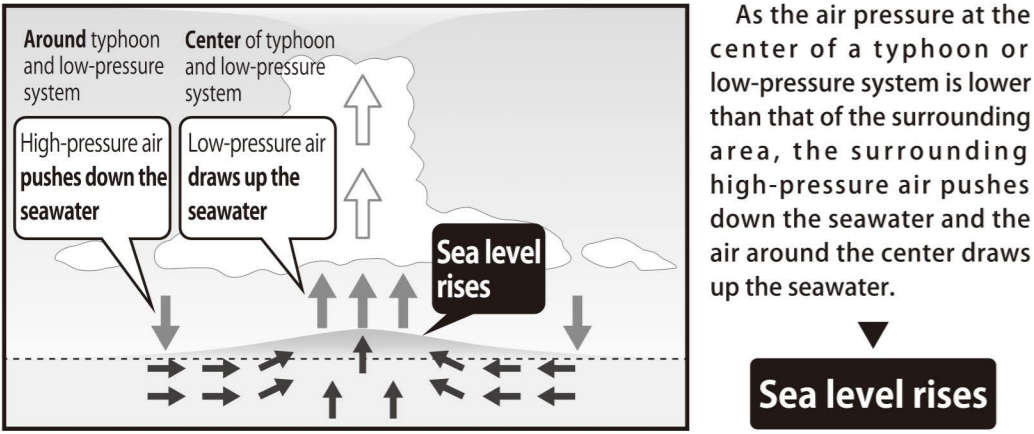


About storm surges

Mechanism of storm surge generation

When a typhoon or a developed low-pressure system passes, sea levels (tide levels) may rise significantly, which is called a "storm surge." Storm surges are mainly caused by ① "inverse barometer effect" due to the decrease in atmospheric pressure; and ② "wind drift effect" due to the wind. Moreover, when high tide coincides with a storm surge, the storm surge water level rises further, making it more likely for a large-scale disaster to occur.

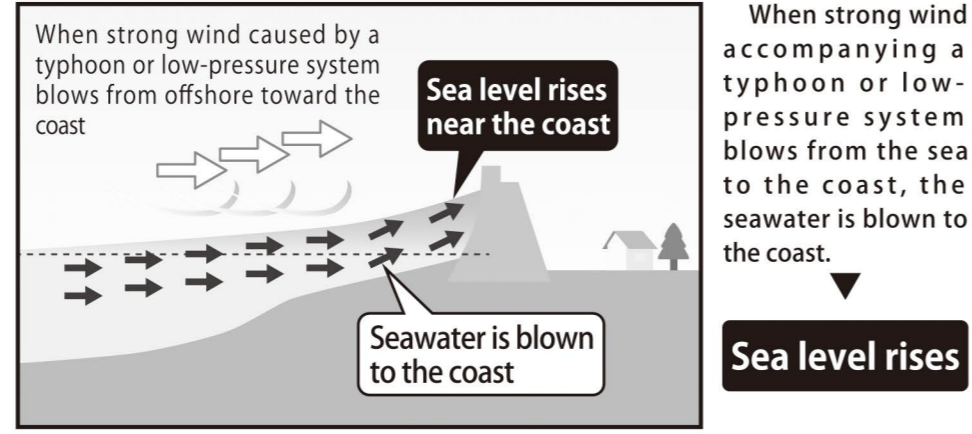
① "Inverse barometer effect" due to the decrease in atmospheric pressure



Air pressure decreases by 1 hPa.
Tide level rises by about 1 cm

For example...
When a typhoon with a central pressure of 910 hPa arrives where it was 1,000 hPa until then,
1,000 hPa - 910 hPa = 90
the sea level rises by about 90 cm near the center of the typhoon.
(Even in the surrounding area, the sea level rises according to the air pressure.)

② "Wind drift effect" due to the wind.



The rise in tide level due to the wind drift effect is proportional to the square of wind speed.

For example...
If the wind speed doubles, the rise in sea level quadruples.

