Status of Sea Area Monitoring for the Handling of ALPS Treated Water

May 26, 2022

TEPCO

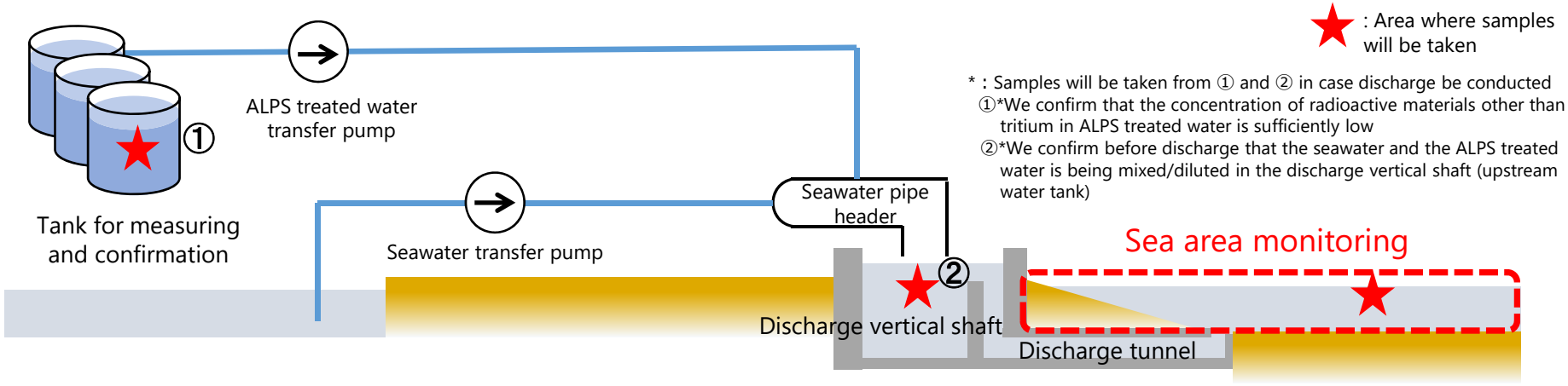
Tokyo Electric Power Company Holdings, Inc.

Sea area monitoring plan （1/2）

【Formulating and starting sea area monitoring plan】

○TEPCO as the organization responsible for ALPS water discharge, formulated and revised the sea area monitoring plan focusing on the area near the outlet. The plan include an increase of sampling locations of seawater and fish for tritium near the station and at the shore of Fukushima, and an additional measuring of seaweed for tritium and iodine 129.
(Published on March 24,2022)

○Sample gathering was started on April 20, 2022 to <u>ascertain normal tritium concentrations and the normal state of marine organisms</u> according to this sea area monitoring plan.



Confirming before discharge and sea area monitoring

Sea area monitoring plan （2/2）

TEPCO

【Objective of the sea area monitoring results assessment】

＜Currently＞

○ Since April 22, we have been gathering monitoring data to **ascertain the normal range for tritium concentrations** (fluctuations in concentrations of tritium and other radioactive materials in subdrain, groundwater drain treated water, groundwater bypass water, site drains).

＜Should treated water be discharged＞

○ We will ascertain how the seawater dispersed and the impact on marine organisms.

○ We will compare the results against sea dispersion simulation results and concentrations used in radiation impact assessments to confirm that seawater dispersion behavior and material concentrations are within the expected range.

○ If measurements exceed the normal range, we will check our measurements with other monitoring organizations and identify the cause.

○ If measurements grossly exceed the normal range *, then sea discharge will be stopped. Measurements will be taken again from the relevant location and the state of scope and frequency of monitoring will be temporarily expanded to ascertain the state of the surrounding sea area.

*：To be set based on data collected in preparation for the possibility of discharge

Sea area monitoring plan　Sampling locations（1/2）

・TEPCO increased the number of samples taken, frequency of measurement for seawater, fish, and seaweed and set the detectable limit to be in line with government targets for seawater, fish and seaweed.

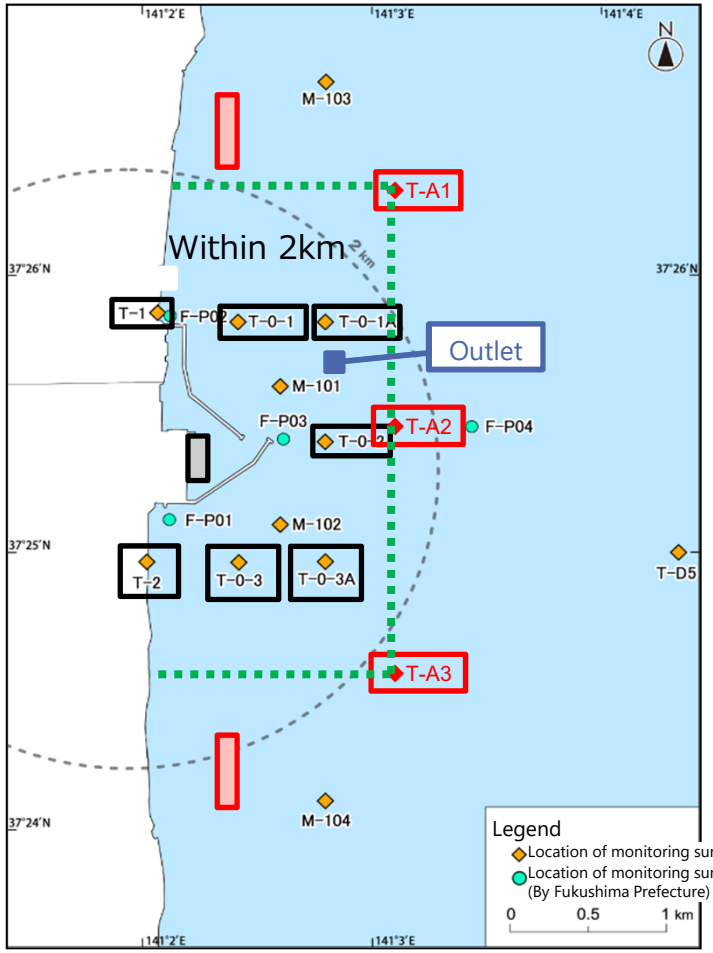


Diagram 1. Near the station (Within 2km outside the harbor)

