The Great East Japan Earthquake

On this map of Japan, the strength of the tremors caused by the Great East Japan Earthquake is shown by color from red (strong) to white (weak).

Earthquake

Earthquake date and time: Friday, March 11, 2011, 2:46 PM
Formal name: The 2011 off the Pacific coast of Tohoku Earthquake
Epicenter: Off the Sanriku coast (38°6.2’N, 142°51.6’E)
Magnitude: 9.0
Tsunami height:

Damage in Sendai (as of March 1, 2017)

<table>
<thead>
<tr>
<th>Casualties: Death toll</th>
<th>904</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing</td>
<td>27</td>
</tr>
<tr>
<td>Injured</td>
<td>2,275</td>
</tr>
<tr>
<td>Flooded households:</td>
<td>8,110</td>
</tr>
<tr>
<td>Damage to residential lots:</td>
<td>5,728</td>
</tr>
<tr>
<td>Damage to buildings:</td>
<td></td>
</tr>
<tr>
<td>Completely collapsed</td>
<td>30,034</td>
</tr>
<tr>
<td>Severely damaged</td>
<td>27,016</td>
</tr>
<tr>
<td>Partially damaged</td>
<td>82,593</td>
</tr>
<tr>
<td>Suffered minor damage</td>
<td>116,046</td>
</tr>
</tbody>
</table>

Damage to buildings: Completely collapsed
Severely damaged
Partially damaged
Suffered minor damage

CASUALTIES: DEATH TOLL

Damage to residential lots: Completely collapsed
Severely damaged
Partially damaged
Suffered minor damage

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Damage to buildings: Completely collapsed
Severely damaged
Partially damaged
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Search and rescue operations
Emergency water supply aid
The looming tsunami
Damage to a road
Damage to an inland residential area on a hill

Sendai Earthquake 02
Sendai Arahama Elementary School, isolated by the tsunami

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Sendai Arahama Elementary School, isolated by the tsunami
Damage

1. The Arahama area of Wakabayashi ward, looking out at the inland area near the coast
2. The tsunami engulfing the Minami-Gamo Wastewater Treatment Plant
3. Residential land damage in the inland hilly area
4. Rescuing people by helicopter
5. The Japan Self-Defense Forces delivers relief supplies
6. An evacuation center at an elementary school
7. People lining up outside of a supermarket seeking food
8. Removing debris
9. Damage at a public facility
10. The Great East Japan Earthquake Sendai Memorial Service (July 2011)

Reconstruction

1. The first Sendai Aoba Festival after the earthquake, in May 2012
2. Residents gathering around prefabricated temporary housing
3. Construction to repair disaster damaged residential land
4. Evacuation stairs built along the Sendai Tobu Road
5. Foreign residents taking part in local disaster prevention drills
6. Disaster Reconstruction Municipal Housing unit built for disaster-affected persons
7. An exchange meetup at a Disaster Reconstruction Municipal Housing
8. The Sendai Subway Tozai Line opened
9. A housing complex site for the Disaster Prevention Collective Relocation
10. Redeveloping the coastal levee to an elevation of 7.2 meters
11. The Sendai 3/11 Memorial Community Center opened at Arai Station on the Tozai Line
Disaster-Resilient and Environmentally-Friendly City, Sendai

Having learned from the lessons of the Great East Japan Earthquake, Sendai is on its way to becoming a “Disaster-Resilient and Environmentally-Friendly City” that is both flexible and resilient to future risks, such as natural disasters and climate change. In order to achieve this goal, in the lush environment that earned the city its nickname of “the City of Trees”, the city is focusing on three elements. First is urban development that pursues ways of city planning leading to robust infrastructure and improved disaster risk reduction in energy supplies. Second is human capacity building that will help support disaster prevention activities in local communities. Third is passing on planning leading to robust infrastructure and improved disaster risk reduction in energy supplies. Second is human

The Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 is the outcome document of the Third United Nations World Conference on Disaster Risk Reduction, held in March 2015 in Sendai, and outlines a range of international disaster risk reduction policies towards the year 2030. The lessons learned from the Great East Japan Earthquake are incorporated into the framework as key concepts and priorities for action. Many countries have started to implement measures for disaster risk reduction based on this framework.

