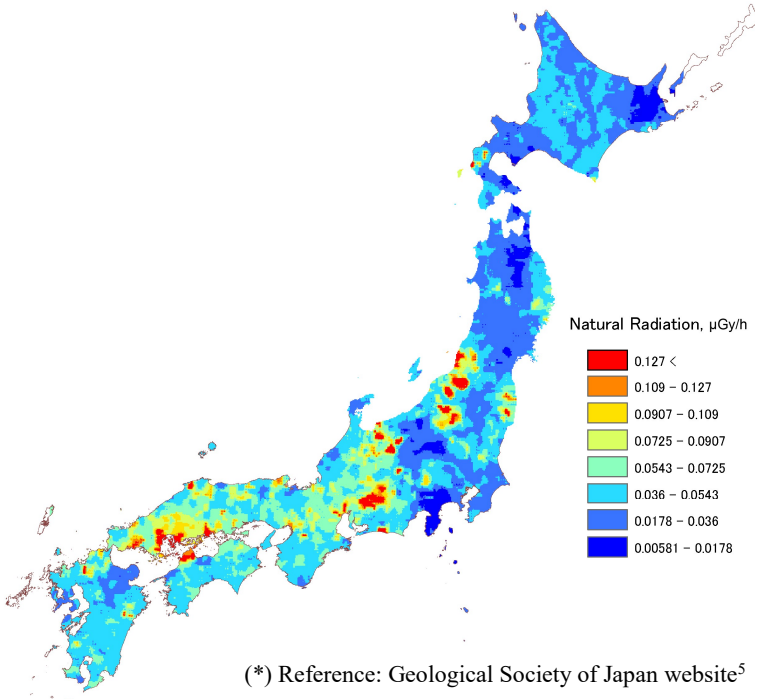
Figure 3.2-5 Correlations among thorium series radionuclides



(*) Reference: Seamless Digital Geological Map of Japan (1:200,000) ®; AIST website[4]

Figure 3.2-6 Distribution of granite in Japan

(parts highlighted in pink in the Figure are locations where granite exists)



(*) Reference: Geological Society of Japan website[5]

Figure 3.2-7 Natural radiation doses in Japan (Gy = Sv for γ-rays and β-rays)

4 https://gbank.gsj.jp/seamless/
5 http://www.geosociety.jp/hazard/content0058.html

(2) Detection of artificial radionuclides

1) Cs-134 and Cs-137 in water samples from public water areas

Radioactive cesium was detected in water samples from public water areas in Tohoku and Kanto blocks (20 locations in total; both Cs-134 and Cs-137 were detected at six locations; only Cs-137 was detected at 14 locations).

As for the six locations where both Cs-134 and Cs137 were detected (all in Tohoku and Kanto blocks), concentration ratio was tested as a reference. The results showed a good correlation between them and the calculated activity concentration ratio was approximately 7.6. Assuming that detected Cs-134 and Cs-137 are those discharged due to the Fukushima NPS Accident, this ratio should be approximately equal to the theoretical ratio (approx. 7.7) as of September 2017 after the discharge in March 2011 (see Figure 3.2-8). This suggests that Cs-134 and Cs-137 detected in the Tohoku and Kanto blocks were indeed derived from the Fukushima NPS Accident.

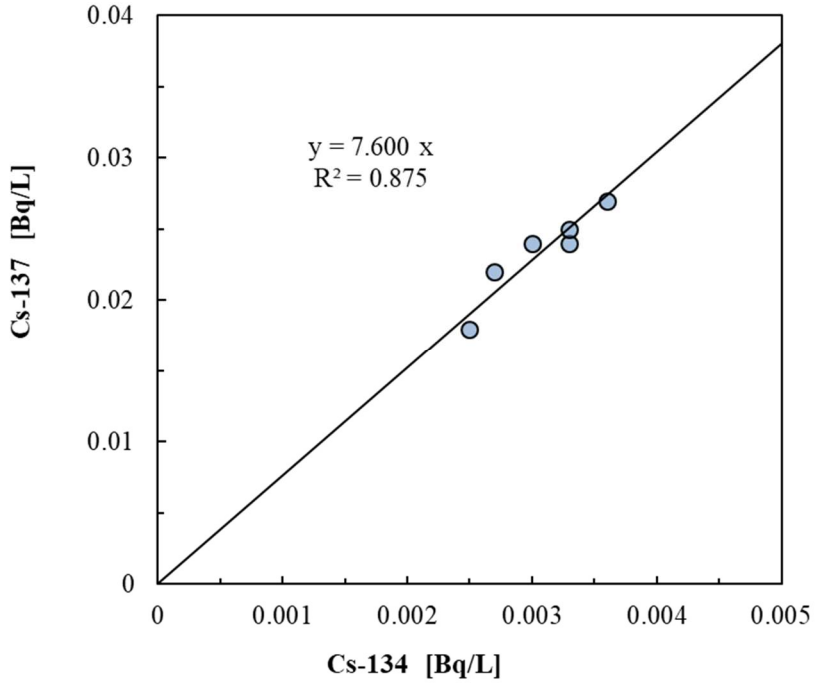


Figure 3.2-8 Concentration ration (Cs-137/Cs-134) [Water (public water areas)]

(Reference: Changes in concentration ratios (Cs-137/Cs-134) over time, accounting for half-life periods)

Radionuclide	Half-life (year)	2011/3	2013/3	2015/3	2017/3	2017/9
Cs-134	2.0648	1	0.51	0.26	0.13	0.11
Cs-137	30.1671	1	0.96	0.91	0.87	0.86
Cs137／Cs134		1	1.87	3.50	6.54	7.68

(*) The concentration ratio at the time of the latest monitoring (around September 2017) is estimated to be approximately 7.7 (highlighted in yellow in the table above).

2) Cs-134 and Cs-137 in sediment samples from public water areas

Radioactive cesium was detected in sediment samples from public water areas in Hokkaido, Tohoku, Kanto, Chubu, and Kinki blocks (43 locations in total; both Cs-134 and Cs-137 were detected at 18 locations (all in Tohoku and Kanto Blocks); only Cs-137 was detected at 25 locations).

For locations that have not been surveyed by Post-Earthquake Monitoring, radioactive cesium species were also detected. Therefore, to better clarify the concentration levels of the detected radioactive cesium species in such locations, the following comparisons were made:

(i) Among the above mentioned, for the same locations within the same prefectures where Post-Earthquake Monitoring is carried out, a comparison between data was carried out.

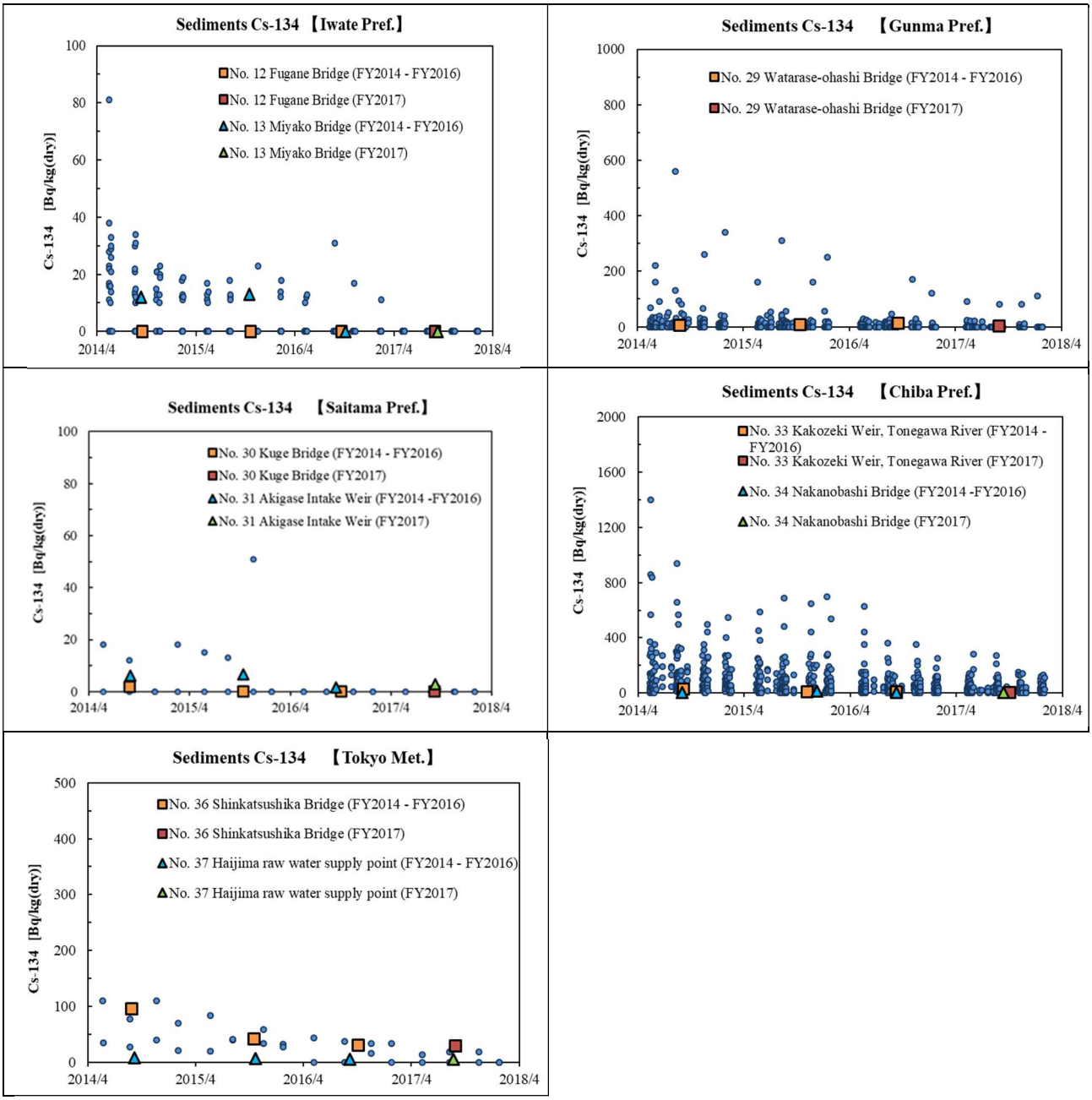
(ii) For locations that Post-Earthquake Monitoring is not conducted for the same locations within the same prefectures, collected data was compared to data from nearby locations obtained via Post-Earthquake Monitoring.

(iii) For locations where Post-Earthquake Monitoring is not conducted nearby, collected data was compared with data obtained through the Monitoring of Levels and other reports.

(i) Comparison with past Post-Earthquake Monitoring results within the same prefectures

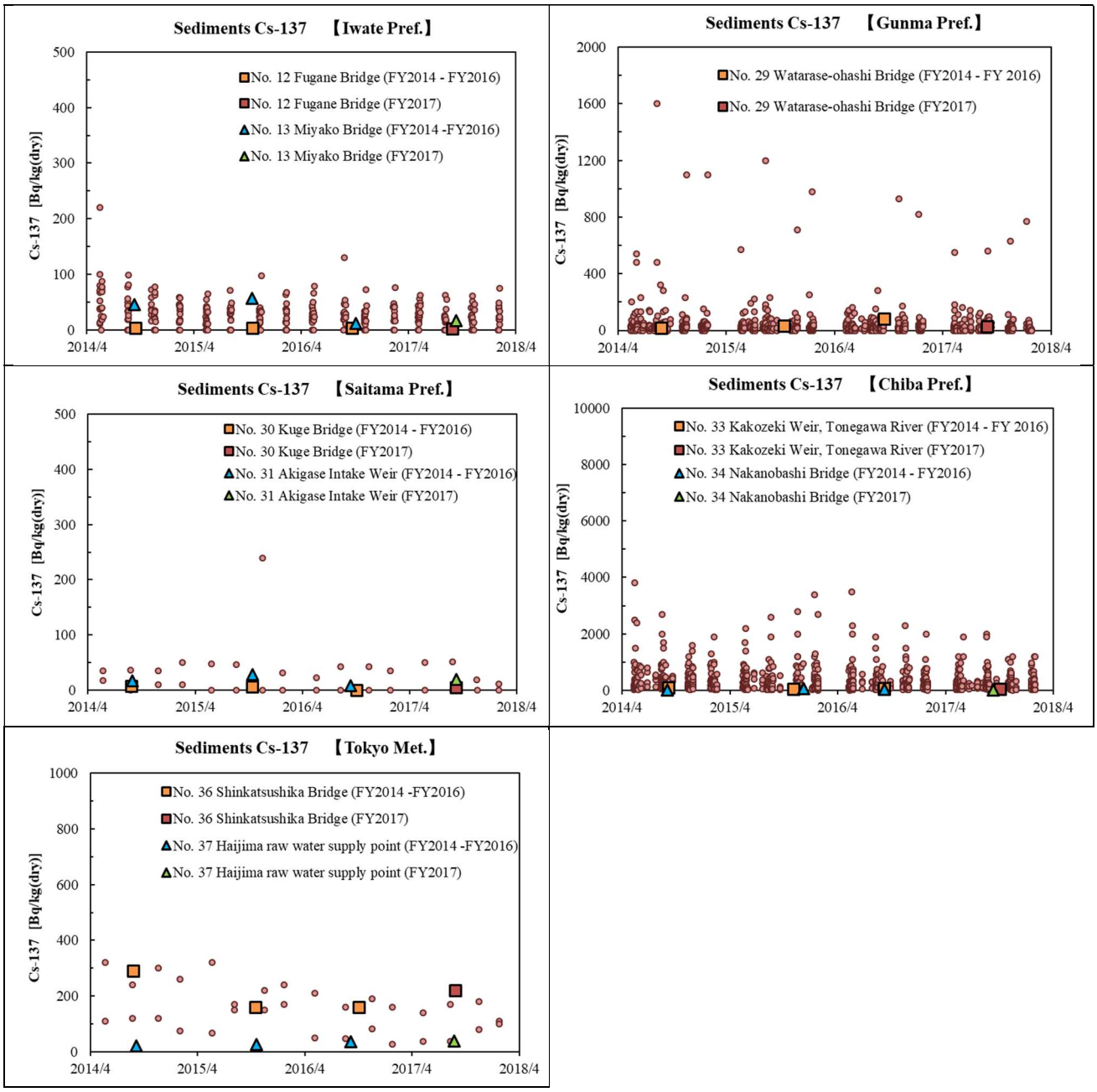
Regarding locations where Post-Earthquake Monitoring is conducted within the same prefectures (excluding locations where the Monitoring has been conducted at the same points), the measured values in the latest monitoring were compared with the past measurement records for the same locations (see Figure 3.2-9).

Measured values from the latest monitoring were found to be within the past measurement trends.



○ : Post-Earthquake Monitoring results

Figure 3.2-9 (1) (i) Comparison with past Post-Earthquake Monitoring results within the same prefectures [Cs-134]



○ : Post-Earthquake Monitoring results

Figure 3.2-9 (2) (i) Comparison with past Post-Earthquake Monitoring results within the same prefectures [Cs-137]

(ii) Comparison with past Post-Earthquake Monitoring results for nearby locations

Regarding Location No. 40 (Rinko Tsurumigawa Bridge, Tsurumi River, Yokohama City, Kanagawa Prefecture), it was considered reasonable to make a comparison with the past data for nearby locations although Post-Earthquake Monitoring had not been conducted in Kanagawa Prefecture. Therefore, a comparison was made with the past data for Location No. 38 (Ryogoku Bridge, Sumida River, Chuo City/Sumida City, Tokyo Metropolis) and Location No. 39 (Kasai Bridge, Arakawa River, Koto City/Edogawa City, Tokyo Metropolis), both of which are located at the mouths of the Sumida River and the Arakawa River to Tokyo Bay (see Figure 3.2-10). As a result, it was found that the measured values for Location No. 40 were within the past measurement trends

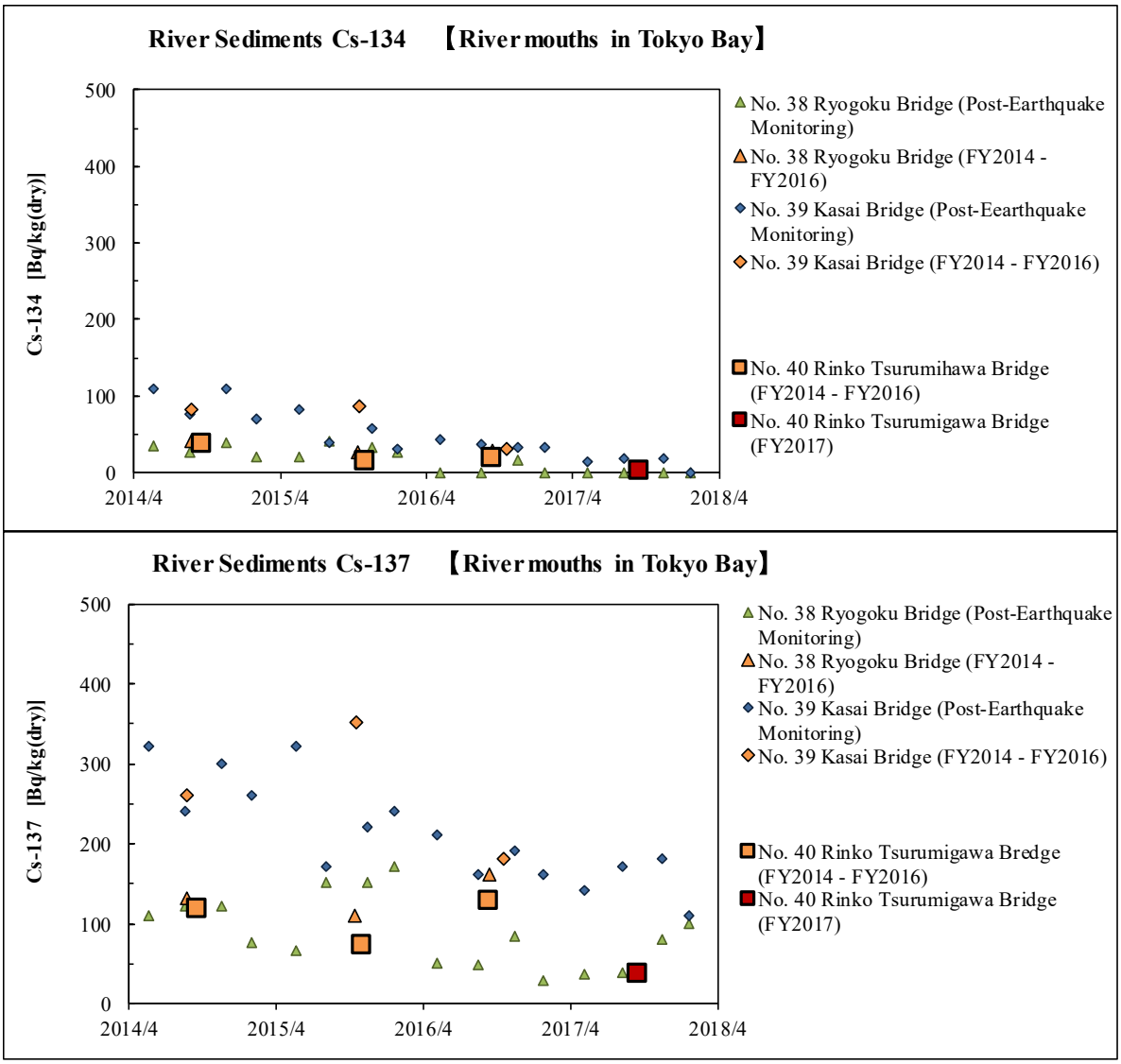
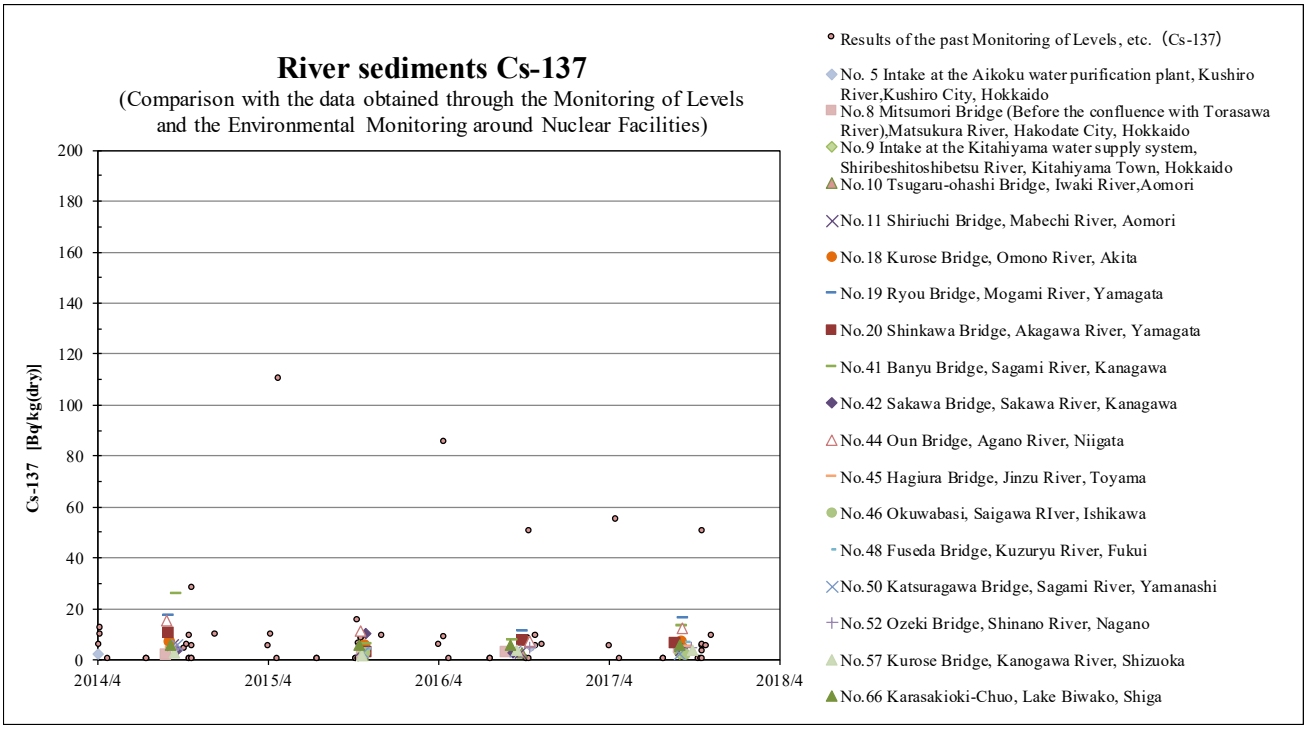


Figure 3.2-10 (ii) Comparison with past Post-Earthquake Monitoring results for nearby locations

(iii) Comparison with the data obtained from the Monitoring of Levels, etc.

For locations where Post-Earthquake Monitoring has not been conducted nearby, a comparison with the results of the Monitoring of Levels was performed in order to evaluate their concentration levels (see Figure 3.2-11).



At 18 locations, only Cs-137 was detected and the measured values all fell within the past measurement trends.

(*) Locations where the detected values were found are used in Figure.

Figure 3.2-11 (iii) Comparison with the data obtained through the Monitoring of Levels

As a reference, Concentration ratios were evaluated similar to the case of the water samples for 18 locations where (all in the Tohoku and Kanto blocks) both Cs-137 and Cs-134 were detected. As a result, a good correlation was confirmed. The calculated activity concentration ratio was approximately 7.7 (Cs-137/Cs-134). Assuming that detected Cs-134 and Cs-137 are those discharged due to the Fukushima NPS Accident, this ratio should be approximately equal to the theoretical ratio (approx. 7.7) as of September 2017 after the discharge in March 2011 (see Figure 3.2-12). This suggests that Cs-134 and Cs-137 detected in sediment samples collected in the Tohoku and Kanto blocks were indeed derived from the Fukushima NPS Accident.

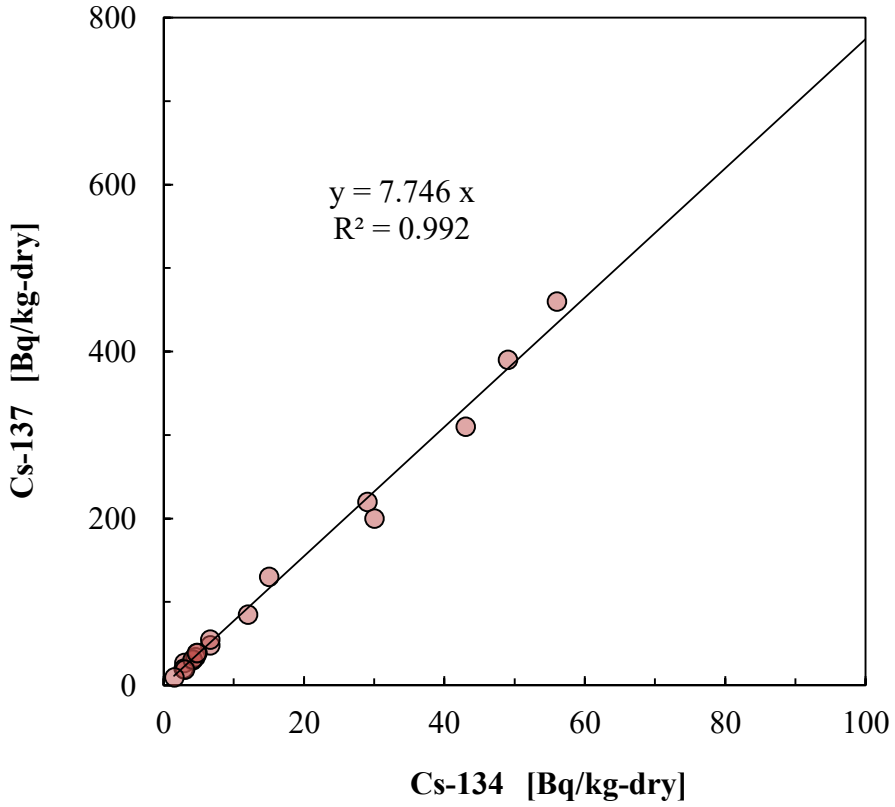


Figure 3.2-12 Concentration ratio (Cs-137/Cs-134) [Sediment (public water areas)]

(Reference: Changes in concentration ratios (Cs-137/Cs-134) over time, accounting for half-life periods)

Radionuclide	Half-life (year)	2011/3	2013/3	2015/3	2017/3	2017/9
Cs-134	2.0648	1	0.51	0.26	0.13	0.11
Cs-137	30.1671	1	0.96	0.91	0.87	0.86
Cs137／Cs134		1	1.87	3.50	6.54	7.68

(*) The concentration ratio at the time of the latest monitoring (around September 2017) is estimated to be approximately 7.7 (highlighted in yellow in the table above).

Given these facts, Cs-134 and Cs-137 detected in sediment samples from public water areas (excluding the case in which only Cs-137 was detected) were mostly considered to be derived from the Fukushima NPS Accident, but the detected values were all within the past measurement trends.

3) Cs-134 and Cs-137 in groundwater

Cs-134 and Cs-137 were not detected in groundwater samples collected at any of the 110 locations (detection limit: approx. 0.001 to 0.002 Bq/L).

3.3 Survey to check annual variation

At two locations[6] (both in rivers), namely, Location No. 28 (Toneozeki Weir, Tonegawa River, Chiyoda Town, Gunma Prefecture) and Location No. 83 (Kasumi Bridge, Takahashi River, Kurashiki City, Okayama Prefecture), surveys were conducted four times during the period from May 29, 2017 to Jan 16, 2018. These two locations had been previously surveyed four times each from FY2014 to FY2016, and the current analysis includes the results from those prior years.

Radionuclides were detected as shown in Table 3.3-1 and Table 3.3-2. Figure 3.3-1 and 3.3-2 show the changes in radionuclides detected in and after FY2014. Table 3.3-1 and Table 3.3-2 also show the coefficients of variation[7] (= sample standard deviation /average) indicating for the variations in detected values.

The coefficients of variation in water samples ranged from 16% to 26% for total β radioactivity and K-40, and stood at 37% for Cs-137, respectively.

The coefficients of variation in sediment samples ranged from 4.9% to 25% for total β radioactivity and naturally occurring radionuclides (Ac-228, Bi-212, Bi-214, Pb-212, Pb-214, Tl-208, and K-40), and from 52 to 59% for radioactive cesium[8].

The reason why the coefficients of variation of radioactive cesium in sediment samples are relatively higher than those in naturally occurring radionuclides is considered to have been associated with the fact that naturally occurring radionuclides are generally contained in minerals, while radioactive cesium is adsorbed in them. Continuous monitoring conducted four times each year at two locations is necessary to clarify fluctuations in the environment.

For reference, sediment grain size distribution and CS-137 concentration change for Location No. 28 are shown in Figure 3.3-3.

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6 It was decided that one location each would be selected in eastern and western Japan. To make the selection, all 110 locations were first divided into two areas for convenience (Locations No. 1 to No. 55 were classified as eastern Japan and Locations No. 56 to No. 110 were classified as western Japan) and the middle number in each area was selected.

7 In this report: coefficient of variation = sample standard deviation divided by the average; hereinafter the same shall apply.

8 Regarding fluctuations due to, among other things, the number of times of the survey conducted for radioactive materials in the environment FY2012 survey instances show 12 to 16% fluctuations in the amount of radioactive cesium contained in riverbed sediment (nine samples collected during the same period). At River Site No. 28 where radioactive cesium was detected, a drop in water transparency probably due to sludge disturbance caused by pleasure boats or winds in the vicinity was observed. Then, the water and bottom sampling points were slightly relocated due to that those points were made off-limits, with recognizable fluctuations in sediment grain-size distribution. Because the changes in sediment grain-size distribution might have affected the concentration of radioactive cesium, the changes in sediment grain-size distribution and Cs-137 concentration at River Site No. 28 are graphically summarized in Figure 3.3-3. This has revealed that sediment samples with high clay and silt contents tend to have higher Cs-137 concentrations. Accordingly, it was inferred that the fluctuation in the amount of radioactive cesium in samples from River Site No. 28 had occurred due to the changes in the grain-size distribution in the sediment samples. In addition, the monitoring during the flood season recognized an increase in clay and silt ratio as well as periodic changes which would have been declining over time towards the next year's flood season. The same shall apply to Cs-137 concentration.

Table 3.3-1 Detection trends for radioactive materials at the same location [River No. 28]

No.28	Water [Bq/L]				Sediment [Bq/kg (dry)]										
Radionuclides	Total β radioactivity	K-40	Cs-134	Cs-137	Total β radioactivity	K-40	Ac-228	Be-7	Bi-212	Bi-214	Pb-212	Pb-214	Tl-208	Cs-134	Cs-137
Aug 25, 2014	0.068	0.097	0.0015	0.0074	410	290	15	<24	<32	<12	18	11	5.8	19	60
Oct 27, 2014	0.12	0.11	0.0020	0.0072	350	330	9.8	<36	<17	11	16	11	4.3	13	44
Dec 15, 2014	0.12	0.078	<0.0010	0.0048	350	280	12	<38	<28	13	21	16	4.7	21	76
Jan 26, 2015	0.11	0.094	0.0018	0.0049	380	280	15	<25	<23	13	16	11	5.0	17	61
Oct 13, 2015	0.090	0.12	<0.0022	0.0029	720	290	23	<76	<46	14	28	14	6.5	51	230
Nov 24, 2015	0.099	0.11	<0.0014	0.0035	460	370	18	<68	<30	15	18	15	4.0	25	110
Dec 25, 2015	0.071	0.096	<0.0014	0.0043	490	320	22	<44	<21	16	16	17	5.4	26	110
Jan 22, 2016	0.10	0.11	<0.0014	0.0052	430	320	20	<28	<23	12	18	13	6.1	21	96
May 24, 2016	0.062	0.059	<0.0014	0.0030	410	280	15	<54	37	12	17	19	5.0	15	74
Sep 15, 2016	0.061	0.078	<0.0014	0.0061	460	300	21	59	29	13	21	17	7.6	26	140
Nov 14, 2016	0.13	0.095	<0.0017	0.0035	400	250	18	<66	<30	16	19	18	5.0	19	96
Jan 20, 2017	0.084	0.083	<0.0013	0.0025	450	260	12	<29	<30	18	19	13	4.7	11	72
May 29, 2017	0.064	0.039	<0.0011	0.0023	320	280	12	<22	<19	9.4	16	13	5.4	5.5	41
Aug 29, 2017	0.074	0.093	<0.0014	0.0026	420	280	19	80	<27	15	19	12	5.4	15	130
Nov 16, 2017	0.11	0.093	<0.0014	0.0036	470	330	18	<49	<22	16	18	14	6.1	9.4	85
Jan 16, 2018	0.066	0.12	<0.0015	0.0052	370	320	14	<25	<29	12	16	13	4.3	4.4	38
Coefficient of variation	26 %	23 %	-	37 %	21 %	10 %	24 %	-	-	17 %	16 %	18 %	17 %	59 %	52 %

(*) The coefficients of variation are shown only for radionuclides detected five times or more.

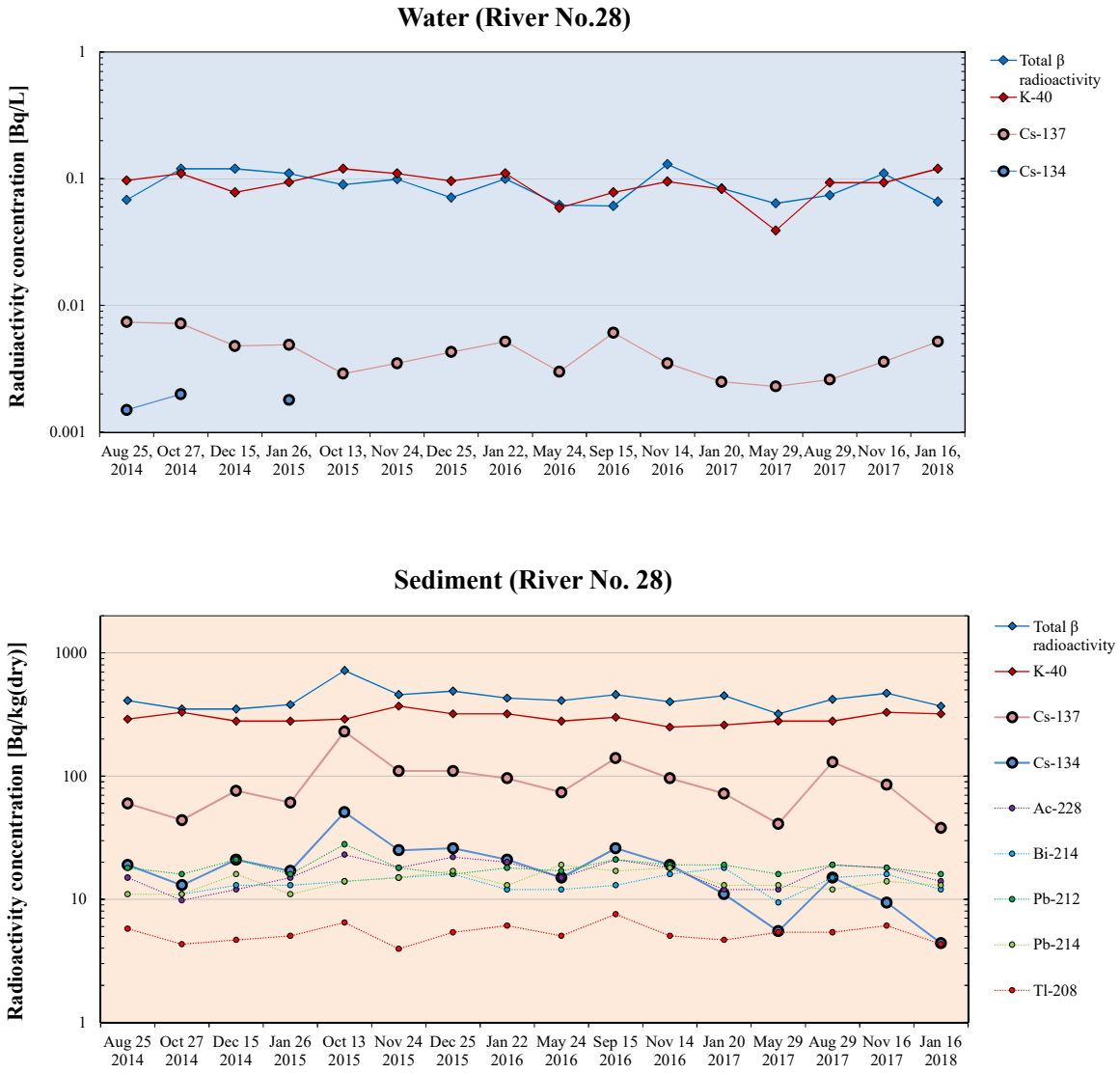


Figure 3.3-1 Changes in detection trends for radioactive materials at the same location [River No. 28]

Table 3.3-2 Detection trends for radioactive materials at the same location [River No. 83]

No.83	Water [Bq/L]				Sediment [Bq/kg (dry)]									
Radiocuclides	Total β radioactivity	K-40	Be-7	Pb-212	Total β radioactivity	K-40	Ac-228	Bi-212	Bi-214	Pb-212	Pb-214	Ra-226	Th-234	Tl-208
Aug 30, 2014	0.046	0.034	<0.024	<0.0019	1000	870	13	42	15	28	21	50	<30	9.0
Oct 28, 2014	0.064	0.045	0.012	<0.0021	980	830	25	34	21	28	23	<42	<41	7.2
Dec 15, 2014	0.037	<0.028	<0.0073	<0.0019	890	910	12	23	17	24	19	36	30	7.6
Jan 26, 2015	0.038	0.034	<0.0073	0.0013	920	770	19	28	17	27	15	<39	42	9.0
Oct 16, 2015	0.048	0.045	<0.024	<0.0019	1000	920	25	28	16	28	21	<37	<31	8.3
Nov 30, 2015	0.047	0.042	<0.018	<0.0015	1000	920	21	<33	19	26	20	<46	<47	8.6
Dec 22, 2015	0.041	0.038	<0.013	<0.0015	950	840	29	37	16	26	22	<44	<45	5.4
Jan 25, 2016	0.035	0.031	<0.0085	<0.0014	940	840	25	<34	19	27	18	<41	<47	6.8
May 30, 2016	0.039	0.050	<0.011	<0.0017	930	840	17	<35	19	24	24	<42	<160	8.3
Aug 23, 2016	0.045	0.043	<0.040	<0.0015	1100	900	18	34	14	21	16	<38	<140	7.6
Nov 15, 2016	0.030	0.046	<0.022	<0.0015	940	840	24	<28	18	22	17	<42	<150	7.6
Jan 27, 2017	0.041	0.036	<0.0078	<0.0014	990	840	15	<29	14	23	17	<39	<140	6.1
May 29, 2017	0.047	0.049	<0.0089	<0.0013	990	850	19	27	16	20	16	<38	<140	7.9
Aug 25, 2017	<0.024	0.042	<0.029	<0.0014	960	850	19	28	15	23	19	<31	<72	6.5
Nov 27, 2017	0.037	0.029	<0.016	<0.0013	950	790	28	30	19	28	24	<36	<80	9.7
Jan 16, 2018	0.044	0.041	<0.0093	<0.0016	960	860	27	<33	22	31	18	<44	<160	7.6
Coefficient of variation	18 %	16 %	-	-	4.9 %	5.0 %	25 %	18 %	14 %	12 %	15 %	-	-	15 %

(*) The coefficients of variation are shown only for radionuclides detected five times or more.