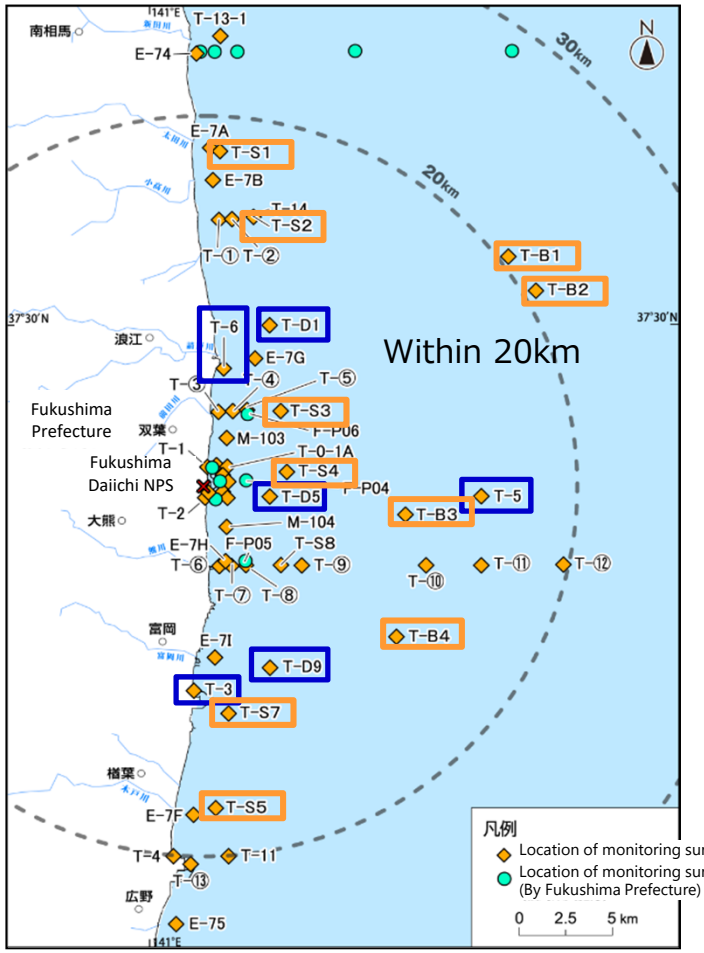


Diagram 2. Within 20km off the coast of Fukushima

【TEPCO's sampling locations】

- : Locations where the detectable limit is being revised (seawater)
- : New sampling locations (seawater)
- : Locations at which sampling frequency will be increased (seawater)
- : Locations at which tritium will be measured in addition to cesium (fish, seaweed)
- : Locations with no change (Seaweed)
- : New sampling locations (Seaweed)
- : Areas where no fishing is being conducted on a daily basis ※
  1.5km (East to West), 3.5 km (South to North)

※：Area where common fishery rights are not set

※On Diagram 1, notation and location of T-A1, T-A2 and T-3 was revised from the sea area monitoring plan published on March 24,2022 to be consistent with the Comprehensive Monitoring Plan

Sea area monitoring plan　Sampling locations（2/2）

・TEPCO increased the number of samples taken for tritium in regards to seawater.

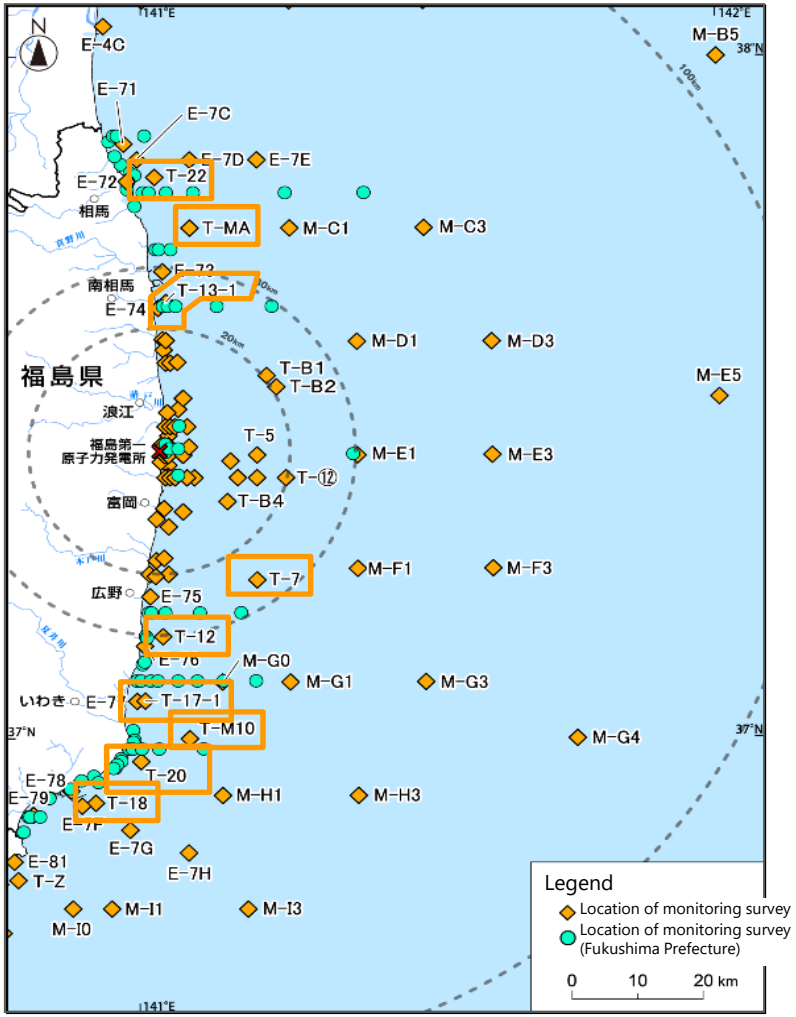


Diagram 3. Outside 20km off the coast of Fukushima

【 TEPCO's sampling locations 】

□ : Locations at which tritium will be measured in addition to cesium (seawater)

State of sea area monitoring results

TEPCO

【State of seawater】

＜Within 2 km outside the harbor＞

◯ Tritium concentrations have remained constant for the past year. Values for new measurement points have also been at the low of the normal range* for seawater around Japan.

◯ While there was a temporary increase in cesium 137 concentrations presumably due to rainfall which has been the cause of the fluctuations in concentrations around the Fukushima Daiichi NPS in the past as well, concentrations have remained constant in the past year. Values for new measurement points have also been at the low of the normal range* for seawater around Japan.

◯ We have lowered the detectable limit for tritium to gain a more detailed picture of the state of tritium after April 18.

＜Within 20 km off the coast＞

◯ Tritium and Cesium 137 concentrations have remained constant for the past year. Values for new measurement points have also been at the low of the normal range* for seawater around Japan.

＜Outside 20 km off the coast＞

◯ Cesium 137 concentrations have remained constant for the past year. Values for new measurement points have also been at the low of the normal range* for seawater around Japan. Sample gathering of tritium was started in April 21 of this year and data is currently being analyzed.

＊：Range of radioactive materials in the seawater in Japan （April 2018 to March 2020）

Tritium concentrations: 0.043 Bq/L ～ 20 Bq/L

Levels have been rising in the environment with more tritium being discharged from PWRs than BWRs.

Cesium 137 concentrations: 0.0010 Bq/L ～ 0.38 Bq/L

Source: Environmental Radiation Database, Environmental Radioactivity and Radiation in Japan
https://www.kankyo-hoshano.go.jp/data/database/ (only in Japanese)

