

01 Concerning the liquefaction map

The liquefaction map was created assessing the potential for liquefaction, taking into consideration the characteristics of the topography and ground of the respective areas. Intensity of shaking, indicated on the seismic vulnerability map, was also taken into consideration at the time.

The degree of risk for liquefaction indicated on this map is an estimated value based on ground information obtained thus far, and does not indicate the degree of damage caused by liquefaction.

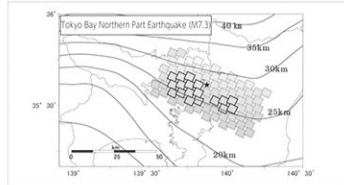
Additionally, it does not reflect measures taken against liquefaction, such as ground improvements already in progress.

02 Purpose of Creation

This liquefaction map is created with the anticipation that it could be used, taking the opportunity of new construction and renovations, to give consideration to detailed ground studies and appropriate measures against liquefaction (improvement of soft ground, etc.).

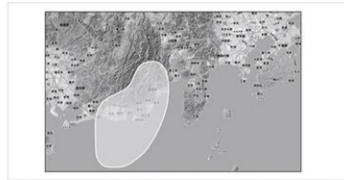
03 Forecasted Earthquake

① Earthquake in the Northern part of Tokyo Bay [Tokyo Inland Earthquake]



Map 1: Epicenter fault model for an earthquake in the Northern part of Tokyo Bay set on the surface of the Philippine Sea plates, in the Special Project for Disaster Prevention/Reduction for Tokyo Inland Earthquake. The "box" is the area where a fracture arises in the epicenter fault. The area where an especially large slip occurs is indicated in bold frame.

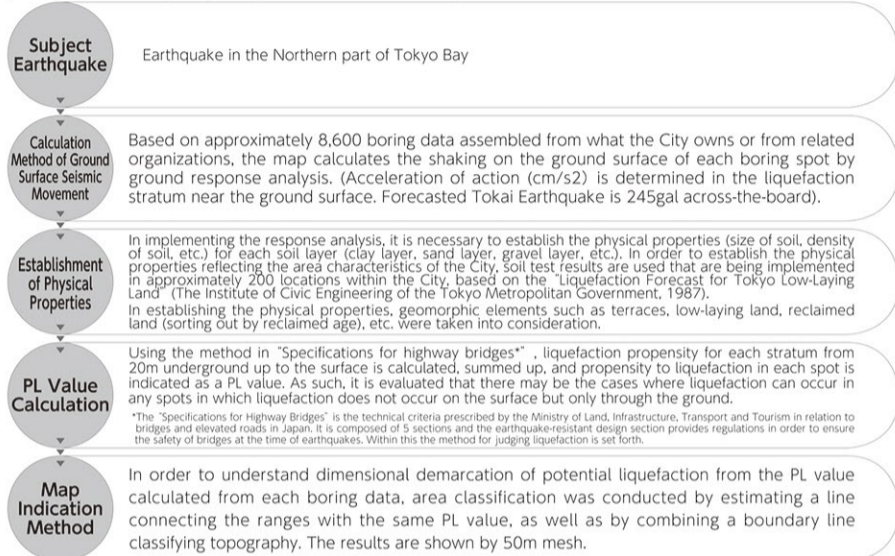
② Forecasted Tokai Earthquake [Ocean Trench-type Earthquake]



Map 2: Nationwide survey on seismic movement forecast map extracted from the probability theory seismic movement forecast map (published by the National Research Institute of Earth Science and Disaster Prevention)

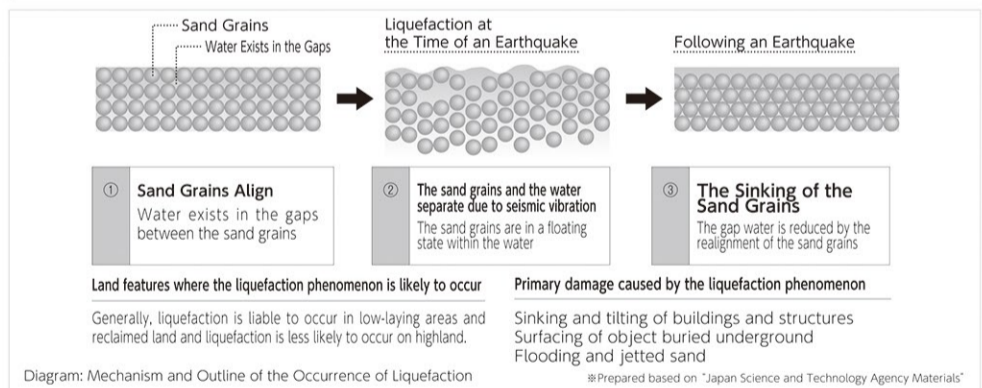
04 Process of Creating the Liquefaction Map

The map was created setting the primary conditions to forecast liquefaction as below.