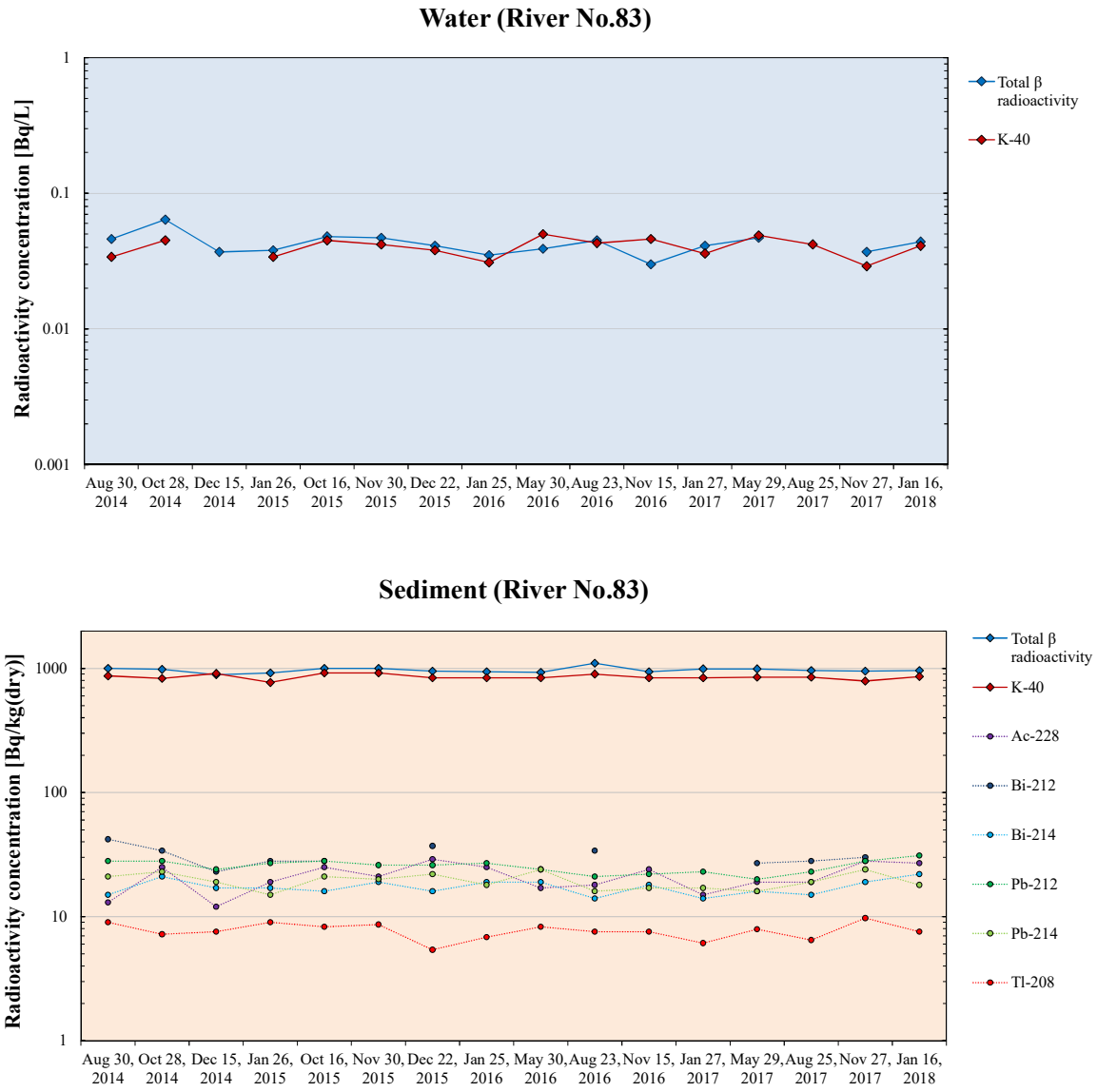


Figure 3.3-2 Changes in detection trends for radioactive materials at the same location [River No. 83]

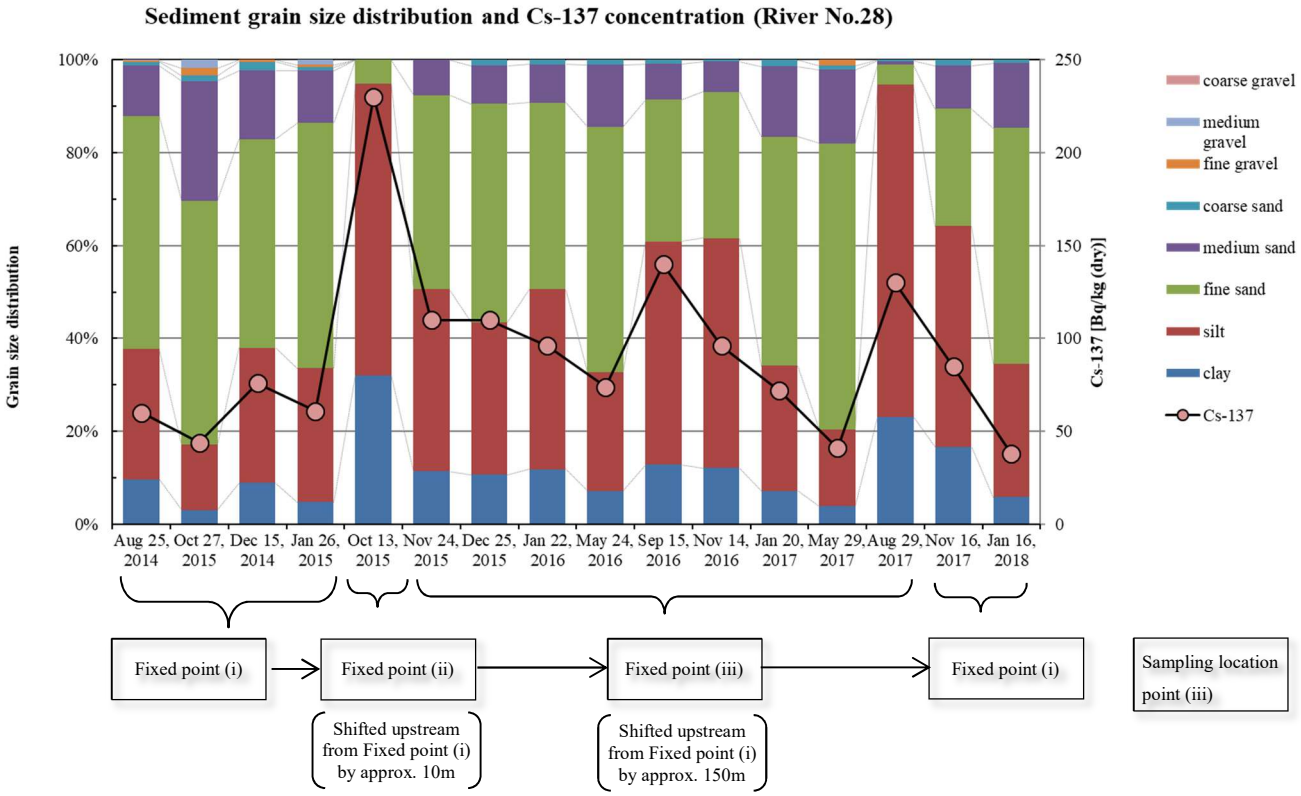


Figure 3.3-3 Changes in sediment grain size distribution and Cs-137 concentration [River No. 28]

Part 2: Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture (FY2017)

1 Objective and Details

1.1 Objective

This monitoring was conducted in response to the Fukushima NPS Accident for the purpose of clarifying the distribution of the accident-derived radioactive materials in the water environment.

1.2 Details

(1) Locations

The survey was conducted mainly in and around Fukushima prefecture at around 600 locations for public water areas and at around 400 locations for groundwater. Specific locations are shown in Figure 1.2-1.

(2) Targets

For public water areas (rivers, lakes, and coastal areas), water and sediment were surveyed. Additionally, radioactivity in soil in the surrounding environment (riverbeds, etc.) near the sampling locations was also surveyed as reference.

Radioactivity in groundwater was also measured.

(3) Frequencies and periods

The monitoring for public water areas was conducted two to 10 times a year (varying by location).

The monitoring for groundwater was conducted one to four times a year (varying by location).

(4) Conducted analyses

Primarily, analyses of Cs-134 and Cs-137 were conducted for the subject samples.

Additionally, analyses on Sr-89, Sr-90 and other artificial radionuclides were also conducted for some of the samples.

(5) Compilation and evaluation of results

The results of the measurement are compiled and released sequentially as preliminary reports on the Ministry of the Environment website.

This report is the compilation of the overall monitoring results, and the details of individual monitoring surveys are available on the following website.

http://www.env.go.jp/en/water/rmms/surveys.html

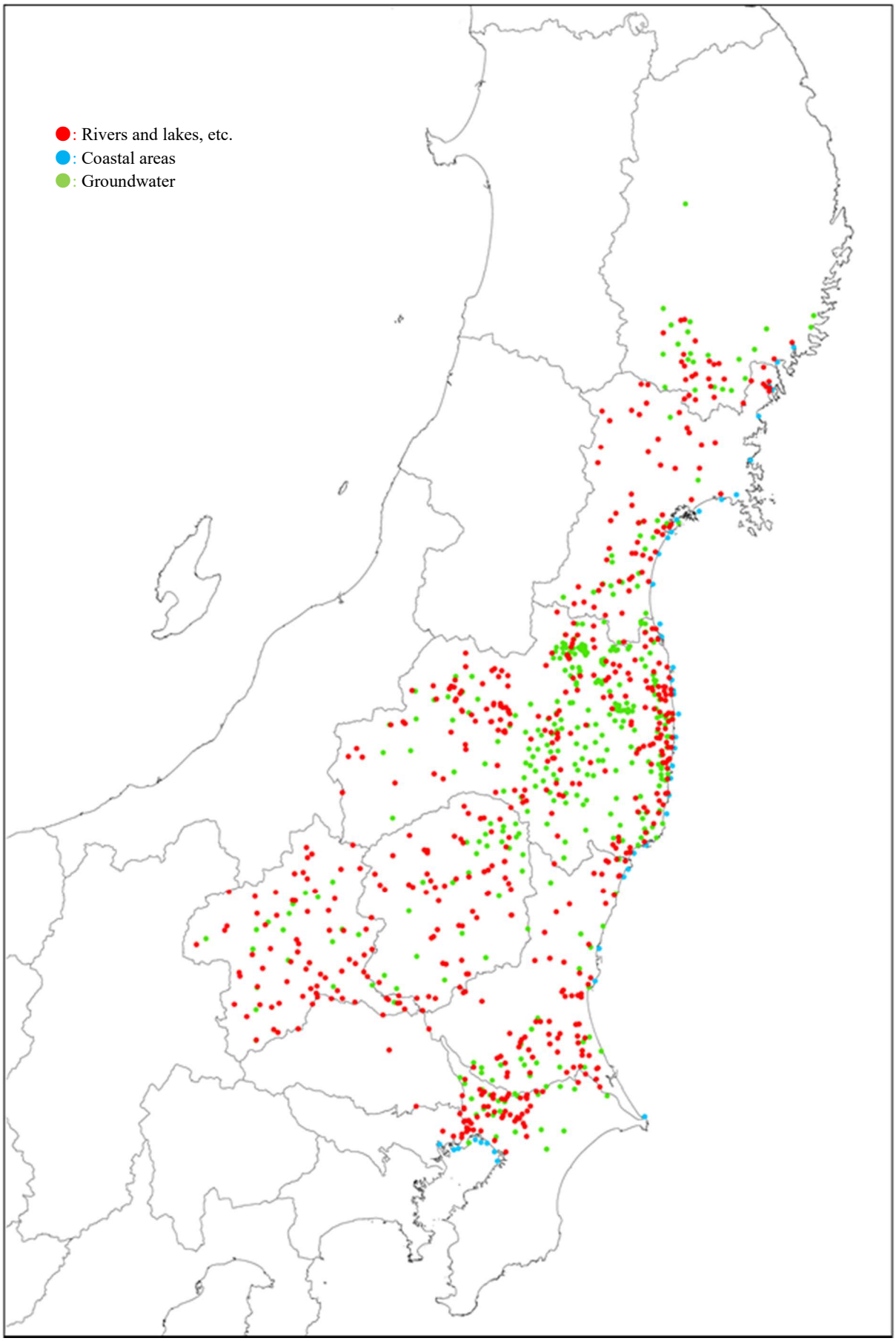


Figure 1.2-1 Map showing locations for the Post-Earthquake Monitoring in FY2017

2 Survey Methods and Analysis Methods

2.1 Survey methods

Samples were collected at predetermined locations (for public water areas and groundwater) and the following analyses of radioactive materials were conducted.

Samples were collected based on the following guidelines in principle, as outlined below.

- Water Quality Survey Method (Sep 30, 1971; Notice Kansuikan No. 30 issued by the Director General of the Water Quality Preservation Bureau, Ministry of the Environment)
- Sediment Survey Method (Aug 8, 2012; Notice Kansuitaisuihatsu No. 120725002 issued by the Director General of the Environmental Management Bureau, Ministry of the Environment)
- Groundwater Quality Survey Method (Sep 14, 1989; Notice Kansuikan No. 189 issued by the Director General of the Water Quality Preservation Bureau, Ministry of the Environment)
- Environmental Sample Collection Method (1983, MEXT's Radioactivity Measurement Method Series)
- Sample Pretreatment for Instrumental Analysis Using Germanium Semiconductor Detectors (1982, MEXT's Radioactivity Measurement Method Series)

2.2 Analysis methods

γ-ray spectrometry measurements using a germanium semiconductor detector were conducted for water samples and sediment samples collected from public water areas and for groundwater samples, primarily targeting Cs-134 and Cs-137.

Additionally, analyses on Sr-89, Sr-90 and other artificial radionuclides were also conducted for some of the collected samples. Detected values were indicated with two significant digits in the unit of "Bq/L" in the case of water samples from public water areas and groundwater samples, and in the unit of "Bq/kg" in the case of sediment samples from public water areas. The measurement results were corrected for attenuation, and results were reported as activity concentrations at the time sampling was completed.

Adopted analysis methods were basically in line with the MEXT's Radioactivity Measurement Method Series. Detection limits are as shown in the table below.

Table 2.2-1 Target values of detection limits for radionuclides in Post-Earthquake Monitoring

Radionuclide		Public water areas (water)	Public water areas (sediment)	Groundwater
Radioactive cesium (Cs-134 and Cs-137)		Approx. 1 Bq/L	Approx. 10 Bq/kg	Approx. 1 Bq/L
Radioactive strontium	Sr-90	Approx. 1 Bq/L	Approx. 1 Bq/kg (0.16 to 2.9 Bq/kg)	Approx. 1 Bq/L
	Sr-89	-	-	Approx. 1 Bq/L
Other artificial radionuclides (*1)		-	-	-

*1: Varies by type of radionuclides.

3 Outlines of the Results

The results of the Post-Earthquake Monitoring conducted in FY2017 are as outlined below.

3.1 Detection of radioactive cesium

Radioactive cesium (the total of Cs-134 and Cs-137) was detected as follows.

(1) Public water areas (water)

In FY2017, radioactive cesium activity concentrations were not all detectable in river water samples and coastal area water samples; from not detectable to 17Bq/L in lake water samples and had a detection rate of 1.7%.

Since FY2011, all prefectures have shown decreasing trends in the detection rate for river water samples (13,000 or more total samples) and lake water samples (8,100 or more total samples). In prefectures other than Fukushima Prefecture, radioactive cesium has not been detected since FY2013 (see Figure 4.1.1-1 and Figure 4.1.1-2). In addition, no survey has detected radioactive cesium in coastal area water samples (3,300 or more total samples) since FY2011.

(2) Groundwater

Radioactive cesium was not detected in any of the groundwater samples in FY2017.

Looking at the trend from FY2011 onward, radioactive cesium was detected in two samples from Fukushima Prefecture in FY2011 (detected values were 2 Bq/L and 1 Bq/L), and has not been detected in groundwater samples (6,500 or more total samples) since FY2012.

(3) Public water areas (sediment)

1) Overall trends

In FY2017, radioactive cesium activity concentrations ranged from not detectable to 6,720 Bq/kg and were detected with a detection rate of 85.0% in river sediment samples, from not detectable to 361,000 Bq/kg and with a detection rate of 99.3% in lake sediment samples, and from not detectable to 556 Bq/kg and at a detection rate of 79.0% in coastal area sediment samples.

Additionally, radioactive cesium activity concentrations were less than 200 Bq/kg in almost all areas in rivers and coastal areas (river: approx. 73%, coastal area: approx. 79%), and were less than 3,000 Bq/kg in almost all areas in lakes (approx. 77%) throughout the year.

2) Status by location

Because radioactive cesium was detected at many locations, its statuses in respective locations were compared. The status in respective locations were compared and relative concentration levels for detected values and their changes were statistically compiled as shown in "4.1-2 (3) Detection of radioactive materials by location."

Detected concentration levels were compiled as shown in Table 3.1-1.

Locations of Categories A and B (top 10 percentile of the whole) were observed in Hamadori District, Fukushima Prefecture as well as in Nakadori, Fukushima Prefecture and in Ibaraki, Gunma, Chiba (all these were for rivers), and Miyagi Prefectures (for coastal areas).

Table 3.1-1 Categorization of detected concentration levels for sediment samples from public water areas (FY2017) (rivers, lakes, and coastal areas)

<Rivers>

Category	Percentile (see Figure 4.1.2-7)	Range [coastal area sediments] [Bq/kg (dry)]	Number of locations												
			Iwate	Miyagi	Fukushima			Ibaraki	Tochigi	Gunma	Chiba	Saitama	Tokyo	Total	
					Hamadori	Nakadori	Aizu							Number of location	Percentage
A	Upper 5 percentile	784 or more	0	0	12	0	0	1	0	0	6	0	0	19	4.8
B	Upper 5 to 10 percentile	367 – 784	0	0	6	3	0	3	0	1	7	0	0	20	5.1
C	Upper 10 to 25 percentile	135 – 367	0	9	12	10	1	10	1	0	17	0	1	61	15.4
D	Upper 25 to 50 percentile	45 – 135	3	15	8	14	5	26	6	8	12	0	1	98	24.7
E	Lower 50 percentile	45 or less	19	19	15	17	20	13	49	39	5	2	0	198	50.0
Total			22	43	53	44	26	53	56	48	47	2	2	396	100.0

<Lakes>

Category	Percentile (see Figure 4.1.2-7)	Range [Lake sediments] [Bq/kg (dry)]	Number of locations									
			Miyagi	Fukushima			Ibaraki	Tochigi	Gunma	Chiba	Total	
				Hamadori	Nakadori	Aizu					Number of locations	Percentage
A	Upper 5 percentile	19,367 or more	0	9	0	0	0	0	0	0	9	5.5
B	Upper 5 to 10 percentile	10,264 ～ 19,367	0	7	0	0	0	0	0	0	7	4.3
C	Upper 10 to 25 percentile	1,842 ～ 10,264	1	11	4	6	1	0	1	1	25	15.2
D	Upper 25 to 50 percentile	511 ～ 1,842	3	10	5	4	4	2	12	1	41	25.0
E	Lower 50 percentile	511 or less	17	4	3	21	14	6	11	6	82	50.0
Total			21	41	12	31	19	8	24	8	164	100.0

<Coastal areas>

Category	Percentile (see Figure 4.1.2-7)	Range [coastal area sediments] [Bq/kg (dry)]	Number of locations							
			Iwate	Miyagi	Fukushima	Ibaraki	Chiba	Tokyo	Total	
									Number of location	Percentage
A	Upper 5 percentile	375 or more	0	1	1	0	0	0	2	4.8
B	Upper 5 to 10 percentile	261 ～ 375	0	1	1	0	0	0	2	4.8
C	Upper 10 to 25 percentile	132 ～ 261	0	2	2	0	0	2	6	14.3
D	Upper 25 to 50 percentile	30 ～ 132	0	3	7	0	0	1	11	26.2
E	Lower 50 percentile	30 or less	2	5	4	5	5	0	21	50.0
Total			2	12	15	5	5	3	42	100.0

Changes in detected concentration levels were compiled as shown in Figure 3.1-1, which shows Table 4.1.2-48 (described later) graphically.

At most monitoring locations for rivers, a decreasing trend was observed. For lakes, a decreasing or unchanged trend was generally observed with some locations showing fluctuations. For coastal areas, a decreasing trend was generally observed with some locations showing fluctuations.

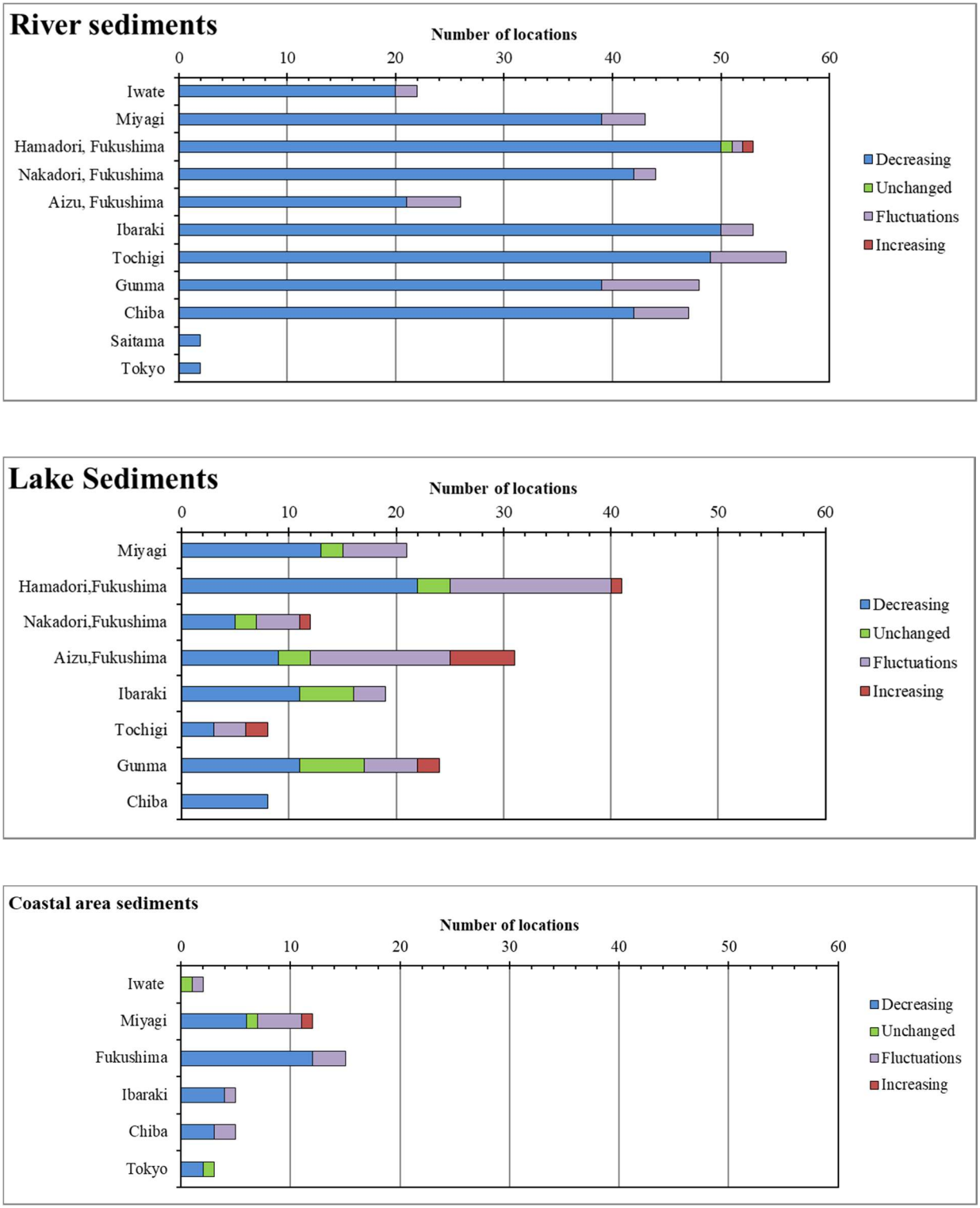


Figure 3.1-1 Changes in detected concentration levels of radioactive materials in sediment samples from public water areas (rivers, lakes, and coastal areas)

3.2 Detection of radionuclides other than radioactive cesium

(1) Sr-89 and Sr-90

Sr-90 was surveyed from FY2011 to FY2017 for sediment samples (approximately 770 samples in total) from public water areas (rivers, lakes, and coastal areas) and for groundwater samples (approximately 340 samples in total) (see Figure 4.2-1). Additionally, from FY2016 to FY2017, water samples (45 samples in FY2016 and three samples in FY2017) were also surveyed at those locations where relatively high concentrations were detected in sediment (1.0 Bq/kg or more in FY2016 and 10 Bq/kg or more in FY2017).

The results of the FY2017 survey were as follows: for public water area sediment samples, Sr-90 concentrations ranged from not detectable to 0.76 Bq/kg and had a detection rate of 33.3% in river sediment; from not detectable to 22 Bq/kg with a detection rate of 94.3% in lakes, and not detectable in coastal areas. As for water samples, Sr-90 was not detected in any public water areas or ground water locations (detection limit: 1 Bq/L for water and 1Bq/kg for sediment).

Sr-89 was not detectable in any of the monitoring surveys conducted for sediment samples from public water areas (a total of 22 samples collected from rivers and lakes in FY2011) or for groundwater samples (a total of approx. 340 samples surveyed from FY2011 to FY2017) (detection limit: 1 Bq/L for water and approximate 2 Bq/kg for sediment).

(2) Other artificial radionuclides

None have been detected since FY 2013.

4 Results

4.1 Radioactive cesium

4.1 -1 Water

(1) Public water areas

1) Rivers

Detection of radioactive cesium in river water samples is as shown in Table 4.1.1-1 and Figure 4.1.1-1.

According to the results, all prefectures have shown decreasing trends in the detection rate since FY2011. In FY2017, radioactive cesium was not detected in any locations.

Detected values (the total of Cs-134 and Cs-137) have also shown decreasing trends since FY2011 (detection limit: 1 Bq/L for both Cs-134 and Cs-137 and the same applies to lakes, coastal areas and ground water).

2) Lakes

Detection of radioactive cesium in lake water samples is as shown in Table 4.1.1-2 and Figure 4.1.1-2.

According to the results all prefectures have shown decreasing trends in the detection rate since FY2012. Radioactive cesium has not been detected in any locations other than Hamadori District, Fukushima Prefecture since FY2013.

Detected values (the total of Cs-134 and Cs-137) have also shown decreasing trends since FY2012. The measured values in FY2017 ranged from not detectable to 17 Bq/L.

3) Coastal areas

Detection of radioactive cesium in coastal area water samples is as shown in Table 4.1.1-3.

According to the results, including the past years, radioactive cesium has not been detected in any locations.

(2) Groundwater

Detection of radioactive cesium in groundwater samples is as shown in Table 4.1.1-4.

According to the results, radioactive cesium has not been detected in any locations since FY2012 including FY2017.

<Reference>

・Specification and Standards for Food, Food Additives, etc. in Accordance with the Food Sanitation Act (Drinking Water) (Ministry of Health, Labor and Welfare Public Notice No.130, Mar 15, 2012)

Radioactive cesium (the total of Cs-134 and Cs-137): 10 Bq/kg

・Target Values for Radioactive Materials in Tap Water (Management Target for Water Supply Facilities) (March 5, 2012; 0305 Notice No.1 from the Director of the Water Supply Division, Health Service Bureau, Ministry of Health, Labor and Welfare)

Radioactive cesium (the total of Cs-134 and Cs-137): 10 Bq/kg

Table 4.1.1-.1 Detection of radioactive cesium in river water samples

Prefecture		FY2017				FY2011-2017			
		Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)
Iwate		79	0	0.0	ND	481	0	0.0	ND
Yamagata		0	0	-	-	10	0	0.0	ND
Miyagi		195	0	0.0	ND	1294	3	0.2	ND - 6.3
Fukushima		812	0	0.0	ND	5,317	59	1.1	ND - 20
	Hamadori	326	0	0.0	ND	2,167	47	2.2	ND - 20
	Nakadori	324	0	0.0	ND	2,149	12	0.6	ND - 8.0
	Aizu	162	0	0.0	ND	1001	0	0.0	ND
Ibaraki		212	0	0.0	ND	1402	0	0.0	ND
Tochigi		278	0	0.0	ND	1,822	1	0.1	ND - 1.0
Gunma		214	0	0.0	ND	1371	0	0.0	ND
Saitama		8	0	0.0	ND	50	0	0.0	ND
Chiba		200	0	0.0	ND	1284	2	0.2	ND - 1.3
Tokyo		8	0	0.0	ND	55	0	0.0	ND
Total		2,006	0	0.0	ND	13,086	65	0.5	ND - 20

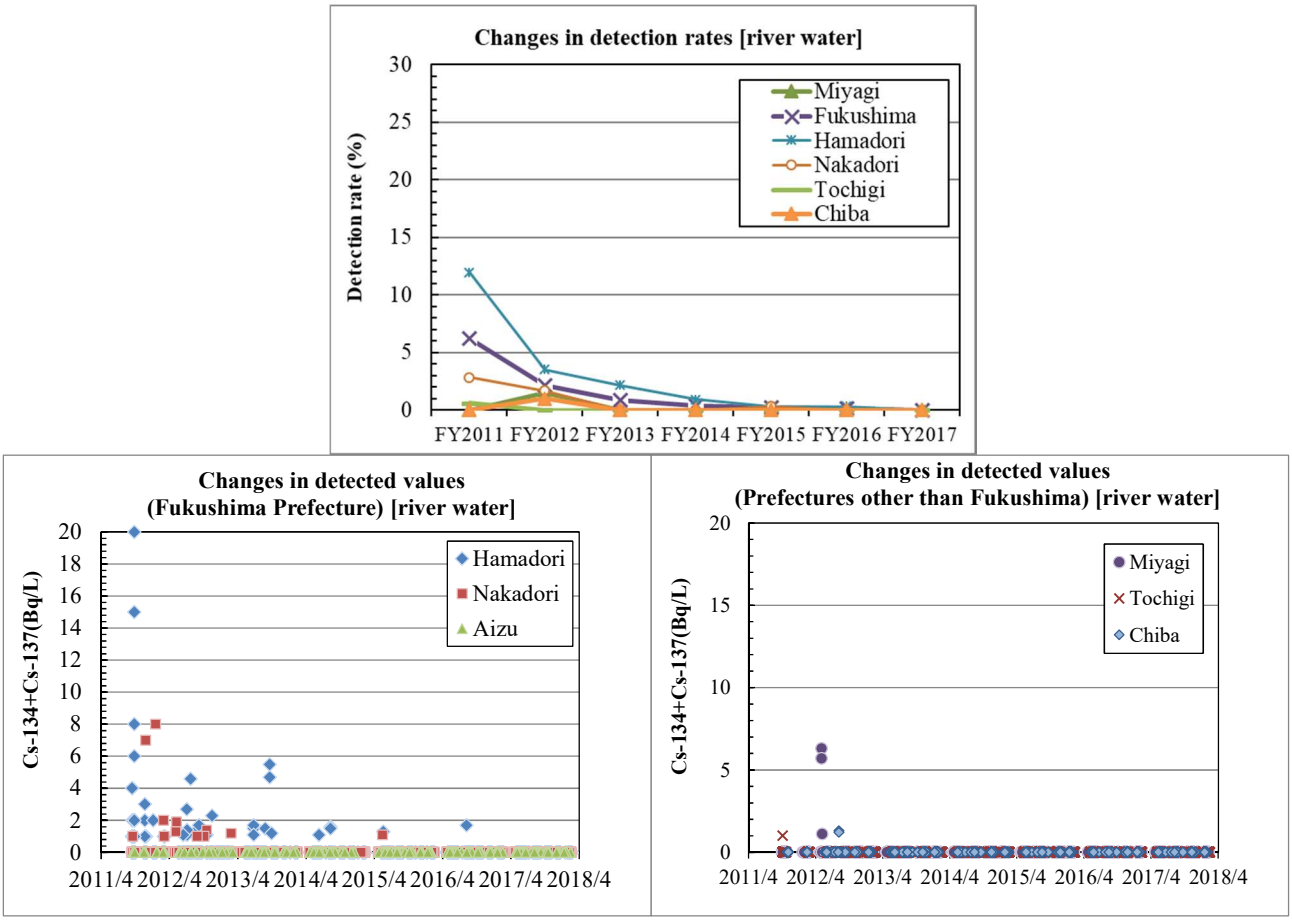
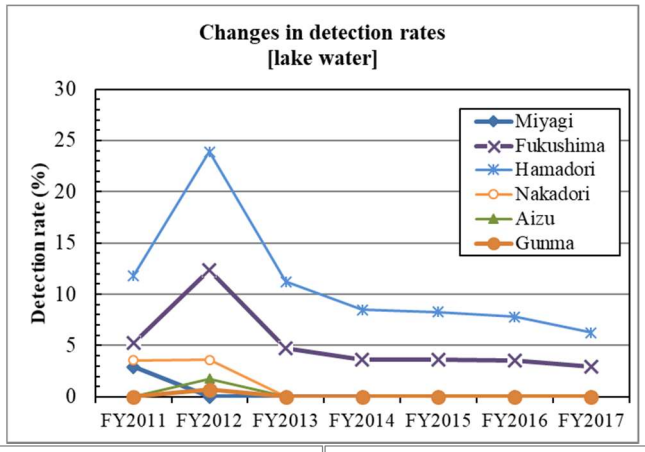


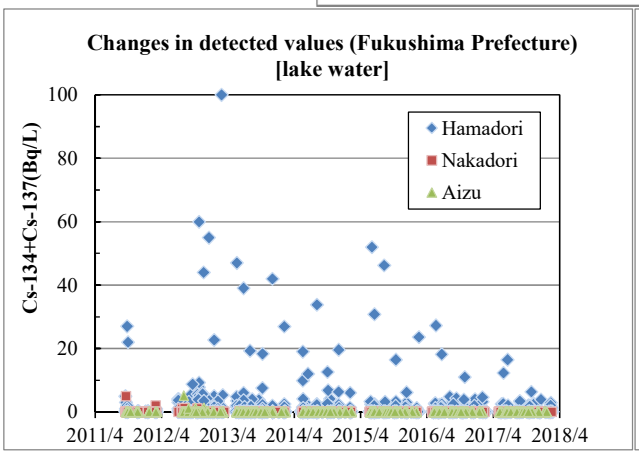
Figure 4.1-1 Detection rates of radioactive cesium in river water samples (top) and changes in detected values (lower left and lower right)

Table 4.1.1-2 Detection of radioactive cesium in lake water samples

Prefecture		FY2017				FY2011-2017			
		Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)
Yamagata		0	0	-	-	4	0	0.0	ND
Miyagi		111	0	0.0	ND	702	1	0.1	ND - 3.0
Fukushima		757	22	2.9	ND - 17	4,713	227	4.8	ND - 100
	Hamadori	352	22	6.3	ND - 17	2,070	218	10.5	ND - 100
	Nakadori	99	0	0.0	ND	680	5	0.7	ND - 5.0
	Aizu	306	0	0.0	ND	1,963	4	0.2	ND - 5.1
Ibaraki		144	0	0.0	ND	885	0	0.0	ND
Tochigi		60	0	0.0	ND	392	0	0.0	ND
Gunma		185	0	0.0	ND	1137	1	0.1	ND - 1.0
Chiba		39	0	0.0	ND	298	0	0.0	ND
Total		1,296	22	1.7	ND - 17	8,131	229	2.8	ND - 100

Figure 4.1.1-2 Detection rates of radioactive cesium in lake water samples (top) and changes in detected values (lower left and lower right)





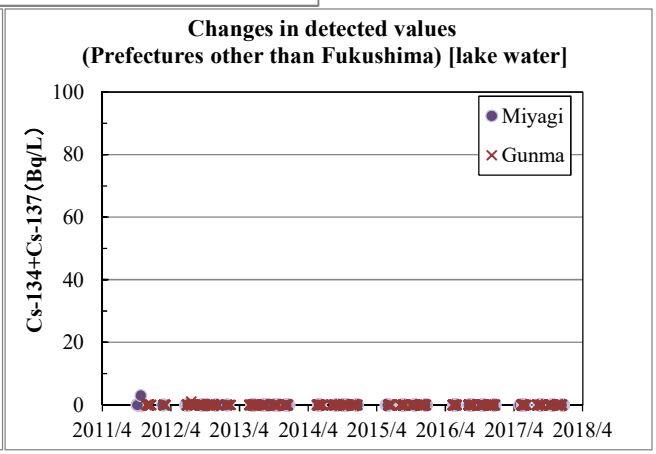


Table 4.1.1-3 Detection of radioactive cesium in coastal area water samples

Prefecture	FY2017				FY2011-2017			
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)	Number of samples	Detection times	Detection rate (B/A) (%)	Range of measured values (Bq/L)
Iwate	8	0	0.0	ND	53	0	0.0	ND
Miyagi	104	0	0.0	ND	708	0	0.0	ND
Fukushima	300	0	0.0	ND	1,805	0	0.0	ND
Ibaraki	40	0	0.0	ND	307	0	0.0	ND
Chiba	46	0	0.0	ND	292	0	0.0	ND
Tokyo	36	0	0.0	ND	218	0	0.0	ND
Total	534	0	0.0	ND	3,383	0	0.0	ND

Table 4.1.1-4 Detection of radioactive cesium in groundwater samples

Prefecture	FY2017				FY2011-2017			
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L)
Iwate	22	0	0.0	ND	218	0	0.0	ND
Miyagi	22	0	0.0	ND	265	0	0.0	ND
Yamagata	0	0	-	-	79	0	0.0	ND
Fukushima	771	0	0.0	ND	4,939	2	0.0	ND - 2.0
Ibaraki	27	0	0.0	ND	305	0	0.0	ND
Tochigi	27	0	0.0	ND	292	0	0.0	ND
Gunma	21	0	0.0	ND	206	0	0.0	ND
Chiba	23	0	0.0	ND	238	0	0.0	ND
Total	913	0	0.0	ND	6,542	2	0.0	ND - 2.0

(*) Detected in FY2011. Both Cs-134 and Cs-137 were detected at one site, and only Cs-137 was detected at another site, at a level of 1 Bq/L (detection limit: 1 Bq/L) (see the main text).

4.1-2 Sediment

Detection of radioactive cesium in sediment samples from public water areas (rivers, lakes, and coastal areas) is as outlined below.

(1) Detection status

1) Rivers

Radioactive cesium detected in river sediment samples is as shown in Table 4.1.2-1 and Figure 4.1.2-1.

According to the results, including the past years, the detection rate has ranged between 50 and 100% and has been slightly decreasing over time in many prefectures.

On the other hand, as for detected values (the total of Cs-134 and Cs-137) shown in Figure 4.1.2-1, the number of locations with high concentration levels has decreased while number of locations with low concentration levels has increased. When the detected values for FY2017 were observed by the concentration category, radioactive cesium was not detectable at 26 locations (approx. 7%), less than 100 Bq/kg at 194 locations (approx. 49%) and less than 100 to 200 Bq/kg at 67 locations (approx. 17%). The locations where their detected values were less than 200 Bq/kg accounted for approximately 73% of the total surveyed locations.

2) Lakes

Detection of radioactive cesium in lake sediment samples is as shown in Table 4.1.2-2 and Figure 4.1.2-2.

According to the results, including the past years, the detection rate has ranged between 83 and 100%. In FY2017, detection rates of 90% or more were observed in all prefectures.

Detected values (the total of Cs-134 and Cs-137) have increased at locations with lower concentrations, however, this trend is relatively moderate compared to those in rivers or coastal areas. The areas with higher concentrations still exist in many locations as in Hamadori District, Fukushima Prefecture where radioactive cesium was still detected at concentrations of 100,000 Bq/kg or more in FY2017. When the detected values for FY2017 are observed by the concentration category, radioactive cesium was not detectable at one location, less than 100 Bq/kg at 13 locations (approx. 8%), less than 100 to 1,000 Bq/kg at 78 locations (approx. 48%), and less than 1,000 to 3,000 Bq/kg at 35 locations (approx. 21%). The locations where their detected values were less than 3,000 Bq/kg accounted for approximately 77% of the total surveyed locations.

3) Coastal areas

Detection of radioactive cesium in coastal area sediment samples is as shown in Table 4.1.2-3 and Figure 4.1.2-3.