（Reference）

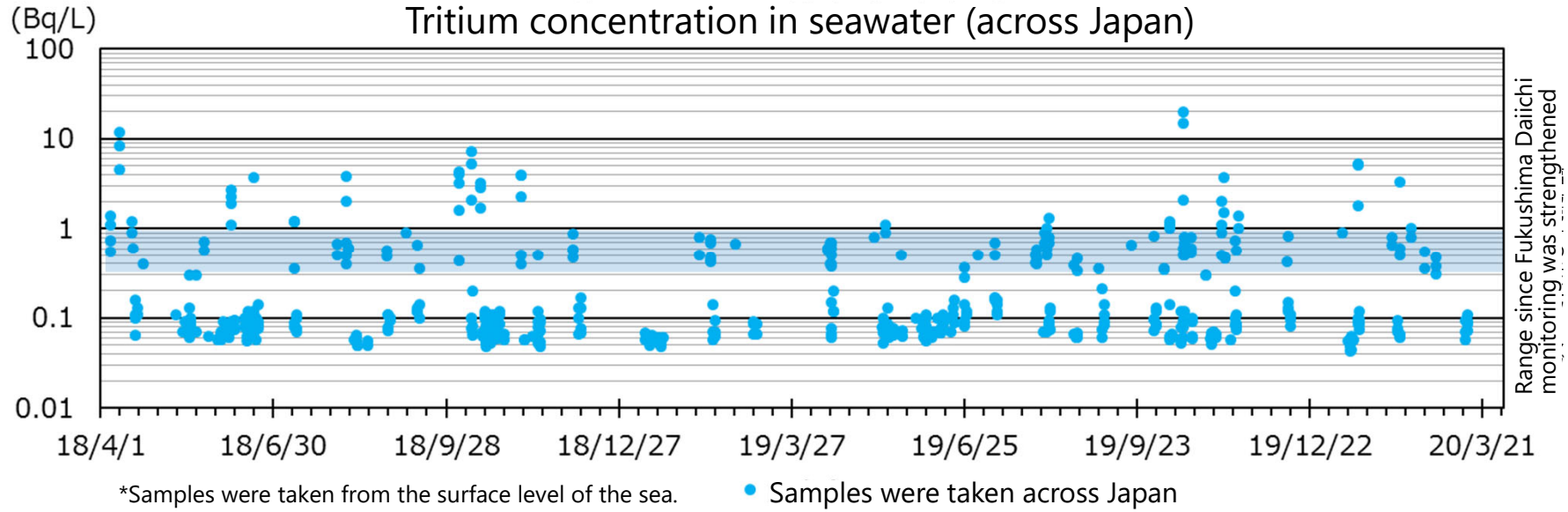
According to WHO Guidelines for drinking-water quality

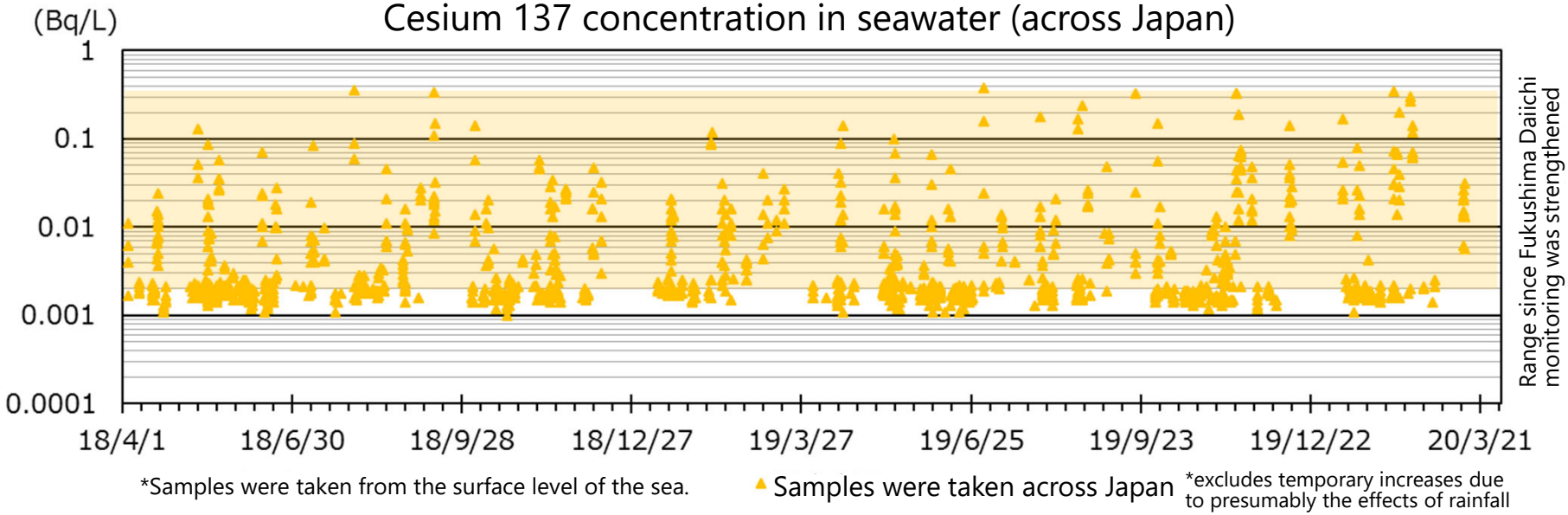
Tritium concentration: 10,000 Bq/L, cesium 137 concentration: 10 Bq/L

【State of fish and seaweed monitoring】

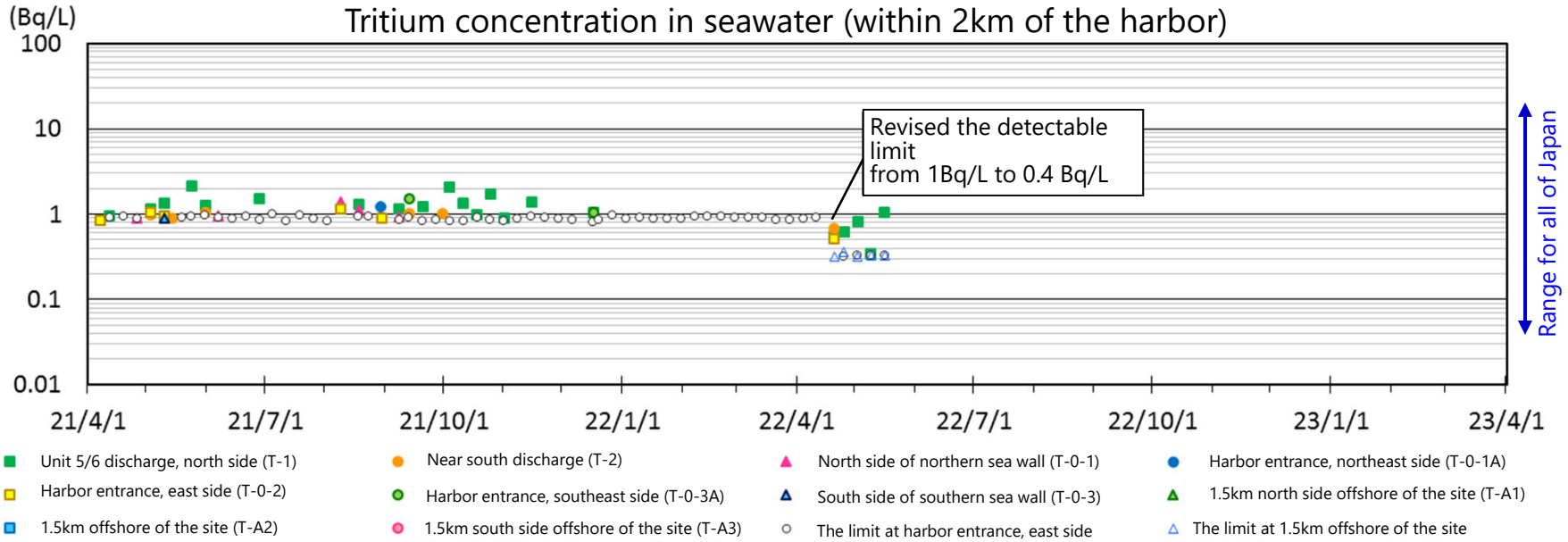
No samples were taken in April.