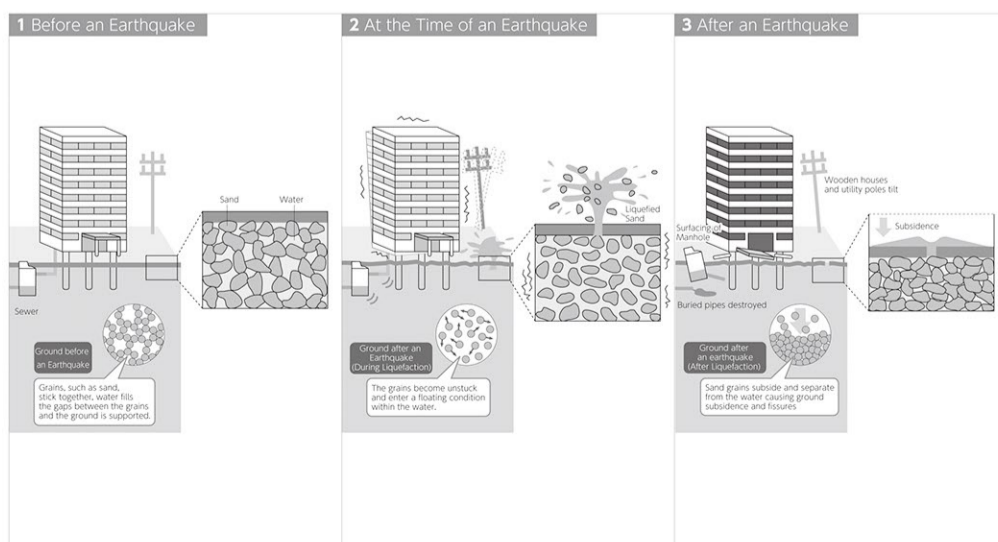


07 Liquefaction Mechanism

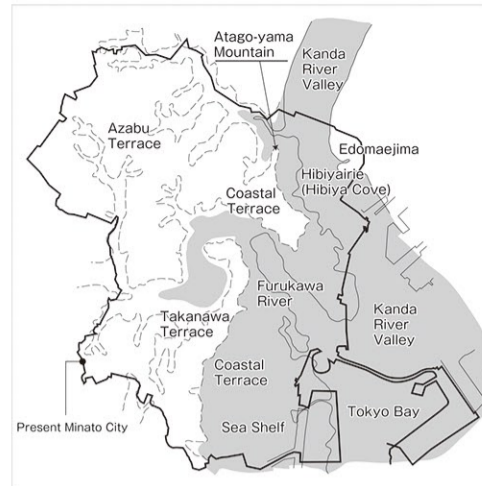
Liquefaction is a phenomenon in which the ground temporarily becomes like liquid due to an earthquake, causing buildings on the ground to tilt or sink. If the sand layer, in a saturated condition due to underground water, maintained in a certain balance (condition (1)) is shaken by a strong earthquake, pressure is put on the water between the gaps among the sand, and connection among the sand grains comes apart. The sand grains whose connection comes apart float upon on the water (condition (2)). The sand grains, in a liquid state, pour out onto the land surface from small cracks in the ground due to pressure caused by an earthquake. Following the earthquake, the pressure on the ground is reduced and the sedimentation and realignment of the sand grains occur (condition (3)). In this way, the phenomenon in which the ground becomes like a liquid is called the "liquefaction phenomenon."



When the Ground Liquefies



05 Liquefaction and the Formation of Minato City Topography



Map 3 Old Land Features

In prehistoric times the Kanto Plain was nothing but deep ocean, and there were only islands in the current southern part of Boso and Miura. In this deep ocean, fan-shaped land developed from sand which flowed from the ravines of the Tanzawa, Chichibu, Myogi, Haruna, Akagi, and Nasu mountain systems.

New sand earth then developed by marine transgression and regression, caused by the global climate fluctuating between warm and glacial periods. Numerous rivers carved out valleys, and by the time land was created volcanic eruptions occurred, including those from Mt. Fuji, and fallen ash loam covered the surface of the land.

In Minato City, the Hibiya Inlet came to be as the Kanda Valley and the old Furukawa formed a V-shape in the glacial period and became a steep mountain range topography. In a following warm period (the Shimo-sueyoshi and Jomon periods), two rivers were completely filled with accumulated clay and silt after a time when sea level was a few meters higher than at present.

In this warm period, the sea encroached inland, and the east slope of Atago-yama Mountain and Takanawa terrace became coastal terrace. Sea cliffs and wave-cut benches developed due to sea waves washing up against the foot of these terraces.