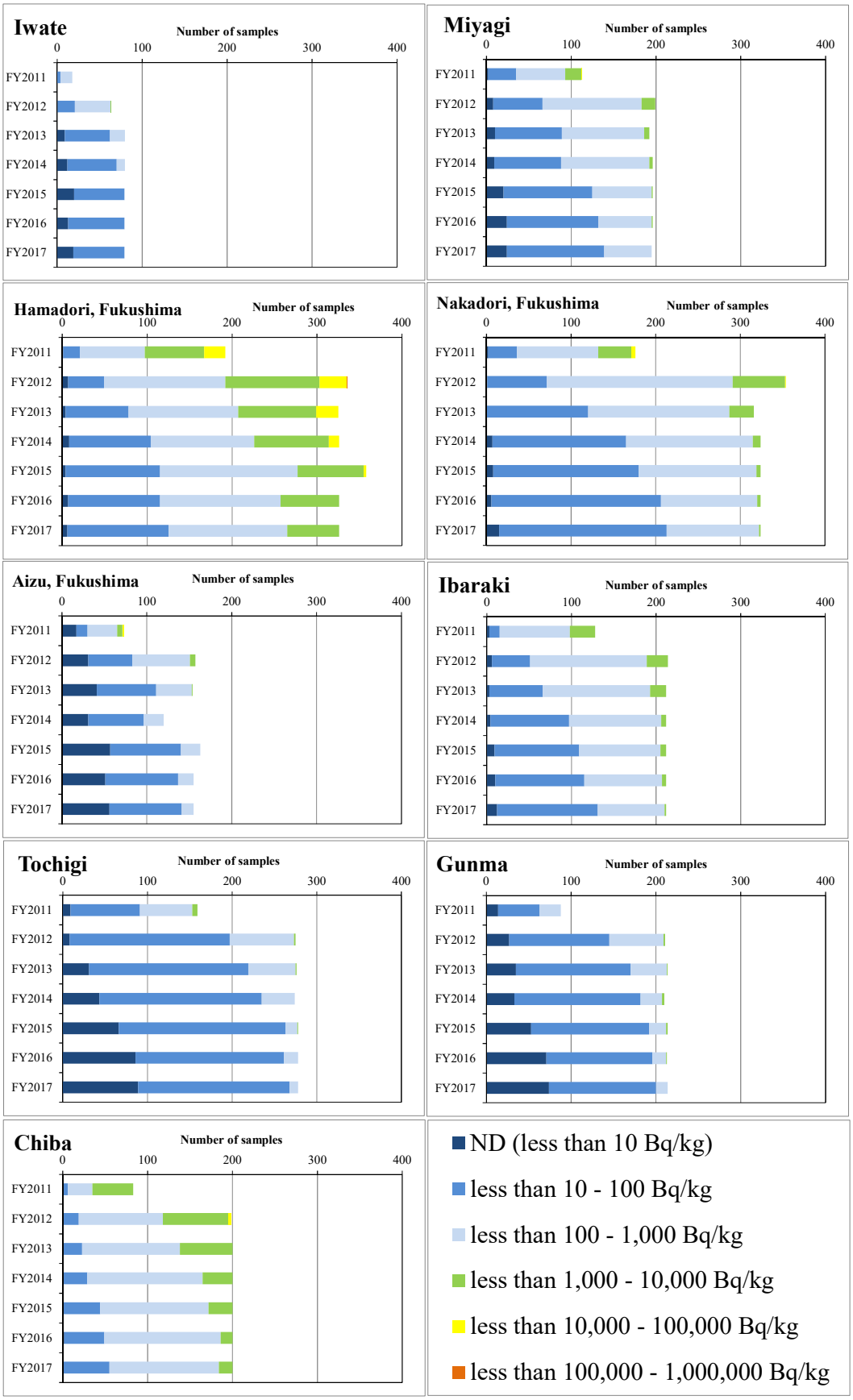
According to the results, including the past years, the detection rate ranged between 30 and 100% except for a small number of samples from Iwate Prefecture.

Coastal area locations showed lower detected values (the total of Cs-134 and Cs-137) than those in rivers or lakes. Radioactive cesium was not detected with a value of 1,000 Bq/kg or more in any prefectures in FY2017 same as in FY2016. When the detected values for FY2017 are observed by the concentration category, radioactive cesium was not detectable at nine locations (approx. 21%), less than 100 Bq/kg at 17 locations (approx. 41%), and less than 100 to 200 Bq/kg at seven locations (approx. 17%). The locations where their detected values were less

than 200 Bq/kg accounted for approximately 79% of the total surveyed locations.

Table 4.1.2-1 Detection of radioactive cesium in river sediment samples

Prefecture	FY2017				FY2011-FY2017				
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Range of detection rate (%)
Iwate	79	60	75.9	ND - 75	481	407	84.6	ND - 1,040	75.0 - 100.0
Yamagata	0	0	-	-	10	6	60.0	ND - 132	60.0 - 60.0
Miyagi	195	171	87.7	ND - 715	1,287	1,190	92.5	ND - 11,100	87.7 - 98.2
Fukushima	805	728	90.4	ND - 6,720	5,308	4,948	93.2	ND - 165,000	90.4 - 95.5
Hamadori	326	320	98.2	ND - 6,720	2,189	2,152	98.3	ND - 165,000	97.5 - 99.5
Nakadori	324	309	95.4	ND - 1,720	2,142	2,103	98.2	ND - 30,000	95.4 - 100.0
Aizu	155	99	63.9	ND - 584	977	693	70.9	ND - 25,000	63.9 - 80.3
Ibaraki	212	200	94.3	ND - 1,380	1,402	1,355	96.6	ND - 5,800	94.3 - 98.6
Tochigi	278	189	68.0	ND - 287	1,818	1,486	81.7	ND - 4,900	68.0 - 97.1
Gunma	214	140	65.4	ND - 880	1,364	1,057	77.5	ND - 2,160	65.4 - 87.2
Saitama	8	4	50.0	ND - 51	50	37	74.0	ND - 540	50.0 - 100.0
Chiba	200	199	99.5	ND - 2,270	1,282	1,277	99.6	ND - 20,200	99.0 - 100.0
Tokyo	8	8	100.0	36 - 199	54	54	100.0	27 - 700	100.0
Total	1,999	1,699	85.0	ND - 6,720	13,056	11,817	90.5	ND - 165,000	50.0 - 100.0



Prefectures where only a small number of samples were collected are omitted.

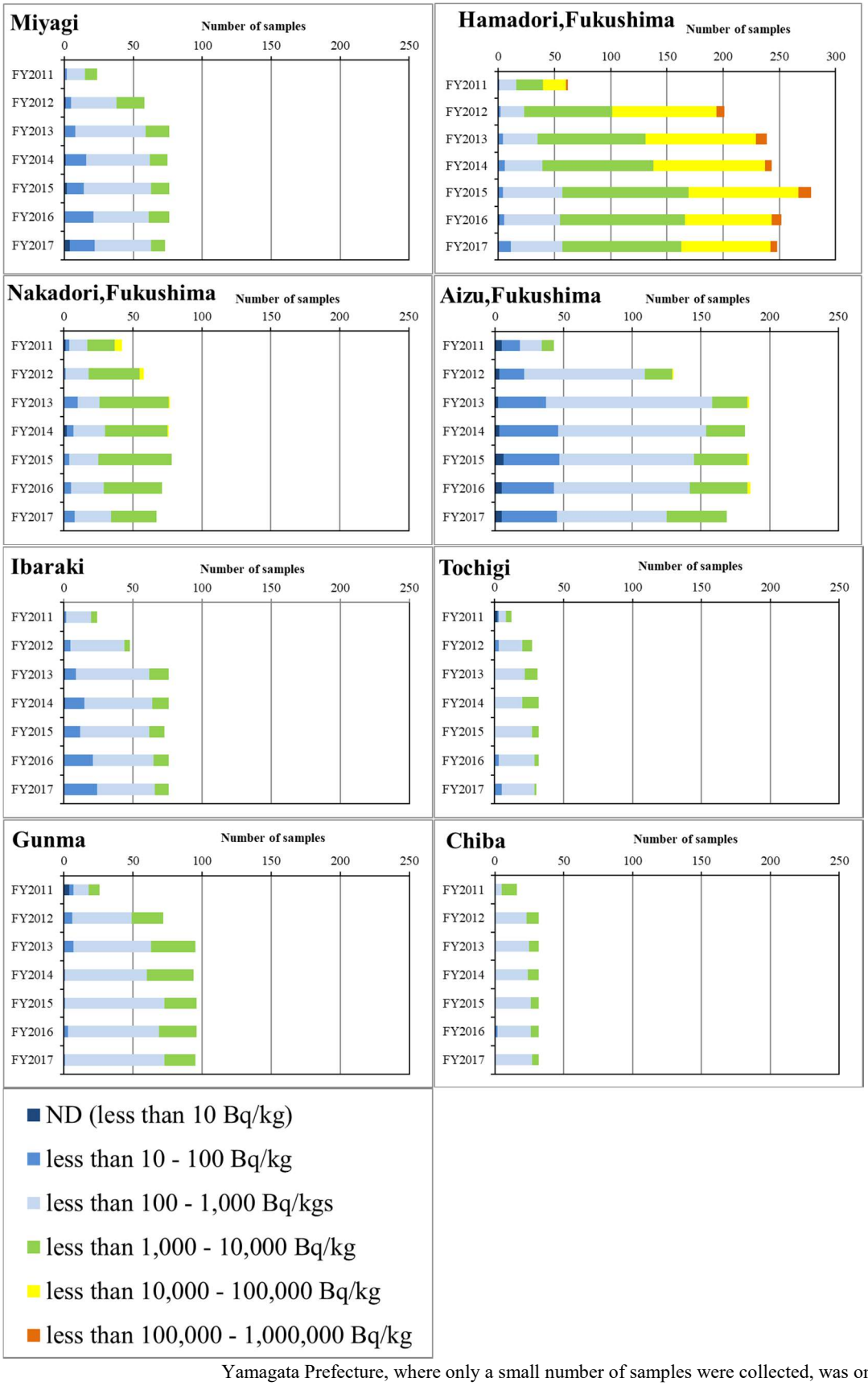
*Number of locations for each category in the maximum concentration values for 2017

ND: 26 locations (approx. 7%), less than 10 to 100 Bq/kg: 194 locations (approx. 49%), and less than 100 to 200 Bq/kg: 67 locations (approx. 17%)

Figure 4.1.2-1 Detection of radioactive cesium in river sediment samples (changes)

Table 4.1.2-2 Detection of radioactive cesium in lake sediment samples

Prefecture	FY2017				FY2011-FY2017				
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Range of detection rate (%)
Yamagata	0	0	-	-	2	2	100.0	34 - 470	100.0
Miyagi	73	69	100.0	ND - 2,350	458	450	98.3	ND - 9,700	94.5 - 100.0
Fukushima	484	479	98.8	ND - 361,000	3,072	3,039	98.9	ND - 920,000	95.9 - 99.6
Hamadori	248	248	99.6	14 - 361,000	1,523	1,522	99.9	ND - 920,000	99.6 - 100.0
Nakadori	67	67	100.0	14 - 8,930	469	466	99.4	ND - 35,000	97.4 - 100.0
Aizu	169	164	97.3	ND - 6,180	1,080	1,051	97.3	ND - 15,400	88.4 - 98.9
Ibaraki	76	76	100.0	29 - 2,330	449	447	99.6	ND - 5,400	98.7 - 100.0
Tochigi	30	30	100.0	47 - 1,120	196	194	99.0	ND - 8,700	83.3 - 100.0
Gunma	95	95	100.0	28 - 2,760	574	570	99.3	ND - 5,100	84.6 - 100.0
Chiba	32	32	100.0	136 - 3,010	208	208	100.0	66 - 8,200	100.0
Total	790	781	99.3	ND - 361,000	4,959	4,910	99.0	ND - 920,000	83.3 - 100.0



Yamagata Prefecture, where only a small number of samples were collected, was omitted.

* Number of locations for each category in the maximum concentration values for 2017

ND: one location, less than 10 to 100 Bq/kg: 13 locations (approx. 8%), less than 100 to 1,000 Bq/kg: 78 locations (approx. 48%), and less than 1,000 to 3,000 Bq/kg: 35 locations (approx. 21%)

Figure 4.1.2-2 Detection of radioactive cesium in lake sediment samples (changes)

Table 4.1.2-3 Detection of radioactive cesium in coastal area sediment samples

Prefecture	FY2017				FY2011-FY2017				
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/kg)	Range of detection rate (%)
Iwate	4	2	50.0	ND – 15	27	10	37.0	ND – 46	0.0 – 50.0
Miyagi	52	39	75.0	ND – 556	359	279	77.7	ND – 2,040	65.4 – 92.2
Fukushima	150	134	89.3	ND – 526	927	864	93.2	ND – 2,950	89.3 – 96.7
Ibaraki	20	8	40.0	ND – 58	159	88	55.3	ND – 230	30.0 – 96.4
Chiba	23	10	43.5	ND – 76	146	80	54.8	ND – 315	43.5 – 64.5
Tokyo	18	18	100.0	43 – 307	109	106	97.2	ND – 780	89.5 – 100.0
Total	267	211	79.0	ND – 556	1,727	1,427	82.6	ND – 2,950	0.0 – 100.0

* Number of locations for each category in the maximum concentration values for 2017

ND: nine locations (approx. 21%), less than 10 to 100 Bq/kg: 17 locations (approx. 41%) and less than 100 to 200 Bq/kg: seven locations (approx. 17%)

Figure 4.1.2-3 Detection of radioactive cesium in coastal area sediment samples (Changes)

(2) Changes in concentration levels

Changes in overall concentration levels were evaluated based on the following method shown below by using data obtained at locations where continuous monitoring has been conducted.

i. Obtain the average value for each location where continuous monitoring has been conducted in order to evaluate changes in overall concentration levels of radioactive cesium each fiscal year (arithmetic average calculated by assuming ND to be zero; hereinafter referred to as the "average for each location").
The analyzation of data from FY2011 was excluded, concerning a small number of samples and locations collected comparing to those in past years.

ii. Arrange all such averages for each location (separately for samples from rivers, lakes, and coastal areas) each fiscal year in descending order and set the following five categories depending on upper percentile ranges.
- Upper 5 percentile of the entirety
- Upper 10 percentile of the entirety
- Upper 25 percentile of the entirety
- Upper 50 percentile of the entirety
- Upper 75 percentile of the entirety

(Incidentally, a correlation between the average for each location and the maximum value by fiscal year revealed a good correlation. Therefore, considering that the evaluation of the average for each location covers that of large detected values (maximum values) that emerge occasionally, the evaluation was conducted by using only the average for each location.)

1) Rivers

Interannual changes in the percentile values of the point averages in river sediment samples are as shown in Figure 4.1.2-4.

Since FY2012, all percentile values have been on a decreasing trend, and in FY2017, they had declined to a level of about 20% of FY2012.

In FY2017, 95% of the total (locations below the upper 5 percentile) was less than 1,000 Bq/kg.

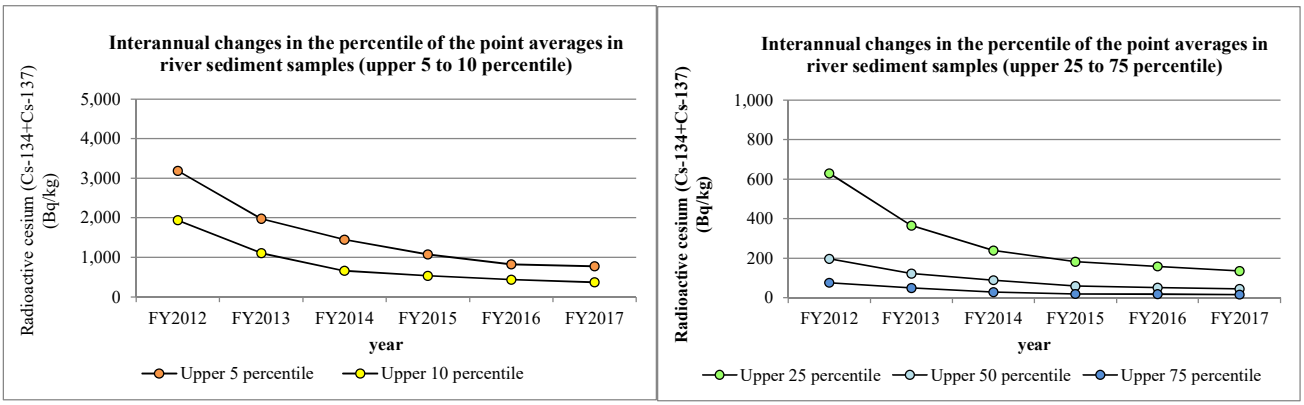


Figure 4.1.2-4 Interannual changes in the percentile values of the point averages in river sediment samples

2) Lakes

Interannual changes in the percentile values of the point averages in lake sediment samples are as shown in Figure 4.1.2-5.

Since FY2012, most of the percentile values have been on a decreasing trend, and in FY2017, they had declined to the level of about half of Y2012.

In FY2017, 90% of the total (locations below the top 10 percentile) was less than about 10,000 Bq/kg, and 75% of the total (locations below the upper 25 percentile) was less than 2,000 Bq/kg.

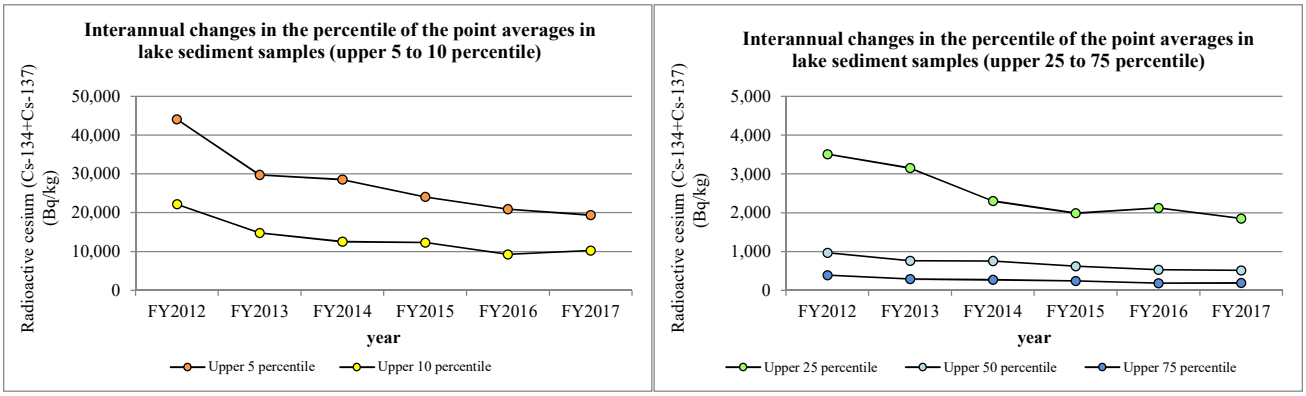


Figure 4.1.2-5 Interannual changes in the percentile values of the point averages in lake sediment samples

3) Coastal areas

Interannual changes in the percentile values of the point averages in coastal area sediment samples are as shown in Figure 4.1.2-6.

Since FY2012, the percentile values have generally been decreasing except for some locations that showed some fluctuations. In FY2017, they declined to about half of those in FY2012 (In coastal areas, the concentration levels were relatively lower than those in rivers or lakes, and the number of survey locations was very small. Therefore, the percentile values showed fluctuations. Of these, the increase in 25 percentile from FY2012 to FY2013 was due to the addition of three survey locations with relatively high concentration. Another partial increase of percentile values in FY2015 was considered to be due to the heavy rains in the Kanto and Tohoku regions occurring in September 2015. This increase was a transient trend and the percentile values have continuously seen decreasing trends since FY2016 as they used to be previously.

In FY2017, 95% of the total (locations below the upper 5 percentile) was less than 400 Bq/kg.

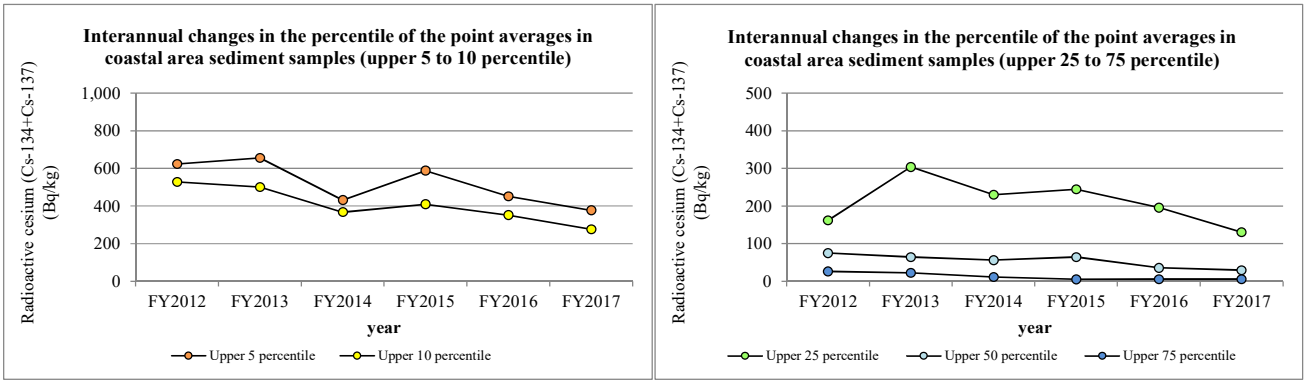


Figure 4.1.2-6 Interannual changes in the percentile values of the point averages in coastal area sediment samples

4.3 Detection of radioactive materials in sediment by location

(1) Evaluation policy

Circumstances where radioactive materials were detected were compiled in further detail by sampling location, while separately considering the property such as rivers, lakes and coastal areas.

Circumstances for each location were statistically analyzed from the following two perspectives by using all available data for each location. Locations where the survey was completed in a single fiscal year (including Yamagata Prefecture) and where the survey has not been conducted since FY2013, were excluded from the evaluation.

1) Relative detected concentration levels

i. Obtain the average value for each location in FY2017 by using all survey results concerning concentrations of radioactive cesium (the total of Cs-134 and Cs-137) (arithmetic average calculated by assuming ND to be zero).

ii. Arrange all such averages for each location (separately for samples from rivers, lakes, and coastal areas) in descending order and set the following five categories depending on upper percentile ranges (see Figure 4.1.2-7).

- Category A: Upper 5 percentile of the entirety
- Category B: Upper 5 to 10 percentile of the entirety
- Category C: Upper 10 to 25 percentile of the entirety
- Category D: Upper 25 to 50 percentile of the entirety
- Category E: Upper 50 to 100 percentile of the entirety (lower 50 percentile)

(Incidentally, a comparison between the average and the maximum value for each location in FY2017 revealed a good correlation (see lower right of Figure 4.1.2-7). Therefore, considering that the evaluation of the average for each location covers that of large detected values (maximum values) that emerge occasionally, the evaluation was conducted by using only the average for each location.)

2) Changes in detected values

i. Changes in detected values were categorized based on the following policy in order to evaluate their changes over the years.

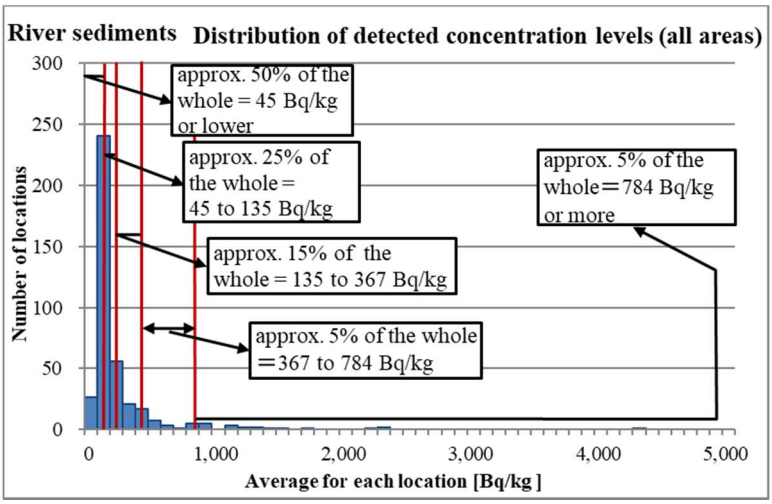
(i) Based on graphs showing changes in detected values of each location over the years, those negatively sloped are set as "decreasing" and those positively sloped are set as "increasing" respectively by eye measurement.

(ii) When eye measurement is difficult, a regression analysis is conducted to check the trend. Specifically, when the lower and upper 95% of the slope are both negative, it is judged as "decreasing," and when the lower and upper 95% of the slope are both positive, it is judged as "increasing."

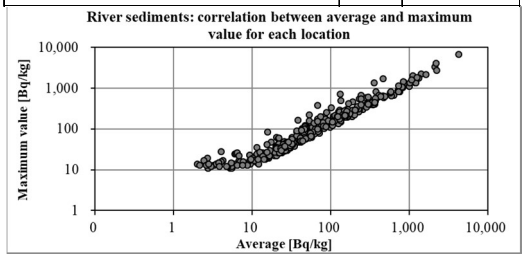
(iii) When increasing or decreasing tendencies are unclear (either the lower or upper limit of 95% of the slope is negative or the other is positive), a coefficient of variation of 0.5 was used as a reference. When the coefficient of variation is less than 0.5, it is judged as "unchanged," and when the coefficient

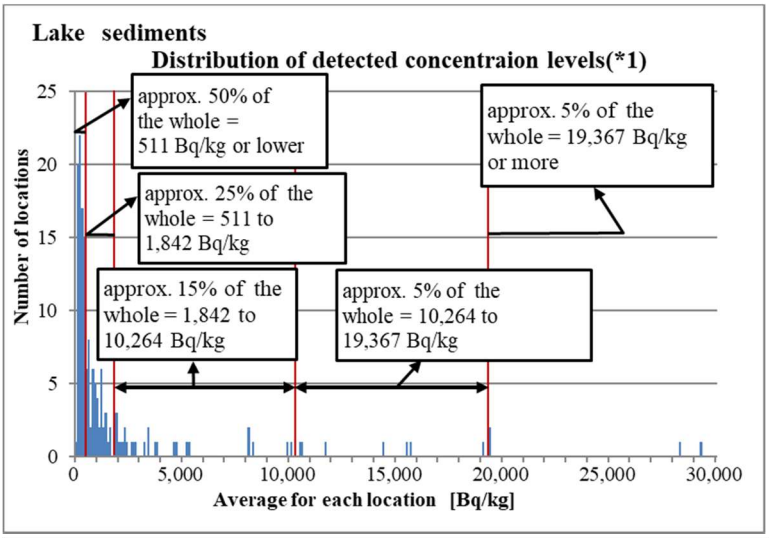
of variation is 0.5 or higher, it is judged as "fluctuations."

ii. However, data may show fluctuations, depending on minor differences in sampling locations or properties of the samples, and it is considered to be too early to make judgments on changes in detected values at this point in time. Even if a certain location is categorized as an “increasing trend” based on the abovementioned policy, whether or not the trend is increasing in a particular location requires further continuous collection of data in order to make an informed judgment.

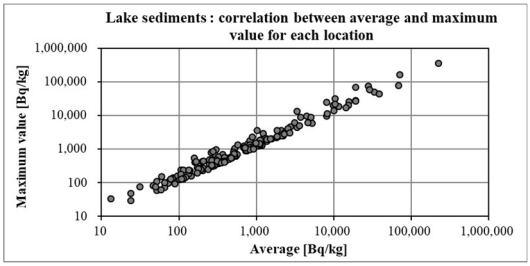


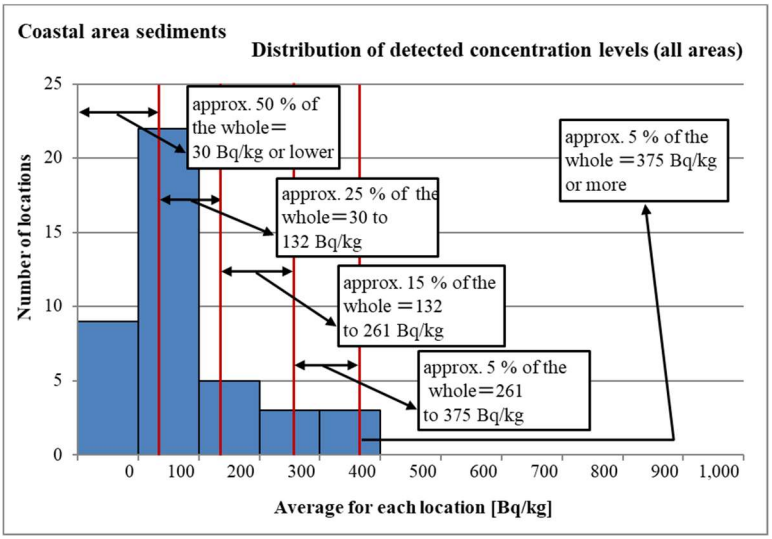
Category	Percentile	Range [River sediments] [Bq/kg (dry)]	Number of locations	Same as on the left. [%]
A	Upper 5 percentile	784 or more	19	4.8
B	Upper 5 to 10 percentile	367 ~ 784	20	5.1
C	Upper 10 to 25 percentile	135 ~ 367	61	15.4
D	Upper 25 to 50 percentile	45 ~ 135	98	24.7
E	Lower 50 percentile	45 or less	198	50.0
Total			396	100.0





Category	Percentile	Range [Lake sediments] [Bq/kg (dry)]	Number of locations	Same as on the left. [%]
A	Upper 5 percentile	19,367 or more	9	5.5
B	Upper 5 to 10 percentile	10,264 ~ 19,367	7	4.3
C	Upper 10 to 25 percentile	1,842 ~ 10,264	25	15.2
D	Upper 25 to 50 percentile	511 ~ 1,842	41	25.0
E	Lower 50 percentile	511 or less	82	50.0
Total			164	100.0





Category	Percentile	Range [Coastal area sediments] [Bq/kg (dry)]	Number of locations	Same as on the left. [%]
A	Upper 5 percentile	375 or more	2	4.8
B	Upper 5 to 10 percentile	261 ~ 375	2	4.8
C	Upper 10 to 25 percentile	132 ~ 261	6	14.3
D	Upper 25 to 50 percentile	30 ~ 132	11	26.2
E	Lower 50 percentile	30 or less	21	50.0
Total			42	100.0

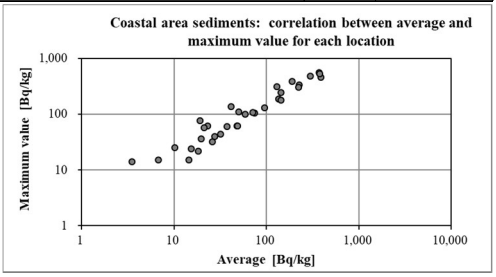


Figure 4.1.2-7 Categories based on the average for each location
(left: picture showing means of categorization; upper right: results of categorization[9];
lower right: correlation between average and maximum value for each location)

*1: locations where the maximum value on the horizontal axis is exceeded are not shown.

9 Method of setting categorization boundary value: The boundary value of adjacent categories is the average value of the minimum value of the upper categorization and the maximum value of the lower categorization.

(2) Concentration levels in sediment samples from rivers, lakes, and coastal areas and their changes by prefecture

(2)-1 Rivers

1) Iwate Prefecture

In Iwate Prefecture, surveys were conducted 13 to 25 times from December 2011 to February 2018 for river sediment samples collected at 22 locations (this analysis excludes the survey results from one location where the survey was conducted only in 2011).

Regarding the concentration levels of detected values, three locations were categorized as Category D and 19 locations were categorized as Category E (see Table 4.1.2-4 and Table 4.1.2-5).

Concentration levels were generally decreasing at 20 locations and were fluctuating at two locations.

Table 4.1.2-4 Categorization of detected values at respective locations (Iwate Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	0	(None)
D	Upper 25 to 50 percentile	3	No. 4, No. 16, No. 22
E	Upper 50 to 100 percentile (lower 50%)	19	No. 1, No. 2, No. 3, No. 5, No. 6, No. 7, No. 8, No. 9, No. 10, No. 11, No. 12, No. 13, No. 14, No. 15, No. 17, No. 18, No. 19, No. 20, No. 21

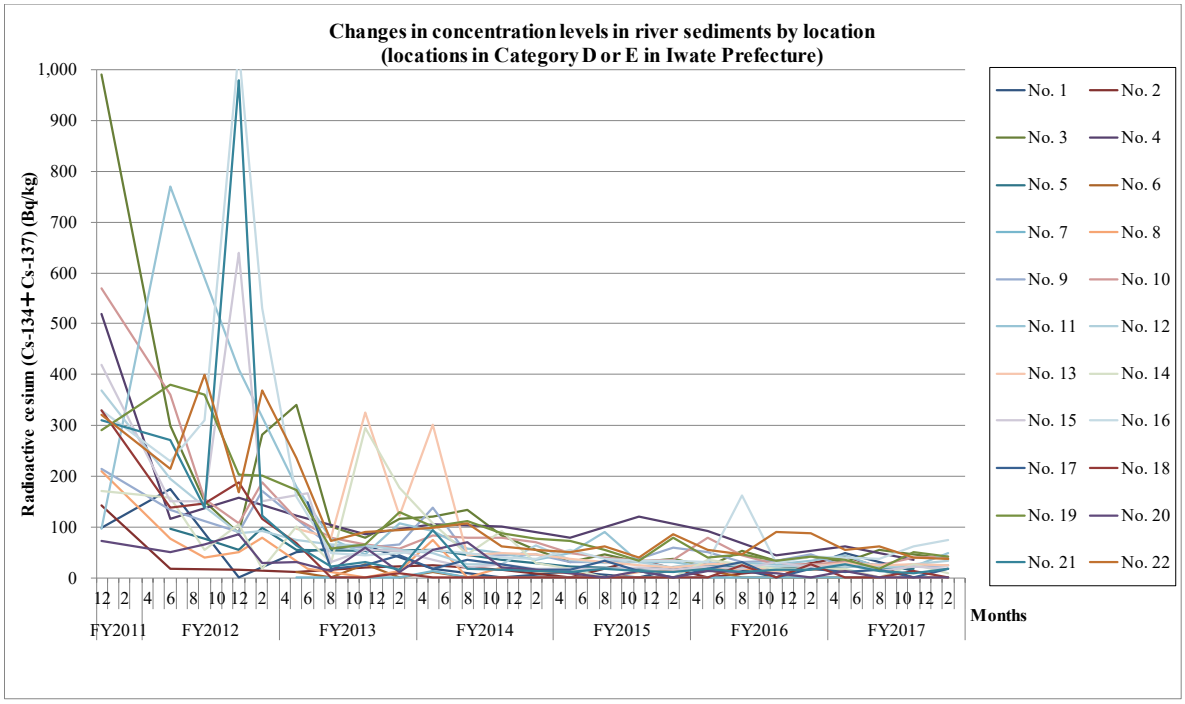
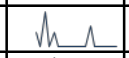
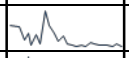


Figure 4.1.2-8 Changes in concentration levels over the years at respective locations (Iwate Prefecture: river sediment)

Table 4.1.2-5 Detection of radioactive cesium at respective locations

(Iwate Prefecture: river sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Sakai River Lower Reaches	Sano Bridge	Ofunato City	14	49	32	0	176	39		1.29	
2	Kesen River	Aneha Bridge	Rikuzentakada City	0	43	22	0	143	26		1.43	
3	Okawa River	Prefectural border with Miyagi	Ichinoseki City	31	55	42	23	990	132		1.50	
4	Tsuyagawa River	Chiyogahara Bridge	Ichinoseki City	36	62	49	36	520	126		0.97	
5	Kitakami River System: Kurosawa River	Kawarada Bridge	Kanegasaki Town	17	22	20	17	99	46		0.62	
6	Kitakami River System: Isawa River	Oago Bridge	Oshu City	0	0	0	0	27	3.4		2.18	
7	Kitakami River System: Isawa River	Saijin Bridge	Oshu City	0	0	0	0	14	0.7		4.47	
8	Kitakami River System: Kitakami River	Fuji Bridge	Oshu City	0	15	3.8	0	210	29		1.55	
9	Kitakami River System: Shiratori River	Shiratori Bridge	Oshu City	23	26	24	23	215	68		0.74	
10	Kitakami River System: Koromo River	Koromogawa Bridge	Hiraizumi Town	24	42	34	24	570	99		1.22	
11	Kitakami River System: Ota River	Hitosuji Bridge	Hiraizumi Town	20	48	34	20	770	103		1.63	
12	Kitakami River System: Iwai River Middle Reaches	Kamino Bridge	Ichinoseki City	20	34	26	20	370	65		1.17	
13	Kitakami River System: Iwai River Lower Reaches	Kozenji Bridge	Ichinoseki City	24	29	26	12	326	69		1.29	
14	Kitakami River System: Kitakami River	Chitose Bridge (Kozenji)	Ichinoseki City	0	26	14	0	294	63		1.15	
15	Kitakami River System: Sokei River	Unada Bridge	Ichinoseki City	14	26	20	14	640	86		1.69	
16	Kitakami River System: Sarusawa River	Kannon Bridge	Ichinoseki City	37	75	53	29	1,040	142		1.57	
17	Kitakami River System: Satetsu River	Oide Bridge	Ichinoseki City	0	18	11	0	149	26		1.22	
18	Kitakami River System: Satetsu River	Kanzaki Bridge	Ichinoseki City	0	14	3.5	0	330	42		1.92	
19	Kitakami River System: Senmaya River Upper Reaches	Miyata Bridge	Ichinoseki City	18	51	37	18	380	111		0.92	
20	Kitakami River System: Kitakami River	Kitakamigawa Bridge	Ichinoseki City	0	13	3.3	0	85	26		1.04	
21	Kitakami River System: Kinomi River	Higuchi Bridge	Ichinoseki City	10	27	17	10	980	91		2.21	
22	Kitakami River System: Kinryu River	Tenjin Bridge	Ichinoseki City	38	62	49	38	400	120		0.88	
Total number of samples		480		0	75	23	0	1,040	72			
Detection times		406										

: Increasing
: Decreasing
: Varying
: Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

2) Miyagi Prefecture

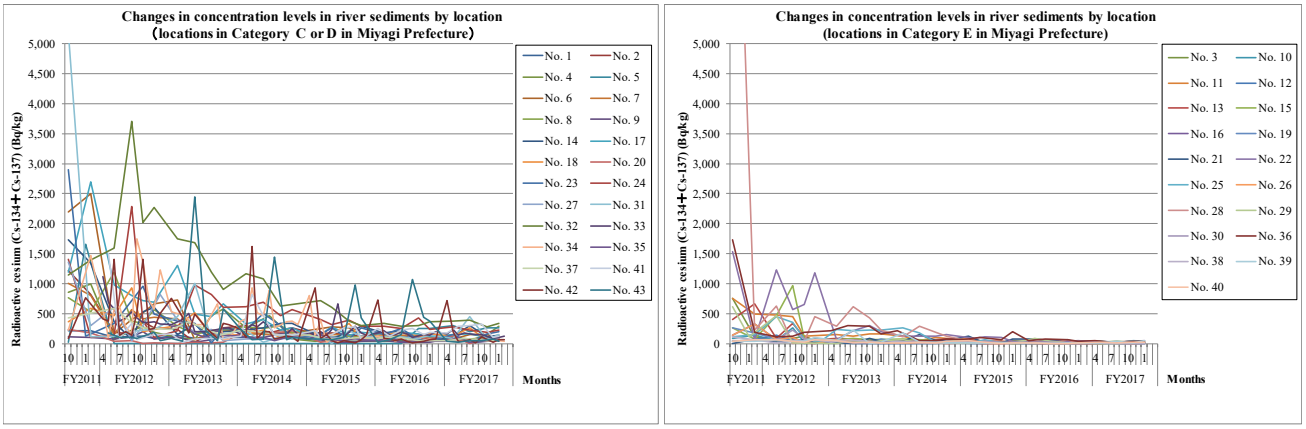
In Miyagi Prefecture, surveys were conducted 24 to 63 times from October 2011 to February 2018 for river sediment samples collected at 43 locations (this analysis excludes the survey results from 38 locations where the survey was conducted only in 2011).

Regarding the concentration levels of detected values, nine locations were categorized as Category C, 15 locations as Category D, and 19 locations as Category E (see Table 4.1.2-6 and Table 4.1.2-7).

Concentration levels were generally decreasing at 39 locations and were fluctuating at four locations.