- Sea with shoals
- Bay opens in the windward direction

The landform works to encourage the rise in sea level, especially at high tide.

Influence of ebb and flow of the tide

When the "high tide" time zone coincides with the approach of a typhoon or low-pressure system, the sea level rises further. Moreover, during a "spring tide" when the tide level is high, the sea level rises even more.

High tide and low tide

The phenomenon where sea levels rise and fall caused by the attractive force of the moon and sun, and the centrifugal force of the earth rotating around the sun, is called sea tide. Twice a day, the sea level gradually rises (high tide) and falls (low tide).

Spring tide and neap tide

When the moon and sun are aligned with the earth in one straight line, the difference in tide level between high and low tide in one day is largest. This period is called "spring tide" (a few days around the new moon and full moon). Conversely, the period when the difference in tide level is smallest is called "neap tide" (a few days around half moon).

What is a water level dissemination coast?

Based on Article 13-3 of the Flood Prevention Act, coasts are designated by prefectural governors as being at risk of causing considerable damage due to storm surges. In Tokyo, the area from the Kyu-Edogawa River (bordering Chiba Prefecture) to the Tamagawa River (bordering Kanagawa Prefecture) is designated as a water level dissemination coast.

What is a storm surge special warning water level?

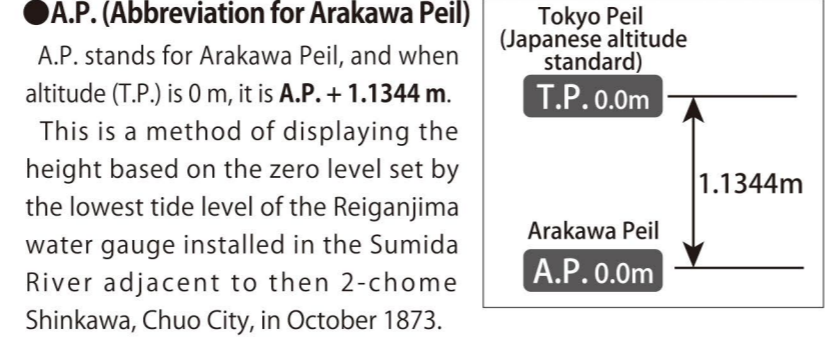
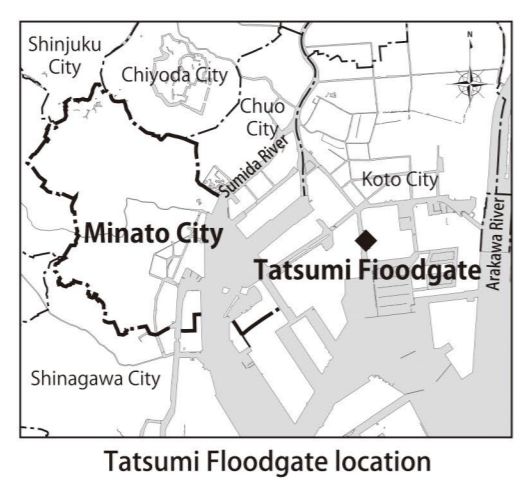
The storm surge special warning water level is the standard water level for informing residents of the danger of flooding of the coast and rivers due to a storm surge caused by the maximum level of a typhoon that can be expected and is set by all wards of Tokyo.

Tide level rises due to storm surge.

Tide level at the **Tatsumi Floodgate (Koto City)**, which is the reference site, reaches the **storm surge special warning water level (A.P. + 3.6 m in the case of Minato City)**.

"Storm Surge Flooding Information" (equivalent to warning level 5 equivalency) is announced.

Storm surge flood risk water level is the water level that takes into account the time necessary for evacuation and information transmission (lead time).