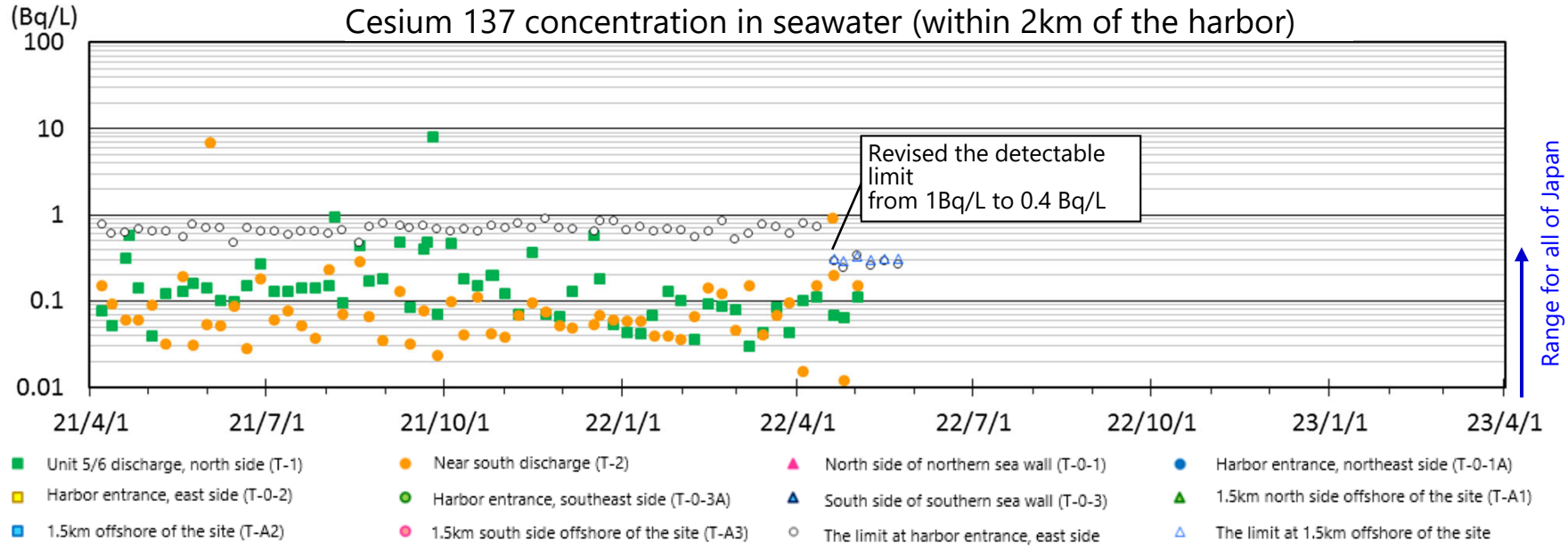
Range of tritium and cesium 137 concentrations in seawater across Japan