Table 4.1.2-6 Categorization of detected values at respective locations
(Miyagi Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	9	No.5, No.14, No.18, No.23, No.24, No.31, No.32, No.33, No.41,
D	Upper 25 to 50 percentile	15	No.1, No.2, No.4, No.6, No.7, No.8, No.9, No.17, No.20, No.27, No.34, No.35, No.37, No.42, No.43
E	Upper 50 to 100 percentile (lower 50%)	19	No.3, No.10, No.11, No.12, No.13, No.15, No.16, No.19, No.21, No.22, No.25, No.26, No.28, No.29, No.30, No.36, No.38, No.39, No.40



Notes: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-9 Changes in concentration levels over the years at respective locations
(Miyagi Prefecture: river sediment)

Table 4.1.2-7 Detection of radioactive cesium at respective locations

(Miyagi Prefecture: river sediment)

Location					FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area		Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Shishiori River		Kinzan Bridge	Kesennuma City	48	63	58	36	211	88		0.51	
2			Namiita Bridge		66	80	72	28	1,220	231		1.09	
3	Okawa River		Tateyama-ohashi Bridge		20	37	27	20	750	74		1.89	
4			Kamiyama Bridge		35	294	131	34	990	221		1.17	
5			Okawa River Estuary		201	299	256	0	1,660	124		2.69	
6	Omose River		Ozaki Bridge		74	156	117	44	2,500	387		1.56	
7	Kitakami River System	Arima River	Unanda Bridge	Kurihara City	28	118	87	28	1,000	246		0.95	
8		Kinryu River	Obata Bridge		78	110	98	78	1,190	270		0.94	
9		Kitakami River	Tome-ohashi Bridge (Tome)		17	104	50	17	199	78		0.63	
10		Hasama River Area: Sanhasama River	Doman Bridge (Kurikoma Dam)		0	24	6.0	0	260	38		1.39	
11		Hasama River Area: Nihasama River	Kajiya Bridge		0	38	21	0	750	147		1.28	
12		Hasama River Area: Hasama River	Hanayama Dam, inflow area		0	0	0	0	135	14		2.25	
13			Wakayanagi		24	30	27	24	670	98		1.51	
14			Yamayoshida Bridge	Tome City	111	301	167	34	1,730	323		1.20	
15		Eai River Area: Eai River	Todoroki Bridge (Todoroki)	Osaki City	18	37	28	0	970	110		1.90	
16			Shimizu Komon Lock		0	11	5.3	0	330	34		2.06	
17		Eai River Area: In Furukawa District,Osaki City	Shinborisaihon, entrance		100	162	130	88	2,700	501		1.13	
18		Eai River Area: Dekigawa River	Kogota Bridge	Misato Town	49	262	135	49	930	242		0.81	
19		Eai River Area: Eai River	Oikawa Bridge (Tandai)	Wakuya Town	13	19	16	0	260	44		1.28	
20		Kyu-Kitakami River	Kadonowaki	Ishinomaki City	0	122	77	0	240	89		0.83	
21	Naruse River		Onobashi Bridge (Ono)	Higashi-Matsushima	24	37	31	0	153	48		0.71	
22	Sunaoshi River		Tagajozeki Weir	Tagajo City	20	46	34	20	1,530	275		1.51	
23			Nenbutsu Bridge		28	197	135	17	2,900	363		1.54	
24	Teizan-unga Canal (Kyu-sunaoshi River)		Teizan Bridge	Shiogama City/Shichiga	193	282	230	95	2,280	496		0.95	
25	Nanakita River System	Nanakita River	Nanakita Bridge	Sendai City	0	50	26	0	450	108		1.14	
26			Fukuda-ohashi Bridge		0	0	0	0	60	11		1.48	
27		Umeda River	Fukuda Bridge		50	76	63	44	1,350	210		1.42	
28		Nanakita River	Takasago Bridge		0	11	2.8	0	11,100	571		3.77	
29	Natori River System	Natori River	Yuriage-ohashi Bridge	Sendai City /Natori City	0	17	6.8	0	610	69		2.16	
30		Masuda River	Yakushi Bridge	Natori City	13	19	16	13	220	39		1.07	
31			Koyama Bridge		59	456	189	0	5,200	380		2.64	
32			Bishamon Bridge		272	393	344	272	3,700	993		0.82	
33	Abukuma River System	Abukuma River	Hadeniwa Bridge	Marumori Town	92	239	150	92	1,120	270		0.66	
34			Marumori Bridge	Marumori Town	34	78	50	27	3,400	358		1.44	
35			Higashine Bridge	Kakuda City	21	104	52	21	301	95		0.73	
36		Shiroishi River Aarea: Shiroishi River	Before the confluence with Kawaragosawa	Shiroishi City	30	48	39	30	1,730	180		1.85	
37		Shiroishi River Aarea: Saikawa River	Etsubo Bridge	Shiroishi City	45	83	55	45	590	176		0.79	
38		Shiroishi River Aarea: Matsukawa River	Miya-ohashi Bridge	Zao Town	0	13	3.3	0	119	25		1.08	
39		Shiroishi River Aarea: Arakawa River	Niragami Bridge	Murata Town/Ogawa	11	49	30	0	222	41		1.25	
40		Shiroishi River Aarea: Shiroishi River	Shirahata Bridge	Shibata Town	17	27	22	0	68	27		0.70	
41		Abukuma River	Tsukinoki-ohashi Bridge	Kakuda City/Shibata	97	325	217	24	2,470	263		1.53	
42			Abukuma-ohashi Bridge (Iwanuma)	Iwanuma City/Watari	11	715	133	0	1,860	287		1.39	
43			Abukuma River Estuary (Watariohashi Bridge)	Iwanuma City/Watari	21	72	46	21	2,450	280		1.73	
Total number of samples			1,243		0	715	83	0	11,100	218			
Detection times			1,147										

: Increasing
: Decreasing
: Varying
: Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

3) Fukushima Prefecture

(i) Hamadori

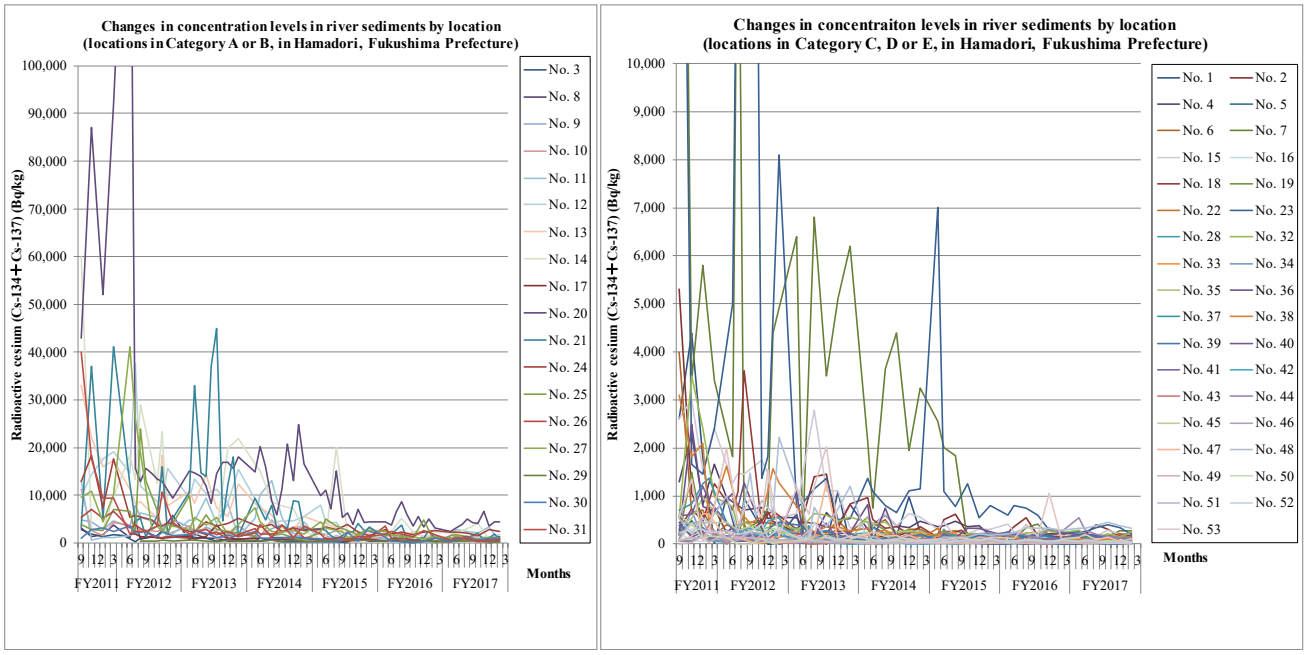
In Hamadori, Fukushima Prefecture, surveys were conducted 35 to 65 times from September 2011 to February 2018 for river sediment samples collected at 53 locations.

Regarding the concentration levels of detected values, 12 locations were categorized as Category A, six locations as Category B, 12 locations as Category C, eight locations as Category D, and 15 locations as Category E (see Table 4.1.2-8 and Table 4.1.2-9).

Concentration levels were generally decreasing at 50 locations, were unchanged at one location, were fluctuating at one location, and were increasing at one location.

Table 4.1.2-8 Categorization of detected values at respective locations
(Hamadori, Fukushima Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	12	No.3, No.11, No.12, No.13, No.14, No.20, No.21, No.24, No.25, No.26, No.27, No.30
B	Upper 5 to 10 percentile	6	No.8, No.9, No.10, No.17, No29, No.31
C	Upper 10 to 25 percentile	12	No.2, No.4, No.7, No.15, No.18, No.22, No.23, No.32, No.36, No.39, No.44, No.48
D	Upper 25 to 50 percentile	8	No.6, No.28, No.33, No.35, No.38, No.41, No.45, No.53
E	Upper 50 to 100 percentile (lower 50%)	15	No.1, No.5, No.16, No.19, No.34, No.37, No.40, No.42, No.43, No.46, No.47, No.49, No.50, No.51, No.52



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-10 Changes in concentration levels over the years at respective locations
(Hamadori, Fukushima Prefecture: river sediment)

Table 4.1.2-9 Detection of radioactive cesium at respective locations

(Hamadori, Fukushima Prefecture: river sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Jizogawa River	Hamahata Bridge	Shinchi Town	0	12	3.8	0	4,400	388		2.19	
2	Koizumi River	Koizumi Bridge	Soma City	169	398	244	114	5,300	518		1.61	
3		Hyakken Bridge		1,000	1,350	1,205	46	2,900	984		0.64	
4	Udagawa River	Horisaka Bridge		135	236	174	135	2,300	504		0.87	
5		Hyakken Bridge		36	56	43	0	490	90		0.96	
6	Manogawa River	Ochiai Bridge	Minamisoma City	34	156	111	34	4,000	353		1.65	
7		Majima Bridge		72	272	160	63	28,000	2,681		1.83	
8	Niida River	Kusano	Iitate Village	123	662	412	123	5,700	1,163		1.03	
9		Komiya		187	635	434	187	7,900	2,084		0.86	
10		Kidouchi Bridge	Minamisoma City	290	543	371	290	11,200	1,911		1.01	
11		Sakekawa Bridge		422	3,360	2,119	103	13,100	3,160		1.06	
12	Ota River	Ishiwatado Bridge		1,050	1,760	1,328	890	61,000	7,920		1.25	
13		Kaminouchi Bridge		662	1,360	1,026	662	33,000	6,608		1.03	
14		Masuda Bridge		821	4,030	2,204	620	60,000	8,339		1.34	
15		JR Tetsudo Bridge		164	294	210	164	3,000	802		0.98	
16		Maruyama Bridge		16	47	29	0	230	54		0.82	
17	Odaka River	Shimokawara Bridge		375	817	587	375	3,800	905		0.68	
18		Zencho Bridge		122	214	158	122	3,600	444		1.29	
19		Hatsukara Bridge		11	30	17	0	1,500	107		2.27	
20	Ukedo River	Murohara Bridge	Namie Town	2,480	6,720	4,237	2,480	165,000	15,977		1.55	
21		Ukedo Bridge		341	2,010	1,111	341	45,000	7,209		1.43	
22	Furumichi River	Before the confluence with Takasegawa River(Kodoshimohira,Miyakoji Town)	Tamura City	101	189	135	32	1,410	216		1.23	
23	Takase River	Keio Bridge	Namie Town	200	407	300	200	24,000	2,983		1.82	
24	Maeda River	National Route 6, west	Futaba Town	1,460	2,770	2,240	1,460	18,300	4,220		0.89	
25		Nakahama Bridge	Namie Town	797	1,800	1,251	132	23,900	3,521		1.17	
26	Kumagawa River	National Route 6, west	Okuma Town	270	1,440	846	270	7,100	1,962		0.84	
27		Mikuma Bridge		697	1,600	1,067	697	41,000	4,737		1.55	
28	Tomioka River	Nabekura Bridge	Kawauchi Village	70	178	131	70	570	208		0.51	
29		Sakaigawa Bridge		195	559	369	195	830	492		0.29	
30		National Route 6, west	Tomioka Town	240	1,070	806	142	3,600	1,436		0.64	
31		Kobama Bridge		424	1,140	732	424	40,000	3,843		1.75	
32	Idegawa River	Motogama Bridge	Naraha Town	122	293	203	94	3,500	455		1.37	
33	Kawauchi River	Before the confluence with Kidogawa River(Futamata Bridge)	Kawauchi Village	86	149	106	39	290	143		0.42	
34	Kidogawa River	Nishiyama Bridge		24	60	41	16	690	94		1.18	
35		Nagatoro Bridge	Naraha Town	22	101	68	22	970	217		0.93	
36		Kidokawa Bridge		77	210	146	68	2,500	382		1.21	
37	Asami River	Boda Bridge	Hirono Town	34	51	42	23	1,370	226		1.35	
38	Ohisa River	Kageiso Bridge	Iwaki City	61	112	87	45	3,100	472		1.43	
39	Kohisa River	Rengo Bridge		97	214	153	92	460	195		0.47	
40	Niida River	Kasumida Bridge		19	35	26	0	460	59		1.38	
41		Matsuba Bridge		25	59	48	25	1,200	188		1.33	
42	Natsui River	Kitanouchi Bridge	Ono Town	0	18	12	0	400	51		1.70	
43		Kyudayu Bridge	Iwaki City	15	33	20	0	440	52		1.79	
44		Rokujumai Bridge		131	546	245	17	546	141		0.76	
45	Yoshima River	Iwaanatsuri Bridge		42	66	57	28	620	152		0.99	
46		Before the confluence with Natsui River		15	33	23	0	480	79		1.38	
47	Fujiwara River	Shima Bridge		16	30	24	13	1,280	122		1.90	
48		Minato-ohashi Bridge		320	453	365	20	2,220	440		0.98	
49	Samegawa River	Idosawa Bridge		0	27	15	0	278	47		1.38	
50		Samegawa Bridge		25	51	44	0	440	71		0.95	
51	Shitoki River	Komuro Bridge		19	38	26	11	300	63		1.04	
52	Binda River	Kobana Bridge		20	93	43	20	450	134		0.82	
53		Binda Bridge		56	204	124	45	2,020	439		1.23	
Total number of samples		2,189		0	6,720	544	0	165,000	1,957			
Detection times		2,152										

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

 : Increasing
 : Decreasing
 : Varying
 : Unchanged

(ii) Nakadori

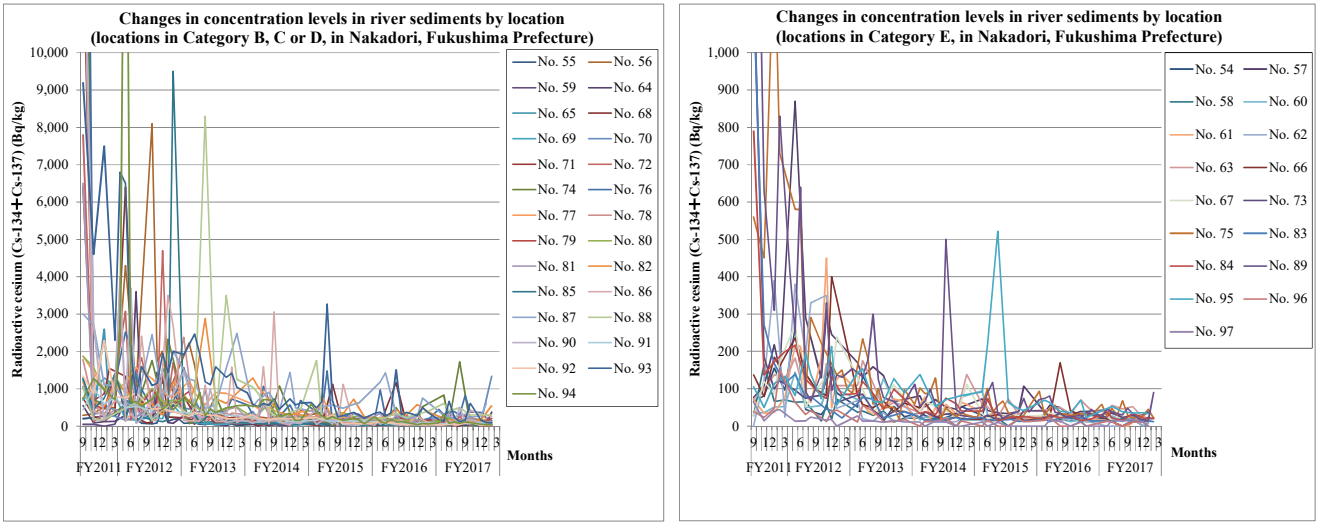
In Nakadori, Fukushima Prefecture, surveys were conducted 39 to 67 times from September 2011 to February 2018 for river sediment samples collected at 44 locations.

Regarding the concentration levels of detected values, three locations were categorized as Category B, 10 locations as Category C, 14 locations as Category D, and 17 locations as Category E (see Table 4.1.2-10 and Table 4.1.2-11).

Concentration levels were generally decreasing at 42 locations and were fluctuating at two locations.

Table 4.1.2-10 Categorization of detected values at respective locations
(Nakadori, Fukushima Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	3	No.74, No.76, No.88
C	Upper 10 to 25 percentile	10	No.56, No.59, No.70, No.77, No.80, No.81, No.82, No.86, No.87, No.93
D	Upper 25 to 50 percentile	14	No.55, No.64, No.65, No.68, No.69, No.71, No.72, No.78, No.79, No.85, No.90, No.91, No.92, No.94
E	Upper 50 to 100 percentile (lower 50%)	17	No.54, No.57, No.58, No.60, No.61, No.62, No.63, No.66, No.67, No.73, No.75, No.83, No.84, No.89, No.95, No.96, No.97



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-11 Changes in concentration levels over the years at respective locations
(Nakadori, Fukushima Prefecture: river sediment)

Table 4.1.2-11 Detection of radioactive cesium at respective locations

(Nakadori, Fukushima Prefecture: river sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
54	Abukuma River	Habuto Bridge	Nishigo Village	18	42	25	10	262	51		0.98	
55		Tamachi-ohashi Bridge	Shirakawa City	11	112	47	11	1,010	92		1.61	
56	Yanta River	Before the confluence with Abukuma River		112	196	152	43	8,100	729		1.98	
57	Yashiro River	Yashirogawa Bridge	Tanagura Town	24	43	32	24	870	109		1.33	
58	Kitasu River	Yanagi Bridge	Hirata Village	0	20	13	0	165	29		1.02	
59	Imade River	Nekonaki Bridge	Ishikawa Town	0	284	149	0	1,450	219		1.53	
60	Yashiro River	Oji Bridge		13	27	20	11	145	45		0.75	
61	Abukuma River	Kawanome Bridge	Tamakawa Village	0	27	13	0	450	57		1.27	
62		Emochi Bridge	Sukagawa City	0	22	6.8	0	390	61		1.78	
63	Shakado River	Sukagawa City water intake point		21	55	39	11	182	70		0.64	
64		Before the confluence with Abukuma River		16	377	68	14	3,600	175		2.70	
65	Sasahara River	Shinbashi Bridge	Koriyama City	17	78	55	17	2,600	330		1.65	
66	Yatagawa River	Yatagawa Bridge		0	21	14	0	400	74		1.20	
67	Otakine River	Funehiki Bridge	Tamura City	17	26	22	17	270	66		0.90	
68		Before the confluence with Abukuma River	Koriyama City	0	221	53	0	6,400	360		2.86	
69	Ouse River	Before the confluence with Babagawa River		28	103	48	18	1,290	190		1.67	
70		Makunouchi Bridge		104	1,340	357	104	1,340	298		0.83	
71		Before the confluence with Abukuma River		39	156	106	39	13,500	507		3.27	
72	Abukuma River	Akutsu Bridge		30	251	89	25	7,800	562		2.45	
73	Gohyaku River	After the confluence with Ishimuro River		15	37	25	15	1,210	79		2.39	
74		Kamisekishita Bridge	Motomiya City	23	1,720	466	18	22,000	985		3.51	
75		Before the confluence with Abukuma River		21	68	37	18	1,320	143		1.62	
76	Abukuma River	Takada Bridge	Nihonmatsu City	148	817	375	99	30,000	1,016		3.63	
77	Kuchibuto River	Kuchibutogawa Bridge		65	222	141	65	1,880	572		0.87	
78	Utsushi River	Osegawa Bridge		46	158	94	24	2,380	318		1.30	
79	Mizuhara River	Getouchi Bridge	Fukushima City	86	200	122	86	6,400	485		2.09	
80	Megami River	Tsurumaki Bridge		108	231	155	108	1,870	464		0.90	
81	Abukuma River	Horai Bridge		89	350	220	28	6,500	370		2.10	
82	Nigori River	Before the confluence with Omori River		132	545	230	132	2,880	603		0.83	
83	Arakawa River	Hinokura Bridge		12	18	14	12	1,160	71		2.61	
84	Sukawa River	Sukawa Bridge		15	37	25	14	790	82		1.55	
85	Arakawa River	Before the confluence with Abukuma River		26	155	68	26	9,500	324		3.66	
86	Matsukawa River			14	426	168	14	15,200	803		2.56	
87	Hattanda River	Hattanda Bridge		135	604	300	135	4,300	945		0.93	
88	Surikami River	Totsuna Bridge		300	608	403	94	8,300	719		1.92	
89		Before the confluence with Abukuma River		11	90	37	11	2,150	153		1.94	
90	Abukuma River	Taisho Bridge	Date City	34	504	134	26	14,200	642		2.89	
91	Hirose River	Tatenokoshi Bridge	Kawamata Town	55	116	81	55	1,030	266		0.83	
92		Jizogawara Bridge	Date City	17	101	46	17	2,300	332		1.29	
93	Oguni River	Before the confluence with Hirose River		90	666	243	90	9,200	1,350		1.33	
94	Hirose River	Before the confluence with Abukuma River		35	327	101	35	20,000	712		3.43	
95	Kurokawa River	Tochigisakai	Shirakawa City	33	53	40	23	522	96		0.88	
96	Kujigawa River	Matsuoka Bridge	Tanagura Town	0	13	7.5	0	150	21		1.27	
97		Takachihara Bridge	Yamatsuri Town	0	18	9.7	0	63	12		1.08	
Total number of samples		2,142		0	1,720	112	0	30,000	377			
Detection times		2,103										

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

(iii) Aizu

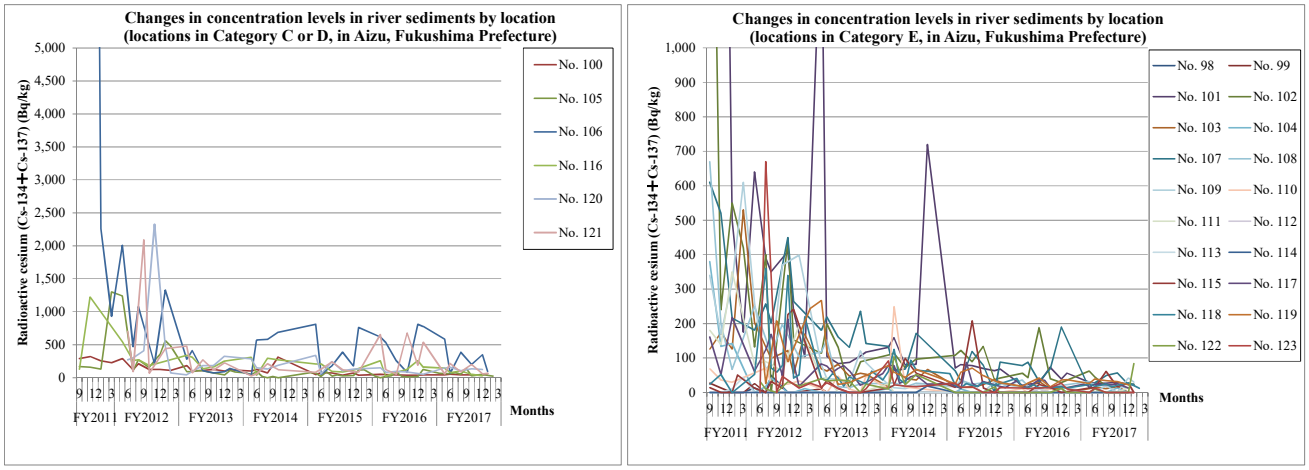
In Aizu, Fukushima Prefecture, surveys were conducted 30 to 59 times from September 2011 to February 2018 for river sediment samples collected at 26 locations.

Regarding the concentration levels of detected values, one location was categorized as Category C, five locations as Category D, and 20 locations as Category E (see Table 4.1.2-12 and Table 4.1.2-13).

Concentration levels were generally decreasing at 21 locations and fluctuating at five locations.

Table 4.1.2-12 Categorization of detected values at respective locations
(Aizu, Fukushima Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No.106
D	Upper 25 to 50 percentile	5	No.100, No.105, No.116, No.120, No.121
E	Upper 50 to 100 percentile (lower 50%)	20	No.98, No.99, No.101, No.102, No.103, No.104, No.107, No.108, No.109, No.110, No.111, No.112, No.113, No.114, No.115, No117, No.118, No.119, No122, No.123



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-12 Changes in concentration levels over the years at respective locations
(Aizu, Fukushima Prefecture: river sediment)

Table 4.1.2-13 Detection of radioactive cesium at respective locations

(Aizu, Fukushima Prefecture: river sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
98	Agano River	Tajima Bridge	Minamiaizu Town	0	0	0	0	50	1.8		4.82	
99		Okawa Bridge	Aizuwakamatsu City	0	0	0	0	27	2.1		3.11	
100	Yukawa River	Takimi Bridge		40	63	47	36	320	113		0.76	
101		Shinyukawa Bridge		22	30	27	20	8,700	472		3.07	
102		Before the confluence with Agano River		18	62	32	0	2,300	190		2.05	
103	Miyakawa River	Saikuna Bridge	Aizubange Town	0	17	11	0	530	69		1.35	
104	Agano River	Miyako Bridge		0	13	2.6	0	380	21		3.34	
105	Nippashi River	Minami-ohashi Bridge	Kitakata City	25	138	62	0	1,300	144		1.70	
106	Kyu-yukawa River	Awanomiya Bridge	Yugawa Village	66	584	280	40	25,000	1,519		2.93	
107	Kyu-miyakawa River	Josuke Bridge	Aizubange Town	12	57	32	0	610	150		0.94	
108	Tatsuki River	Ohashi	Kitakata City	12	31	21	0	670	76		1.61	
109		Shimokawara Bridge		0	42	15	0	730	99		1.69	
110	Nigori River	Nigorigawa Bridge		0	0	0	0	249	22		2.01	
111		Yamazaki Bridge		0	14	2.8	0	350	44		2.00	
112	Inagawa River	Aoyagi Bridge	Minamiaizu Town	0	0	0	0	10	0		6.08	
113		Kurosawa Bridge	Tadami Town	0	0	0	0	44	1.6		4.77	
114	Tadami River	Nishitani Bridge	Kaneyama Town	0	0	0	0	19	0.5		5.92	
115		Fuji Bridge	Aizubange Town	0	61	22	0	241	35		1.75	
116	Agano River	Shingo Dam	Kitakata City	27	143	80	22	1,220	215		1.00	
117	Sukawa River	Sukawano	Inawashiro Town	13	26	22	12	218	52		0.93	
118	Nagase River	Kogane Bridge		12	28	21	0	360	50		1.35	
119	Takahashi River	Shinbashi Bridge		22	39	30	16	267	68		1.01	
120	Koguro River	Umeno Bridge		107	159	135	42	2,330	249		1.64	
121	Hishinuma River	Sekido District		56	216	114	28	2,090	275		1.39	
122	Funatsu River	Funatsu Bridge	Koriyama City	0	84	16	0	104	17		1.42	
123	Haragawa River	Estuary, front	Aizuwakamatsu City	0	13	2.2	0	670	34		3.37	
Total number of samples		977		0	584	38	0	25,000	151			
Detection times		693										

: Increasing
: Decreasing
: Varying
: Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

4) Ibaraki Prefecture

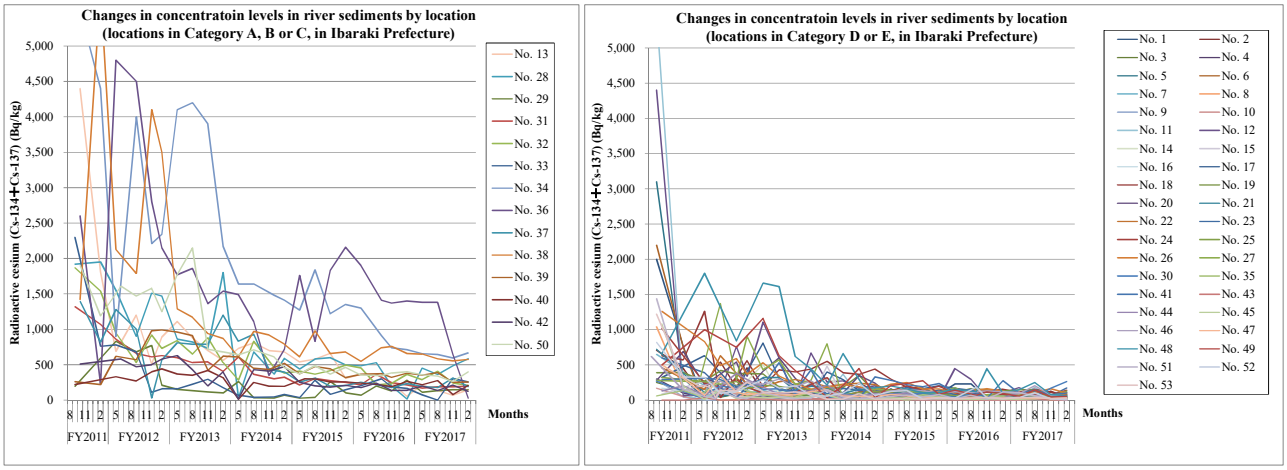
In Ibaraki Prefecture, surveys were conducted 23 to 29 times from August 2011 to February 2018 for river sediment samples collected at 53 locations (this analysis excludes the survey results from 40 locations where the survey was conducted only in 2011).

Regarding the concentration levels of detected values, one location was categorized as Category A, three locations as Category B, 10 locations as Category C, 26 locations as Category D, and 13 locations as Category E (see Table 4.1.2-14 and Table 4.1.2-15).

Concentration levels were generally decreasing at 50 locations and fluctuating at three locations.

Table 4.1.2-14 Categorization of detected values at respective locations
(Ibaraki Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	1	No.36
B	Upper 5 to 10 percentile	3	No.28, No.34, No.38
C	Upper 10 to 25 percentile	10	No.13, No.29, No.31, No.32, No.33, No.37, No.39, No40, No.42, No.50
D	Upper 25 to 50 percentile	26	No.1, No.2, No.6, No.7, No.11, No.12, No.14, No.16, No.17, No.18, No.19, No.20, No.21, No.22, No.23, No.24, No.25, No.26, No.27, No.30, No.41, No.44, No.46, No.48, No.49, No.51
E	Upper 50 to 100 percentile (lower 50%)	13	No.3, No.4, No.5, No.8, No.9, No.10, No.15, No.35, No.43, No.45, No.47, No.52, No.53



Notes: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-13 Changes in concentration levels over the years at respective locations
(Ibaraki Prefecture: river sediment)

Table 4.1.2-15 Detection of radioactive cesium at respective locations (Ibaraki Prefecture: river sediment)

No.	Water area			Location	Municipality	FY2017 Minimum value	FY2017 Maximum value	FY2017 Average	FY2011 - FY2017 Minimum value	FY2011 - FY2017 Maximum value	FY2011 - FY2017 Average	Changes	Coefficient of variation	Trends (*3)
1	Taga River System		Satone River	Yamagoya Bridge	Kitaibaraki City	30	93	51	23	2,000	186		2.13	
2				Murayama Bridge		32	126	67	32	710	170		1.01	
3			Hanazono River	Kurabeishi		19	32	27	19	250	61		0.81	
4				Isonare Bridge		12	78	41	12	300	65		0.89	
5			Okita River	Sakae Bridge	Takahagi City	18	43	31	0	3,100	163		3.68	
6				Sakai Bridge	Kitaibaraki City	34	110	58	24	2,200	186		2.34	
7			Hananuki River	Shinhananuki Bridge	Takahagi City	18	82	57	18	650	131		1.00	
8	Kujigawa River System		Kujigawa River	Yamagata	Hitachiomiya City	0	38	20	0	1,040	73		2.76	
9				Sakaki Bridge	Hitachi City/Tokai Village	14	30	22	0	290	51		1.29	
10	Nakagawa River System	Nakagawa River Area	Nakagawa River	Noguchi	Hitachiomiya City/Shirosato Town	0	14	9.5	0	169	27		1.66	
11				Shimokunii	Mito City	31	180	73	12	5,500	311		3.41	
12				Katsuta Bridge	Mito City/ Hitachinaka City	0	177	68	0	4,400	376		2.17	
13			Nakamaru River	Yanagisawa Bridge	Hitachinaka City	68	217	142	53	4,400	745		1.13	
14		Hinumagawa River Area	Hinumamae River	Nagaoka Bridge	Ibaraki Town	51	64	55	20	510	132		1.01	
15			Hinuma River	Takahashi		0	12	3.0	0	480	50		2.18	
16			Kansei River	Kansei Bridge		18	114	50	18	167	68		0.69	
17			Daiya River	Oya Bridge	Hokota City	48	87	71	48	810	209		0.90	
18			Hinuma River	Hinuma Bridge	Mito City/Oarai Town	70	156	113	36	1,260	317		0.83	
19	Tonegawa River System	Kitaura River Area	Hokota River	Asahi Bridge	Hokota City	70	149	110	68	420	199		0.61	
20			Tomoe River	Shintomoegawa Bridge		35	150	70	35	690	204		0.92	
21			Taiyo River	Tazuka Bridge		37	126	80	37	720	162		0.88	
22			Takeda River	Uchijuku-ohashi Bridge	Namegata City	66	102	82	66	630	201		0.65	
23			Yamada River	Nioroshi Bridge		52	173	87	35	600	154		0.81	
24			Kurakawa River	Kurakawa Bridge		48	142	85	48	1,020	175		1.09	
25			Gantsu River	JA Yokohashi Bridge		57	127	77	53	320	137		0.55	
26			Nagare River	Suhoi Bridge	Kashima City	82	163	113	82	1,260	292		0.93	
27		Kasumigaura River Area	Sonobe River	Sonobeshin Bridge	Omitama City	39	93	67	11	1,370	273		1.18	
28			Sanno River	Tokoro Bridge		362	586	471	17	1,950	785		0.71	
29			Koise River	Heiwa Bridge	Ishioka City	112	149	135	27	830	210		1.05	
30			Kajinashi River	Kamishuku Bridge	Namegata City	34	263	126	34	270	111		0.65	
31			Hishiki River	Hishiki Bridge	Kasumigaura City	170	199	187	170	1,320	448		0.65	
32			Ichinose River	Kawanaka Bridge		206	407	286	206	1,870	596		0.67	
33			Sakai River	Sakai Bridge/National Route 354	Tsuchiura City	0	305	159	0	2,300	305		1.50	
34			Shinkawa River	Shinten Bridge		595	666	641	595	5,500	1,992		0.72	
35			Sakura River	Eiri Bridge	Tsuchiura City/Tsukuba City	0	34	22	0	270	70		0.88	
36			Bizen River	Bizengawa Bridge	Tsuchiura City	31	1,380	860	31	4,800	1,668		0.66	
37			Hanamuro River	Shinwa Bridge		178	314	219	29	1,390	538		0.74	
38			Seimei River	Katsuhashi Bridge	Ami Town	555	650	591	546	5,800	1,319		0.96	
39			Onogawa River	Okuhara-ohashi Bridge	Ryugasaki City/Ushiku City	251	390	313	220	990	495		0.47	
40			Shintone River	Shintone Bridge	Inashiki City	76	276	195	11	440	263		0.37	
41		Hitachitonegawa River Area	Yorokoshi River	Horinouchi Bridge	Itako City	75	147	105	22	530	197		0.65	
42			Maekawa River	Ayame Bridge		122	215	168	16	630	314		0.56	
43		Kinugawa River Area	Kinugawa River	Kawashima Bridge	Chikusei City	0	17	4.3	0	32	5.2		1.77	
44				Takishita Bridge	Moriya City	27	110	60	11	380	103		0.85	
45			Tagawa River	Tagawa Bridge	Chikusei City	13	34	25	0	1,080	78		2.68	
46		Kokaigawa River Area	Kokai River	Kuroko Bridge		63	204	107	13	620	166		0.72	
47				Fumimaki Bridge	Toride City	26	30	28	26	500	97		1.18	
48			Yatagawa River	Maruyama Bridge	Tsukuba City	61	249	134	61	1,800	468		1.14	
49			Nishiyata River	Sakaimatsu Bridge		44	143	72	30	1,160	302		1.05	
50			Inari River	Oguki Bridge		264	400	340	264	2,150	818		0.71	
51		Tonegawa River Area	Tonegawa River	Kurihashi Bridge	Koga City	0	107	48	0	1,440	105		2.47	
52				Fukawa	Tone Town	15	103	43	14	820	144		1.19	
53				Sawara	Inashiki City	22	37	30	11	1,220	123		1.85	
Total number of samples			1,362			0	1,380	134	0	5,800	318			
Detection times			1,316											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

5) Tochigi Prefecture

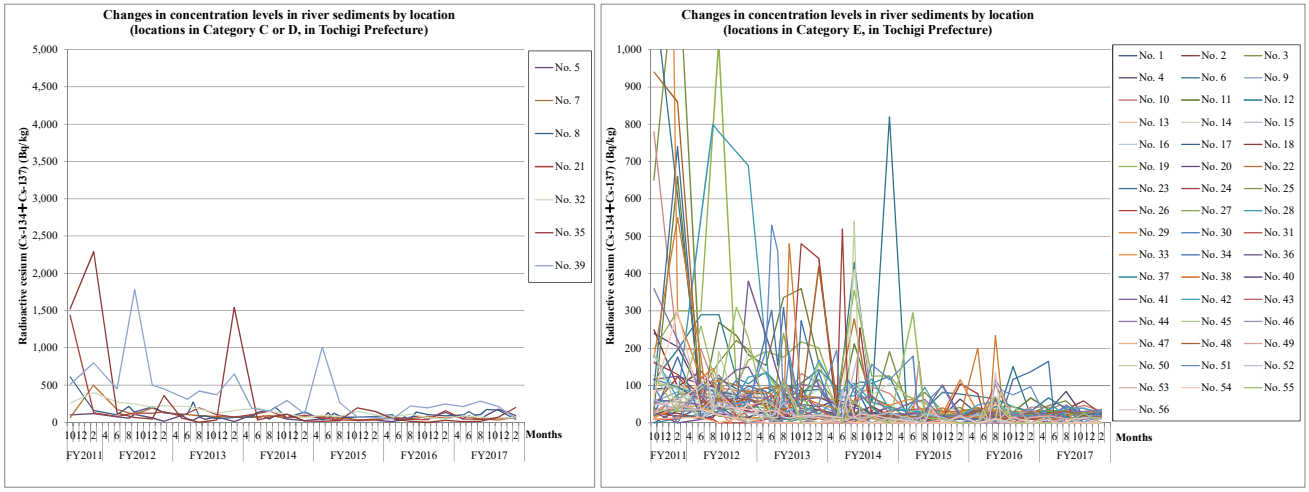
In Tochigi Prefecture, surveys were conducted 23 to 44 times from October 2011 to February 2018 at 56 locations (rivers) in public water areas (this analysis excludes the survey results from 49 locations where the survey was conducted only in 2011).

Regarding the concentration levels of detected values, one location was categorized as Category C, six locations were categorized as Category D and 49 locations were categorized as Category E (see Table 4.1.2-16 and Table 4.1.2-17).

Concentration levels were generally decreasing at 49 locations and fluctuating at seven locations.