Features

1. Establishment of seven global targets such as reducing the mortality rate from global disasters for the first time.
2. Presentation of new ideas, such as mainstreaming disaster prevention, pre-disaster investment to be used in measures for disaster prevention and disaster risk reduction, and the concept of “Build Back Better”.
3. Emphasis on the roles of various relevant stakeholders, including not only the local governments, citizens, organizations and research institutes, but also women, youth and the private sector taking action to prevent disaster and reduce disaster risks.

Stakeholders: The wide range of people and entities who held a stake or interest in a given activity in society.

Towards the Realization of the Sendai Framework for Disaster Risk Reduction 2015-2030

Fumihiko Imamura
Director, International Research Institute of Disaster Science (IRIDeS), Tohoku University

A professor of tsunami engineering. Since 2014, Imamura has acted as director of the International Research Institute of Disaster Science (IRIDeS), Tohoku University. IRIDeS is an international research center located in Sendai that is focused on studying natural disaster science. The center researches a range of fields including the humanities, social sciences, science, engineering, informatics, medicine, and more. It also encompasses the Global Centre for Disaster Statistics, which works with the United Nations Development Programme (UNDP).

No matter where one may be in the world, there is the risk of being struck by a natural disaster. In recent years, with a growing population, socio-economic globalization, as well as increasing climate change, better response to disasters has become an issue of utmost urgency.

The 2011 Great East Japan Earthquake caused major damage to the Pacific Ocean side of the Tohoku region, such as that in Sendai. This calamity must never again be repeated. We feel we must convey the lessons we learned from this experience far and wide and reduce the disaster risks that other regions and the next generation may be exposed to. As people living in the stricken regions, we faced this issue head-on.

The Sendai Framework for Disaster Risk Reduction 2015-2030 was created at the Third United Nations World Conference on Disaster Risk Reduction, held in Sendai in 2015.

This framework describes a series of targets and priorities for action for countries around the globe to implement over the next 15 years in order to reduce damage caused by disasters. People who come from overseas to visit Sendai show an interest in both how the reconstruction is proceeding and in what things citizens are doing at the local level. The impression one gets is that they are deeply interested in changing the established thought that disaster risk reduction is something achieved top-down by governmental administration and not citizens. The way in which local residents, NPOs, corporations, specialists, and many other stakeholders have come together for Sendai’s reconstruction will prove to be a vital case study for other regions.

As the name beater of the Sendai Framework, the world is looking to Sendai to foster a culture of disaster risk reduction. Utilizing opportunities such as the World Bosai Forum/International Disaster Risk Conference 2017 in Sendai, which will be held every other year from 2017 on, we must foster the further sharing of information and collaboration.
The tsunami that far exceeds prior estimations caused extensive damage—both to citizens and structures—in Sendai City, flooding an area larger than 4,500 ha. Since the disaster, in order to prepare for another potential tsunami, we have developed multiple lines of protection against tsunamis, such as a coastal levee, disaster prevention forests, and an elevated road. The areas that are still not guaranteed to be safe have been designated as Disaster Risk Areas. In such locations, the construction of homes is prohibited and former residents have moved to safer inland areas.

The tsunami engulfed the Shinhama area. Some residents lost their lives and the disaster left the district covered with mud and debris. Following the tsunami, the area closer to the sea was designated as a Disaster Risk Area, although the zone that is inland from the elevated road remained available for rebuilding homes. The City of Sendai decided to build tsunami evacuation towers. As the representative of the area, I attended meetings to express opinions on matters such as the appropriate location for the tower. Now that the tsunami evacuation tower has been completed, the residents can evacuate on foot when an emergency arises. There are about 70 households in the area and, thanks to the multiple defenses including the coastal levee and the elevated road, we are feeling safer and safer each day.