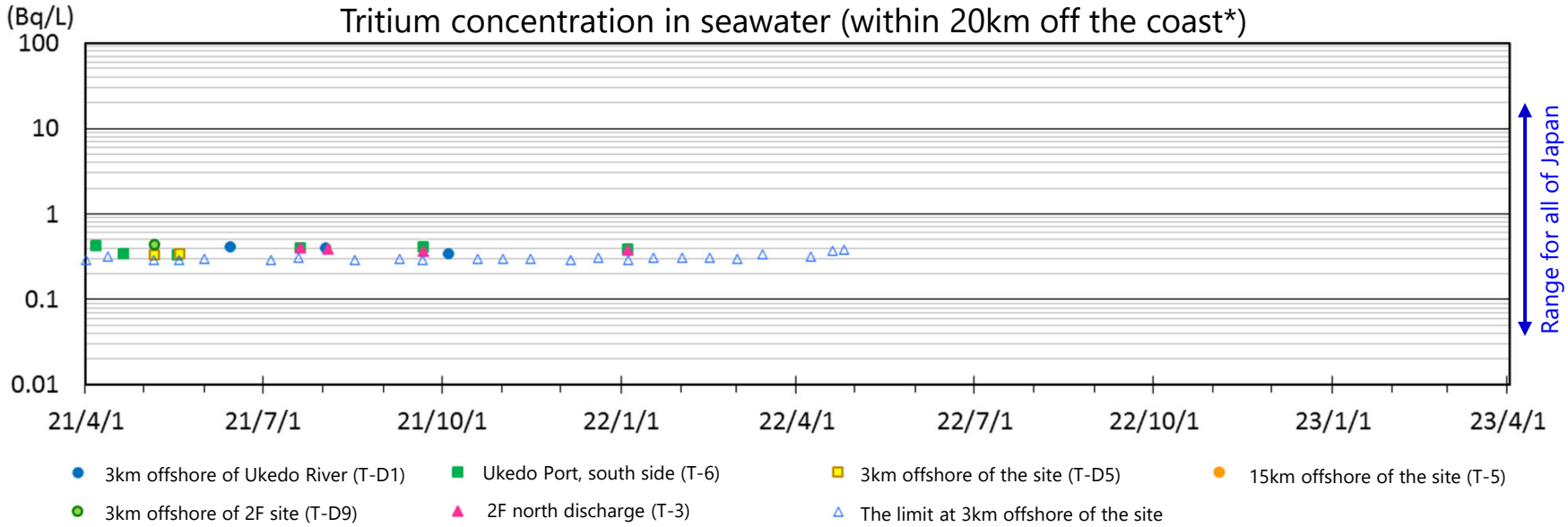


Trends in seawater tritium and cesium 137 concentrations（1/3）

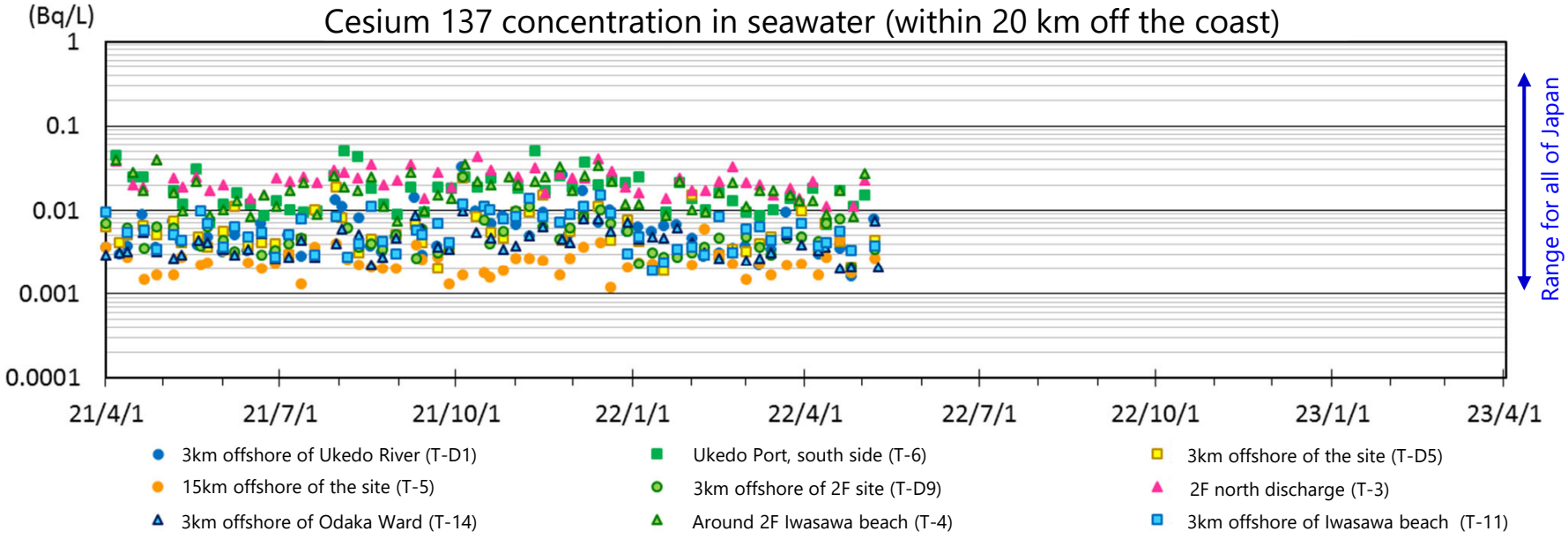




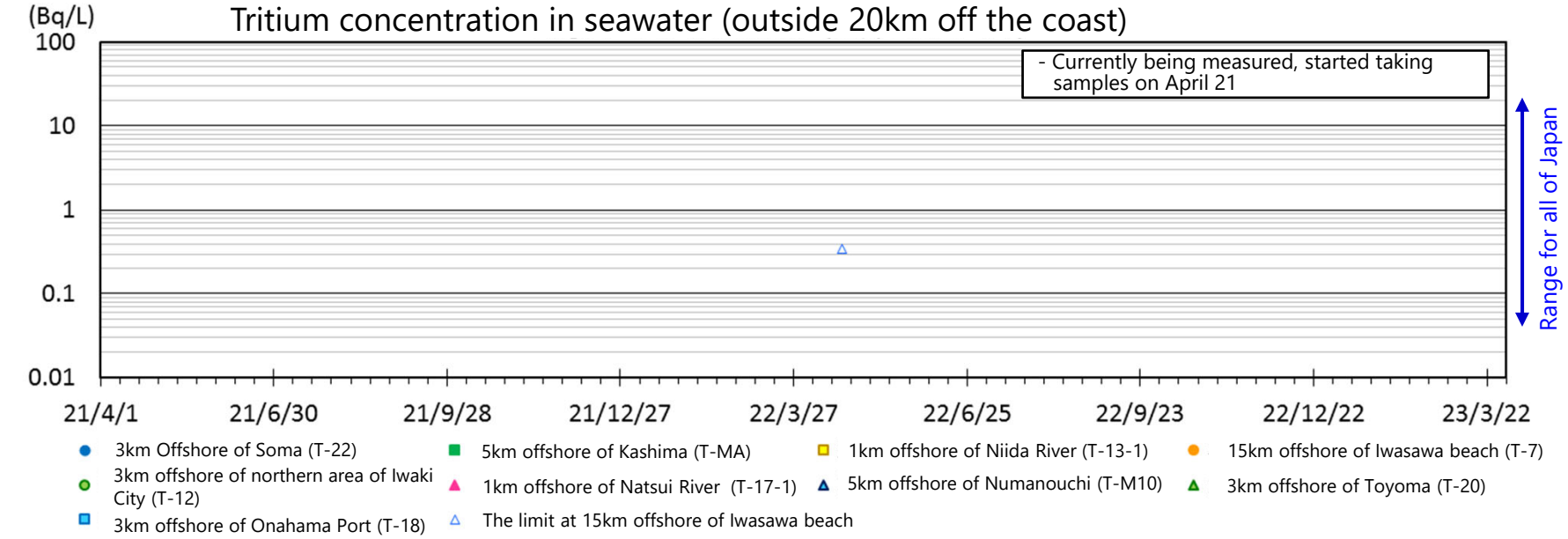
Trends in seawater tritium and cesium 137 concentrations（2/3）

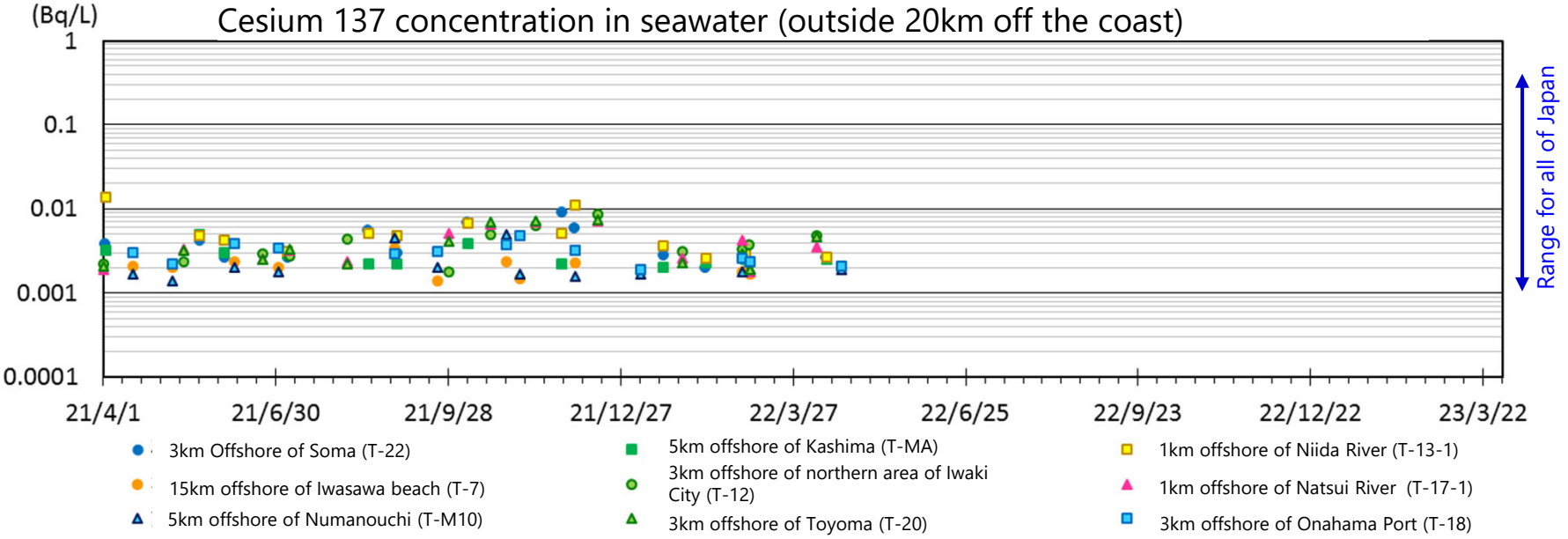


*: See P.10 for data on tritium levels at fish sampling points within 20 km off the coast