Lead time
The minimum required lead time, from reaching the storm surge special warning water level to information transmission and evacuation, is as follows:
- 10 minutes for preparation for announcement and information transmission
- 20 minutes for evacuation (preparation and movement)
- 30 minutes in total

Major storm surge damage in the past

Date (M/D/Y)	Main cause	Main damaged areas	Highest tide level (m)	Maximum deviation (m)	Damage situation
October 1, 1917	Typhoon in 1917	Tokyo Bay	3.0	2.1	When the typhoon approached Tokyo Bay, the spring tide coincided with high tide time, and as a result, the sea level rose immediately, causing enormous damage in the Tokyo Bay coastal area. A total of 1,324 people were killed or went missing, and 55,733 houses were destroyed or severely damaged.
September 21, 1934	Muroto Typhoon	Osaka Bay	3.1	2.9	20% of Osaka City, 30% of Sakai City, and 40% of Amagasaki City were flooded. The tide level increase in Osaka Bay was rapid. In less than 20 minutes, the flood depth reached more than 2 m according to the record on the street of Chikko, Osaka Bay. A total of 3,036 people were killed or went missing, and 80,246 houses were destroyed or severely damaged.
September 27, 1959	Isewan Typhoon	Ise Bay	3.9	3.4	Considerable damage centered around Nagoya City, the most inner part of Ise Bay. The sea level of the entire bay rose by 2 m and the total length of the embankment breach reached almost 33 km at 220 sites centered on low-lying areas in the inner part of the bay. A total of 5,098 people were killed or went missing, and 151,973 houses were destroyed or severely damaged.
September 16, 1961	Second Muroto Typhoon	Osaka Bay	3.0	2.5	In Osaka City, a 31-km ² area was inundated, and flooding also occurred in Hyogo Prefecture, Wakayama Prefecture, and the eastern part of Shikoku. A total of 200 people were killed or went missing, and 54,246 houses were destroyed or severely damaged.
August 30, 2004	Typhoon 16	Seto Inland Sea	2.5	1.3	In Takamatsu City, Kagawa Prefecture, the tide level exceeded the embankment by about 70 cm, and 15,561 households were inundated, covering 960 ha.
September 4, 2018	Typhoon 21	Osaka Bay	3.3	2.8	In Osaka City and Kobe City, figures exceeding all-time-high tide levels were observed. The runway of Kansai International Airport was inundated, and shipping containers were toppled at Kobe Port.

Reference: Ministry of Land, Infrastructure, Transport and Tourism website, Japan Meteorological Agency website, Cabinet Office website, National Research Institute for Earth Science and Disaster Resilience website

Maximum deviation: The maximum difference between the tide level without a storm surge (estimated astronomical tide level) and the actual tide level.

Things to keep in mind before, during, and after a disaster

Prepare before Always be prepared in case of an emergency

- Confirm the location of the designated evacuation center and a safe route to that location.
 - Indicate the location of the evacuation center on this map and confirm the route from your home by walking it.
 - Take care as cliffs and steep hills are vulnerable to landslides.
- Prepare an emergency bag with basic necessities.
 - flashlights
 - portable radio
 - batteries
 - drinking water
 - emergency provisions
 - first aid kits
 - towels
 - clothes, underwear
 - rope
 - valuables, cash, etc.
- Prepare sandbags and water bars in basements and half-basements.
 - Consider installing drainage pumps for underground and semi-underground facilities such as underground garages.

What you can do at home to prevent flooding

A simple method of preventing flooding is to use something in your home as a water barrier. Of course, this method will only work when the water is still shallow. Continue to pay attention to water levels and do not miss the chance to evacuate at the appropriate time.

- Make a simple water barrier out of plastic trash bags.
 - Take two 40-liter plastic trash bags and insert one inside the other to make a double bag. Fill the double bag half-way with water (so it is not too heavy to carry).
 - Make several of these bags and pile them up with no spaces at the entrance as if they were sandbags. The barrier will be stronger if you pile the bags in cardboard boxes and the water-bag barrier can be piled higher.
- Make a water bar
 - Use a long board or metal plate as a water barrier. If a board or metal plate is not available, a table, cabinet, office locker, tatami mat or other material may be used.
- Use planters and a plastic ground sheet (tarpaulin)
 - Arrange the planters in a row and wrap them in the ground sheet/tarp to prevent water from entering.
- Use simple absorbent sandbags
 - These substitute sandbags will swell when submerged in water. Commercially available simple absorbent sandbags can be used to prevent water from entering.