Table 4.1.2-16 Categorization of detected values at respective locations
(Tochigi Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No.39
D	Upper 25 to 50 percentile	6	No.5, No.7, No.8, No21, No.32, No.35
E	Upper 50 to 100 percentile (lower 50%)	49	No.1, No.2, No.3, No.4, No.6, No.9, No.10, No.11, No.12, No.13, No.14, No.15, No.16, No.17, No.18, No.19, No.20, No.22, No.23, No.24, No.25, No.26, No.27, No.28, No.29, No.30, No.31, No.33, No.34, No.36, No.37, No.38, No.40, No.41, No.42, No.43, No.44, No.45, No.46, No.47, No.48, No.49, No.50, No.51, No.52, No.53, No.54, No.55, No.56



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-14 Changes in concentration levels over the years at respective locations
(Tochigi Prefecture: river sediment)

Table 4.1.2-17 Detection of radioactive cesium at respective locations (Tochigi Prefecture: river sediment)

No.	Water area			Location	Municipality	FY2017 Minimum value	FY2017 Maximum value	FY2017 Average	FY2011 - FY2017 Minimum value	FY2011 - FY2017 Maximum value	FY2011 - FY2017 Average	Changes	Coefficient of variation	Trends (*3)
1	Nakagawa River System		Nakagawa River	Ikuyobashishita	Nasushiobara City	0	35	12	0	96	24		1.13	
2				Komei Bridge		20	33	27	11	250	48		1.07	
3			Takaomata River	Takaomata Bridge	Nasu Town	18	59	39	12	1,290	146		1.83	
4			Yukawa River	Yukawa Bridge		14	84	37	14	240	59		0.91	
5			Nakagawa River	Kamikuroiso	Nasushiobara City/Nasumachi Town	40	178	85	11	178	65		0.55	
6			Yosasa River	Yosasa Bridge	Nasu Town	21	28	24	0	1,160	161		1.75	
7			Kurokawa River	Shinden Bridge		33	85	59	30	500	96		0.94	
8			Yosasa River	Kawada Bridge	Otawara City	38	173	118	21	610	124		0.75	
9			Nakagawa River	Kurobane		16	40	26	15	102	35		0.56	
10			Matsuba River	Tributary		32	48	42	19	780	87		1.38	
11			Sabigawa River	Udagawa Bridge		22	36	29	10	660	121		1.25	
12			Momura River	Momuranaka Bridge		26	67	40	21	290	100		0.70	
13			Hokigawa River	Yunohara	Nasushiobara City	0	14	8.8	0	100	34		0.98	
14				Sekiba Bridge		15	36	22	15	410	77		1.03	
15				Iwai Bridge	Otawara City	12	18	15	12	204	38		1.11	
16				Hokigawa Bridge		0	24	13	0	165	26		1.12	
17			Nakagawa River	Shinnaka Bridge	Nakagawa Town	0	24	12	0	107	22		1.02	
18			Mumogawa River	Kosei Bridge		0	16	7.7	0	43	14		0.72	
19			Arakawa River	Saikachi Bridge	Shioya Town	21	34	28	14	1,020	151		1.35	
20				Renjo Bridge	Sakura City	0	13	8.8	0	63	14		1.13	
21			Uchikawa River	Tanaka Bridge	Yaita City	38	57	48	26	1,440	137		1.98	
22				Asahi Bridge	Sakura City	29	34	31	18	279	61		0.87	
23			Arakawa River	Mukada Bridge	Nasu Karasuyama City	0	15	12	0	740	45		2.49	
24			Egawa River	Tributary		0	59	21	0	520	75		1.62	
25	Tonegawa River System	Kinugawa River System	Kinugawa River	Kawaji Daiichi Power Station, front	Nikko City	15	33	23	0	75	27		0.63	
26			Yunishi River	Maesawa Bridge		0	13	6.5	0	25	6.3		1.26	
27			Ojika River	Tributary		0	0	0	0	240	21		2.25	
28			Kinugawa River	Kosagoe		11	43	22	11	800	128		1.87	
29			Itaana River	Tributary		12	35	21	12	4,900	176		4.25	
30			Yukawa River	Tributary		0	0	0	0	137	26		1.70	
31			Daiya River	Shinkyo Bridge		0	11	2.8	0	123	27		1.02	
32			Shidobuchi River	Sujichigai Bridge		57	88	70	44	400	146		0.59	
33			Daiya River	Kaishin Bridge (Harigai)		0	19	2.7	0	69	13		1.15	
34			Kinugawa River	Sanuki	Shioya Town	11	165	39	0	470	62		1.55	
35			Nishi-Kinugawa River	Nishi-Kinugawa Bridge	Utsunomiya City	11	201	74	0	2,290	270		2.13	
36			Kinugawa River	Kinugawabashi Bridge(Hoshakuji Temple)		0	0	0	0	31	6.4		1.55	
37				Daidoizumi Bridge	Mooka City	0	15	3.8	0	95	17		1.34	
38			Egawa River	Tributary	Shimotsuke City	11	14	12	0	550	72		1.57	
39			Akabori River	Nikko City Hall, front	Nikko City	55	287	192	49	1,780	380		0.97	
40				Kiwadajima		14	47	28	14	380	69		1.11	
41			Tagawa River	Ozobashi Bridge	Utsunomiya City	0	12	4.9	0	150	27		1.36	
42			Kamagawa River	Tsukushi Bridge		22	41	33	14	182	63		0.74	
43			Tagawa River	Meiji Bridge	Kaminokawa Town	0	0	0	0	122	24		1.47	
44				Yanabashi Bridge	Oyama City	25	35	30	12	360	69		1.07	
45		Watarase River Area	Omoi River Area	Kurokawa River	Kaijima Bridge	Kanuma City	0	0	0	0	109	15		1.90	
46					Onari Bridge	Mibu Town	0	0	0	0	75	11		1.78	
47				Oashi River	Akaishi Bridge	Kanuma City	0	0	0	0	53	5.5		2.08	
48				Koyabu River	Koyabu Bridge		16	33	23	0	940	112		2.19	
49				Omoi River	Tamotsu Bridge	Tochigi City	0	12	3.0	0	119	13		2.35	
50					Otome-ohashi Bridge	Oyama City	0	17	2.4	0	540	42		2.14	
51			Uzuma River Area	Uzuma River	Uzuma Bridge	Tochigi City	0	48	17	0	530	89		1.22	
52			Watarase River Area	Watarase River	Watarasegawa River intake weir at Sori Power Station	Nikko City	0	15	5.4	0	90	21		0.91	
53					Hajika Bridge	Ashikaga City	0	19	10	0	80	19		1.06	
54					Nakabashi Bridge		0	0	0	0	300	20		3.02	
55					Watarase-ohashi Bridge	Tatebayashi City	0	26	6.5	0	310	69		1.44	
56					Shinkai Bridge	Tochigi City	0	12	4.7	0	164	27		1.33	
Total number of samples			1,769			0	287	25	0	4,900	66			
Detection times			1,442											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

6) Gunma Prefecture

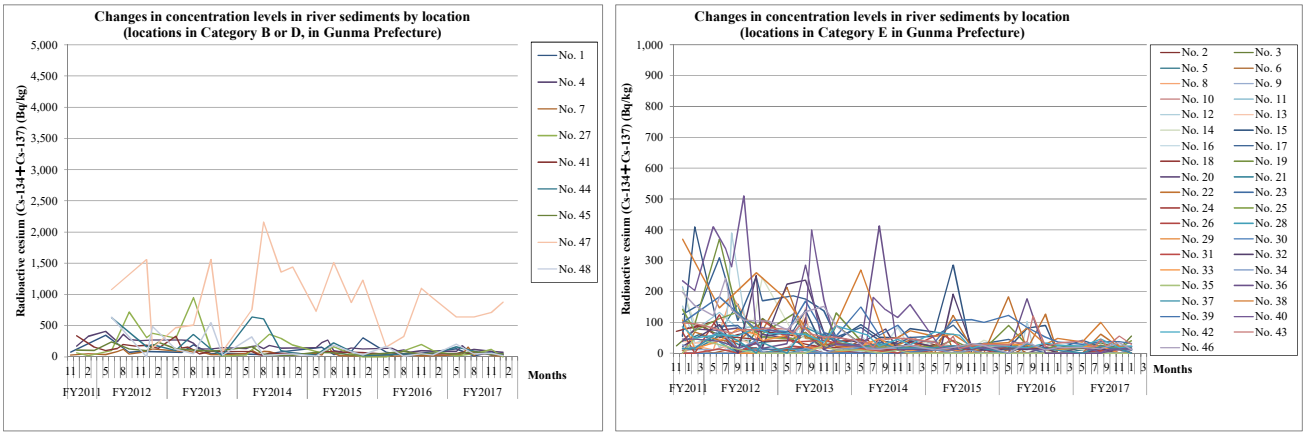
In Gunma Prefecture, surveys were conducted 14 to 44 times from November 2011 to January 2018 at 48 locations (rivers) in public water areas (this analysis excludes the survey results from eight locations where the survey was conducted only in 2011).

Regarding the concentration levels of detected values, one location was categorized as Category B, eight locations as Category D, and 39 locations as Category E (see Table 4.1.2-18 and Table 4.1.2-19).

Concentration levels were generally decreasing at 39 locations and fluctuating at nine locations.

Table 4.1.2-18 Categorization of detected values at respective locations
(Gunma Prefecture: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	1	No. 47
C	Upper 10 to 25 percentile	0	(None)
D	Upper 25 to 50 percentile	8	No.1, No.4, No.7, No.27, No.41, No.44, No.45, No.48
E	Upper 50 to 100 percentile (lower 50%)	39	No.2, No.3, No.5, No.6, No.8, No.9, No.10, No.11, No.12, No.13, No.14, No.15, No.16, No.17, No.18, No.19, No.20, No.21, No22, No.23, No.24, No.25, No.26, No.28, No.29, No.30, No.31, No.32, No.33, No.34, No.35, No.36, No.37, No.38, No.39, No.40, No.42, No.43, No.46



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-15 Changes in concentration levels over the years at respective locations
(Gunma Prefecture: river sediment)

Table 4.1.2-19 Detection of radioactive cesium at respective locations (Gunma Prefecture: river sediment)

Location					FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area			Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Tonegawa River System	Tonegawa River Area	Tonegawa River	Hirose Bridge	Minakami Town	18	131	64	18	350	97		0.88	
2				Tsukiyono Bridge		11	23	16	11	115	38		0.66	
3			Akaya River	Kosode Bridge		15	56	32	11	113	36		0.79	
4			Sakura River	In Ooaza Yachi	Kawaba Village	74	182	109	74	500	179		0.52	
5			Katashina River	Kirinoki Bridge	Katashina Village	0	11	5.5	0	159	26		1.26	
6				Tonemachitakatoya	Numata City	0	28	4.0	0	58	7		1.92	
7				Futae Bridge		14	158	53	14	161	58		0.71	
8			Agatsuma River	Shinto Bridge	Naganohara Town	0	0	0	0	187	16		2.48	
9			Shirasuna River	Shuttatsu Bridge	Nakanojo Town	0	14	6.0	0	19	4		1.55	
10			Agatsuma River	Downstream of Azuma Bridge	Higashi-Agatsuma Town	0	0	0	0	22	2		2.43	
11			Nakuta River	Tonoda Bridge	Takayama Village	24	37	28	15	215	49		0.96	
12			Agatsuma River	Agatsuma Bridge	Shibukawa City	0	14	2.0	0	610	37		2.60	
13			Tonegawa River	Taisho Bridge		0	17	9.3	0	147	26		0.98	
14			Takizawa River	Shintakizawa Bridge	Shibukawa City/ Yoshioka Town	0	13	8.8	0	245	46		1.27	
15			Tonegawa River	Gunma-ohashi Bridge	Maebashi City	12	19	16	0	410	69		1.33	
16				Fukushima Bridge	Tamamura Town	0	23	9.3	0	112	29		1.04	
17		Karasu River Area	Nagai River	Kamigonda Bridge	Takasaki City	19	42	26	15	310	88		0.90	
18			Karasu River	Karasugawa Bridge		0	16	7.0	0	88	26		0.85	
19			Usui River	Nakase Bridge	Annaka City	0	20	14	0	370	61		1.24	
20				Hanataka Bridge	Takasaki City	11	22	17	0	82	25		1.11	
21			Kabura River	Tadakawa Bridge	Shimonita Town	0	0	0	0	56	7		1.79	
22				Kaburagawa Bridge	Takasaki City/ Fujioka City	0	62	21	0	214	50		1.12	
23			Ogawa River	Kinzan Bridge	Kanra Town	0	18	11	0	90	24		1.01	
24			Nanmoku River	Ozawa Bridge	Nanmoku Village	0	12	5.5	0	68	7		1.99	
25			Someya River	Yakushi Bridge	Shinto Village	16	41	25	11	142	42		0.89	
26			Inogawa River	Kamakura Bridge	Takasaki City	0	25	6.3	0	125	19		1.44	
27			Karasu River	Iwakura Bridge	Takasaki City/ Tamamura Town	0	120	47	0	950	182		1.25	
28			Kanna River	Shinkaname Bridge	Ueno Village	0	0	0	0	37	6		1.83	
29			Kanna River	Morito Bridge	Kanna Town	0	0	0	0	13	1		4.00	
30			Kanna River	Tobukyo Bridge	Fujioka City/ Kamikawa Town	0	0	0	0	43	4		3.11	
31			Kanna River	Kannagawa Bridge	Kamisato Town	0	13	6.5	0	107	21		1.48	
32		Tonegawa River Area	Tonegawa River	Bando-ohashi Bridge	Honjo City	0	16	4.0	0	252	57		1.38	
33			Akagishirakawa River	In Shimohosoi Town	Maebashi City	0	23	11	0	108	29		0.89	
34			Momonoki River	Utsuboi Bridge		0	14	3.5	0	75	12		1.41	
35			Arato River	Okuhara Bridge		0	0	0	0	48	5		2.35	
36			Kasukawa River	Hozumi Bridge	Isesaki City	0	15	3.8	0	413	49		1.96	
37			Hirose River	Nakajima Bridge		0	23	9.3	0	83	24		0.89	
38			Hayakawa River	Hayakawa Bridge		21	100	45	21	370	93		1.00	
39				Maejima Bridge	Ota City	29	38	34	29	183	80		0.55	
40			Tonegawa River	Tone-ozeki Weir	Chiyoda Town/ Gyoda City	0	18	12	0	640	105		1.35	
41		Watarase RiverArea	Koguro River	Kayano Bridge	Kiryu City	41	75	57	26	340	96		0.73	
42			Watarase River	Takatsudo	Midori City	18	46	27	16	89	46		0.50	
43				Intake for Akaiwayosui water channel	Kiryu City	21	56	35	15	121	51		0.50	
44			Tatara River	Ejiri Bridge	Oura Town	39	160	85	19	640	169		1.17	
45			Kiryu River	Kannon Bridge	Kiryu City	42	84	58	25	240	89		0.64	
46				Sakai Bridge	Kiryu City/ Ashikaga City	12	35	20	0	243	70		0.94	
47			Tsuruuda River	Lake Jonuma	Tatebayashi City	641	880	719	92	2,160	907		0.58	
48			Yatagawa River	Togoda Bridge	Meiwa Town/Itakura	22	204	83	0	640	140		1.32	
Total number of samples			1,356			0	880	37	0	2,160	68			
Detection times			1,051											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

7) Chiba and Saitama Prefectures and Tokyo Metropolis

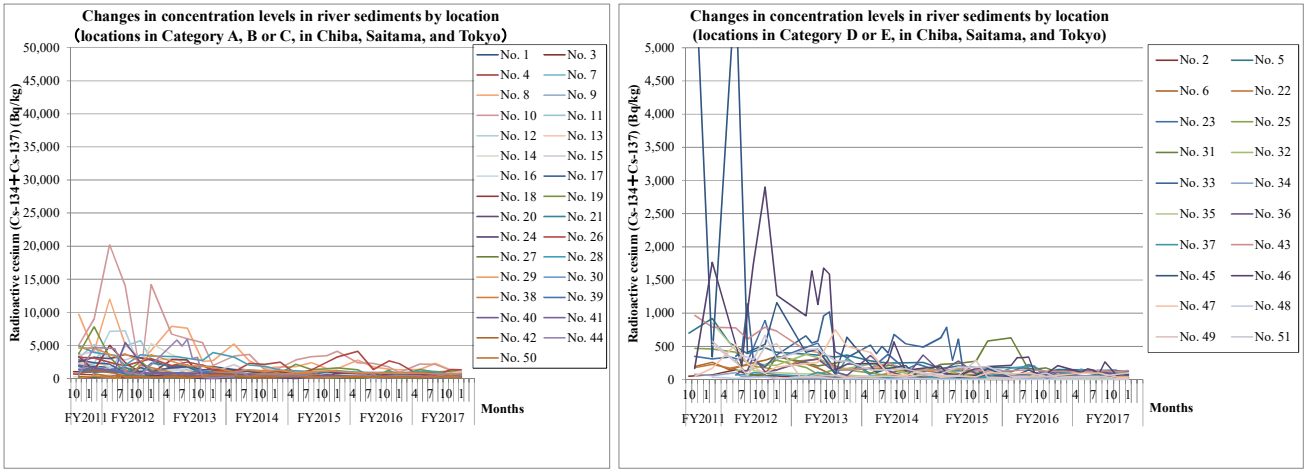
In Chiba and Saitama Prefectures and Tokyo Metropolis, surveys were conducted 24 to 43 times from October 2011 to January 2018 at 51 locations (rivers) in public water areas (47 locations in Chiba Prefecture, two locations in Saitama Prefecture, and two locations in Tokyo Metropolis).

Regarding the concentration levels of detected values, six locations were categorized as Category A, seven locations as Category B, 18 locations as Category C, 13 locations as Category D, and seven locations as Category E (see Table 4.1.2-20 and Table 4.1.2-21).

Concentration levels were generally decreasing at 46 locations and fluctuating at five locations.

Table 4.1.2-20 Categorization of detected values at respective locations
(Chiba and Saitama Prefectures and Tokyo Metropolis: river sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	6	No.8, No.10, No.15, No.19, No.26, No.28
B	Upper 5 to 10 percentile	7	No.1, No.11, No.12, No.14, No.18, No.20, No.29
C	Upper 10 to 25 percentile	18	No.3, No.4, No.7, No.9, No.13, No.16, No.17, No.21, No.24, No.27, No.30, No.38, No.39, No.40, No.41, No.42, No.44, No.50
D	Upper 25 to 50 percentile	13	No.5, No.22, No.23, No.25, No.31, No32, No.33, No.36, No.37, No.43, No.46, No.47, No.51
E	Upper 50 to 100 percentile (lower 50%)	7	No.2, No.6, No.34, No.35, No.45, No.48, No.49



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-16 Changes in concentration levels over the years at respective locations
(Chiba and Saitama Prefectures and Tokyo Metropolis: river sediment)

Table 4.1.2-21 Detection of radioactive cesium at respective locations (Chiba and Saitama Prefectures and Tokyo Metropolis: river sediment)

No.	Location: Prefecture	Water area		Location	Municipality	FY2017: Minimum value	FY2017: Maximum value	FY2017: Average	FY2011 - FY2017: Minimum value	FY2011 - FY2017: Maximum value	FY2011 - FY2017: Average	Changes	Coefficient of variation	Trends (*3)
1	Chiba Prefecture	Tonegawa River System	Shogen River	Fukama-ohashi Bridge	Inzai City/Sakae Town	703	824	762	590	1,910	1,193		0.35	
2				Shinbei Bridge		16	25	22	0	149	40		0.76	
3			Nagato River	Intake at Maeshinden Water	Sakae Town	318	411	365	171	1,230	460		0.56	
4				Nagato Bridge		71	239	162	71	660	253		0.56	
5				Fujimi Bridge		106	146	127	106	920	301		0.65	
6			Ryudai River	Ryumatsuno Bridge	Narita City	25	50	34	25	350	117		0.81	
7			Nekona River	Shinkawa Floodgate		69	511	365	69	2,300	845		0.61	
8		Feeder rivers of Lake Teganuma	Ohori River	Kitakashiwa Bridge	Kashiwa City	747	2,270	1,409	747	12,000	3,457		0.83	
9			Otsu River	Sanno Bridge, under	Kamagaya City	269	483	352	269	3,900	790		0.98	
10				Kaminuma Bridge	Kashiwa City	1,000	2,180	1,630	380	20,200	4,606		1.04	
11			Someiriotoshi	Someishinbashi Bridge		287	645	464	24	5,700	1,355		1.18	
12			Kanayamaotoshi	Downstream of Karuizawasakai Bridge	Kamagaya City/Shiroi City	414	764	569	305	7,200	1,265		1.44	
13				Nauchi Bridge	Shiroi City	274	408	349	129	2,400	803		0.75	
14			Kamenari River	Kamenari Bridge	Inzai City	291	485	373	162	5,300	829		1.46	
15		Feeder rivers of Lake Inbanuma	Igusasuiro Channel	Downstream of Igusasuiro	Kamagaya City	695	1,120	1,001	695	4,100	1,648		0.65	
16			Futae River	Tomigaya Bridge	Funabashi City/Shiroi City	291	475	362	291	3,300	899		0.85	
17			Kanzaki River	Kanzaki Bridge	Yachiyo City/Inzai City	253	447	334	97	2,800	864		0.85	
18			Kanno River	Kanno Bridge	Yachiyo City	419	617	494	58	5,000	1,047		1.15	
19			Inba Discharge Channel (upperreaches)	Yachiyo Bridge		970	1,340	1,190	106	7,800	1,583		0.96	
20			Teguri River	Mumei Bridge	Sakura City	577	910	745	577	3,600	1,447		0.66	
21			Moroto River	Moroto Bridge	Inzai City	153	292	204	145	2,330	748		0.92	
22			Kashima River	Iwatomi Bridge	Sakura City	43	60	54	43	307	135		0.55	
23			Takasaki River	Ryuto Bridge		91	141	124	91	890	243		0.73	
24			Kashima River	Kashima Bridge		17	316	216	0	1,080	203		1.06	
25			Inbasuiro Channel	Tsurumaki Bridge	Inzai City	83	122	105	20	470	157		0.79	
26		Edogawa River System	Toneunga Canal	Unga Bridge	Nagareyama City/Noda City	404	1,340	875	404	4,130	2,036		0.45	
27			Edogawa River	Nagareyama Bridge	Nagareyama City/Misato City	32	254	153	32	520	224		0.56	
28			Sakagawa River	Benten Bridge	Matsudo City	613	1,040	824	613	4,900	2,065		0.63	
29			Shinsaka River	Sakane Bridge		681	830	727	681	4,600	1,731		0.71	
30			Edogawa River	Shinkatsushika Bridge	Matsudo City/Katsushika City	167	263	229	149	1,360	604		0.59	
31				Ichikawa Bridge	Ichikawa City/Edogawa City	33	93	70	33	629	210		0.71	
32				Vicinity of Keiyo Road		34	111	63	34	380	135		0.68	
33				Gyotokukadozeki Weir (upperreaches)	Ichikawa City	28	110	58	21	1,140	347		0.87	
34				Shingyotokubashi Bridge		0	16	11	0	104	27		0.87	
35			Kyu-Edogawa River	Edogawa Floodgate, down	Ichikawa City/Edogawa City	19	22	21	15	850	83		2.02	
36				8 km Point to the estuary		56	154	100	30	368	148		0.70	
37				Imai Bridge		19	153	68	18	323	79		0.87	
38				Urayasu Bridge	Urayasu City/Edogawa City	183	361	262	29	2,050	563		0.72	
39			Mamagawa River	Nemoto Floodgate	Ichikawa City	128	191	163	128	1,100	393		0.75	
40			Kokubu River	Suwada Bridge		252	346	287	223	5,400	862		1.25	
41			Haruki River	Before the confluence with Kokubu River		156	308	229	134	1,380	476		0.78	
42			Hasen-okashiwa River	Downstream of Nakazawashinbashi	Kamagaya City/Ichikawa City	188	221	201	56	1,220	321		0.78	
43			Okashiwa River	Sengen Bridge	Ichikawa City	113	136	127	113	970	314		0.88	
44			Mamagawa River	Mitomae Bridge		226	445	341	34	5,900	1,164		1.42	
45		Ebigawa River		Yachiyo Bridge	Funabashi City	21	60	40	21	6,400	682		2.41	
46		Inba Discharge Channel (lowerreaches)		Shinhanamigawa Bridge	Chiba City	67	266	131	67	2,900	517		1.26	
47		Miyako River		Miyako Bridge		38	100	68	37	750	173		1.05	
48	Saitama Prefecture	Arakawa River System	Arakawa River Middle Reaches	Onari Bridge	Konosu City	0	0	0	0	38	11		1.28	
49			Arakawa River Lower Reaches	Sasame Bridge	Toda City	11	51	33	11	540	120		1.37	
50	Tokyo Metropolis			Kasai Bridge	Koto City/Edogawa City	110	199	163	75	700	281		0.49	
51			Sumida River	Ryogoku Bridge	Chuo City	36	100	64	27	670	226		0.78	
Total number of samples			1,386			0	2,270	328	0	20,200	762			
Detection times			1,368											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

(2)-2 Lakes

1) Miyagi Prefecture

In Miyagi Prefecture, surveys were conducted 13 to 25 times from October 2011 to December 2017 for lake sediment samples collected at 21 locations.

Regarding the concentration levels of detected values, one location was categorized as Category C, three locations were categorized as Category D and 17 locations were categorized as Category E (see Table 4.1.2-22 and Table 4.1.2-23).

Concentration levels were generally decreasing at 13 locations, unchanged at two locations, and fluctuating at six locations.

Table 4.1.2-22 Categorization of detected values at respective locations
(Miyagi Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No. 16
D	Upper 25 to 50 percentile	3	No. 9, No. 13, No. 17
E	Upper 50 to 100 percentile (lower 50%)	17	No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7, No. 8, No. 10, No. 11, No. 12, No. 14, No. 15, No. 18, No. 19, No. 20, No. 21

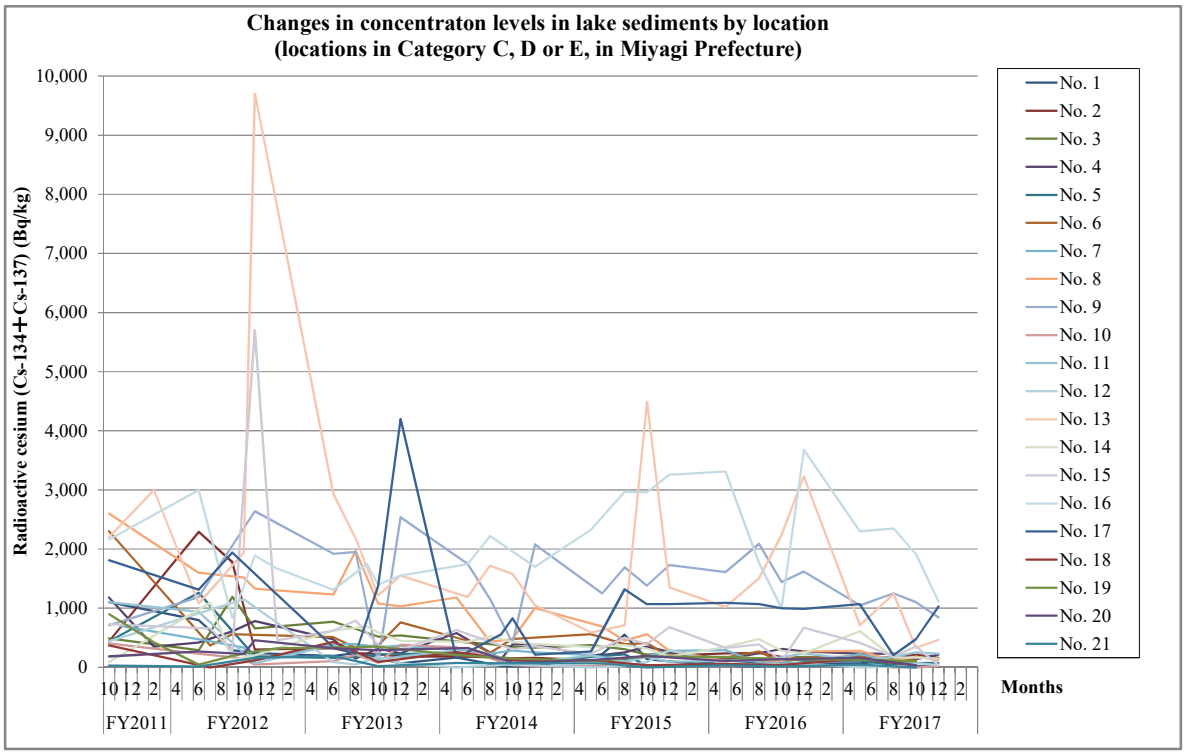


Figure 4.1.2-17 Changes in concentration levels over the years at respective locations
(Miyagi Prefecture: lake sediment)

Table 4.1.2-23 Detection of radioactive cesium at respective locations (Miyagi Prefecture: lake sediment)

Location					FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area		Location	Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Kitakami River System	Kurikoma Dam	Dam site	Kurihara City	10	111	52	10	1,100	194		1.37	
2		Hanayama Dam	Dam site		150	217	175	123	2,290	359		1.47	
3		Narugo Dam	Dam site	Osaki City	130	159	145	130	1,190	383		0.67	
4		Lake Naganuma	Dam site		135	232	203	133	1,180	353		0.66	
5		Shukunosawata meike Pond	Pond exit	Kurihara City	41	113	76	10	1,260	189		1.33	
6	Naruse River System	Futatsuishi Dam	Dam site	Kami Town	96	186	134	81	2,300	434		1.05	
7		Urushizawa Dam	Dam site		89	226	141	51	700	254		0.59	
8		Minamikawa Dam	Dam site	Taiwa Town	112	277	173	103	2,600	780		0.87	
9	Sunaoshi River System	Sonoseki Dam	Dam site	Rifu Town	844	1,250	1,061	88	2,640	1,456		0.43	
10	Nanakita River System	Nanakita Dam	Dam site	Sendai City	0	34	13	0	400	100		1.22	
11	Marutazawatameike Pond		Pond exit		123	250	194	69	1,100	247		1.04	
12	Natori River System	Okura Dam	Dam site		0	75	32	0	1,150	128		1.95	
13	Lake Amanuma		Lake exit		332	1,240	687	332	9,700	1,969		0.96	
14	Natori River System	Kamafusa Dam	Dam site	Kawasaki Town	150	613	274	85	1,090	387		0.59	
15	Abukuma River System	Kawarago Dam	Dam site	Shiroishi City	36	415	246	36	5,700	637		1.68	
16		Shichikashuku Dam	Dam site	Shichikashuku Town	1,110	2,350	1,918	840	3,680	2,086		0.36	
17	Lake Bagyunuma		Lake exit	Shiroishi City	207	1,070	696	160	4,200	1,028		0.83	
18	Abukuma River System	Murata Dam	Dam site	Murata Town	29	141	85	0	430	139		0.96	
19	Kitakami River System	Lake Izunuma	Lake exit	Tome City	97	130	114	48	900	252		0.80	
20	Natori River System	Tarumizu Dam	Dam site	Natori City	34	158	96	34	460	208		0.56	
21	Naruse River System	Miyatoko Dam	Dam site	Taiwa Town	0	48	24	0	195	56		1.09	
Total number of samples		458			0	2,350	344	0	9,700	597			
Detection times		450											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

: Increasing
: Decreasing
: Varying
: Unchanged

A	B	C	D	E

2) Fukushima Prefecture

(i) Hamadori

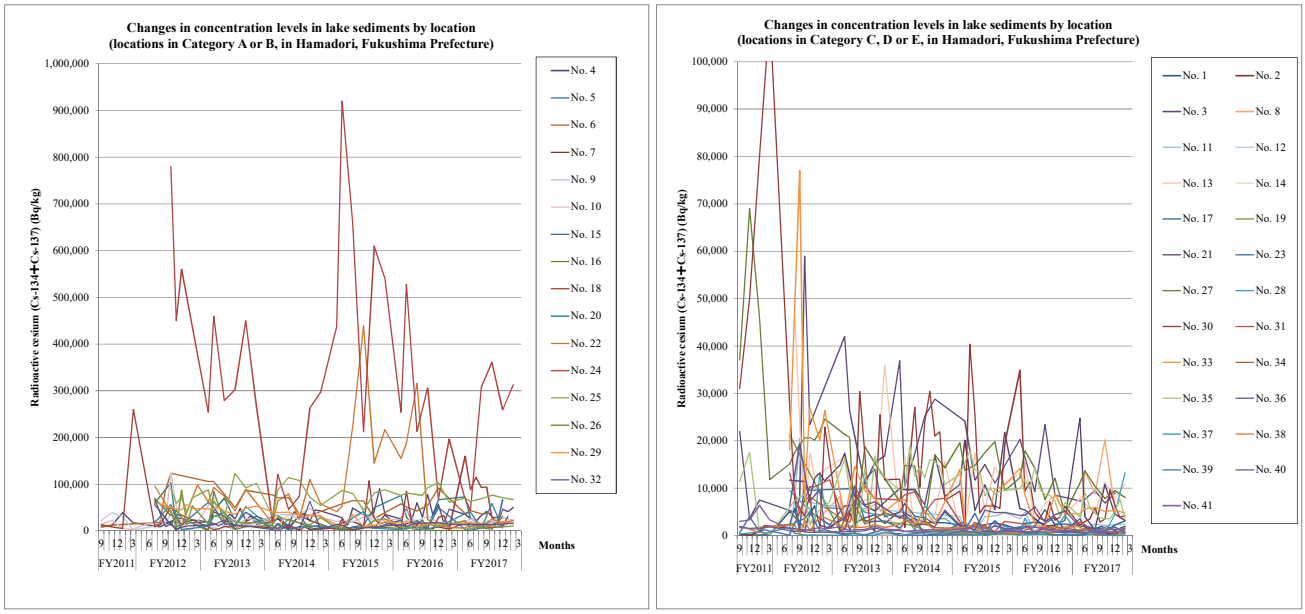
In Hamadori, Fukushima Prefecture, surveys were conducted 25 to 64 times from September 2011 to February 2018 for lake sediment samples collected at 41 locations.

Regarding the concentration levels of detected values, nine locations were categorized as Category A, seven locations as Category B, 11 locations as Category C, 10 locations as Category D, and four locations as Category E (see Table 4.1.2-24 and Table 4.1.2-25).

Concentration levels were generally decreasing at 22 locations, were unchanged at three locations, were fluctuating at 15 locations, and were generally increasing at one location.

Table 4.1.2-21 Categorization of detected values at respective locations
(Hamadori, Fukushima Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	9	No. 4, No. 5, No. 6, No. 9, No. 10, No. 18, No. 20, No. 24, No. 25
B	Upper 5 to 10 percentile	7	No. 7, No. 15, No. 16, No. 22, No. 26, No. 29, No. 32
C	Upper 10 to 25 percentile	11	No. 3, No. 8, No. 11, No. 13, No. 17, No. 21, No. 27, No. 28, No. 30, No. 33, No. 35
D	Upper 25 to 50 percentile	10	No. 1, No. 2, No. 23, No. 31, No. 34, No. 36, No. 38, No. 39, No. 40, No. 41
E	Upper 50 to 100 percentile (lower 50%)	4	No. 12, No. 14, No. 19, No. 37



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-18 Changes in concentration levels over the years at respective locations
(Hamadori, Fukushima Prefecture: lake sediment)

Table 4.1.2-25 Detection of radioactive cesium at respective locations (Hamadori, Fukushima Prefecture: lake sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area		Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Soso (farm pond)	Takei	Shinchi Town	1,080	2,200	1,828	129	6,300	2,557		0.59	
2		Uchizawa	Soma City	241	940	516	45	2,140	556		0.78	
3	Matsugabo Dam (Lake Utagawa)			6,850	9,500	8,062	3,600	59,000	17,589		0.67	
4	Mano Dam		Iitate Village	13,500	50,300	33,850	42	90,000	30,261		0.56	
5	Soso (farm pond)	Ainosawa		9,100	73,100	28,300	334	103,000	28,693		0.92	
6	Ganbe Dam Reservoir			36,400	43,500	38,700	8,200	123,000	60,475		0.49	
7	Soso (farm pond)	Fugane Dam		6,940	18,200	11,686	1,930	41,000	16,027		0.65	
8		Sasatoge		1,260	20,200	9,876	384	20,200	3,713		1.17	
9	Takanokura Dam Reservoir		Minamisoma City	10,100	28,100	19,367	960	39,000	21,916		0.43	
10	Yokokawa Dam Reservoir			9,400	26,400	19,367	1,240	125,000	25,428		0.86	
11	Soso (farm pond)	Tarayachi		1,580	2,450	2,222	420	20,500	3,880		1.03	
12		Takeshiyachi		16	238	106	0	1,340	483		0.87	
13		Ryugasaku		4,670	11,300	8,225	900	47,000	10,409		0.93	
14		Uwatashiro	Kawamata Town	14	235	114	14	5,100	680		1.75	
15		Koakuto	Namie Town	1,380	67,400	19,072	1,380	67,400	19,131		1.03	
16		Yosouchi	Iitate Village	910	31,500	10,444	520	84,000	15,262		1.28	
17		Myobusaku No. 2	Minamisoma City	800	3,520	2,095	294	14,000	3,499		0.88	
18	Ogaki Dam		Namie Town	9,470	160,000	72,008	740	260,000	30,175		1.53	
19	Soso (farm pond)	Uenokawa	Katsurao Village	158	683	290	114	21,200	1,798		2.18	
20		Heigoiri	Iitate Village	5,570	58,800	29,258	1,910	58,800	21,018		0.86	
21		Mekurasawa No. 2	Namie Town	1,240	24,800	8,088	1,240	24,800	9,302		0.62	
22		Joroku		6,100	25,500	15,683	6,100	439,000	85,174		1.13	
23	Furumichigawa Power Plant Dam		Tamura City	185	1,460	783	87	11,000	3,025		1.15	
24	Soso(farm pond)	Sawairi No. 1	Futaba Town	43,600	361,000	225,450	20,500	920,000	330,915		0.66	
25		Suzunai No. 4	Okuma Town	63,000	76,800	69,517	27,700	123,000	75,420		0.30	
26		Nishihaguro	Futaba Town	4,000	21,800	10,505	1,880	87,000	20,976		0.93	
27	Sakashita Dam		Okuma Town	7,800	13,700	10,083	350	69,000	17,005		0.69	
28	Soso (farm pond)	Atamamori 2		54	13,300	3,355	54	13,300	3,704		0.90	
29		Yonomori	Tomioka Town	9,100	20,300	15,450	8,200	62,000	30,117		0.55	
30	Takikawa Dam		Kawauchi Village	2,170	9,700	4,501	630	110,000	14,208		1.35	
31	Soso(farm pond)	Takinosawa	Tomioka Town	92	2,860	1,233	92	13,200	4,635		0.83	
32		Kamisigeoka No. 1	Naraha Town	13,600	16,700	14,317	590	67,000	14,315		0.97	
33		Shimoshigeoka		4,630	5,950	5,237	650	77,000	10,153		1.29	
34	Komachi Dam		Ono Town	932	1,550	1,226	142	8,200	2,548		0.75	
35	Kido Dam		Naraha Town	3,550	9,000	5,102	290	18,700	9,340		0.52	
36	Soso(farm pond)	Otsutsumi		1,220	2,040	1,592	1,200	19,300	4,728		0.81	
37	Iwaki(farm pond)	Shinike	Iwaki City	19	408	160	18	1,780	303		1.08	
38	Kodama Dam Reservoir (Lake Kodama)			619	1,900	1,177	213	4,000	1,618		0.58	
39	Iwaki (farm pond)	Kanoritsutsumishita		28	1,790	828	28	5,000	1,074		1.19	
40	Takashiba Dam Reservoir (Lake Takashiba)			605	871	734	605	1,940	947		0.34	
41	Shitoki Dam Reservoir			663	1,130	923	663	6,400	1,562		0.63	
Total number of samples		1,523		14	361,000	17,987	0	920,000	22,688			
Detection times		1,522										

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

: Increasing
: Decreasing
: Varying
: Unchanged

A	B	C	D	E

(ii) Nakadori

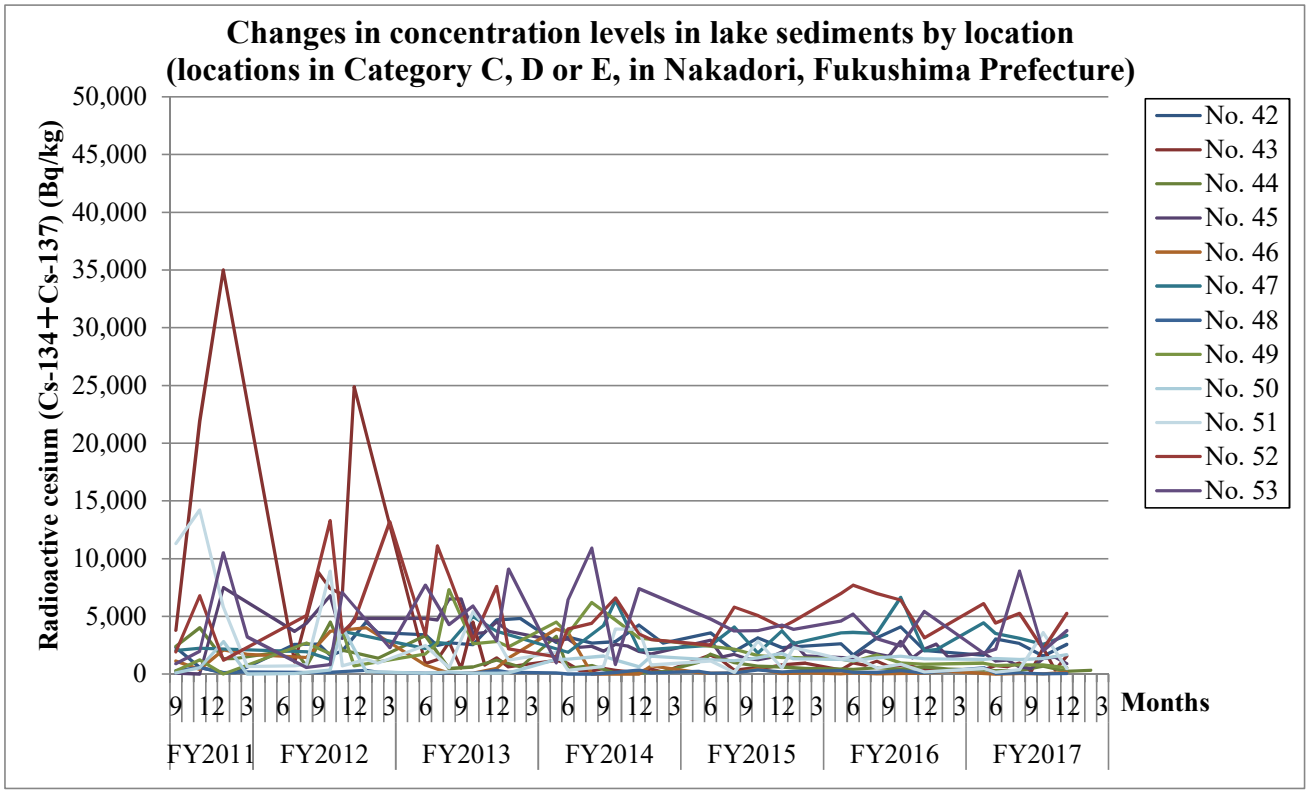
In Nakadori, Fukushima Prefecture, surveys were conducted 32 to 54 times from September 2011 to February 2018 for lake sediment samples collected at 12 locations.