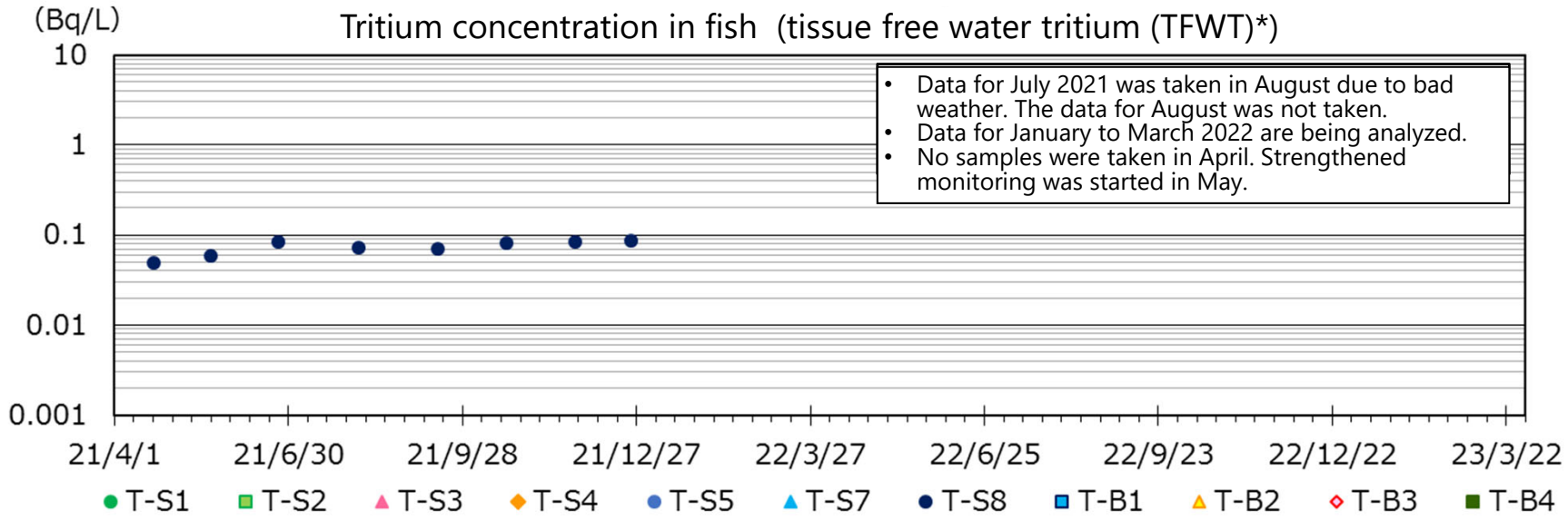


Trends in seawater tritium and cesium 137 concentrations（3/3）



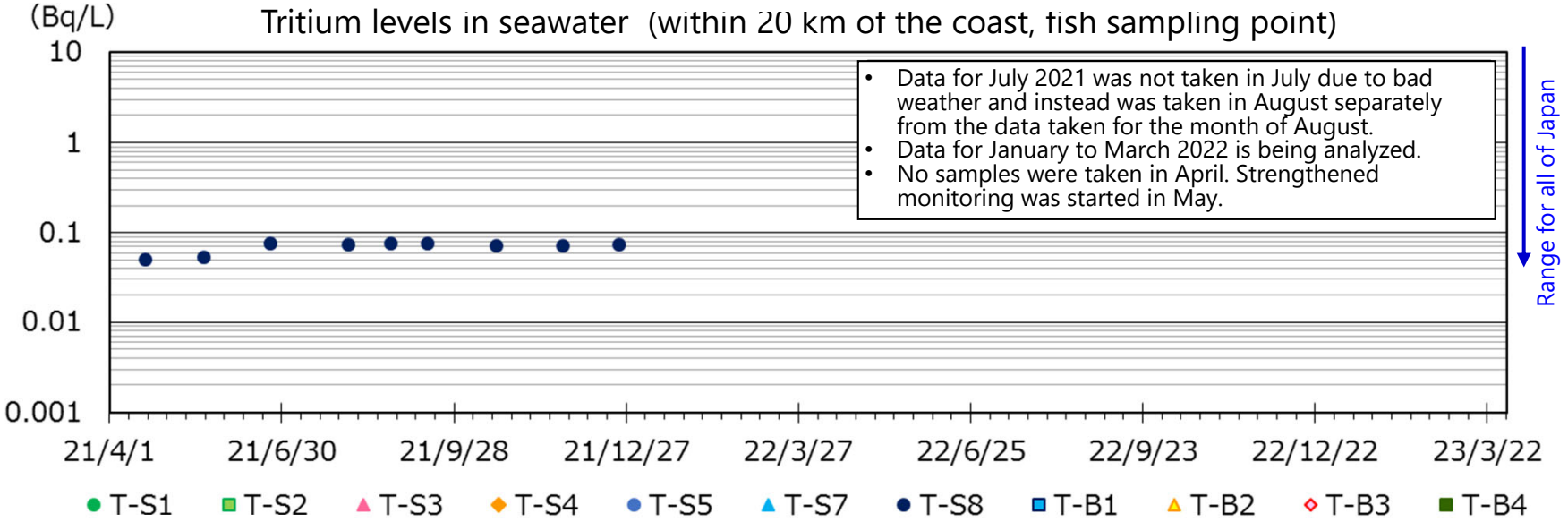


Trends in tritium concentrations in fish and seawater



- Data for July 2021 was taken in August due to bad weather. The data for August was not taken.
- Data for January to March 2022 are being analyzed.
- No samples were taken in April. Strengthened monitoring was started in May.

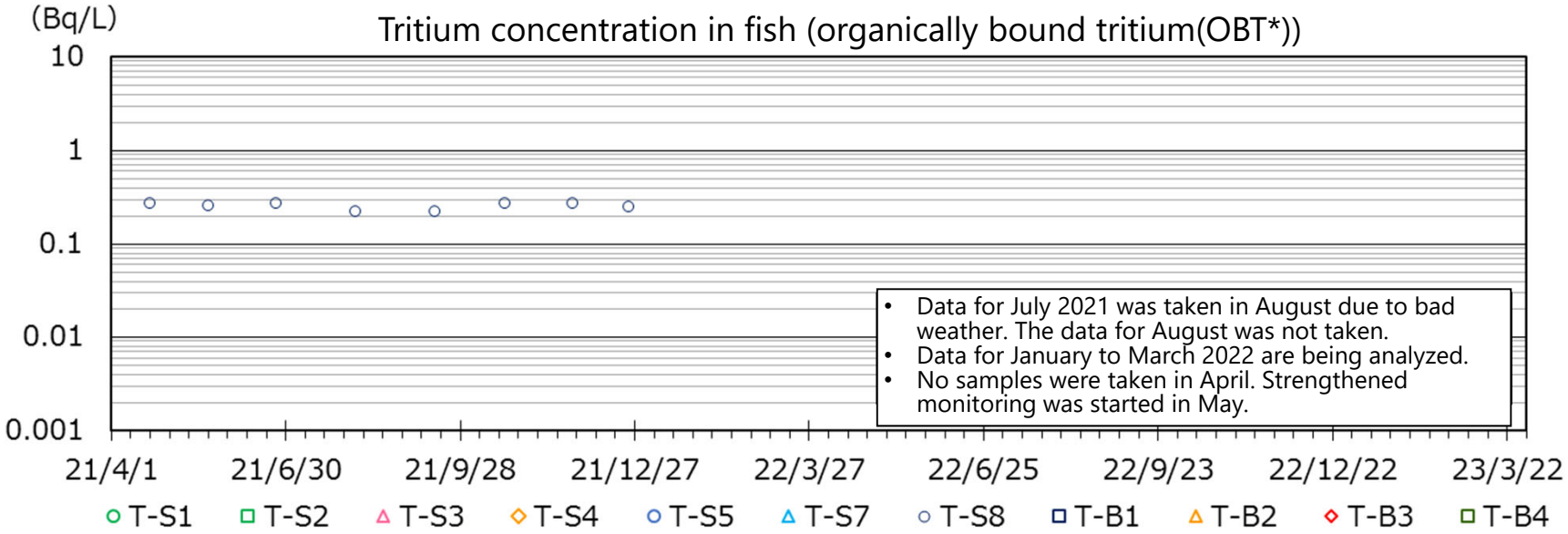
*Fish sampled are flatfish. *: Tissue free water tritium is tritium that exists as water in the tissue in animals and plants and is discharged outside of the tissue similarly to water.



- Data for July 2021 was not taken in July due to bad weather and instead was taken in August separately from the data taken for the month of August.
- Data for January to March 2022 is being analyzed.
- No samples were taken in April. Strengthened monitoring was started in May.

*Samples were taken from the surface level of the sea.