If a disaster occurs Be careful when evacuating

- Always gather the latest weather information from TV, radio, or PC.
- Pay attention to evacuation orders from City Hall or the police department.
- Turn off gas at the supply valve and turn off electricity at the circuit breakers.
- Evacuate to a nearby tall building or evacuation center. (Please contact Minato City Hall when you evacuate to an evacuation center.)
 - Take no chances if water is as deep as your waist, remain in a high place and wait for rescue.

After After flooding has receded

- Disinfect to prevent infectious diseases.
- Check for broken electric wires or cables.
- Check for leakage of hazardous materials such as kerosene.
- Check the exterior of your home, including roof tiles and antennas.
- Dry out used sandbags and return or store them.
 - If sandbags are put away wet, they cannot be reused.

Information on disaster prevention and timing of evacuation

Criteria for issuing evacuation information and actions to be taken by residents

Evacuation information issued by Minato City, criteria for issuance, and actions to be taken by city residents are shown in the following table. Please take appropriate action according to this information.

Warning level	Actions to be taken by residents	Evacuation information (Issued by Minato City)
Warning level 5	◆ A disaster has already occurred or is imminent. So take immediate life-saving action. (Move to a relatively safe place, such as an indoor upper-floor evacuation. (vertical evacuation))	Emergency Safety Measures
Warning level 4	◆ There is a high risk of disaster. Evacuate everyone from areas that are dangerous. (Evacuation to outdoors or securing indoor safety.) (Securing indoor safety means actions taken at one's own discretion after confirming that one's personal safety is secured indoors.)	Evacuation Instruction
Warning level 3	◆ There is a risk of a disaster. Evacuate from dangerous places. Prepare for evacuation or conduct early evacuation. Others	Evacuation of the Elderly, Etc.
Warning level 2	◆ As weather conditions are becoming worse. Check evacuation actions such as evacuation sites and the timing of evacuation using hazard maps, etc.	—
Warning level 1	◆ As there is a possibility that weather conditions will worsen in the future. Improve preparedness for disasters by looking at weather forecasts, etc.	—