Safe Living Thanks to Multiple Defenses

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Three Measures for Tsunami Defense

1. Moving the residents to safer inland areas
2. Multiple Defenses: defending against a tsunami with multiple countermeasures (coastal levee, coastal disaster prevention forests, and an elevated road)
3. Evacuation: running away from a tsunami using evacuation facilities and evacuation roads
4. Relocation: moving the residents to safer inland areas

Disaster Risk Area: These areas are designated by local government regulations as being highly vulnerable in a disaster situation. Building new residential structures is prohibited in the area.

The Disaster Prevention Collective Relocation Promotion Project: This is a project to promote collective relocation to safer areas for those who used to live in a Disaster Risk Area. The national government’s fund is used to develop residential land at the relocation destination and for subsidies to those who relocate.
Many people lost their homes as a result of the Great East Japan Earthquake. These individuals were forced to live in temporary housing, and the number of displaced households exceeded 12,000 at its peak. After the disaster, the City of Sendai and NPOs collaborated to provide support to those households by responding to actual situations and requests. After individuals rebuilt their everyday lives via the Disaster Prevention Collective Relocation or Disaster Reconstruction Municipal Housing, a number of activities in various locations were also created to prevent isolation in a new environment and to build a new community.

Joining Forces for a New Life

After living in evacuation centers and temporary housing following the Great East Japan Earthquake, we moved into municipal housing that was developed in 2015 for disaster-affected people. This is an apartment-style municipal housing structure with 13 stories and 163 houses; it also accommodated those who evacuated from disaster-affected areas outside of Sendai. Following advice from the ward office that “It is crucial that people get to know each other so that you can live safely in a new area,” residents began drinking tea together. As they got to know each other, their exchanges became more active and led to a variety of collaborative, spontaneous activities, such as passage cleaning, summer festivals, and visiting single elderly people.

Supporting the Disaster-Affected People Psychologically by Keicho (Attentive Listening) Activities

We have been conducting attentive listening to people’s problems and anxieties since 2008. After the Great East Japan Earthquake occurred, we learned that mental care for disaster-affected people was essential; we then began visiting evacuation centers. By talking, people are able to cleanse what has accumulated in their mind; as a result, they feel lighter. We have regularly visited prefabricated temporary housing and meetings for disaster-affected people, conducting activities to support those who have problems. We believe that seeing more and more people who are overcoming sorrow and living positively is the real reconstruction.

By June 2011, 1,505 units of prefabricated temporary housing had been built

A student volunteer gives a moment of relaxation to a disaster-affected person with a hand massage

Disaster Reconstruction Municipal Housing built for disaster-affected people

Katsunori Sugawara (pictured in center) and residents of the Asuto Nagamachi Disaster Reconstruction Municipal Housing

Talking while cleaning makes it a fun activity

Support for disaster-affected people continues with roughly 200 members
Sendai is the economic center in the Tohoku region with a population of 1.08 million people. Numerous major corporations have branches here. Many of the local companies are small/medium enterprises and have developed around a focus on the service industry. The Great East Japan Earthquake caused damage to vast numbers of facilities and equipment of private companies, caused a loss to sales channels, and a decrease in tourists, leading to serious damage to the local economy. As part of the reconstruction, administrative policy and a range of ideas and initiatives by business operators came together to revitalize the local economy.

**Initiatives to Support Recoveries of Businesses**

In June 2011, the Sendai Chamber of Commerce and Industry drew on the nationwide network of chambers of commerce and industry to launch a project to provide machinery that disaster-affected businesses needed. Over five years, more than 3,200 spare pieces of machinery were utilized to make major contributions to restarting business and restoring the enthusiasm company operators had towards their businesses. In addition, many firms lost ties to their trading partners and clients as they had to suspend business or downsize their operations. To that end, we are organizing trade fairs to allow them to carve out sales channels anew.