Trends in tritium concentrations in fish

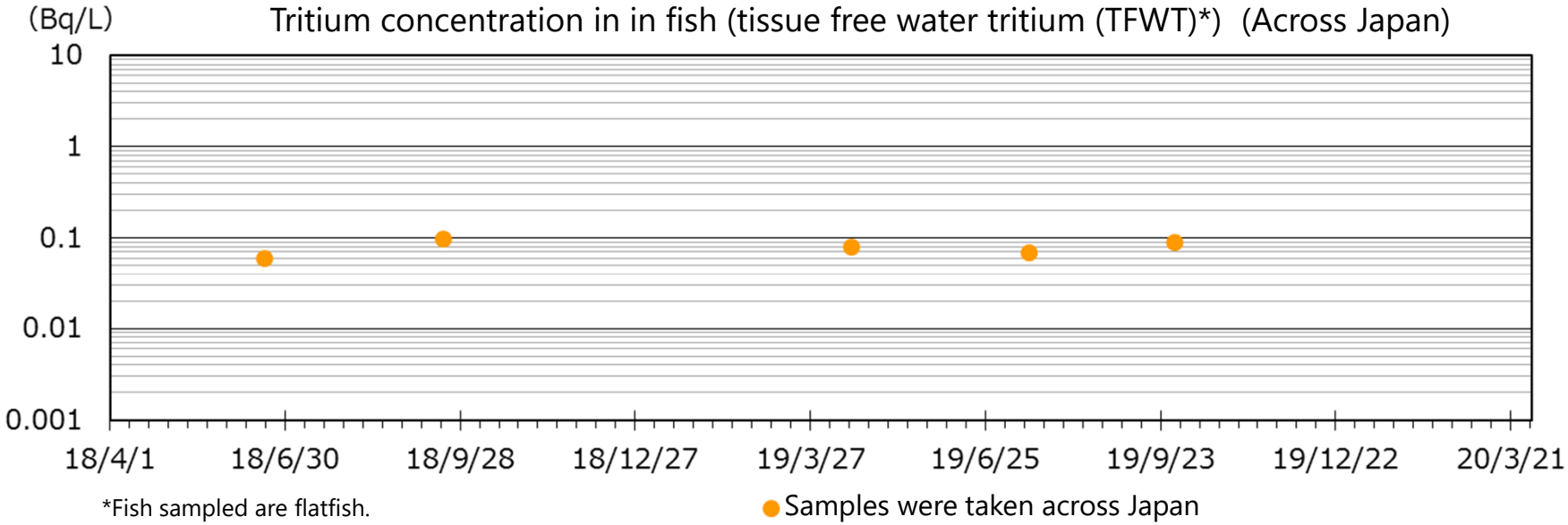


*Fish sampled are flatfish.

*Organically bound tritium was only detected at levels below the detection limit; each point represents the detection limit.

*: Organically bound tritium is bind organically to proteins to be taken into the tissue of the fish or animal, and is discharged from the tissue through cellular metabolism.

Trends in tritium concentrations in fish across Japan



*: Tissue free water tritium is tritium that exists as water in the tissue in animals and plants and is discharged outside of the tissue similarly to water.

Source: Environmental Radiation Database, Environmental Radioactivity and Radiation in Japan

<Reference> Sea area monitoring plan (1/2)

【seawater】

・TEPCO increased the number of samples taken, frequency of measurement for tritium and set the detectable limit to be in line with government targets.

Red：Strengthened compared to the current plan

Target	Sampling location (See 2-3. Diagram 1,2,3)	Number of samples taken	Subject of measurement	Frequency	Detectable limit
Sea water	Inside the harbor	10	Cesium-134,137	Daily	0.4 Bq/L
			Tritium	Weekly	3 Bq/L
	Outside the harbor, within a 2km radius of the station	2	Cesium-134,137	Weekly	0.001 Bq/L
				Daily	1 Bq/L
		5 → 8	Cesium-134,137	Weekly	1 Bq/L
		7 → 10	Tritium	Weekly	1 → 0.4 Bq/L*1
	Within 20 km of the coast	6	Cesium-134,137	Weekly	0.001 Bq/L
			Tritium	Twice a month → Weekly*2	0.4 → 0.1 Bq/L*3
	Within 20 km of the coast (Fish sampling location)	1	Tritium	Monthly	0.1 Bq/L
		0 → 10	Tritium	None → Monthly	0.1 Bq/L*3
	20 km+ off the coast of Fukushima	9	Cesium-134,137	Monthly	0.001 Bq/L
		0 → 9	Tritium	None → Monthly	0.1 Bq/L*3

※：All samples were taken from the surface level of the sea

1：Values will be measured using the electrolytic concentration method as needed.

*2：To be measured monthly when the detectable limit is at 0.1Bq/L

*3：To be set at 0.4 Bq/L until the electrolytic concentration device is installed.

*：Concentration method that uses the fact that tritium water is less easily electrolyzed. See reference for details on the electrolytic concentration device.

<Reference> Sea area monitoring plan (2/2)

TEPCO

【Fish and seaweed】

・TEPCO increased the number of samples taken, frequency of measurement and set the detectable limit to be in line with government targets.

Red：Strengthened compared to the current plan

Target	Sampling location (See 2-3. Diagram 1,2)	Number of samples taken	Subject of measurement	Frequency	Detectable limit
Fish	Within 20 km of the coast	11	Cesium134,137	Monthly	10 Bq/kg (live)
			Strontium 90 (5 samples with the highest concentrations of cesium)	Quarterly	0.02 Bq/kg (live)
		1	Tritium (tritiated water)	Monthly	0.1 Bq/L
			Tritium (organically bound)		0.5 Bq/L
		0 → 10	Tritium (tritiated water) *1	None → Monthly	0.1 Bq/L*3
			Tritium (organically bound) *2		0.5 Bq/L
Seaweed	Inside the harbor	1	Cesium134,137	Annually → Three times a year	0.2 Bq/kg (live)
	Outside the harbor, within a 2km radius of the station	0 → 2	Cesium134,137	None → Three times a year	0.2 Bq/kg (live)
			Iodine 129	None → Three times a year	0 .1 Bq/kg (live)
			tritium (tritiated water)*1	None → Three times a year	0.1 Bq/L*3
			tritium (organically bound) *2		0.5 Bq/L

*1：Tritium that exists in water form and is excreted similarly to water. Half of the radiation is excreted in around 10 days.

*2：Tritium ingested bound to organic material such as protein. Most of it is excreted in around 40 days while a portion may take up to a year to be excreted.