Criteria for issuing evacuation information

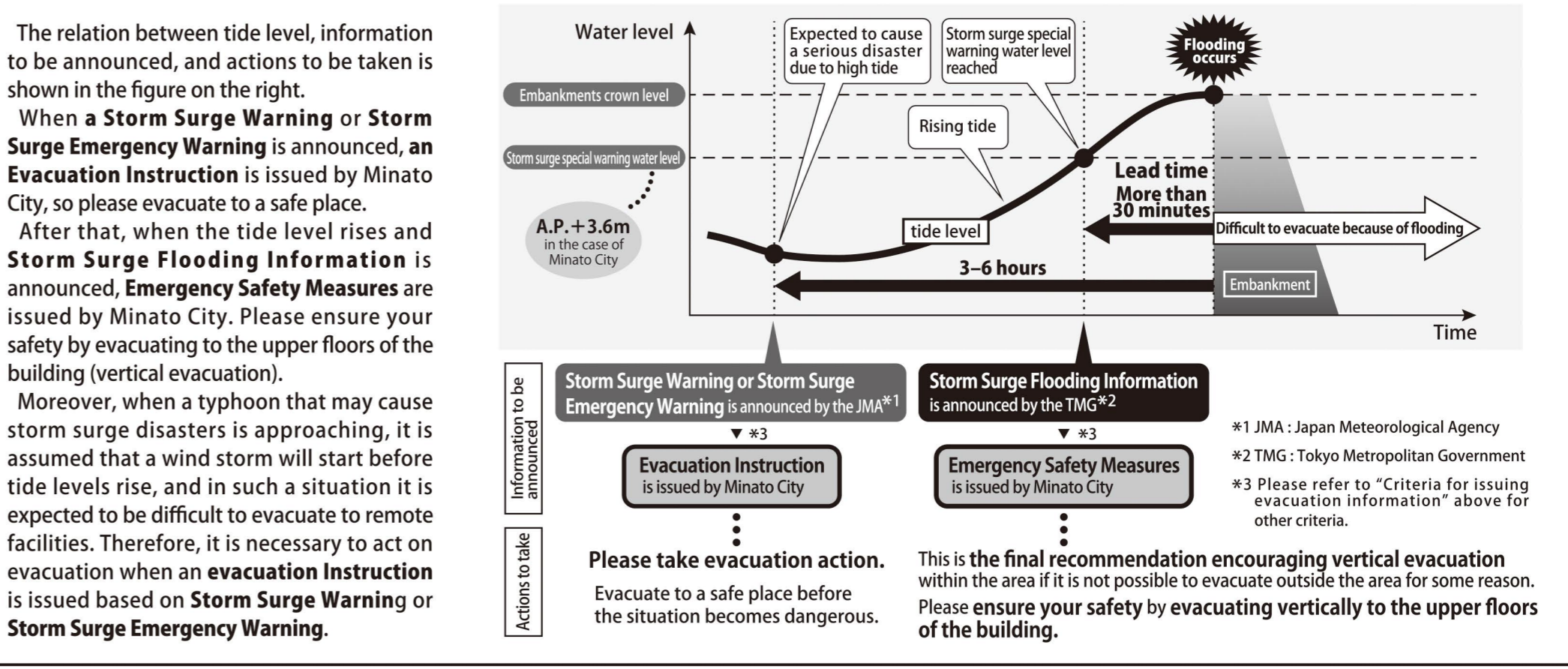
If the following events occur or information is announced, evacuation information will be issued.

- Immediately before a disaster occurs or may have already occurred
 - When abnormality at a flood gate, land lock, etc. is confirmed.
 - When the tide level exceeds a dangerous level (T.P. + 2.4 m) and flooding is estimated to have occurred.
 - In the case where Storm Surge Flooding Information is announced at a beach where storm surge may cause considerable damage.
- Confirm the occurrence of a disaster
 - In the case of collapse of a coastal embankment, etc.
 - When abnormal overtopping wave or overflow occurs.
 - In the case of storm surge flooding at a beach where a storm surge may cause considerable damage.
- When a Storm Surge Warning or Storm Surge Emergency Warning is announced.
- When a typhoon with heavy rainfall that requires the issuance of an Evacuation Instruction (Warning Level 4) is expected to approach or pass from night to dawn. (An Evacuation Instruction is issued in the evening)
- When it is mentioned in the announcement of a Storm Surge Advisory that there is a high possibility of a Storm Surge Warning.
- When a Storm Surge Advisory is issued and that the area is expected to be in the typhoon storm zone. (A typhoon information indicates that a typhoon is approaching.)
- When a typhoon with heavy rainfall that requires the issuance of an Evacuation of the Elderly, Etc. (Warning Level 3) is expected to approach or pass from night to dawn. (An Evacuation of the Elderly, Etc. is issued in the evening)
- When it is known from prefectural meteorological information or a press conference by the Japan Meteorological Agency that an "Ise Bay typhoon"-class typhoon is approaching and there is a possibility of Special Warning issuance 24 hours in advance of landing.