Regarding the concentration levels of detected values, four locations were categorized as Category C, five locations as Category D, and three locations as Category E (see Table 4.1.2-26 and Table 4.1.2-27).

Concentration levels were generally decreasing at five locations, unchanged at two locations, fluctuating at four locations, and were generally increasing at one location.

Table 4.1.2-26 Categorization of detected values at respective locations
(Nakadori, Fukushima Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	4	No. 42, No. 47, No. 52, No. 53
D	Upper 25 to 50 percentile	5	No. 43, No. 45, No. 49, No. 50, No. 51
E	Upper 50 to 100 percentile (lower 50%)	3	No. 44, No. 46, No. 48

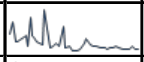
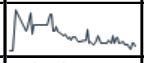
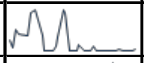
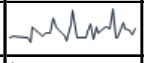
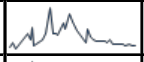
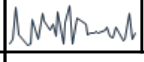


Notes: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-19 Changes in concentration levels over the years at respective locations
(Nakadori, Fukushima Prefecture: lake sediment)

Table 4.1.2-27 Detection of radioactive cesium at respective locations

(Nakadori, Fukushima Prefecture: lake sediment)

Location			FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
42	Surikamigawa Dam	Fukushima City	1,570	3,040	2,290	104	4,800	2,665		0.42	
43	Lake Handanuma (farm pond)	Kori Town	241	2,270	892	176	35,000	2,865		2.27	
44	Oike Pond (farm pond)	Motomiya City	242	693	370	71	5,700	1,167		1.08	
45	Miharu Dam	Miharu Town	490	1,810	1,127	0	7,500	2,614		0.65	
46	Hounokusa (farm pond)	Koriyama City	14	149	60	0	4,000	781		1.56	
47	Lake Hatori	Tenei Village	2,570	4,430	3,388	1,270	6,640	3,114		0.41	
48	Hirodaira (farm pond)	Sukagawa City	29	549	158	0	570	182		0.73	
49	Sengosawa Dam Reservoir	Ishikawa Town	546	960	767	17	7,300	2,156		0.77	
50	Watariike Pond (farm pond)	Yabuki Town	1,250	1,690	1,378	17	4,100	1,035		0.82	
51	Izumikawa (farm pond)	Shirakawa City	181	3,590	1,026	153	14,200	2,356		1.32	
52	Hokkawa Dam	Nishigo Village	2,160	6,110	4,642	1,210	13,300	5,203		0.56	
53	Lake Nanko	Shirakawa City	1,830	8,930	3,738	580	10,900	4,457		0.64	
Total number of samples	469		14	8,930	1,576	0	35,000	2,376			
Detection times	466										

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).

*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)

*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

 : Increasing

 : Decreasing

 : Varying

 : Unchanged

A	B	C	D	E

(iii) Aizu

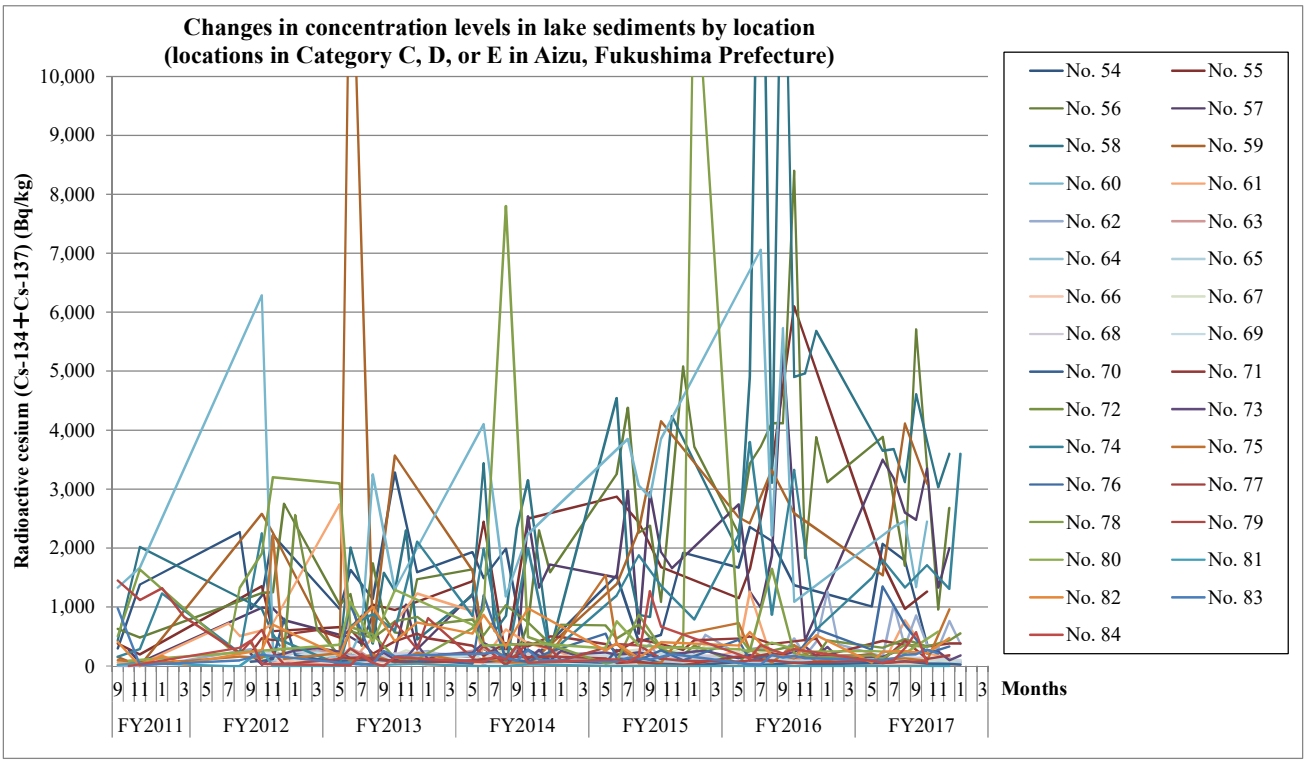
In Aizu, Fukushima Prefecture, surveys were conducted 22 to 58 times from September 2011 to January 2018 for lake sediment samples collected at 31 locations.

Regarding the concentration levels of detected values, six locations were categorized as Category C, four locations were categorized as Category D and 21 locations were categorized as Category E (see Table 4.1.2-28 and Table 4.1.2-29).

Concentration levels were generally decreasing at nine locations, unchanged at three locations, fluctuating at 13 locations, and increasing at six locations.

Table 4.1.2-28 Categorization of detected values at respective locations
(Aizu, Fukushima Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	6	No. 56, No. 57, No. 58, No. 59, No. 60, No. 74
D	Upper 25 to 50 percentile	4	No. 54, No. 55, No. 62, No. 76
E	Upper 50 to 100 percentile (lower 50%)	21	No. 61, No. 63, No. 64, No. 65, No. 66, No. 67, No. 68, No. 69, No. 70, No. 71, No. 72, No. 73, No. 75, No. 77, No. 78, No. 79, No. 80, No. 81, No. 82, No. 83, No. 84



Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-20 Changes in concentration levels over the years at respective locations
(Aizu, Fukushima Prefecture: lake sediment)

Table 4.1.2-29 Detection of radioactive cesium at respective locations

(Aizu, Fukushima Prefecture: lake sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area		Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
54	Nicchu Dam		Kitakata City	377	2,070	1,312	43	3,280	1,468		0.56	
55	Lake Sohara		Kitashiobara Village	970	1,920	1,433	130	6,100	1,663		0.78	
56	Lake Hibara			960	6,180	3,126	192	8,400	2,313		0.77	
57	Lake Onogawa			1,330	4,610	2,743	57	5,370	1,492		0.84	
58	Lake Akimoto		Inawashiro Town	2,270	5,030	3,645	177	15,400	2,924		1.05	
59	Lake Bishamonnuma		Kitashiobara Village	400	4,110	2,570	0	13,400	2,309		1.17	
60	Lake Oguninuma			1,340	2,460	2,153	198	10,200	2,790		0.79	
61	Aizu (farm pond)	Lake Onuma	Nishiaizu Town	22	773	263	0	2,740	457		1.23	
62	Lake Inawashiro	Center	Aizuwakamatsu City	160	1,040	524	0	1,260	246		0.97	
63		Takahashi River Estuary	Inawashiro Town	58	133	83	58	300	149		0.44	
64		Oguro River Estuary		46	58	52	46	245	97		0.45	
65		Tenjinhama Beach		46	84	66	39	208	100		0.43	
66		Hishinuma River Estuary		20	30	24	12	108	43		0.59	
67		Intake of Asakasosui		64	181	107	59	440	183		0.41	
68		Hamajihama Beach	Koriyama City	80	145	123	80	242	173		0.22	
69		Funatsu Port		100	136	115	100	382	171		0.38	
70		Offshore of Funatsu River Estuary		23	82	46	13	800	105		1.32	
71		Seishogahama Beach		335	425	375	174	620	405		0.28	
72		Haragawa River Estuary	Aizuwakamatsu City	309	552	416	45	2,560	516		0.82	
73		Koishigahama Floodgate	Inawashiro Town	100	273	207	22	389	204		0.39	
74	Higashiyama Dam Reservoir		Aizuwakamatsu City	1,310	3,600	1,873	18	3,800	1,329		0.76	
75	Lake Numazawa	Center	Kaneyama Town	88	961	300	45	2,210	296		1.56	
76		Midpoint between the center of the lake and off the estuary		212	1,350	573	37	1,350	347		1.06	
77		Offshore of Maenosawa River Estuary		100	430	201	15	430	136		0.59	
78	Aizu (farm pond)		Aizumisato Town	126	362	247	41	12,300	1,368		1.88	
79	Okawa Dam Reservoir		Aizuwakamatsu City	50	95	73	14	1,450	313		1.19	
80	Tagokura Reservoir		Tadami Town	218	583	325	90	1,290	429		0.68	
81	Minamiaizu (farm pond)	Fukui		0	0	0	0	270	18		2.88	
82	Tajima Dam Reservoir (Lake Funehana)		Minamiaizu Town	59	475	249	0	1,000	390		0.69	
83	Okutadami Reservoir		Tadami Town	99	274	185	18	980	166		0.97	
84	Lake Ozenuma		Hinoemata Village	41	840	275	0	1,380	267		1.20	
Total number of samples		1,080		0	6,180	850	0	15,400	724			
Detection times		1,051										

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

: Increasing
: Decreasing
: Varying
: Unchanged

A	B	C	D	E

3) Ibaraki Prefecture

In Ibaraki Prefecture, surveys were conducted 17 to 26 times from September 2011 to February 2018 for lake sediment samples collected at 19 locations.

Regarding the concentration levels of detected values, one location was categorized as Category C, four locations as Category D, and 14 locations as Category E (see Table 4.1.2-30 and Table 4.1.2-31).

Concentration levels were generally decreasing at 11 locations, unchanged at five locations, and fluctuating at three locations.

Table 4.1.2-30 Categorization of detected values at respective locations
(Ibaraki Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No. 13
D	Upper 25 to 50 percentile	4	No. 12, No. 14, No. 15, No. 16
E	Upper 50 to 100 percentile (lower 50%)	14	No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7, No. 8, No. 9, No. 10, No. 11, No. 17, No. 18, No. 19

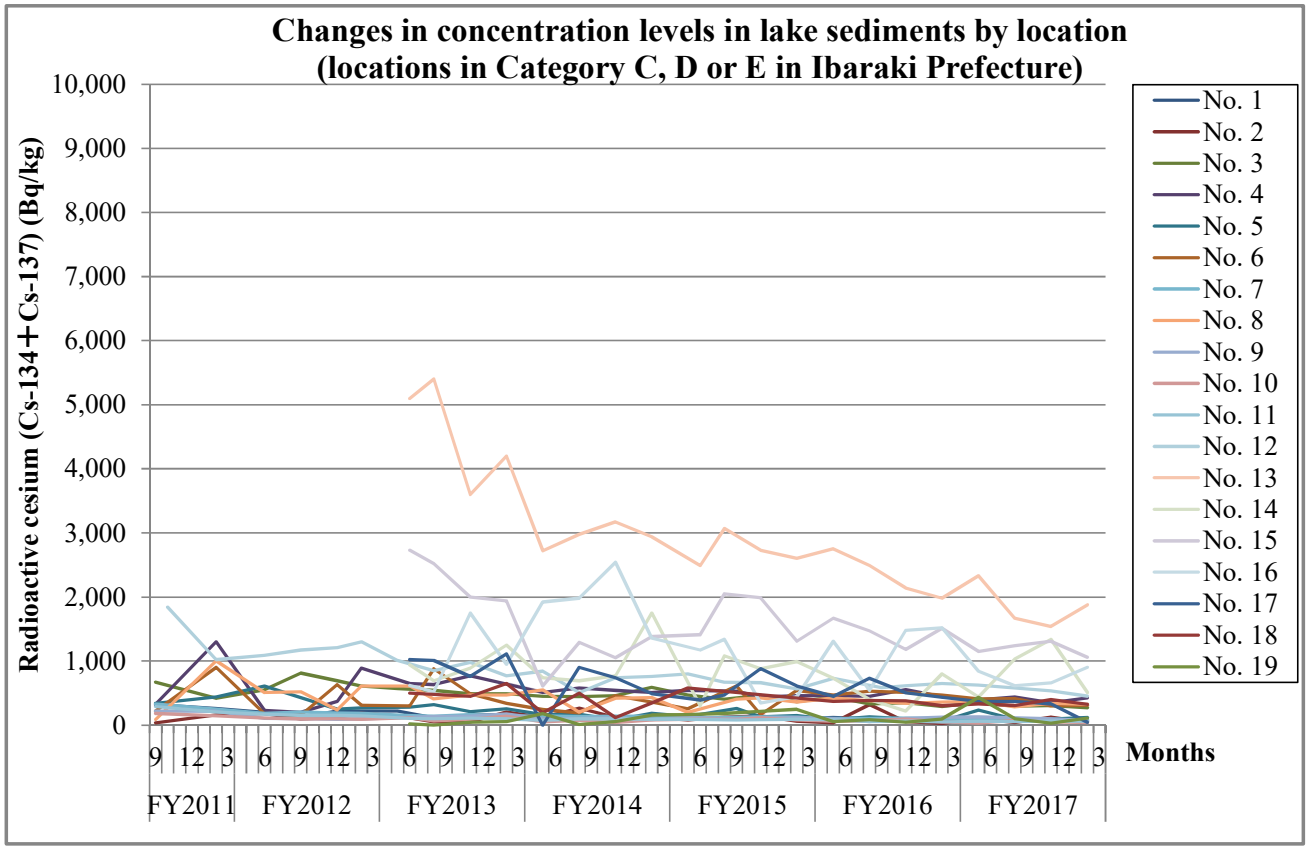


Figure 4.1.2-21 Changes in concentration levels over the years at respective locations
(Ibaraki Prefecture: lake sediment)

Table 4.1.2-31 Detection of radioactive cesium at respective locations

(Ibaraki Prefecture: lake sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area		Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Hinuma	Hiroura	Ibaraki Town	54	73	65	54	320	136		0.49	
2		Miyamae		40	127	78	23	319	116		0.63	
3		Oyazawa		274	355	308	274	810	467		0.29	
4	Lake Kasumigaura	Offshore of Tamatsukuri	Namegata City	350	441	404	201	1,300	525		0.42	
5		Offshore of Kakeuma	Ami Town	91	235	135	62	610	215		0.61	
6		Center	Miho Village	304	413	359	151	900	409		0.48	
7		Offshore of Aso	Inashiki City	84	94	88	84	330	144		0.38	
8	Lake Kitaura	Offshore of Kamaya	Namegata City	286	372	331	90	1,000	413		0.42	
9		Jingu Bridge	Itako City	68	125	102	53	220	118		0.32	
10	Hitachitone River	Lake Sotonasakaura		34	75	50	34	184	86		0.41	
11		Ikisu	Kamisu City	55	61	59	51	290	104		0.52	
12	Lake Ushikunuma	Center of Lake Ushikunuma	Ryugasaki City	454	624	549	454	1,840	829		0.37	
13	Mizunuma Dam	Center	Kitaibaraki City	1,540	2,330	1,855	1,540	5,400	2,889		0.36	
14	Koyama Dam		Takahagi City	440	1,340	830	220	1,750	822		0.45	
15	Hananuki Dam			1,060	1,310	1,190	610	2,730	1,544		0.34	
16	Jyuou Dam		Hitachi City	613	900	752	346	2,540	1,140		0.53	
17	Ryuji Dam		Hitachiota City	47	373	281	0	1,110	581		0.53	
18	Fujiigawa Dam		Shirosato Town	306	399	341	117	650	389		0.34	
19	Iida Dam		Kasama City	29	429	167	0	429	114		0.91	
Total number of samples		449		29	2,330	418	0	5,400	537			
Detection times		447										

: Increasing
: Decreasing
: Varying
: Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

4) Tochigi Prefecture

In Tochigi Prefecture, surveys were conducted 22 to 26 times from October 2011 to December 2017 for lake sediment samples collected at eight locations.

Regarding the concentration levels of detected values, two locations were categorized as Category D, and six locations as Category E (see Table 4.1.2-32 and Table 4.1.2-33).

Concentration levels were generally decreasing at three locations, fluctuating at three locations, and increasing at two locations.

Table 4.1.2-32 Categorization of detected values at respective locations
(Tochigi Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	0	(None)
D	Upper 25 to 50 percentile	2	No. 1, No. 7
E	Upper 50 to 100 percentile (lower 50%)	6	No. 2, No. 3, No. 4, No. 5, No. 6, No. 8

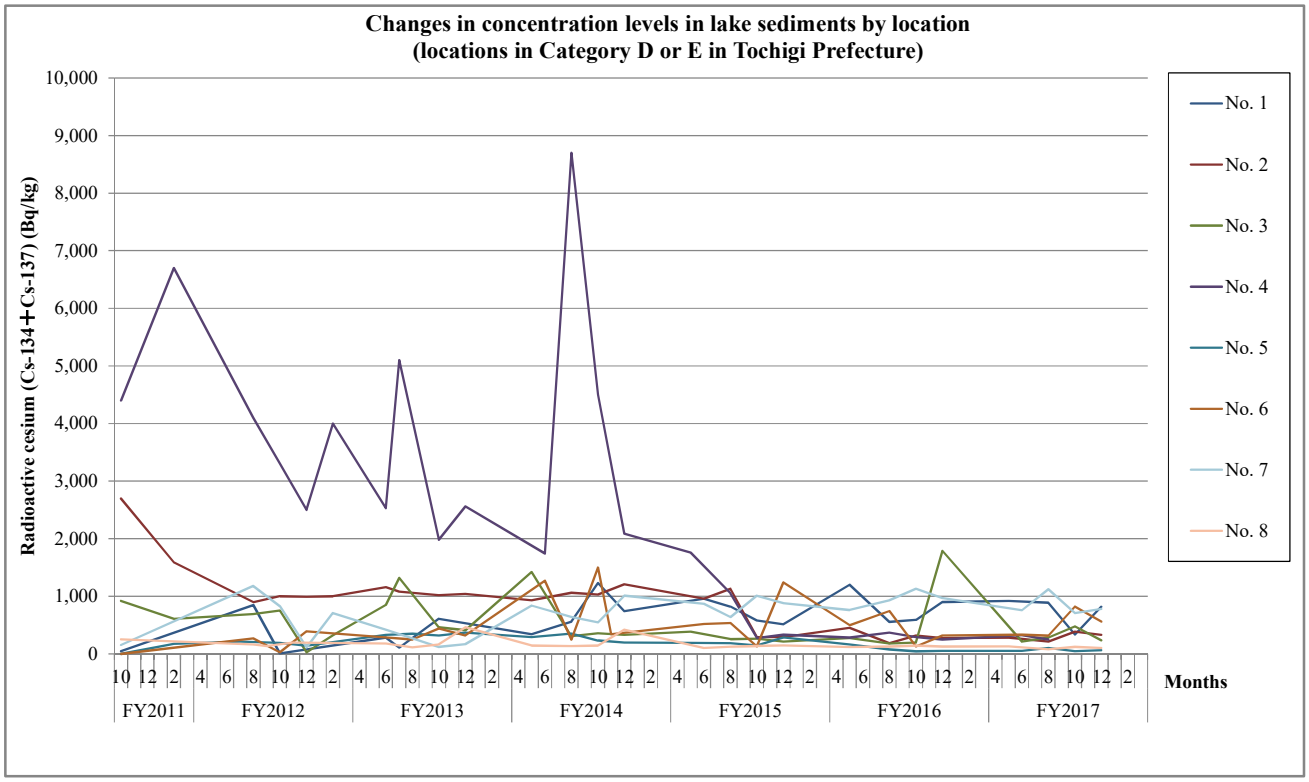
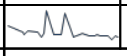


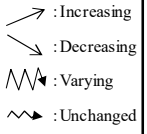
Figure 4.1.2-22 Changes in concentration levels over the years at respective locations
(Tochigi Prefecture: lake sediment)

Table 4.1.2-33 Detection of radioactive cesium at respective locations

(Tochigi Prefecture: lake sediment)

Location					FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location		Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Nakagawa River System	Miyama Dam Reservoir	Center	Nasushiobara City	338	920	742	11	1,230	630		0.54	
2		Shiobara Dam Reservoir	Center		213	388	303	185	2,700	839		0.66	
3	Kinugawa River System	Kawaji Dam Reservoir	Center	Nikko City	211	479	302	25	1,790	521		0.82	
4		Ikari Dam Reservoir	Center		248	322	285	248	8,700	2,474		0.92	
5		Kawamata Dam Reservoir	Center		47	99	65	0	370	183		0.61	
6		Lake Yuno	Center		315	820	507	0	1,500	478		0.81	
7		Lake Chuzenji	Center		708	1,120	842	115	1,180	703		0.47	
8	Watarase River System	Watarase Reservoir	Center	Tochigi City	81	130	109	81	460	165		0.55	
Total number of samples		196			47	1,120	402	0	8,700	746			
Detection times		194											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)



A	B	C	D	E

5) Gunma Prefecture

In Gunma Prefecture, surveys were conducted 20 to 26 times from November 2011 to December 2017 for lake sediment samples collected at 24 locations.

Regarding the concentration levels of detected values, one location was categorized as Category C, 12 locations were categorized as Category D and 11 locations were categorized as Category E (see Table 4.1.2-34 and Table 4.1.2-35).

Concentration levels were generally decreasing at 11 locations, unchanged at six locations, fluctuating at five locations, and increasing at two locations.

Table 4.1.2-34 Categorization of detected values at respective locations
(Gunma Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No. 2
D	Upper 25 to 50 percentile	12	No. 1, No. 5, No. 6, No. 7, No. 9, No. 10, No. 12, No. 15, No. 16, No. 17, No. 21, No. 22
E	Upper 50 to 100 percentile (lower 50%)	11	No. 3, No. 4, No. 8, No. 11, No. 13, No. 14, No. 18, No. 19, No. 20, No. 23, No. 24

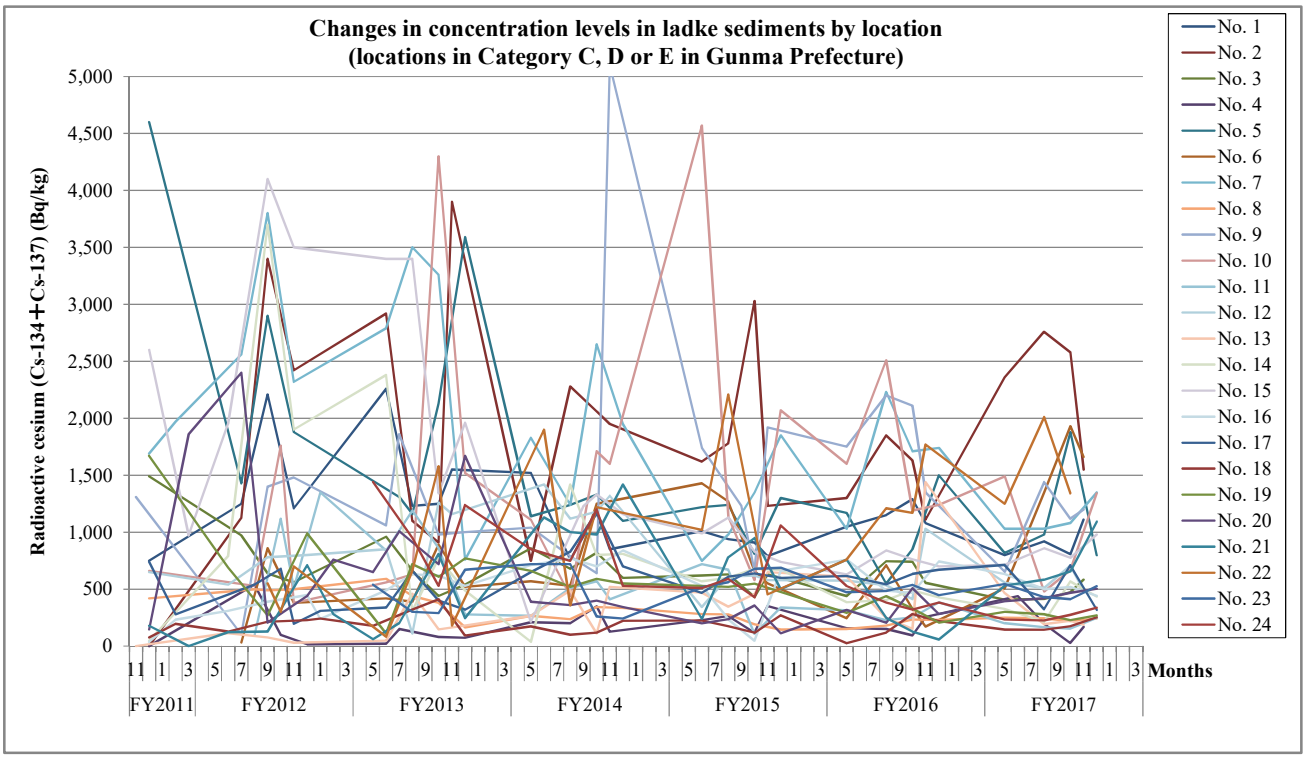


Figure 4.1.2-23 Changes in concentration levels over the years at respective locations
(Gunma Prefecture: lake sediment)

Table 4.1.2-35 Detection of radioactive cesium at respective locations

(Gunma Prefecture: lake sediment)

Location					FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Water area	Location		Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Tonegawa River	Lake Okutone (Yagisawa Dam)	Center	Minakami Town	800	1,110	909	750	2,260	1,161		0.34	
2		Lake Naramata (Naramata Dam)	Center		1,550	2,760	2,313	0	3,900	1,901		0.48	
3		Lake Dogen (Sudagai Dam)	Center		409	584	470	409	1,490	662		0.36	
4		Lake Marunuma (Marunuma Dam)	Center	Katashina Village	28	439	209	0	540	180		0.75	
5		Lake Fujiwara (Fujiwara Dam)	Center	Minakami Town	798	1,880	1,119	548	4,600	1,539		0.61	
6		Lake Tanbara (Tanbara Dam)	Center	Numata City	508	1,930	1,362	33	1,930	757		0.68	
7		Lake Akaya (Aimata Dam)	Center	Minakami Town	1,030	1,350	1,123	750	3,800	1,858		0.46	
8		Lake Sonohara (Sonohara Dam)	Center	Numata City	220	251	239	146	590	305		0.41	
9		Lake Akagionuma	Center	Maebashi City	651	1,440	1,103	104	5,100	1,422		0.66	
10	Agatsuma River Area	Lake Okushima (Shimagawa Dam)	Center	Nakanojo Town	481	1,490	995	380	4,570	1,420		0.77	
11		Lake Shimako (Nakanojo Dam)	Center		155	249	193	94	1,350	491		0.73	
12		Lake Tashiro (Kazawa Dam)	Center	Tsumagoi Village	484	708	565	110	1,420	756		0.45	
13	Karasu River	Lake Haruna	Center	Takasaki City/Higashi-	190	464	267	0	1,440	335		0.92	
14		Lake Kirizumi (Kirizumi Dam)	Center	Annaka City	213	568	386	38	3,700	801		1.02	
15		Lake Usui (Sakamoto Dam)	Center		714	980	832	215	4,100	1,484		0.72	
16		Lake Arafune (Dodairagawa Dam)	Center	Shimonita Town	442	633	524	37	840	499		0.43	
17		Lake Oshio (Oshio Dam)	Center	Tomioka City	318	713	517	196	1,170	564		0.38	
18		Lake Kanna (Shimokubo Dam)	Center	Fujioka City/Kamikawa	143	254	180	26	410	187		0.45	
19		Lake Hebikami (Shiozawa Dam)	Center	Kanna Town	227	300	270	111	1,670	524		0.61	
20	Watarase River Area	Lake Kusaki (Kusaki Dam)	Center	Midori City	393	504	447	115	2,400	591		0.95	
21		Lake Umeda (Kiryugawa Dam)	Center	Kiryu City	532	1,093	716	0	1,420	531		0.76	
22	Nakatsu River	Lake Nozori (Nozori Dam)	Center	Nakanojo Town	1,250	2,010	1,533	82	2,210	1,037		0.60	
23	Watarase River Area	Lake Jonuma	Center	Tatebayashi City	412	545	479	241	720	502		0.30	
24		Lake Tataranuma	Center		226	337	268	226	1,440	638		0.57	
Total number of samples		574			28	2,760	700	0	5,100	840			
Detection times		570											

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

: Increasing
: Decreasing
: Varying
: Unchanged

6) Chiba Prefecture

In Chiba Prefecture, surveys were conducted 26 times from November 2011 to February 2018 for lake sediment samples collected at eight locations.

Regarding the concentration levels of detected values, one location was categorized as Category C, one location into Category D, and six locations as Category E (see Table 4.1.2-36 and Table 4.1.2-37).

Concentration levels were generally decreasing at all eight locations.

Table 4.1.2-36 Categorization of detected values at respective locations
(Chiba Prefecture: lake sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	1	No. 4
D	Upper 25 to 50 percentile	1	No. 3
E	Upper 50 to 100 percentile (lower 50%)	6	No. 1, No. 2, No. 5, No. 6, No. 7, No. 8

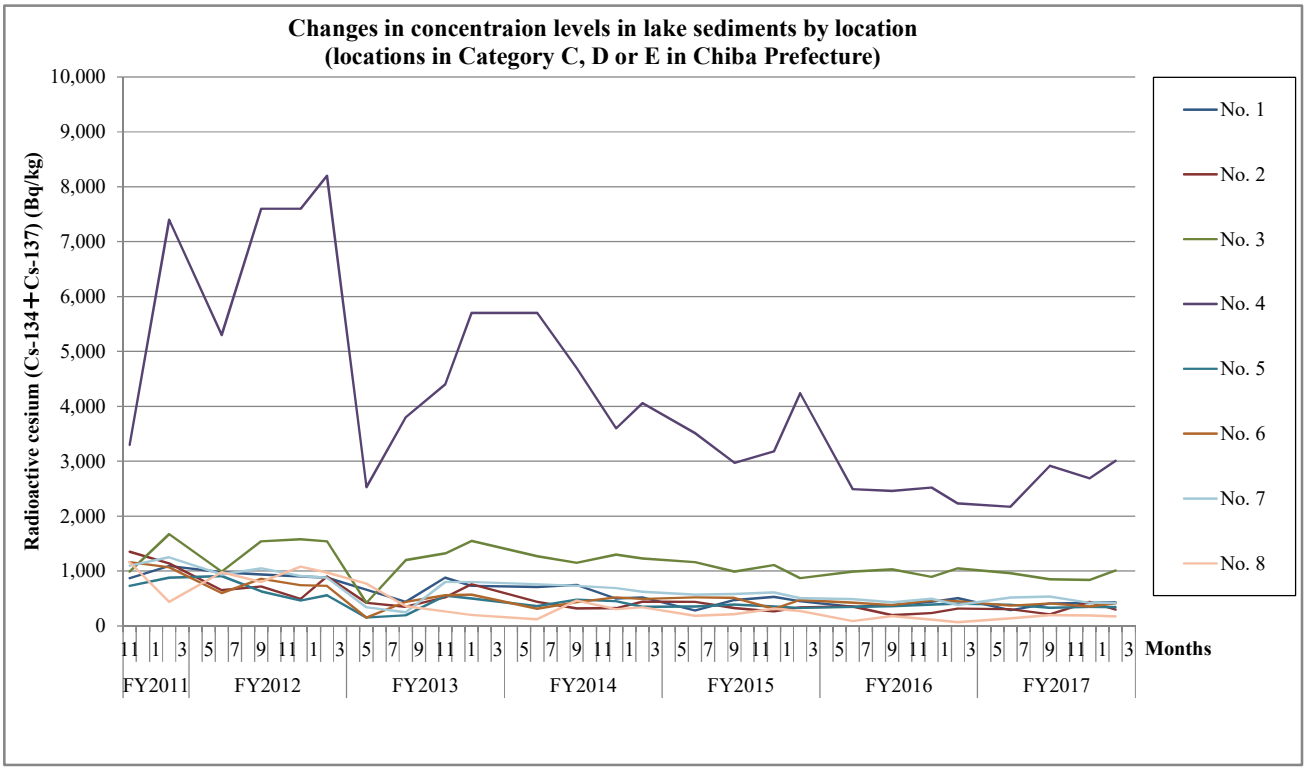


Figure 4.1.2-24 Changes in concentration levels over the years at respective locations
(Chiba Prefecture: lake sediment)

Table 4.1.2-37 Detection of radioactive cesium at respective locations

(Chiba Prefecture: lake sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Location		Municipality	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Lake Teganuma	Fusashita	Inzai City	285	433	386	283	1,090	608		0.39	
2		Shimoteganuma Chuo		213	441	315	197	1,350	483		0.59	
3		Teganuma Chuo	Abiko City/Kashiwa City	838	1,013	915	420	1,670	1,135		0.25	
4		Nedoshita		2,170	3,010	2,698	2,170	8,200	4,165		0.44	
5	Lake Inbanuma	Kita-Inbanuma Chuo	Inzai City/Narita City	333	388	352	151	910	444		0.40	
6		Ipponmatsushita	Inzai City	354	415	387	152	1,160	528		0.43	
7		Lower area of Josuido water	Sakura City	417	535	472	251	1,250	657		0.38	
8		Asobashi Bridge	Yachiyo City	136	196	174	66	1,160	400		0.84	
Total number of samples		208		136	3,010	712	66	8,200	1,052			
Detection times		208										

 : Increasing

 : Decreasing

 : Varying

 : Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).

*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)

*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

(2)-3 Coastal areas

1) Iwate Prefecture

In Iwate Prefecture, surveys were conducted 13 times from January 2012 to November 2017 for coastal area sediment samples collected at two locations (this analysis excludes the survey results from one location where the survey was conducted only in FY2011).

Regarding the concentration levels of detected values, both locations were categorized as Category E (see Table 4.1.2-38 and Table 4.1.2-39).

Concentration levels were unchanged at one location and fluctuating at the other location.