*3： Set at 0.4 Bq/L until the electrolytic concentration device is installed

<Reference> Overview of facilities for securing safety

Secondary treatment facility（newly installed reverse osmosis membrane facility）

Secondary treatment of treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is between 1 and 10)

Secondary treatment facility（ALPS）

Secondary treatment of Treated water to be re-purified (sum of the ratios of nuclides, excluding tritium, is 1 or higher)

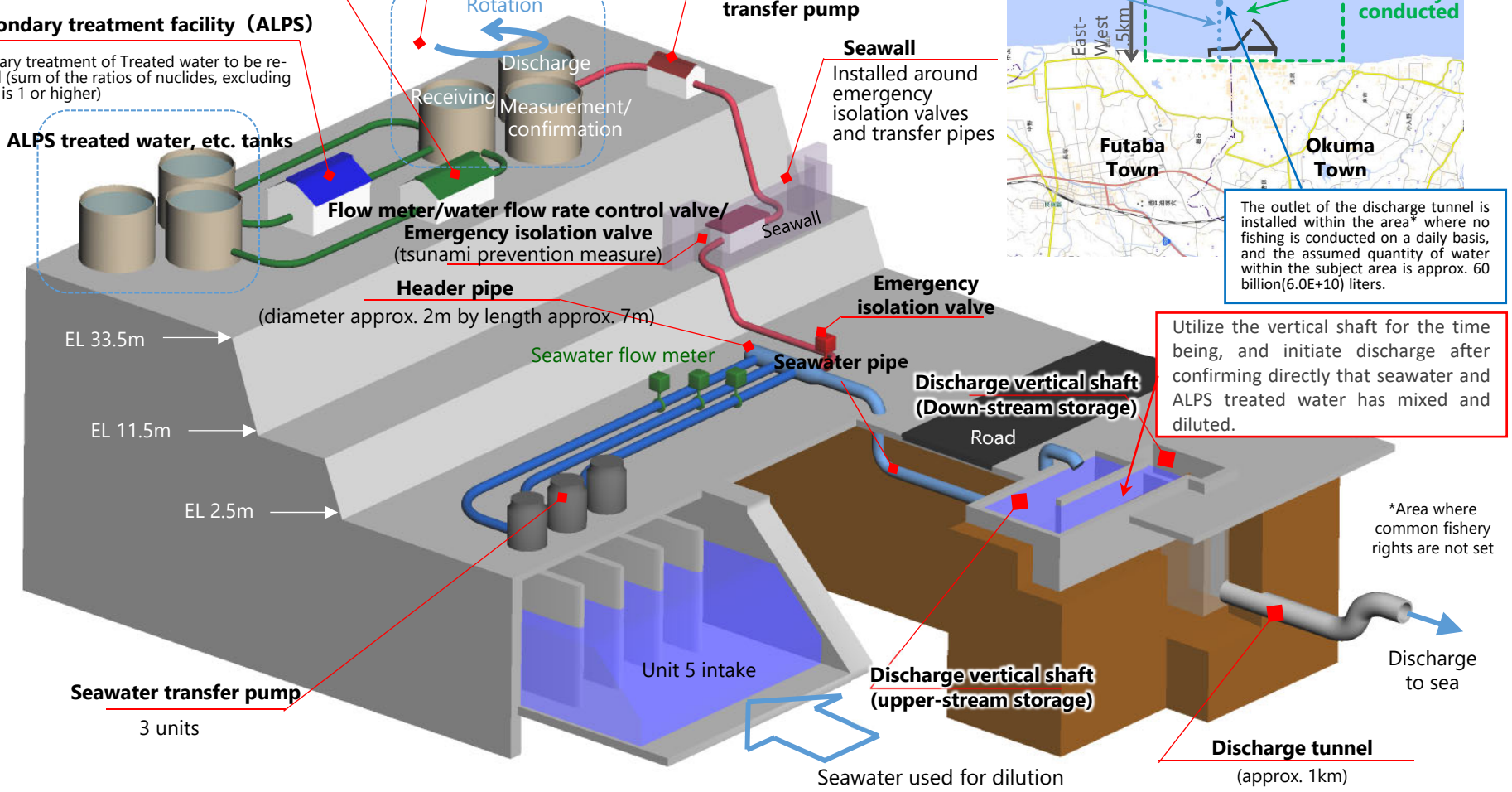
Measurement/confirmation facility (K4 tank group)

Comprised of three sets of tank groups each with the role of receiving, measurement/confirmation, and discharge. In the measurement/confirmation stage, water that has been made homogenized through circulation and agitating is sampled and analyzed (approx. 10,000m³ × 3 groups)

ALPS treated water transfer pump

Seawall

Installed around emergency isolation valves and transfer pipes



Utilize the vertical shaft for the time being, and initiate discharge after confirming directly that seawater and ALPS treated water has mixed and diluted.

Source: Developed by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (electronic territory web)
https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0s0m0f1

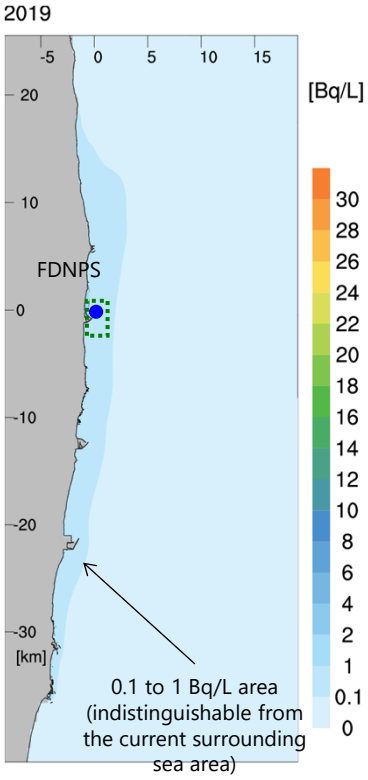
The outlet of the discharge tunnel is installed within the area* where no fishing is conducted on a daily basis, and the assumed quantity of water within the subject area is approx. 60 billion(6.0E+10) liters.

*Area where common fishery rights are not set

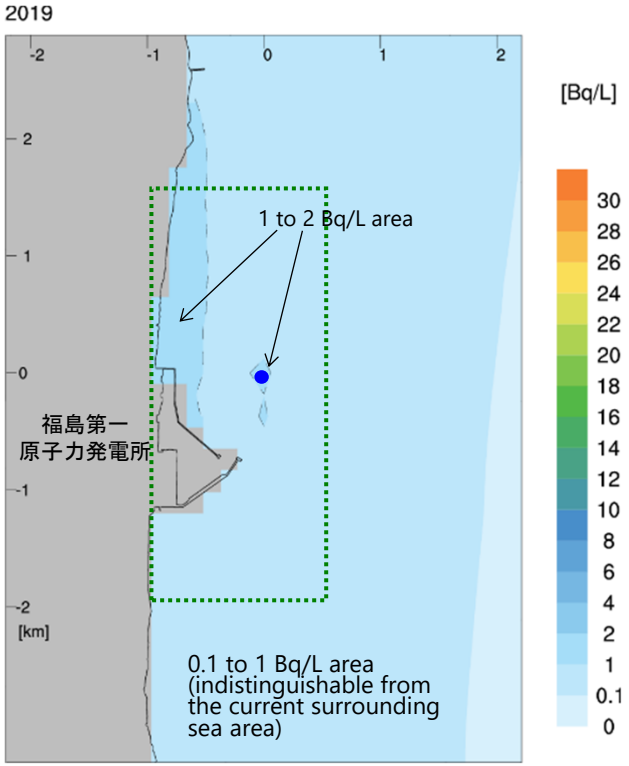
<Reference> Results of dispersion simulation at sea

○ Assessment using the meteorological and sea conditions data from 2019 found that the area with higher tritium concentrations than the current surrounding area (0.1-1 Bq/L*) (the area inside the dotted line) will be <u>the area 2 to 3 km from the station as 1 to 2 Bq/L which is 1/100 thousandth to 1/10 thousandth of the WHO Guidelines for drinking-water quality (10,000 Bq/L)</u> .

⇒ Monitoring will be strengthened to confirm the status of dispersion.



Enlarge the area by approx. 500 times



※：The simulation was conducted using a program based on sea scattering model (ROMS) originally developed by a US university and widely used by universities and research institutes, and further improved by CRIEPI

Enlarged view of the area off the coast of Fukushima
(Largest value in scale at 30 Bq/L)

Enlarged view of the area around the station
(Largest value in scale at 30 Bq/L)