Disaster prevention meteorological information on Storm Surge

Types	Contents	Warning level	Announcing organization
Storm Surge Flooding Information	Announced when the coast designated as a water level dissemination coast has reached the storm surge special warning water level.	Warning level 5 (equivalency)	Tokyo Metropolitan Government
Warnings / Advisories	Storm Surge Emergency Warning If a storm surge caused by a strong typhoon that occurs once every few decades or similar-level extratropical cyclone is predicted.	Warning level 4 (equivalency)	Japan Meteorological Agency
	Storm Surge Warning If it is predicted that there is a risk of serious disasters caused by abnormal rise of sea levels due to a typhoon or low-pressure system, etc.	Warning level 3 (equivalency)	
	Storm Surge Advisory If it is predicted that there is a risk of disaster caused by abnormal rise of sea levels due to a typhoon or low-pressure system, etc.	Warning level 2 (equivalency)	
Typhoon Information	Information on typhoon conditions, such as center location of the typhoon, air pressure, maximum wind speed, predicted course, and storm surge.	—	—

Relation between tide level, information to be announced, and actions to be taken



About communication of information

Register with Minato City's Disaster Information E-mail Service!

Minato City sends information on disasters including storm surges by e-mail to mobile phones, smartphones, tablets, and personal computers. The registration method is easy, and you can register, deregister, and make changes at any time.

- ### How to Register
- Send a blank e-mail to the following: kumin@bousai.city.minato.tokyo.jp (If your cell phone supports QR codes, scan the QR code on the right to access the site.)
 - The "Minato City's disaster information e-mail service terms of use" will be sent to you as a reply. You can then click on the address shown in the e-mail for registration.
 - You can choose either Japanese or English.
 - Select the combination of "Information for Delivery" (see the table below).
 - Click the execute button and your registration is completed.

Information for Delivery

Types	Criteria for Information Delivery
1 Earthquakes	An earthquake with a seismic intensity of 4 or higher has been recorded in Minato City.
2 Water levels	When the observed value of the water gauge managed by Minato City exceeds the warning value.
3 Amount of rainfall	When the observed value of the rain gauge managed by Minato City exceeds the warning value.
4 Advisories and warnings	Weather warnings, emergency warnings, or advisories have been issued for Minato City.
5 Tsunami	Tsunami advisories, major tsunami warnings, or similar warnings have been issued for the inner part of Tokyo Bay.
6 Civil protection	Information on civil protection, such as armed attacks or ballistic missile attacks, has been issued for Minato City.
7 Disaster prevention (weather)	Alert information has been released on sediment disasters, information on a record-breaking deluge in a short period, flood forecasting for the Shibuya River, Furukawa River and Arakawa River, tsunami forecasts, information on volcanoes, or storm surge flooding information.
8 Other emergency information	When there is disaster prevention information concerning Minato City other than above information on evacuation (emergency safety measures, evacuation instruction, evacuation of the elderly, etc.) information on evacuation shelters or opening and closing of evacuation facilities for those voluntarily evacuating out of concern about a typhoon, etc.

Minato City Disaster App Currently Being Distributed

Minato City offers the "Minato City Disaster App" for free. With the "Disaster Prevention Map" in the app, you can make use of various contents, such as checking each hazard map. Please use this app to check the risk and prepare for disasters (available on tablets and smartphones only).

- ### How to download
- Read the QR code on the right to access the download page. (Search for "Minato-ku Bosai Appli" in your app download service.)
 - Press the install button and install "Minato City Disaster App."
- ### Main Contents
- Disaster Prevention Map
 - Disaster Prevention Map by Minato City Area
 - Water level/rainfall information
 - Safety information
 - Links
 - Disaster information
 - Buzzer function (Linked to device)
 - Light function (Linked to device)
 - Various disaster prevention pamphlets

How can I check the contents of the disaster prevention wireless system?

Disaster information is broadcast from speakers installed outdoors, but if you could not catch it or missed it, you can also check it by the following methods.

- Telephone call to check the contents of broadcasts: 03-5401-0742
- Minato City's disaster information e-mail service
- Minato City's official website
- Minato City's official Twitter
- Minato City's official Facebook
- JCOM channel (11ch)

Disaster prevention related agencies, etc.

Please contact the following facilities in case of flood or typhoon damage.