Table 4.1.2-38 Categorization of detected values at respective locations
(Iwate Prefecture: coastal area sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	0	(None)
D	Upper 25 to 50 percentile	0	(None)
E	Upper 50 to 100 percentile (lower 50%)	2	No. 1, No. 2

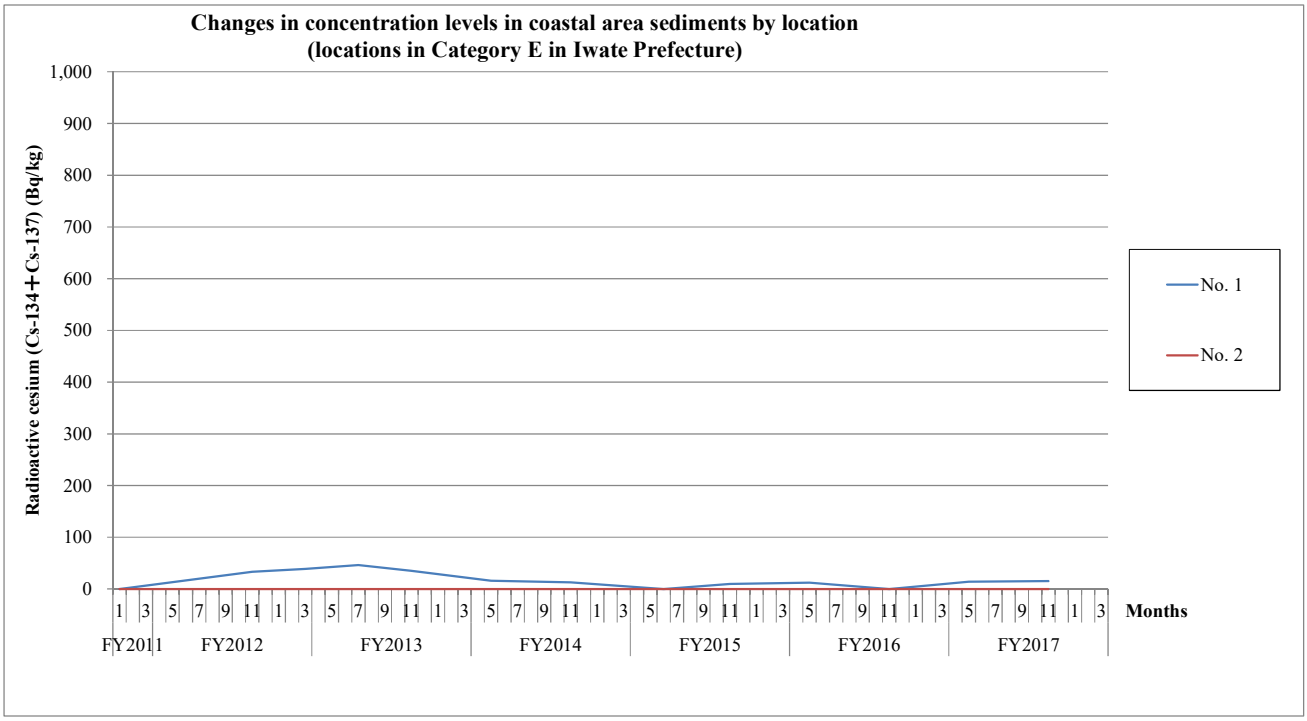


Figure 4.1.2-25 Changes in concentration levels over the years at respective locations
(Iwate Prefecture: coastal area sediment)

Table 4.1.2-39 Detection of radioactive cesium at respective locations

(Iwate Prefecture: coastal area sediment)

Location		FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Ofunato Bay (A)	14	15	15	0	46	18		0.86	
2	Hirota Bay	0	0	0	0	0	0		-	
Total number of samples	26	0	15	7.3	0	46	9.0			
Detection times	10									

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

 : Increasing
 : Decreasing
 : Varying
 : Unchanged

2) Miyagi Prefecture

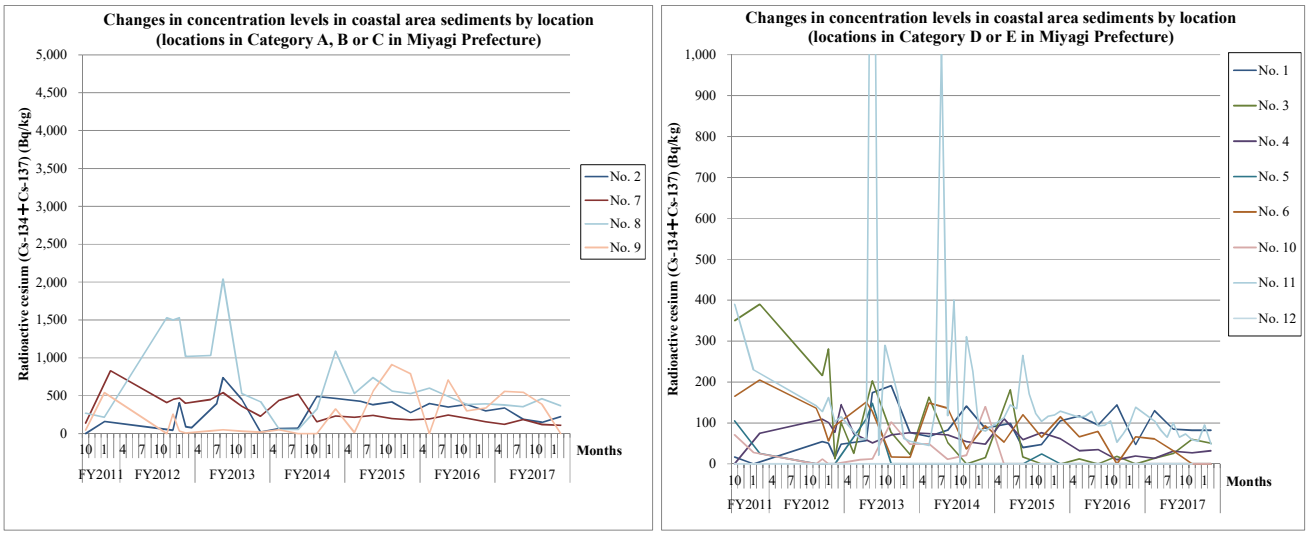
In Miyagi Prefecture, surveys were conducted 13 to 57 times from October 2011 to February 2018 for coastal area sediment samples collected at 12 locations (this analysis excludes the survey results from 28 locations where the survey was conducted only in FY2011).

Regarding the concentration levels of detected values, one location was categorized as Category A, one location into Category B, two locations as Category C, three locations as Category D, and five locations as Category E (see Table 4.1.2-40 and Table 4.1.2-41).

Concentration levels were generally decreasing at six locations, unchanged at one location, fluctuating at four locations, and increasing at one location.

Table 4.1.2-40 Categorization of detected values at respective locations
(Miyagi Prefecture: coastal area sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	1	No. 8
B	Upper 5 to 10 percentile	1	No. 9
C	Upper 10 to 25 percentile	2	No. 2, No. 7
D	Upper 25 to 50 percentile	3	No. 1, No. 3, No. 11
E	Upper 50 to 100 percentile (lower 50%)	5	No. 4, No. 5, No. 6, No. 10, No. 12

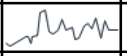
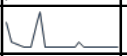
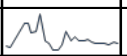


Notes: 1) For locations where surveys were conducted multiple times in one month, their average value is used in the figures.
2) Scales of the vertical axes differ in the left and right figures.

Figure 4.1.2-26 Changes in concentration levels over the years at respective locations
(Miyagi Prefecture: coastal area sediment)

Table 4.1.2-41 Detection of radioactive cesium at respective locations

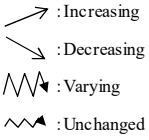
(Miyagi Prefecture: coastal area sediment)

Location			FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Location		Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Kesennuma Bay (B)	Offshore of Hachigasaki	82	130	95	0	191	82		0.57	
2	Kesennuma Bay (C)	Offshore of Oshimakita	150	339	225	0	740	282		0.65	
3	All other neighboring sea areas	Oppa Bay (Jyusanhama Beach)	14	60	37	0	390	88		1.30	
4	Neighboring sea area of Ishinomaki (C)	Lake Mangokuura, M-6 (center)	14	32	26	0	145	59		0.59	
5	Neighboring sea area of Ishinomaki (B-3)	Offshore of Kitakami River Estuary	0	0	0	0	148	16		2.51	
6	Neighboring sea area of Ishinomaki (C)	Offshore of Naruse	0	61	23	0	205	82		0.68	
7	Matsushima Bay (B)	Nishihama Beach	110	187	135	110	830	300		0.58	
8	Neighboring sea area of Sendai Port(A)	Naiko Inner Port, 4-Nai	356	459	390	54	2,040	669		0.75	
9	Neighboring sea area of Sendai Port (B)	Gamo-3	0	556	372	0	910	250		1.15	
10	All other neighboring sea areas	Ido-5	0	0	0	0	140	19		1.84	
11	Offshore of Abukuma River Estuary		48	105	75	0	2,030	173		1.67	
12	Offshore of Tsuyagawa River Estuary		0	0	0	0	0	0		-	
Total number of samples		330	0	556	115	0	2,040	175			
Detection times		264									

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).

*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)

*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)



A	B	C	D	E

3) Fukushima Prefecture

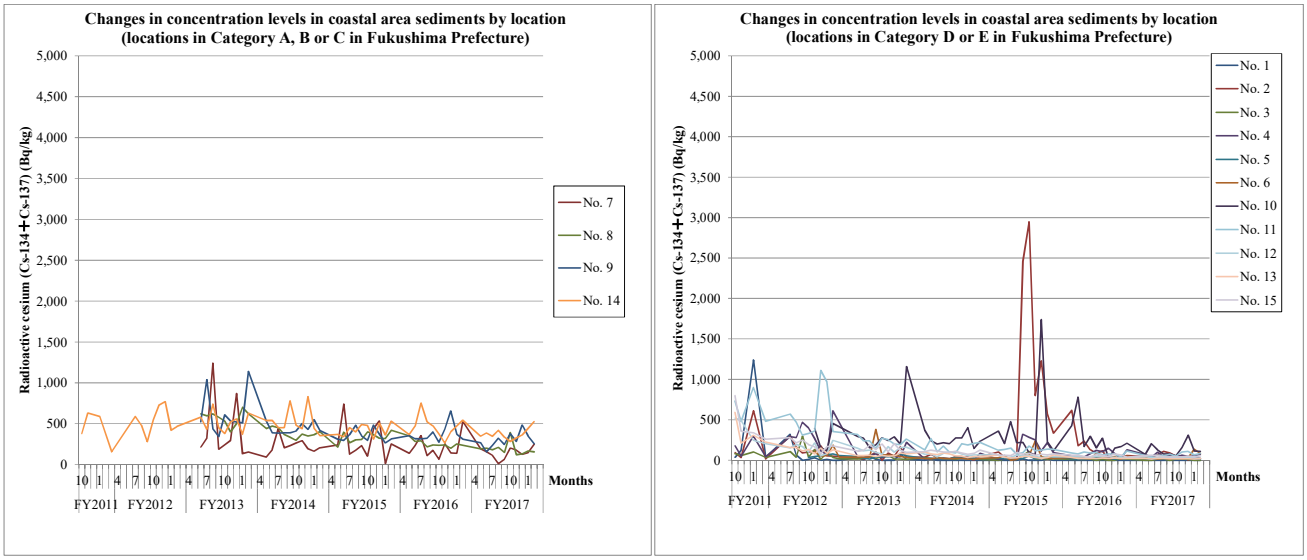
In Fukushima Prefecture, surveys were conducted 50 to 63 times from October 2011 to February 2018 for coastal area sediment samples collected at 15 locations (this analysis excludes the survey results from 11 locations where the survey was conducted only once in FY2011).

Regarding the concentration levels of detected values, one location was categorized as Category A, one location into Category B, two locations as Category C, seven locations as Category D, and four locations as Category E (see Table 4.1.2-42 and Table 4.1.2-43).

Concentration levels were generally decreasing at 12 locations and fluctuating at three locations.

Table 4.1.2-42 Categorization of detected values at respective locations
(Fukushima Prefecture: coastal area sediment)

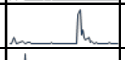
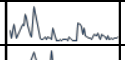
Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	1	No. 14
B	Upper 5 to 10 percentile	1	No. 9
C	Upper 10 to 25 percentile	2	No. 7, No. 8
D	Upper 25 to 50 percentile	7	No. 2, No. 4, No. 6, No. 10, No. 11, No. 12, No. 15
E	Upper 50 to 100 percentile (lower 50%)	4	No. 1, No. 3, No. 5, No. 13



Notes: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-27 Changes in concentration levels over the years at respective locations
(Fukushima Prefecture: coastal area sediment)

Table 4.1.2-43 Detection of radioactive cesium at respective locations
(Fukushima Prefecture: coastal area sediment)

Location			FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Location		Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Neighboring sea area of Soso	Approx. 2,000 m offshore of Tsurushihama Fishing Port	0	0	0	0	1,240	33		4.83	
2	Matsukawaura sea area	Around center of Fishing Right Area-1 in Matsukawaura sea area	0	109	50	0	2,950	210		2.40	
3	Neighboring sea area of Soso	Approx. 2,000 m offshore of Manogawa River	0	15	6.8	0	300	31		1.44	
4	Neighboring sea area of Haramachi City	Approx. 1,000 m offshore of Niida River	37	99	59	0	610	109		1.12	
5		Approx. 1,000 m offshore of Ota River	11	36	20	10	81	29		0.55	
6	Neighboring sea area of Soso District	Approx. 1,000 m offshore of Odaka River	15	137	42	0	380	51		1.20	
7		Approx. 2,000 m offshore of Ukedo River	12	246	144	12	1,240	253		0.86	
8		Approx. 1,000 m offshore of Kumagawa River	120	392	190	120	700	347		0.43	
9		Approx. 1,000 m offshore of Tomioka River	155	484	298	155	1,600	427		0.53	
10	Neighboring sea area of Naraha Town	Approx. 1,000 m offshore of Kidogawa River	52	309	130	20	1,740	277		0.97	
11	Approx. 1,000 m offshore of Asami River Estuary		51	108	71	41	1,110	226		0.99	
12	Approx. 1,000 m offshore of Ohisa River Estuary		22	44	32	22	520	97		0.99	
13	Neighboring sea area of Iwaki City	Approx. 1,500 m offshore of Natsui River	14	22	18	14	590	72		1.21	
14	Onahama Port	Approx. 400 m north of Nishibouhatei No. 2	282	526	378	156	830	469		0.29	
15	Joban coastal sea area	Approx. 1,000 m offshore of Binda River	40	61	48	38	800	121		0.94	
Total number of samples		883	0	526	99	0	2,950	178			
Detection times		823									

 :Increasing
 :Decreasing
 :Varying
 :Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

4) Ibaraki Prefecture

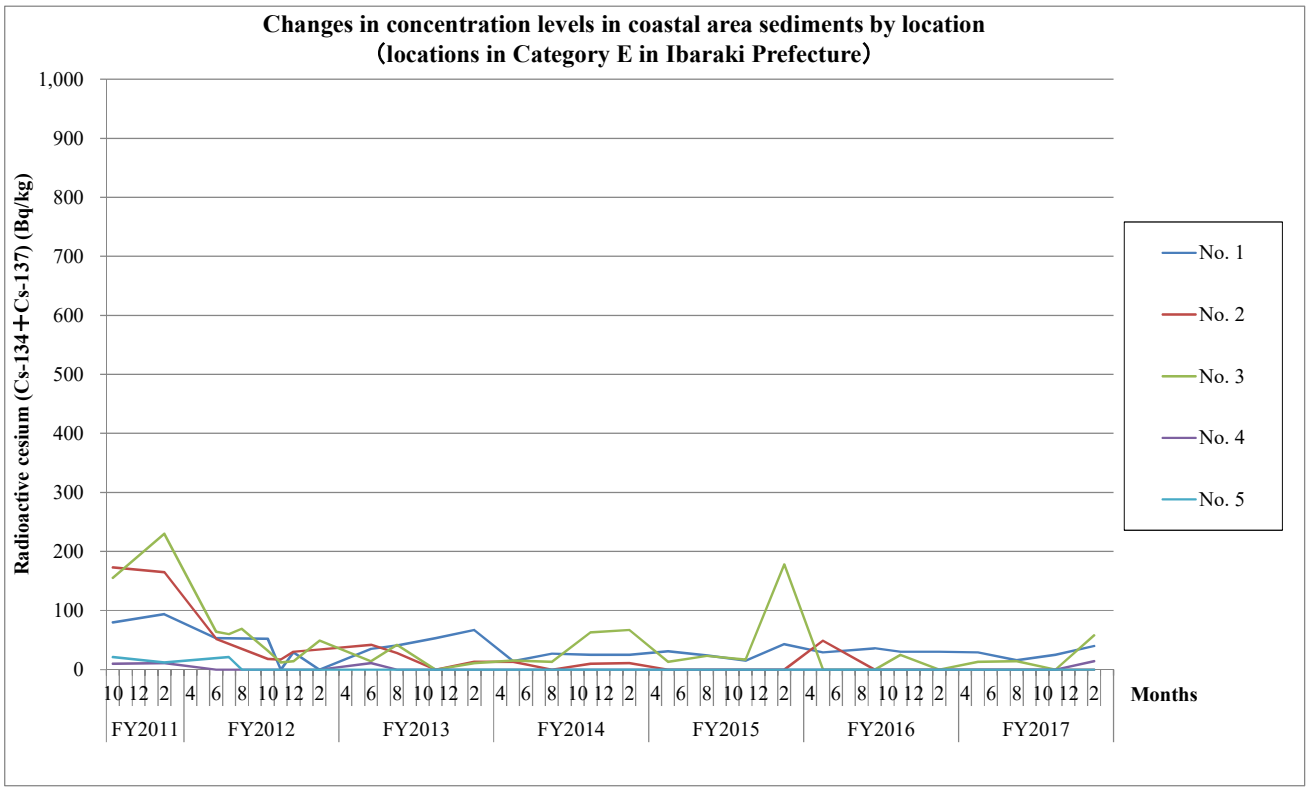
In Ibaraki Prefecture, surveys were conducted 27 to 29 times from October 2011 to February 2018 for coastal area sediment samples collected at five locations (this analysis excludes the survey results from 18 locations where the survey was conducted only once in FY2011).

Regarding the concentration levels of detected values, all five locations were categorized as Category E (see Table 4.1.2-44 and Table 4.1.2-45).

Concentration levels were generally decreasing at four locations and fluctuating at one location.

Table 4.1.2-44 Categorization of detected values at respective locations
(Ibaraki Prefecture: coastal area sediment)

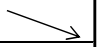
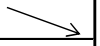
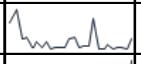
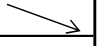
Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	0	(None)
D	Upper 25 to 50 percentile	0	(None)
E	Upper 50 to 100 percentile (lower 50%)	5	No. 1, No. 2, No. 3, No. 4, No. 5



Note: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-28 Changes in concentration levels over the years at respective locations
(Ibaraki Prefecture: coastal area sediment)

Table 4.1.2-45 Detection of radioactive cesium at respective locations
(Ibaraki Prefecture: coastal area sediment)

Location		FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Location	Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Offshore of Satone River Estuary	16	40	28	0	94	35		0.61	
2	Offshore of Okita River Estuary	0	0	0	0	173	24		1.85	
3	Offshore of Momiya River/Kujigawa River	0	58	21	0	230	43		1.29	
4	Neighboring water body of Ken-o Offshore of	0	14	3.5	0	14	1.6		2.57	
5	Offshore of Tonegawa River Estuary	0	0	0	0	25	2.6		2.64	
Total number of samples	141	0	58	10	0	230	21			
Detection times	71									

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

 : Increasing
 : Decreasing
 : Varying
 : Unchanged

A	B	C	D	E

5) Chiba Prefecture and Tokyo Metropolis

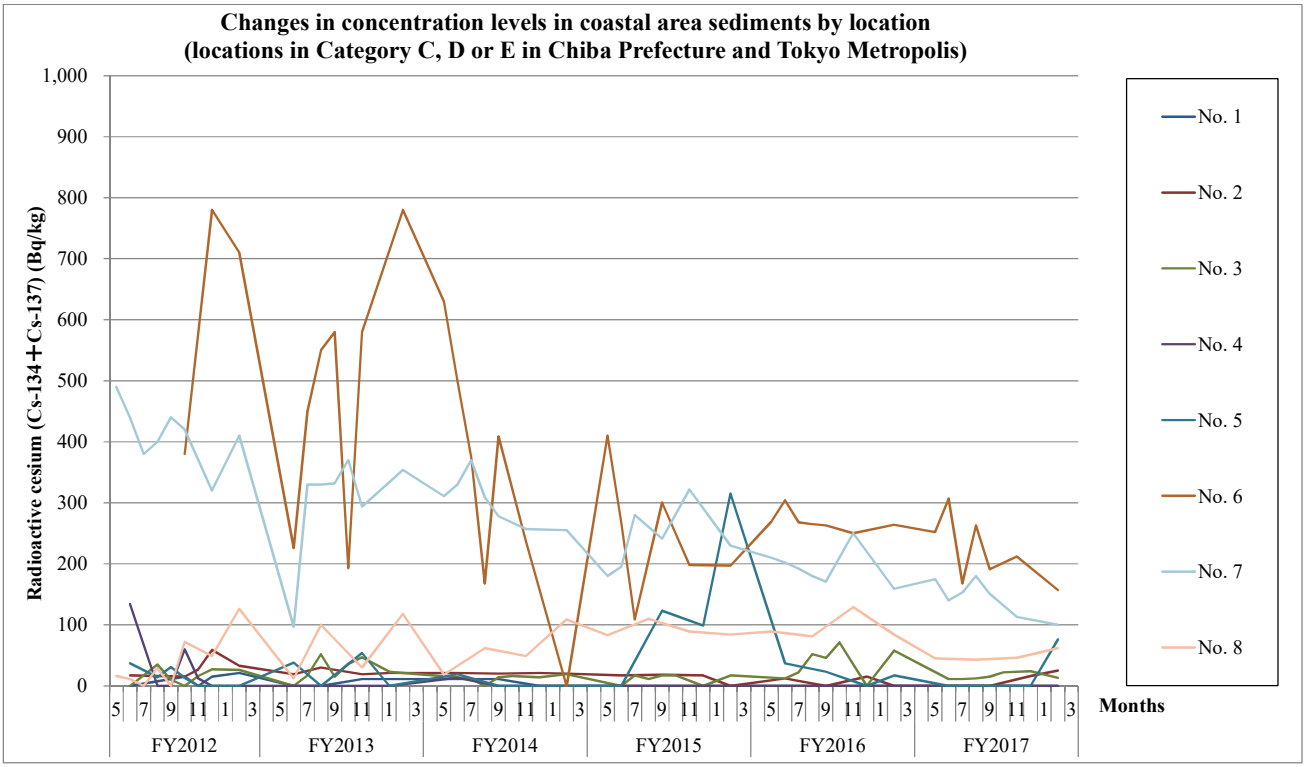
In Chiba Prefecture and Tokyo Metropolis, surveys were conducted 25 to 43 times from May 2012 to February 2018 for coastal area sediment samples collected at eight locations in total.

Regarding the concentration levels of detected values, two locations were categorized as Category C, one location was categorized as Category D and five locations were categorized as Category E (see Table 4.1.2-46 and Table 4.1.2-47).

Concentration levels were generally decreasing at five locations, unchanged at one location and fluctuating at two locations.

Table 4.1.2-46 Categorization of detected values at respective locations
(Chiba Prefecture and Tokyo Metropolis: coastal area sediment)

Category	Percentile (percentile in all detected values)	Number of locations	Locations
A	Upper 5 percentile	0	(None)
B	Upper 5 to 10 percentile	0	(None)
C	Upper 10 to 25 percentile	2	No. 6, No. 7
D	Upper 25 to 50 percentile	1	No. 8
E	Upper 50 to 100 percentile (lower 50%)	5	No. 1, No. 2, No. 3, No. 4, No. 5

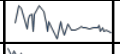


Notes: For locations where surveys were conducted multiple times in one month, their average value is used in the figures.

Figure 4.1.2-29 Changes in concentration levels over the years at respective locations
(Chiba Prefecture and Tokyo Metropolis: coastal area sediment)

Table 4.1.2-47 Detection of radioactive cesium at respective locations

(Chiba Prefecture and Tokyo Metropolis: coastal area sediment)

Location				FY2017			FY2011 - FY2017			Changes	Coefficient of variation	Trends (*3)
No.	Prefecture	Location		Minimum value	Maximum value	Average	Minimum value	Maximum value	Average			
1	Chiba Prefecture	Tokyo Bay 7	Offshore of Yorogawa River Estuary	0	0	0	0	21	3.8		1.71	
2		Tokyo Bay 5	Offshore of Miyako River Estuary	0	25	10	0	59	18		0.72	
3		Coastal sea area of Makuhari	Offshore of Inbanuma Discharge Channel	11	24	15	0	71	20		0.85	
4		Approx. 1 km offshore of Ebigawa River Estuary	Coastal area of Keiyo Port (Ebigawa River Estuary)	0	0	0	0	134	8.1		3.43	
5		Approx. 1 km offshore of Edogawa River Estuary		0	76	19	0	315	33		1.96	
6	Tokyo Metropolis	Approx. 1 km offshore of Kyu-Edogawa River Estuary	Offshore of Kyu-Edogawa River Estuary	157	307	221	0	780	336		0.55	
7		St-8	Offshore of Arakawa River/Kyu-Edogawa	100	180	145	97	490	269		0.38	
8		Southwestern area of Toyosu Wharf	Offshore of Sumida River Estuary	43	62	49	0	129	62		0.63	
Total number of samples		255		0	307	73	0	780	112			
Detection times		186										

: Increasing
: Decreasing
: Varying
: Unchanged

*1 Detected values are the total of Cs-134 and Cs-137 (Bq/kg-dry).
*2 Average values are arithmetic; calculated by assuming ND=0; Color codes show categories according to 1) (i)
*3 Results of the analysis of trends at respective locations using the method explained in 1) (ii)

A	B	C	D	E

2)-4 Conclusion

The concentration levels of detected values for sediment samples from public water areas (rivers, lakes, and coastal areas) from FY2011 to FY2017 and their changes shown so far are summarized as follows (see Figure 4.1.2-30 and Table 4.1.2-48).

1) Concentration levels of detected values

- Rivers

  Out of all surveyed locations (396 locations), the number categorized as Categories A and B, which fall under the upper 10%, was the largest in Hamadori in Fukushima Prefecture (18 locations). Other such locations were also found in Nakadori in Fukushima Prefecture, Ibaraki Prefecture, Gunma Prefecture and Chiba Prefecture.

- Lakes

  Out of all surveyed locations (164 locations), locations categorized as Category A or B were found in Hamadori in Fukushima Prefecture.

- Coastal areas

  Out of all surveyed locations (42 locations), locations categorized as Category A or B were found in Miyagi and Fukushima Prefectures.

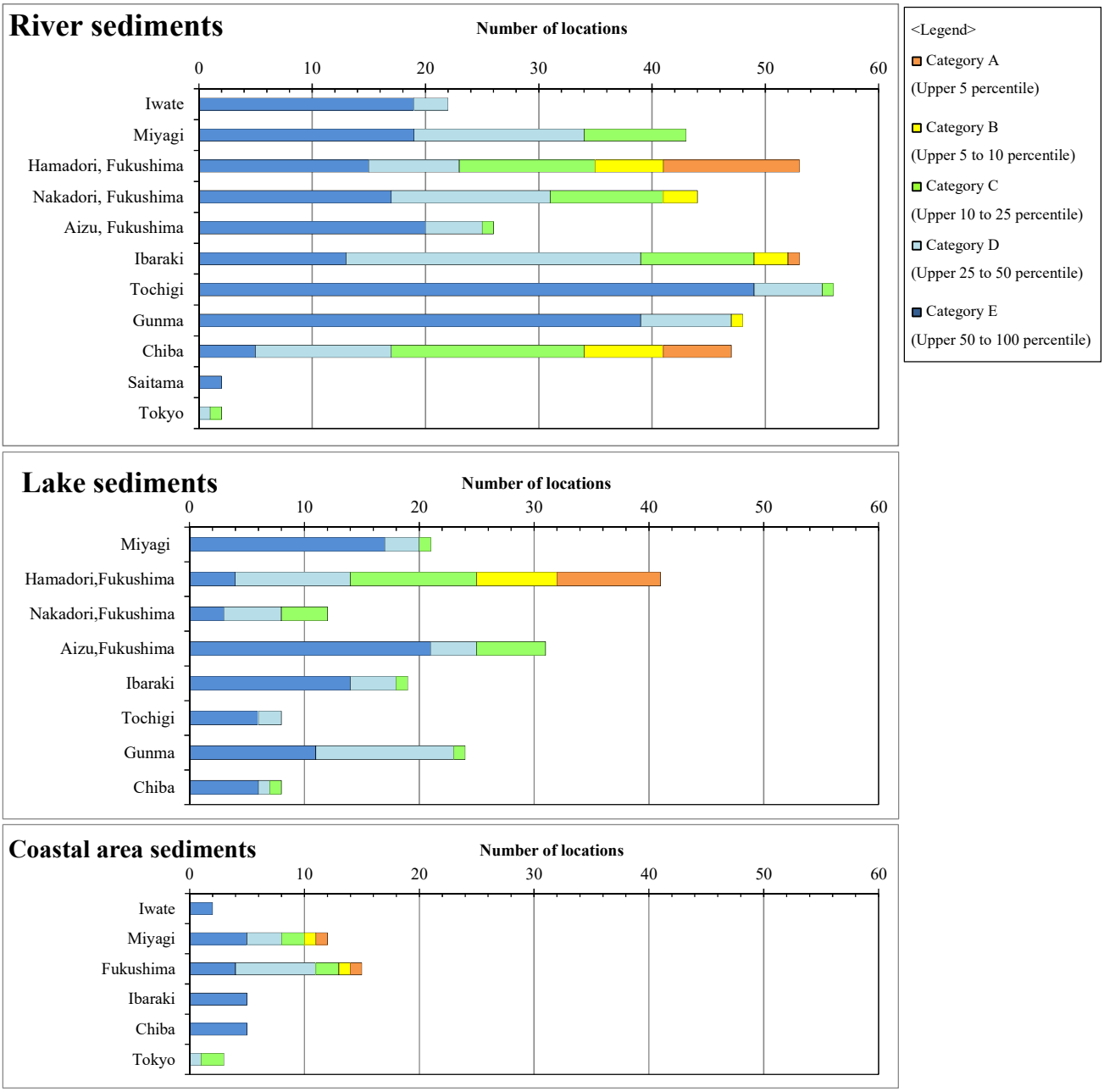


Figure 4.1.2-30 Categorization by concentration levels of detected values for sediment samples (upper: rivers; middle: lakes; lower: coastal areas)

(* Figure 4.1.2-30 shows the aforementioned Table 3.1-1 graphically.)

2) Changes in detected values

・Rivers

A decreasing trend was observed at most locations.

・Lakes

Mostly a decreasing or an unchanged trend was observed but some locations showed fluctuations.

• Coastal areas

Mostly a decreasing trend was observed but some locations showed fluctuations.

Table 4.1.2-48 Changes in detected values for sediment samples from public water areas (rivers, lakes, and coastal areas)

<Rivers>

Trends	Number of locations												
	Iwate	Miyagi	Fukushima			Ibaraki	Tochigi	Gunma	Chiba	Saitama	Tokyo	Total	
			Hamadori	Nakadori	Aizu							Number of locations	Percentage
Decreasing	20	39	50	42	21	50	49	39	42	2	2	356	89.9
Unchanged	0	0	1	0	0	0	0	0	0	0	0	1	0.3
Fluctuations	2	4	1	2	5	3	7	9	5	0	0	38	9.6
Increasing	0	0	1	0	0	0	0	0	0	0	0	1	0.3
Total	22	43	53	44	26	53	56	48	47	2	2	396	100.0

<Lakes>

Trends	Number of locations									
	Miyagi	Fukushima			Ibaraki	Tochigi	Gunma	Chiba	Total	
		Hamadori	Nakadori	Aizu					Number of locations	Percentage
Decreasing	13	22	5	9	11	3	11	8	82	50.0
Unchanged	2	3	2	3	5	0	6	0	21	12.8
Fluctuations	6	15	5	13	3	3	5	0	50	30.5
Increasing	0	1	0	6	0	2	2	0	11	6.7
Total	21	41	12	31	19	8	24	8	164	100.0

<Coastal areas>

Trends	Number of locations							
	Iwate	Miyagi	Fukushima	Ibaraki	Chiba	Tokyo	Total	
							Number of locations	Percentage
Decreasing	0	6	12	4	3	2	27	64.3
Unchanged	1	1	0	0	0	1	3	7.1
Fluctuations	1	4	3	1	2	0	11	26.2
Increasing	0	1	0	0	0	0	1	2.4
Total	2	12	15	5	5	3	42	100.0

3) Summary by prefecture

Concentration levels of detected values and their changes are summarized by prefecture as follows (see Figures 4.1.2-31 to 4.1.2-33).

(i) Iwate Prefecture

- For rivers, all the 22 surveyed locations were categorized as either Category D or E. A decreasing trend was observed at most locations.
- For coastal areas, the two surveyed locations were categorized as Category E. An unchanged trend was observed at most locations except for some locations that showed fluctuations.

(ii) Miyagi Prefecture

- For rivers, of the 43 surveyed locations, some locations in the lower reaches were categorized as Category C, but over 80% of the surveyed locations were categorized as Category D or E. A decreasing trend was observed at most locations.
- For lakes, of the 21 surveyed locations, most locations were categorized as Category D or E, while one location was categorized as Category C. Concentration levels were generally decreasing except for some locations that showed fluctuations.
- For coastal areas, approximately 70% of the 12 surveyed locations were categorized as Category D or E, rest of them were categorized as Category A, B or C. There was a location categorized as Category A in the Sendai Port. Although concentration levels were fluctuating at some locations, most other locations showed decreasing or unchanged trends.

(iii) Hamadori, Fukushima Prefecture

- For rivers, approximately 60% of the 53 surveyed locations were categorized as Category A, B or C.

Many locations categorized as Category A or B were found near to or between the northern and northwest of Fukushima Daiichi NPS, while locations categorized as Category C were seen in the southern parts of the district. A decreasing trend was observed at most locations.

- For lakes, approximately 70% of the 41 surveyed locations were categorized as Category A, B or C.

Many locations categorized as Category A or B were found northwest of Fukushima Daiichi NPS. Mostly a decreasing or an unchanged trend was observed except for some locations that showed fluctuations.

- For coastal areas, approximately 70% of the 15 surveyed locations were categorized as Category D or E, and the rest were categorized as Category A, B, or C. One location categorized as Category A was seen in Onahama port. A decreasing trend was observed at most locations.

(iv) Nakadori, Fukushima Prefecture

- For rivers, more than 70% of the 44 surveyed locations were categorized as Category D or E, and the rest were categorized as Category B or C. Many locations categorized as Category B or C were found between the center and the northern part of the Abukuma River system. A decreasing trend was observed at most locations.
- For lakes, eight of the 12 surveyed locations were categorized as Category D or E, and the remaining four locations were categorized as Category C. The locations categorized as Category C were seen in the upper and lower reaches of the Abukuma River basin. A decreasing or an unchanged trend was observed at most

locations except for some locations that showed fluctuations.

(v) Aizu, Fukushima Prefecture

- For rivers, one of the 26 surveyed locations was categorized as Category C, and all the remaining locations were categorized as Category D or E. A decreasing trend was observed at most locations.
- For lakes, six of the 31 surveyed locations were categorized as Category C, and approximately 80% of the locations were categorized as Category D or E. Although concentration levels were fluctuating at some locations, decreasing or unchanged trends were mostly observed at rest of the locations.

(vi) Ibaraki Prefecture

- For rivers, approximately 70% of the 53 surveyed locations were categorized as Category D or E, and the rest were categorized as Category A, B, or C. The locations categorized as Category A or B were found in rivers flowing into Lake Kasumigaura. A decreasing trend was observed at most locations.
- For lakes, out of the 19 surveyed locations, one in the northern part of the prefecture was categorized as Category C, and the remaining locations were categorized as Category D or E. A decreasing or an unchanged trend was observed at most locations.
- For coastal areas, all the five surveyed locations were categorized as Category E. A decreasing trend was observed at most locations.

(vii) Tochigi Prefecture

- For rivers, one of the 56 surveyed locations was categorized as Category C, and the remaining locations were categorized as Category D or E. A decreasing trend was observed at most locations.
- For lakes, all eight locations were categorized as Category D or E. Concentration levels were fluctuating at many of the locations, and rest of the locations showed a variety of trends.

(viii) Gunma Prefecture

- For rivers, out of the 48 surveyed locations, some locations in the lower reaches of the Watarase River basin were categorized as Category B, and all the remaining locations were categorized as Category D or E. Mostly a decreasing trend was observed.
- For lakes, one of the 24 surveyed locations were categorized as Category C, and the remaining locations were all categorized as Category D or E. Mostly a decreasing or an unchanged trend was observed.

(ix) Chiba and Saitama Prefectures and Tokyo Metropolis

- For rivers, over 60% of the 51 surveyed locations were categorized as Category A, B, or C. The locations categorized as Category A or B were found in rivers flowing into Lake Teganuma or Lake Inbanuma, the Edogawa River system and a part of the Tonegawa River system. A decreasing trend was observed at most locations.
- For lakes, one of the eight surveyed locations, in Lake Teganuma, was categorized as Category C, and all the remaining locations were categorized as Category D or E. A decreasing trend was observed at all locations.
- For coastal areas, one of the eight surveyed locations, the mouth of the Kyuedogawa River, was categorized as Category C, and all remaining locations were categorized as Category D or E. Mostly a decreasing trend was observed except for some locations showing fluctuations.

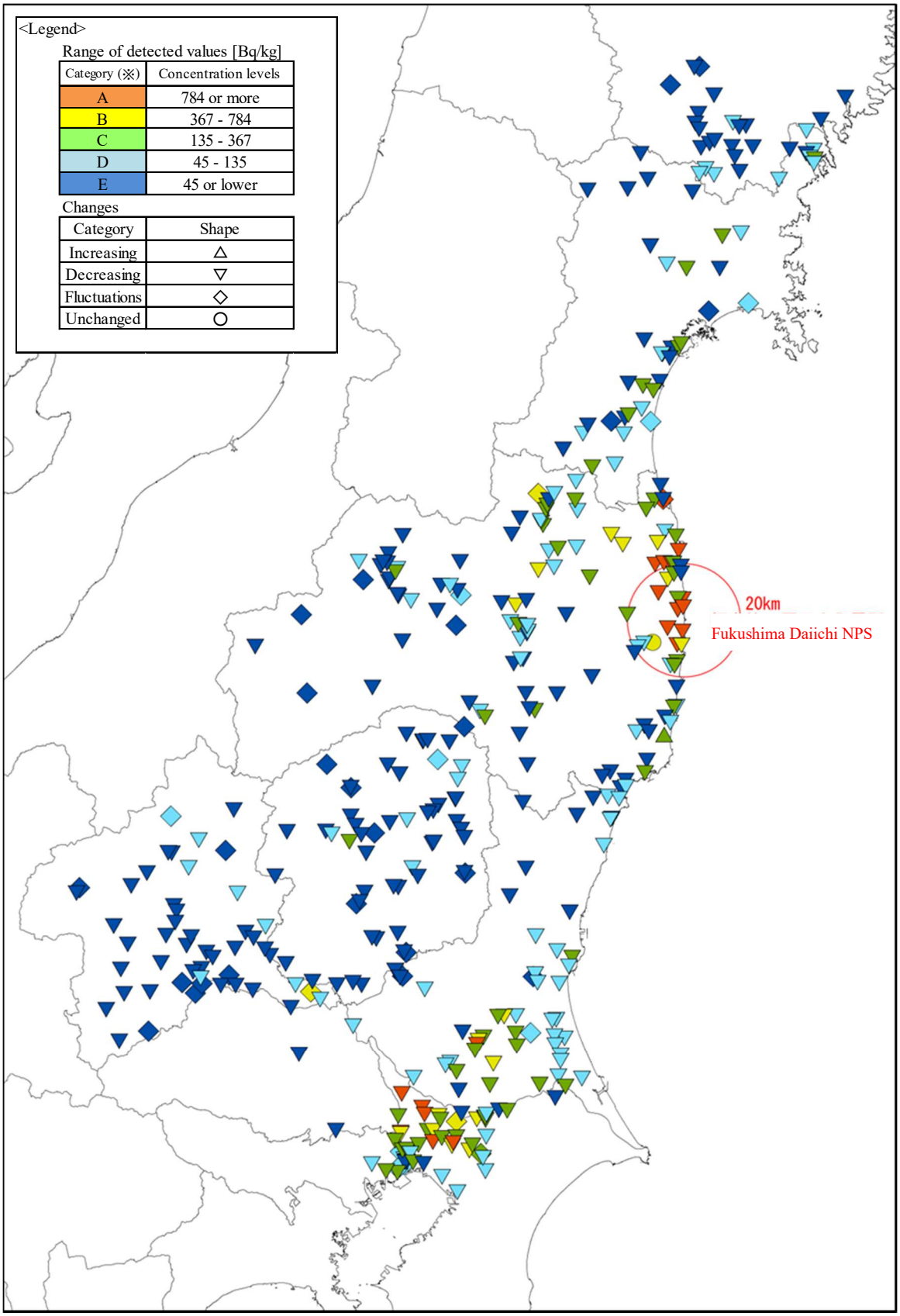


Figure 4.1.2-31 Categorization of and changes in concentration levels for river sediment samples from public water areas

(*) Categories A to E show relative concentration levels for river sediment samples and cannot be compared with those for lake sediment samples or coastal area sediment samples.