In the meantime, shallow sea spread across the Shibaura-konan area, and the Daiba area was a shoal across from the Kanda river valley, the old Tokyo river tributary. In this shoal there were comparatively shallow and deep areas. In the shallow areas, rough sand was prone to accumulation, and in the deep areas fine sand was prone to accumulation.

Liquefaction is thus more prone in the areas where there are wave-cut benches and shallow sea sediment.

06 In Order to Reduce Damage caused by Liquefaction

In order to reduce damage caused by liquefaction, firstly, it is critical to know what type of ground there is in the location where you live. Additionally, it is also important to investigate what type of place that location was in the past. On that basis, it will be critical to implement measures against liquefaction.

Ground prone to Liquefaction

Places prone to liquefaction are those where sand was lightly (loosely) compacted and the underground water is located high, and the places which were rivers, rice paddies and swamps in the past.

Plans to Deal with Liquefaction

The following are the principal methods as effective measures against liquefaction for comparatively small buildings, such as single family homes, etc.
(1) Improve the ground to make liquefaction less likely
(2) Make the foundation a pile foundation
Suitable method varies depending on residential environment etc., so please consult with specialists.

Measures Against Liquefaction (Construction Methods)

Methods Tailored to the Foundation of the Building		Method by Improving the Ground	
Small Diameter Pile Method	Deep Soil Mixing Method	Shallow Soil Mixing Method	Injection Method
<p>After ensuring the strength supporting the weight of the building with the bottom face of the foundation, this method installs piles, such as steel tubes, by rotation or pressure insertion, to reduce total settlement.</p>	<p>This is a method to improve the ground by installing improved column cross sections consisting of soil and solidification material beneath a base slab (underground beam) or foundation footing (inverted T-shaped foundation base member), in a pile-like form.</p>	<p>This is a method to improve cement-type solidified materials and current soil in thin laminae and or in placibus by completely churning and mixing beneath the base slab or base footing, including the building periphery.</p>	<p>This is a method to inject cement slurry (a liquid mixture of water and cement and chemical (liquid glass, etc.))</p>

08 Q&A concerning Liquefaction

- Q** What should I do if my home is in area with a high risk of liquefaction?
- A** Please consult with an expert and gain an understanding of conditions such as the stratum and underground water. On that basis, you can reduce damage by undertaking improvements in the building's seismic resistance and ground.
- Q** I'd like to know what kind of place it was in the past.
- A** Confirming land history is one way to forecast potential liquefaction. Comparing topography maps and older maps makes it possible to trace the history of land usage. In the Great East Japan Earthquake, there were many reports of liquefaction damage in reclaimed land. Particular attention is necessary, as it is said that liquefaction damage is comparatively more likely to occur on land which was once a river or rice paddy in the past. Topography maps are available at bookstores, as well as libraries. Old maps are partially available via the following website: Ministry of Land, Infrastructure, Transport and Tourism, Geographical Survey Institute <http://maps.gsi.go.jp/history/index5-25.html> Viewing of the materials noted below may be done at Construction Guidance Section, Structural Guidance Subsection.
- Neighborhood boring data
 - Old land feature maps prior to 1935 / before and after 1955 / before and after 1975 old edition land feature maps
 - Current land feature map (2011 edition)
 - The land conditions map (2011 edition) shows the types of land features

09 Precautions in the Use of the Liquefaction Map

The "high potential liquefaction" areas indicated on the liquefaction map does not mean that it will definitely occur, but does mean that there is a comparatively high probability compared to other areas. If you would like to make a more detailed study, please view neighborhood boring data and land feature maps, etc.

Minato City Disaster App Currently Being Distributed

A Minato City disaster preparedness app is available for download.

This free app (Minato-ku Bosai Appli) was created to provide information and raise awareness of disaster preparedness among residents and businesses based on experience gained through the Great East Japan Earthquake. Please use this app to help you recognize the risks and prepare for disasters (available for smart phones only).

Main Contents

"3D image of flood depth caused by tsunami" "Hazard map with flood depth caused by tsunami" "Liquefaction map" "Tsunami animation" "Disaster information mail (link)" "Voice mail message service at time of disaster (link)" "Minato City Hazard Map (link)" "List of evacuation centers" "Location of buildings for evacuation in case of tsunami" "How to use AED" "Disaster preparedness facilities in parks" "Flood hazard map, list of evacuation centers in case of flood" (available March, 2014)

How to download Minato City disaster preparedness app (Minato-ku Bosai Appli).

Use your smart-phone to read the QR code shown below to access the download page or type the keyword "Minato-ku Bosai Appli" in the search box of your app download service.

Apple's App Store

For iPhone

Google Play

For Android phones



App Store
(For iPhone Terminal)



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(For Android Terminal)