Content of request	Name of facility	Location	Contact information
Certificate of damage	General Administration Subsection, General Administration Section, Each Minato City Regional City Office	Each Regional City Office (see below)	Each Regional City Office (see below)
	Minato Recycling and Waste Management Office	3-9-59 Konan	3450-8025
Request for disinfection after flooding recedes	Life Hygiene Counseling Subsection, Life Hygiene Section, Minato Public Health Center	1-4-10 Mita	6400-0043
Health consultation	Health and Welfare Subsection, Residents Support Section, Each Minato City Regional City Office	Each Regional City Office (see below)	Each Regional City Office (see below)
	Collaboration Project Subsection, Collaboration Project Section, Each Minato City Regional City Office	Each Regional City Office (see below)	Each Regional City Office (see below)
Relief money after small-scale disaster	Industry Promotion Section, Minato City	Fudanotsuji Square (5-36-4 Shiba)	6435-4620
Loans for living assistance and welfare	Livelihood Support Section, Minato Council of Social Welfare	Azabu Regional City Office (see below)	6230-0282
	Shiba tax office	5-8-1 Shiba	3455-0551
Tax exemption	Azabu tax office	3-3-5 Nishi-azabu	3403-0591
	Minato Metropolitan Taxation Office	3-5-6 Azabudai	5549-3800
	Taxation Section, Minato City	2F Minato City Hall	3578-2593
Consultation regarding National Health Insurance fees	National Health Insurance and Pension Section, Minato City	3F Minato City Hall	3578-2111 (ext.2643-5)

Contact information for related facilities

Information needed	Name of facility	Location	Contact information
Disaster prevention in general	Disaster Prevention Section, Disaster Prevention and Crisis Management Department, Minato City	5F Minato City Hall	3578-2541
	Public Works Subsection, Community Development Section, Each Minato City Regional City Office	Each Regional City Office (see below)	Each Regional City Office (see below)
Flood preparation, sandbags	Shiba Fire Station, Shiba Volunteer Fire Company	2-13-7 Higashi-Shimbashi	3431-0119
	Azabu Fire Station, Azabu Volunteer Fire Company	3-4-42 Moto-azabu	3470-0119
Fire Station, paramedics	Akasaka Fire Station, Akasaka Volunteer Fire Company	2-16-9 Minami-ayumi	3478-0119
	Takanawa Fire Station, Takanawa Volunteer Fire Company	2-4-12 Shirokane	3446-0119
Police	Atago Police Station	6-18-12 Shimbashi	3437-0110
	Azabu Police Station	4-7-1 Roppongi	3479-0110
Tokyo Metropolitan streets/roads	Akasaka Police Station	4-18-19 Akasaka	3475-0110
	Takanawa Police Station	3-15-20 Takanawa	3440-0110
Routes 1 and 15	Mita Police Station	4-2-12 Shibaura	3454-0110
	Tokyo Wangan Police Station	2-7-1 Aomi, Koto City	3570-0110
Route 246	Bureau of Construction, Tokyo Metropolitan Government, 1st Construction Office, Minato Area (Minato Branch, excluding Daiba area)	1-2-13 Mita	3452-1464 3343-4061 (Nights and holidays)
	Tokyo National Highway Office, Shinagawa Branch	1-1-3 Yashio, Shinagawa City	3799-6315 (Nights and holidays)
Sewers	Tokyo National Highway Office, Yoyogi Branch	4-30-8 Yoyogi, Shibuya City	3374-9451 (Nights and holidays)
	Bureau of Sewerage, Tokyo Metropolitan Government, Toku 1st Sewerage Office, Koto Branch (only for Daiba area)	2-20-14 Mita	3798-5243 (Nights and holidays)
	Bureau of Sewerage, Tokyo Metropolitan Government, Toku 1st Sewerage Office, Koto Branch (only for Daiba area)	7-1-14 Toyo, Koto City	3645-9641 (Nights and holidays)