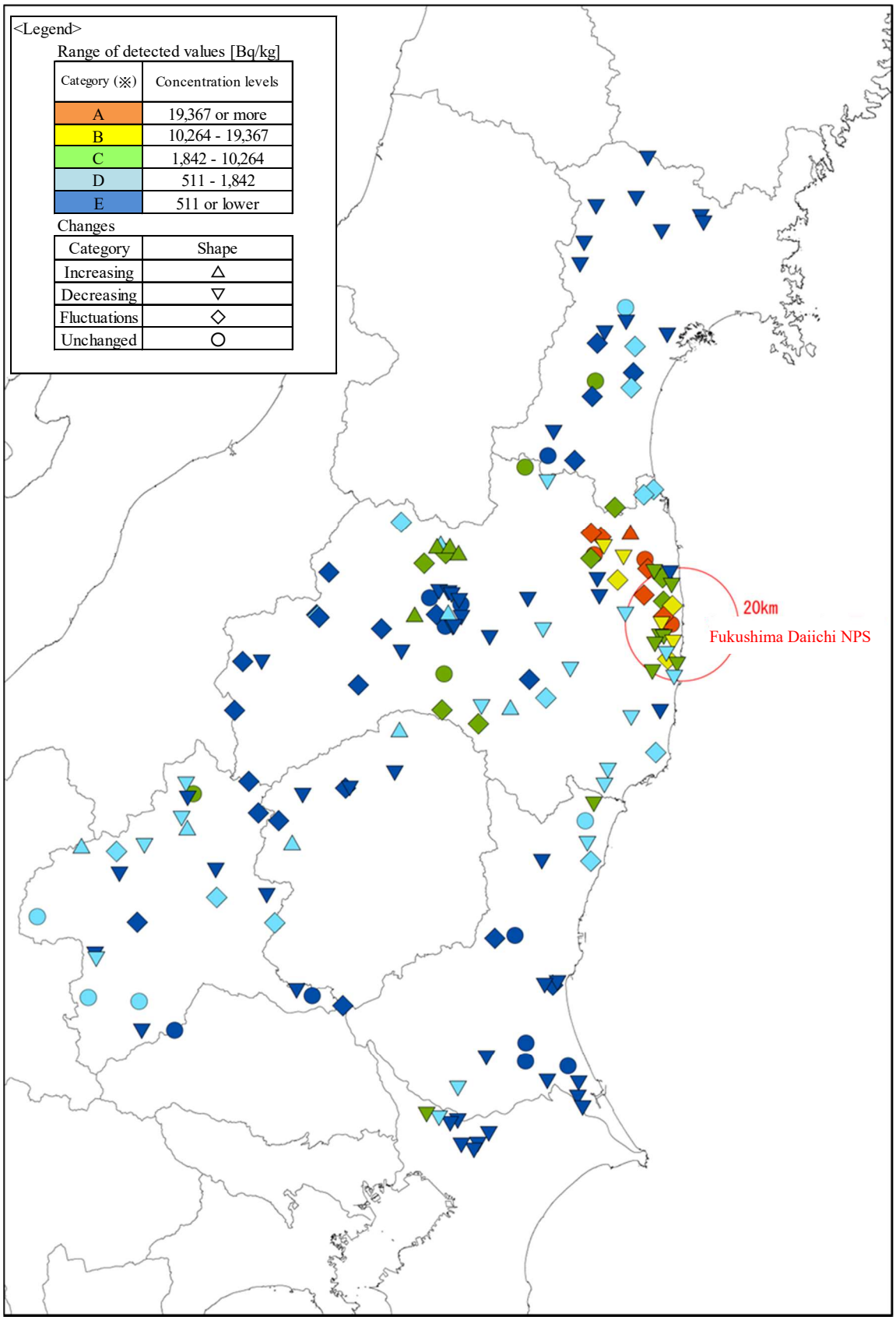


Figure 4.1.2-32 Categorization of and changes in concentration levels for lake sediment samples from public water areas

(*) Categories A to E show relative concentration levels for lake sediment samples and cannot be compared with those for river sediment samples or coastal area sediment samples.

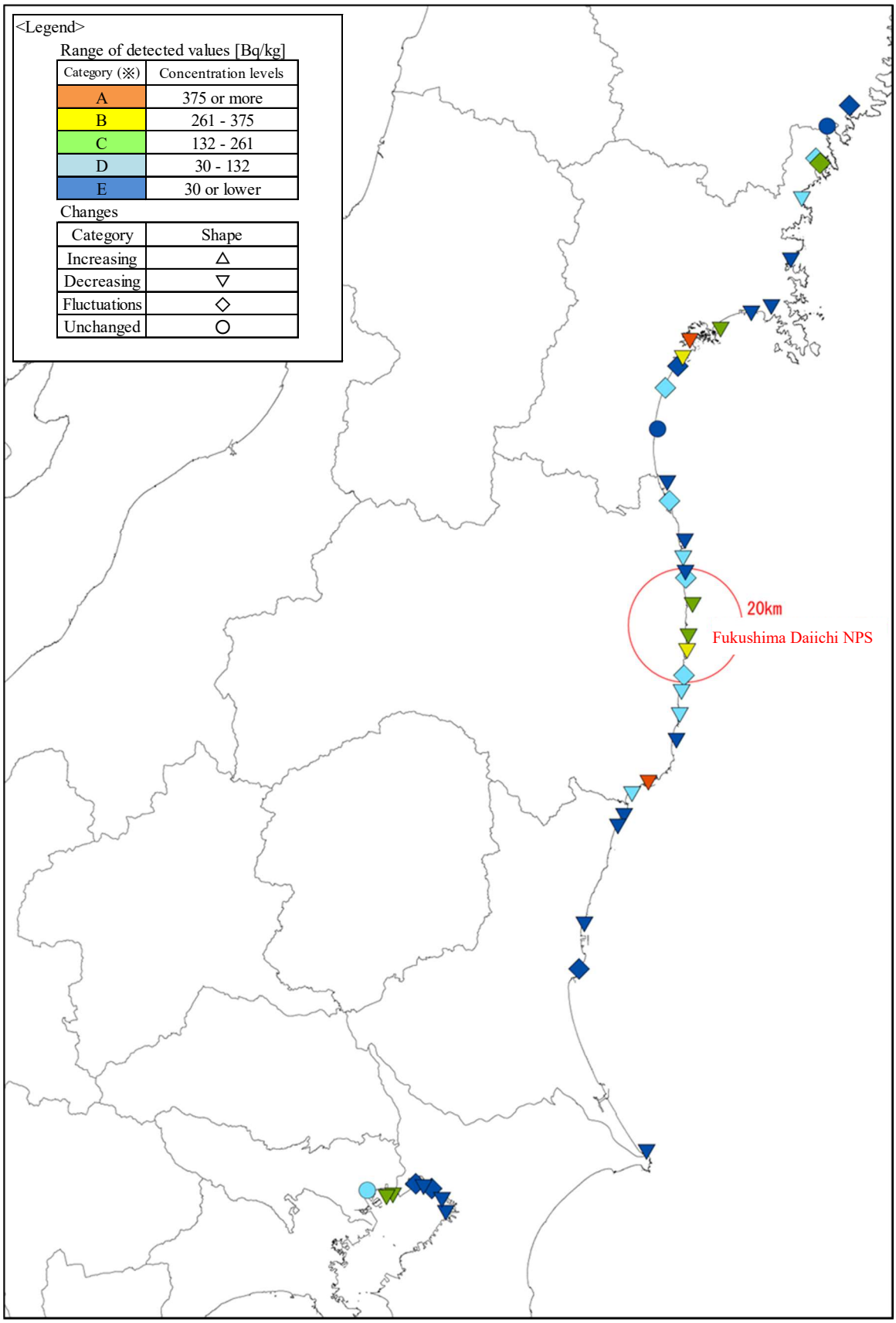


Figure 4.1.2-33 Categorization of and changes in concentration levels for coastal area sediment samples from public water areas

(*) Categories A to E show relative concentration levels for coastal area sediment samples and cannot be compared with those for river sediment samples or lake sediment samples.

5 Results (Radionuclides other than radioactive cesium)

5.1 Radioactive strontium (Sr-90 and Sr-89)

(1) Public water areas

In principle, radioactive strontium was measured at locations where the radioactive cesium concentration in the sediment was high. (detection limit: approx.1 Bq/kg for Sr-90 and approx. 2 Bq/kg for Sr-89, both for sediment samples).

From FY2016 to FY2017, Sr-90 was surveyed (detection limit: approx. 1 Bq/L for Sr-90 for water samples) for the water samples collected on the same day from the same public water area (lakes) sediment samples where Sr-90 concentration levels were relatively high (1.0 Bq/kg or more in FY2016 and 10 Bq/kg or more in FY2017). On the other hand, a survey was conducted for Sr-89 on 22 samples (13 river sediment samples and nine lake sediment samples) in FY2011, Sr-89 was not detectable in any of them, and the survey has not been conducted since FY2012.

1) Sediment

(i) River sediment

Sr-90 was detected at eight out of 24 river sediment samples surveyed in FY2017 (detection rate: 33.3%). Detected values were less than 1 Bq/kg (see Table 4.2-1).

Sr-90 has been continuously detected since FY2011 at some locations in Ota River and Ukedo River in Fukushima Prefecture, but the detected values have gradually decreased to fall below 2 Bq/kg from FY2014 on (see Figure 4.2-1).

(ii) Lake sediment

In FY2017, 70 lake sediment samples were surveyed for Sr-90; Sr-90 was detected at 66 samples (detection rate: 94.3%) (see Table 4.2-1).

Sr-90 has been continuously detected until FY2017 in each prefecture surveyed.

When reviewed location by location, detected values have basically been at relatively low levels, and the range of measured values in FY2017 was from not detectable to 22 Bq/kg (see Figure 4.2-1).

(iii) Coastal area sediment

In FY2017, 32 coastal area sediment samples were surveyed; Sr-90 was not detectable in any of them (see Table 4.2-1).

2) Water

Surveys for Sr-90 on three samples collected from water area (lakes) were conducted in FY2017. Sr-90 was not detectable at any surveyed locations even in measurements at the lower limit value (0.038 to 0.047 Bq/L) which was even lower than 1 Bq/L.

Table 4.2-1 Detection of Sr-90 in sediment samples from public water areas (rivers, lakes, and coastal areas)

○ Sr-90

Property	Prefecture	FY2017				FY2011 - FY2017			
		Number of samples	Detection times	Detection rate (%)	Range of measured values [Bq/kg]	Number of samples	Detection times	Detection rate (%)	Range of measured values [Bq/kg]
Rivers	Miyagi	2	1	50.0	ND - 0.76	24	11	45.8	ND - 1.2
	Fukushima	10	1	10.0	ND - 0.32	92	51	55.4	ND - 12
	Ibaraki	4	2	50.0	ND - 0.75	29	15	51.7	ND - 1.8
	Tochigi	-	-	-	-	8	3	37.5	ND - 1.3
	Gunma	-	-	-		6	2	33.3	ND 0.70
	Chiba	8	4	50.0	ND - 0.65	33	14	42.4	ND - 1.1
	Total	24	8	33.3	ND - 0.76	192	96	50.0	ND - 12
Lakes	Miyagi	7	6	85.7	ND - 1.2	38	33	86.8	ND - 2.2
	Fukushima	38	38	100.0	0.56 - 22	236	235	99.6	ND - 150
	Ibaraki	7	5	71.4	ND - 1.8	39	31	79.5	ND - 7.0
	Tochigi	1	1	100.0	1.2 - 1.2	12	11	91.7	ND - 2.2
	Gunma	13	13	100.0	0.68 - 2.0	39	38	97.4	ND - 2.6
	Chiba	4	3	75.0	ND - 0.57	23	17	73.9	ND - 4.4
	Total	70	66	94.3	ND - 22	387	365	94.3	ND - 150
Coastal areas	Miyagi	2	0	0.0	ND	14	0	0.0	ND
	Fukushima	30	0	0.0	ND	171	8	4.7	ND - 0.78
	Tokyo	-	-	-	-	2	0	0.0	ND
	Total	32	0	0.0	ND	187	8	4.3	ND - 0.78

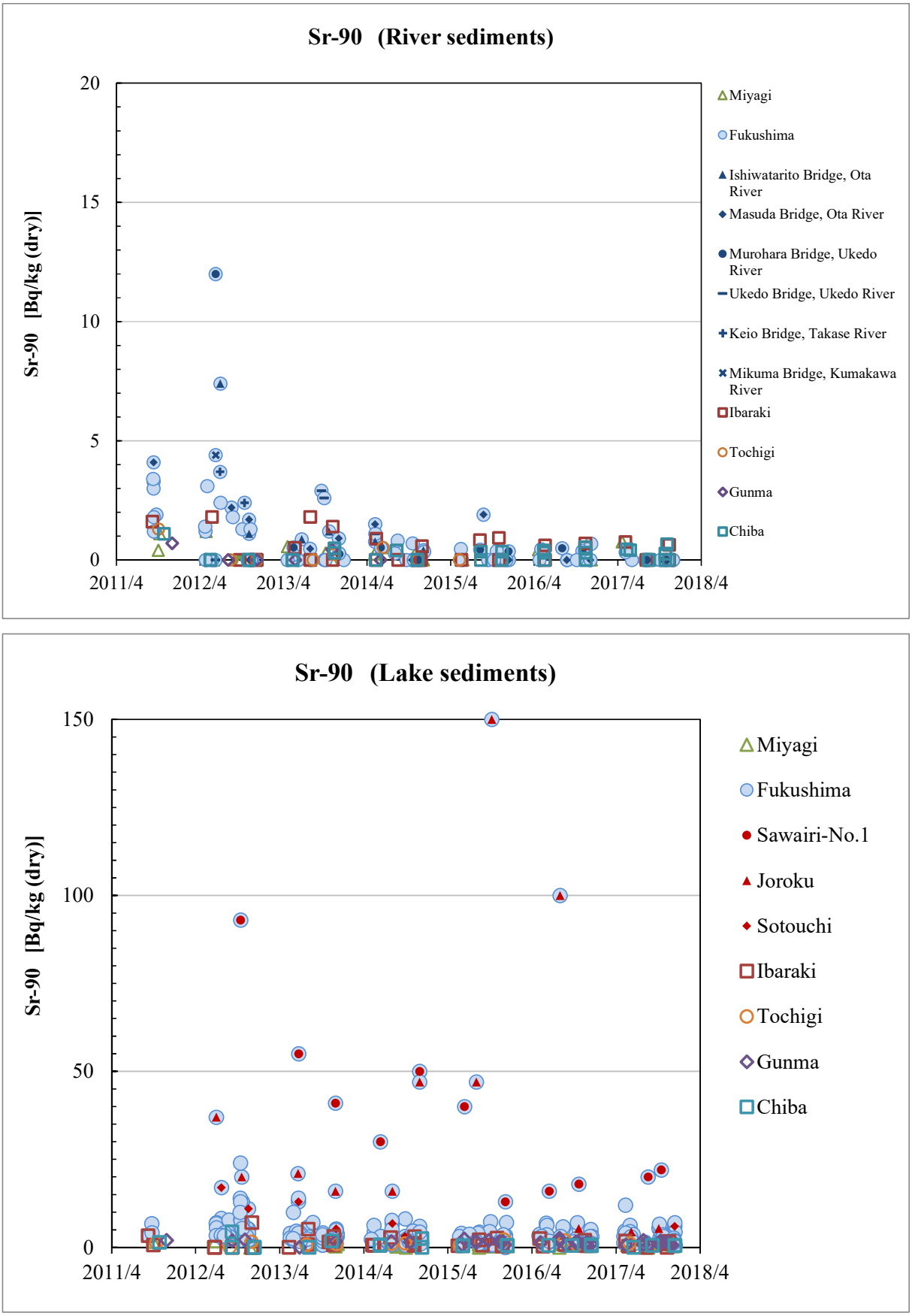


Figure 4.2-1 Detection of Sr-90 in sediment samples from public water areas (upper: rivers; lower: lakes)

(2) Groundwater

Surveys for Sr-89 and Sr-90 were conducted on approximately 340 groundwater samples collected in Fukushima Prefecture between January 2012 and November 2017.

An outline of these survey results is as shown in Table 4.2-2. Detected values of Sr-89 and Sr-90 were all below the detection limit (1 Bq/L).

Table 4.2-2 Detection of Sr-89 and Sr-90 in groundwater samples (all collected in Fukushima Prefecture)

Year (FY)	Sr-90				Sr-89			
	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L) (*1)	Number of samples	Detection times	Detection rate (%)	Range of measured values (Bq/L) (*1)
FY2011	8	0	0.0	ND	8	0	0.0	ND
FY2012	60	0	0.0	ND	60	0	0.0	ND
FY2013	77	0	0.0	ND	77	0	0.0	ND
FY2014	48	0	0.0	ND	48	0	0.0	ND
FY2015	48	0	0.0	ND	48	0	0.0	ND
FY2016	48	0	0.0	ND	48	0	0.0	ND
FY2017	48	0	0.0	ND	48	0	0.0	ND
Total	337	0	0.0	ND	337	0	0.0	ND

*1: Results were compiled by setting the detection limit at 1 Bq/L.
Additionally, the detection limit of Sr-90 was 0.0002 Bq/L in FY2011, and 1 Bq/L thereafter, and similarly, the detection limit of Sr-89 was 0.001 Bq/L in FY2011, and 1 Bq/L thereafter.
In the FY2011 survey (calendar year 2012), Sr-90 was detected in all eight samples, with detected values ranging from 0.0004 to 0.0029 Bq/L. Similarly, while the detection limit for Sr-89 was 0.001 Bq/L in FY2011 (calendar year 2012), Sr-89 in all eight samples was below the detection limit.

5.2 Other γ-ray emitting radionuclides

Apart from the aforementioned radionuclides (Cs-134, Cs-137, Sr-89 and Sr-90), measurement results for water samples and sediment samples using a germanium semiconductor detector were analyzed from FY2011 to FY2017 to obtain activity concentrations of accident-derived radionuclides (Ag-110m, Te-129m, Nb-95, Sb-125 and Ce-144, etc.[10]) and major naturally occurring radionuclides such as K-40. The summary of the results is as shown in Table 4.2-3 and Table 4.2-4.

Among the detected radionuclides, no artificial radionuclides were detected in water samples for FY2011 and FY2012, while two types of radionuclides, Ag-110m and Sb-125, were detected in sediment samples with detection rates of 1% or less. Since FY2013, neither radionuclide has been detected.

Although six naturally occurring radionuclides (K-40, Pb-212, Pb-214, Tl-208, Ac-228 and Bi-214) were detected, K-40 is a naturally occurring radionuclide entrained during the Earth's formation, while the other species are all either uranium series or thorium series radionuclides, which are widely distributed in nature including the Earth's crust.

Table 4.2-3 Detection of other radionuclides (Water)

Year (FY)	Number of samples	Major detected artificial radionuclide		Major detected naturally occurring radionuclide	
		Nuclide	Detection rate and detected values	Nuclide	Detection rate
FY2011	1,755	-	-	K-40	10%
FY2012	3,518	-	-	K-40	6%
FY2013	3,860	-	-	K-40	13%
FY2014	3,856	-	-	K-40	10%
FY2015	3,916	-	-	K-40	7%
				Pb-212	7%
				Pb-214	9%
FY2016	3,890	-	-	K-40	8%
				Pb-212	17%
				Pb-214	10%
FY2017	3,836	-	-	K-40	7%
				Pb-214	8%

[10] Among the accident-derived radionuclides, I-131 was investigated in water samples from public water areas (3,111 river water samples, 1,416 lake water samples, and 715 coastal area water samples) and sediment samples (3,073 river sediment sample, 877 lake sediment samples, and 393 coastal area sediment samples) from FY 2011 to FY 2012, and in groundwater samples (3,793 samples) from FY 2011 to FY 2014. In none of these samples was I-131 detected (detection limit values: 1 Bq/L for water and 10 Bq/kg for sediment).

Table 4.2-4 Detection of other radionuclides (Sediment)

Year (FY)	Number of samples	Major detected artificial radionuclide		Major detected naturally occurring radionuclide	
		Nuclide	Detection rate and detected values	Nuclide	Detection rate
FY2011	1,559	Ag-110m	4 samples (0.26%) 46 - 170 Bq/kg	K-40	79%
				Pb-212	41%
				Pb-214	16%
				Tl-208	14%
FY2012	2,885	Ag-110m	26 samples (0.90%) 7.9 - 350 Bq/kg	Ac-228	41%
				Bi-214	43%
				K-40	97%
		Sb-125	3 samples (0.10%) 140 - 420 Bq/kg	Pb-212	75%
				Pb-214	44%
				Tl-208	39%
FY2013	3,062	-	-	Ac-228	25%
				Bi-214	25%
				K-40	91%
				Pb-212	49%
				Pb-214	23%
				Tl-208	23%
FY2014	3,035	-	-	Ac-228	24%
				Bi-214	24%
				K-40	91%
				Pb-212	48%
				Pb-214	24%
				Tl-208	24%
FY2015	3,158	-	-	Ac-228	32%
				Bi-214	60%
				K-40	88%
				Pb-212	63%
				Pb-214	67%
				Tl-208	37%
FY2016	3,088	-	-	Ac-228	35%
				Bi-214	66%
				K-40	92%
				Pb-212	64%
				Pb-214	75%
				Tl-208	40%
FY2017	3,056	-	-	Ac-228	45%
				Bi-214	35%
				K-40	92%
				Pb-212	73%
				Pb-214	80%
				Tl-208	46%

Note: detection limits of artificial radionuclides (detected radionuclides): 7 - 180 Bq/kg for Ag-110m, and 130 - 330 Bq/kg for Sb-125

Part 3: Other Radioactive Material Monitoring Conducted Nationwide (FY2017)

1 Outline of the Monitoring

1.1 Covered monitoring

As other radioactive material monitoring activity conducted nationwide, the results of the Monitoring of Environmental Radioactivity Levels in FY2017, which was conducted in FY2017 by the Nuclear Regulation Authority for the purpose of clarifying the existence or nonexistence of the influence of nuclear facilities, etc. nationwide, are compiled here.

Monitoring locations are as shown in Table 1.1-1 and Figure 1.1-1. See the relevant website for more details. (http://www.env.go.jp/air/rmcm/result/nsr.html)

1.2 Compilation methods

Measurement data are available on the website of Environmental Radioactivity and Radiation in Japan.[11]

Data for this report were collected from this website under the following search criteria.

(i) Period: April 2017 to March 2018 (Published on Feb 1, 2019)

(ii) Coverage: Nationwide

(iii) Targets: All radionuclides

(iv) Targeted samples: Inland water (river water, lake water, freshwater), seawater, sediment (river sediment, sea sediment)

[11] Environmental Radioactivity and Radiation in Japan "Environmental Radiation Database" http://search.kankyo-hoshano.go.jp/servlet/search.top. (Japanese only, accessed Feb 1, 2019)

Table 1.1-1 Locations for the Monitoring of Environmental Radioactivity Levels (30 in total)

No.	Prefecture	Property	Sampling locations	Water	Sediment
1	Hokkaido	Lake	Oyafuru, Ishikari City (Lake Barato)	○	-
2		Coastal area	Yoichi Town, Yoichi County (Yoichi Bay)	○	○
3	Aomori	Coastal area	Fukaura Town, Nishitsugaru County (off Kasose)	○	○
4		Coastal area	Hiranai Town, Higashitsugaru County (Mutsu Bay)	○	○
5	Iwate	Coastal area	Hirono Town, Kunohe County (off Taneichi)	○	○
6	Akita	River	Asahikawa, Akita City	○	-
7	Fukushima	Coastal area	Soma City (off Haragama Beach)	○	○
8		River	Zainiwasaka, Fukushima City	○	-
9	Ibaraki	Lake	Kasumigaura	○	-
10		Coastal area	Tokai Village, Naka County (off the NPS)	○	○
11	Chiba	Coastal area	Tokyo Bay (off Sodegaura City)	○	○
12	Kanagawa	Coastal area	Yokosuka City (Odawa Bay)	○	○
13	Niigata	Lake	Shichikuyama, Chuo Ward, Niigata City	○	-
14		Coastal area	off Niigata Port	○	○
15	Fukui	Lake	Inogaike Pond, Tsuruga City	○	-
16	Nagano	Lake	Lake Suwa	○	-
17	Aichi	Coastal area	Tokoname City (off Kosugaya)	○	○
18	Mie	River	Seki Town, Kameyama City (Suzuka River)	○	-
19	Kyoto	Freshwater	Tenno, Ogura Town, Uji City	○	-
20	Osaka	Coastal area	Osaka City (Entrance to Osaka Port)	○	○
21	Tottori	River	Katamo (Katamo River System)	○	○
22		River	Kawakami (Kawakami River System)	○	○
23		River	Hotani (Iwakura River System)	○	○
24		River	Bessho (except for Katamo River System)	○	○
25		River	Kannokura (Oshika River System)	○	○
26	Hiroshima	River	Kawate Town, Shobara City (Saijo River)	○	-
27	Yamaguchi	Coastal area	Ajisu, Yamaguchi City (Yamaguchi Bay)	○	○
28	Fukuoka	Coastal area	Higashiminato Town, Moji Ward, Kitakyushu City (off Chichisaki)	○	○
29	Kagoshima	Coastal area	Minamisatsuma City (off the mouth of Manose River)	○	○
30	Okinawa	Coastal area	Katsuren White Beach, Uruma City	○	○

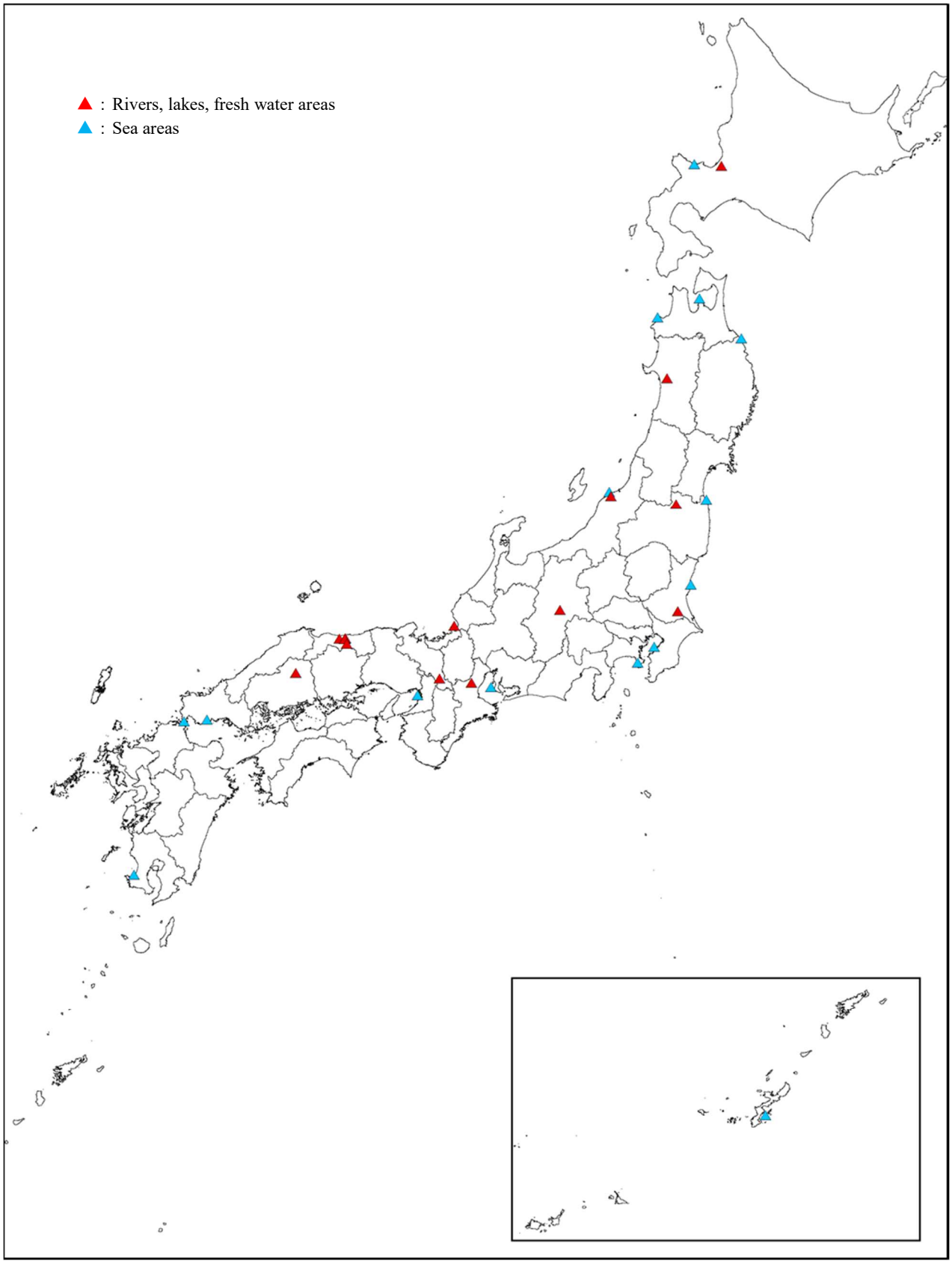


Figure 1.1-1 Locations for the Monitoring of Environmental Radioactivity Levels

2 Results

2.1 Water

(1) Inland water[12]

In the Monitoring of Levels in FY2017, inland water samples were reported for 9 radionuclides (Be-7, K-40, U-234, U-235, U-238, Cs-134, Cs-137, I-131 and Sr-90), as shown in Table 2.1-1.

A comparison with the results of the Monitoring of Levels for the last twenty years (excluding data of artificial radionuclides from Mar 11, 2011, to Mar 10, 2014) revealed that all these radionuclides were considered to be within the past measurement trends (see Figure 2.1-1).

Table 2.1-1 Detection of radionuclides in the Monitoring of Levels [inland water]

Nuclides		Number of reported data	Detection times	Range of measured values (Bq/L)			The range of past measurement records (Bq/L) (*1)		
Naturally Occurring radionuclides	Be-7	7	4	ND	-	0.018	ND	-	0.034
	K-40	10	10	0.012	-	0.18	0.0067	-	0.30
	U-234	10	10	0.0015	-	0.0073	0.00042	-	0.015
	U-235	10	0		ND		ND	-	0.00054
	U-238	10	10	0.00086	-	0.0054	ND	-	0.013
Artificial radionuclides	Cs-134	9	1	ND	-	0.0023	ND	-	0.015
	Cs-137	9	3	ND	-	0.015	ND	-	0.041
	I-131	9	0		ND		ND	-	0.013
	Sr-90	10	8	ND	-	0.0025	ND	-	0.0050

(*1) Results of the Monitoring of Levels from FY1997 to FY2016 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014)

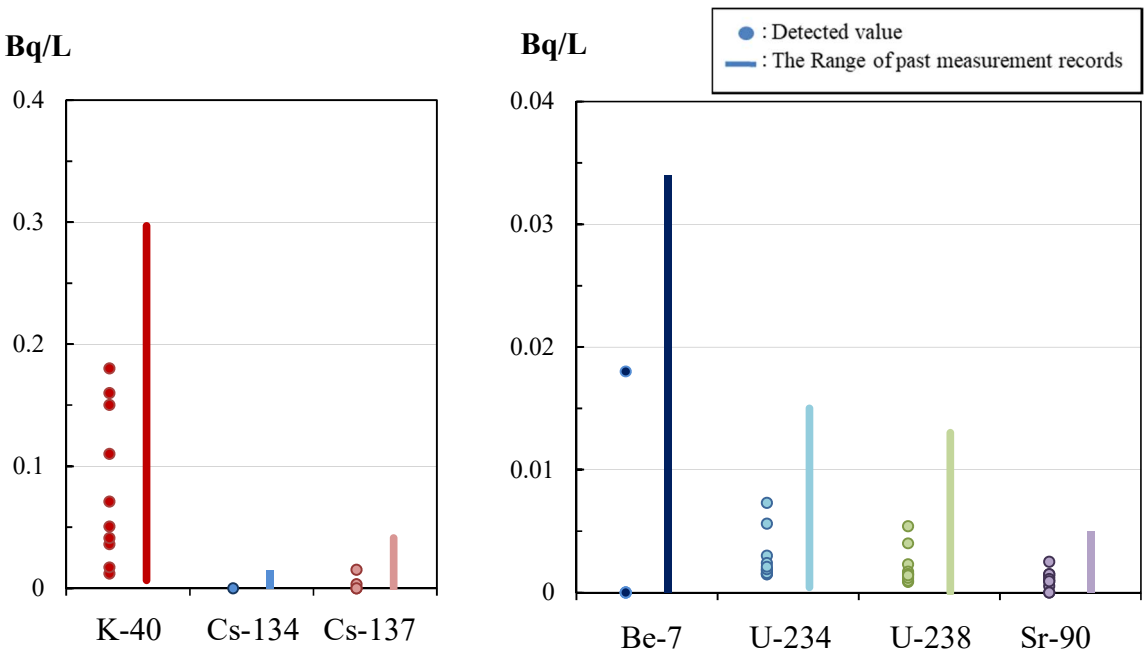


Figure 2.1-1 Detection of radionuclides in the Monitoring of Levels [inland water]

[12] This report only covers data for river water, lake water, and freshwater in the Monitoring of Levels.

(2) Seawater

In the Monitoring of Levels in FY2017, six radionuclides (Be-7, K-40, Cs-134, Cs-137, I-131 and Sr-90) were reported from seawater samples, as shown in Table 2.1-2.

A comparison with the results of the Monitoring of Levels for the last twenty years (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014) revealed that detected values for all above mentioned radionuclides were within the range of the past measurement trends (see Figure 2.1-2).

Table 2.1-2 Detection of radionuclides in the Monitoring of Levels [seawater]

Nuclides		Number of reported data	Detection times	Range of measured values (Bq/L)			Range of past measurement records (Bq/L) (*1)		
Naturally occurring radionuclides	Be-7	2	0	ND			ND		
	K-40	16	16	0.19	-	12	0.078	-	15
Artificial radionuclides	Cs-134	16	0	ND			ND		
	Cs-137	16	1	ND	-	0.0023	ND	-	0.064
	I-131	12	0	ND			ND		
	Sr-90	15	15	0.00069	-	0.0012	ND	-	0.0022

(*1) Results of the Monitoring of Levels from FY1997 to FY2016 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014)

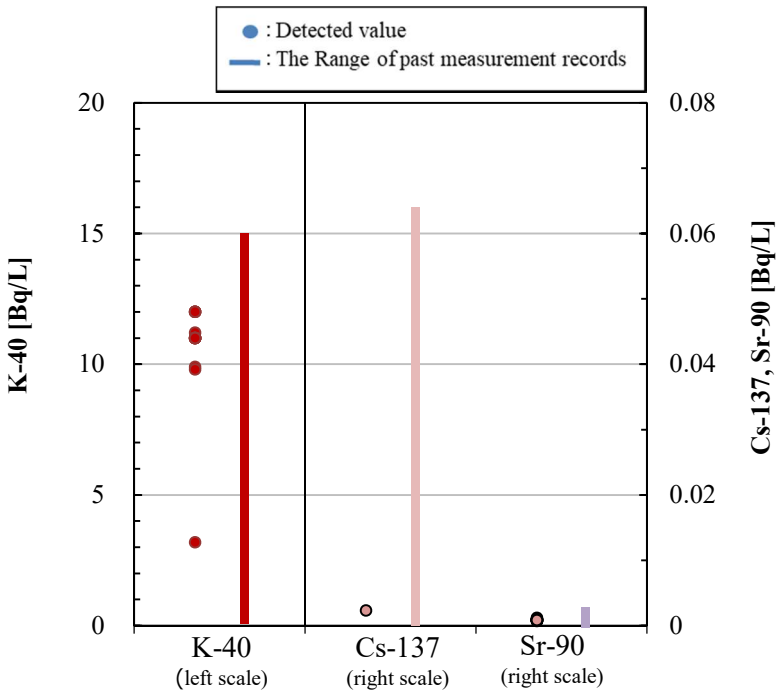


Figure 2.1-2 Detection of radionuclides in the Monitoring of Levels [seawater]

2.2 Sediment

(1) Inland water sediment (river sediment)

In the Monitoring of Levels in FY2017, three radionuclides (U-234, U-235 and U-238) were reported from inland water sediment samples (river sediment) as shown in Table 2.2-1.

A comparison with the results of the Monitoring of Levels for the last twenty years revealed that detected values for all three detected radionuclides were within the past measurement trends (see Figure 2.2-1).

Table 2.2-1 Detection of radionuclides in the Monitoring of Levels
[Inland water sediment (river sediment)]

Nuclides		Number of reported data	Detection times	Range of measured values (Bq/L)			Range of past measurement records (Bq/L) (*1)		
Naturally occurring radionuclides	U-234	5	5	13	-	34	6.5	-	64
	U-235	5	5	0.62	-	1.4	0.20	-	2.7
	U-238	5	5	16	-	34	6.6	-	66

(*1) Results of the Monitoring of Levels from FY1997 to FY2016 (excluding the results reported in mg/kg units)

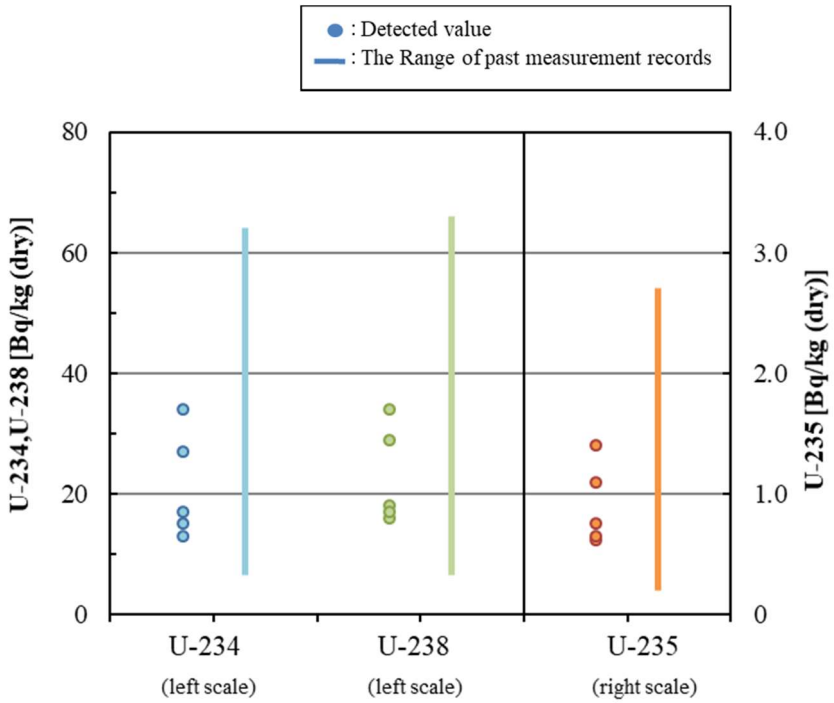


Figure 2.2-1 Detection of radionuclides in the Monitoring of Levels [Inland water sediment [(river sediment)]

(2) Sea sediment

In the Monitoring of Levels in FY2017, six radionuclides (Be-7, K-40, Cs-134, Cs-137, I-131, and Sr-90) were reported from seawater sediment samples as shown in Table 2.2-2.

A comparison with the results of the Monitoring of Levels for the last twenty years (excluding data of artificial radionuclides from Mar 11, 2011, to Mar 10, 2014) revealed that detected values for all these radionuclides were within the past measurement trends (see Figure 2.2-2).

Table 2.2-2 Detection of radionuclides in the Monitoring of Levels [Sea sediment]

Nuclides		Number of reported data	Detection times	Range of measured values (Bq/L)			Range of past measurement records (Bq/L) (*1)		
Naturally occurring radionuclides	Be-7	4	0	ND			ND	-	13
	K-40	15	15	93	-	680	33	-	750
Artificial radionuclides	Cs-134	15	3	ND	-	1.2	ND	-	4
	Cs-137	15	9	ND	-	9	ND	-	13
	I-131	8	0	ND			ND		
	Sr-90	15	0	ND			ND	-	0.41

(*1) Results of the Monitoring of Levels from FY1997 to FY2016 (excluding data of artificial radionuclides from Mar 11, 2011 to Mar 10, 2014)

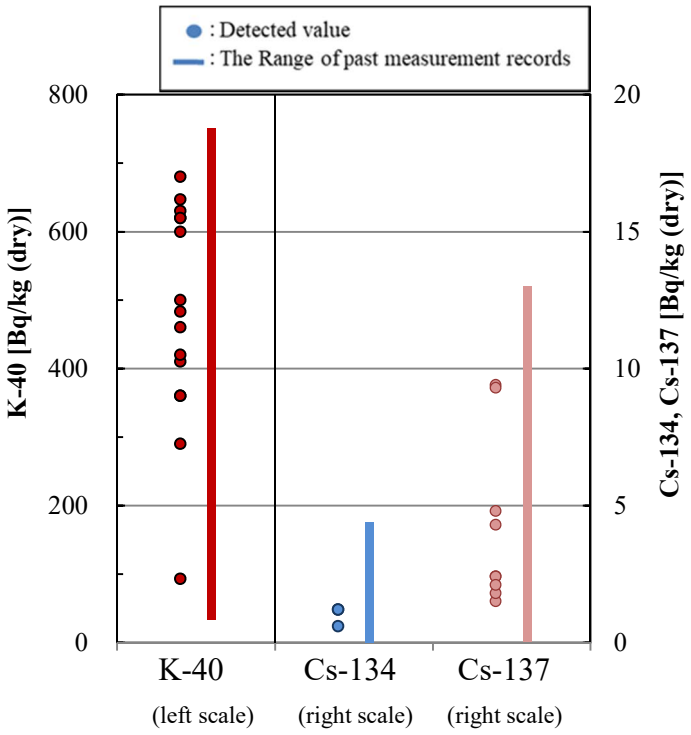


Figure 2.2-2 Detection of radionuclides in the Monitoring of Levels [Sea sediment]