**The Joy of Working with Colleagues**

My home, farmland, warehouse, and equipment were all damaged by the tsunami. I had almost given up hope of restarting agriculture, but the female farmers said they wanted to continue working together and voiced their support. Thanks to their enthusiasm, we restarted making miso that we had been working on since before the tsunami. In 2013, we opened a new restaurant-cum-market together. The large rice balls and homemade side dishes have built up a reputation by word of mouth, and the shop is always packed. I am so grateful to have a place to work that the busy schedule doesn’t feel like a bother at all. I feel that what those affected by the disaster need is work.
Agriculture

The plains spanning throughout eastern Sendai are where the staple crop of rice, as well as various vegetables, are grown. At the time of the Great East Japan Earthquake, the tsunami flooded 1,860 hectares of farmland, submerged them in mud and debris and salinated the soil. Through reconstruction efforts, the debris was cleared, the area desalinated, and repairs made to farmland and equipment. In order to enhance the management of farms that sustained damage, farmland development for larger zoning is underway.

Reconstructing damaged farmland and starting up rice production again

The Sendai Agriculture and Horticulture Center, restored after the tsunami

A new agricultural firm dedicated to growing vegetables in large greenhouses

Restoring Damaged Farmland

<table>
<thead>
<tr>
<th>Year</th>
<th>Restoration of Damaged Farmland</th>
</tr>
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<tbody>
<tr>
<td>2011</td>
<td>30%</td>
</tr>
<tr>
<td>2012</td>
<td>70%</td>
</tr>
<tr>
<td>2013</td>
<td>90%</td>
</tr>
<tr>
<td>2014</td>
<td>100%</td>
</tr>
</tbody>
</table>

Supporting Affected Farmers from Their Perspective

Soon after the earthquake and tsunami, I set about volunteering to clear the mud and debris in the tsunami-affected areas. In April 2011, I launched a group with the students I had worked with at that time, and we began helping the disaster-affected farms rebuild. We brought on young volunteers from around the country and worked together. We aimed to look at things from the perspective of the disaster-affected people and to support their lives and livelihoods.

Since farming has resumed, various programs like farm work, sale of crops, and events have allowed us to continue engaging with local residents towards reconstruction and vitalizing the region.

Bringing Back Vitality to the Region by Restoring Agriculture

In the earthquake and tsunami, my home was washed away, and my farm, which was on a plain, was covered in mud and debris. Many of my friends were also lost to the disaster. I was despondent for some time, but I worked together with 15 colleagues with the same passion for agriculture and we founded an agricultural cooperative in 2013. After the soil was desalinated, we began testing crops. Through trial and error such as losing all the lettuce crops, we planted green onion and succeeded in harvesting a crop of sweet and delicious plants. The Green Onion Festival celebrates the harvest, and it was lively with many guests. Going forward, we want to continue making the venture more profitable in order to increase employment and long-term residents of the area.

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Supporting Affected Farmers from Their Perspective

Eastern Sendai’s farmlands, which were struck by the tsunami, are pursuing increased productivity and more efficient management, with smaller farms congregating together to rezone into larger one hectare plots. In 2014, farming began in the rezoned areas.
Disaster Risk Reduction in Communities

Drawing on the lessons learned from the 1978 Miyagi Offshore Earthquake, Sendai has been continuing its efforts to foster the creation of volunteer disaster-prevention organizations to act as the core for mutual assistance in a disaster. Following the 2011 earthquake, while aid from public organizations was delayed, and there were some limits to what could be done, a range of independent activities were carried out to meet demand, raising awareness of the importance of local disaster preparedness. After the disaster, training and support for the Sendai City Community Disaster Preparedness Leaders was pursued. This resulted in the development of operation manuals tailored to each evacuation center, taking the actual situations of each community into consideration.

Leading Disaster Risk Reduction on a Community Level

I live in the Fukuzumimachi area, which was subject to flooding before. This led local residents to create an independent disaster preparedness manual and work with local organizations to hold drills. Thanks to these efforts, when the Great East Japan Earthquake struck, we were able to smoothly confirm the safety and whereabouts of elderly residents and other people needing care. After the earthquake, I took part in training courses put on by the City of Sendai, and now I am active as a Community Disaster Preparedness Leader. The disaster prevention and disaster risk reduction skills learned are put to use in operating the neighborhood association. I believe that local safety is something residents are responsible for. To that end, interacting with others through local festivals and other events is important, as is conveying to children the importance of safe community building, both now and into the future.

Public and Private Sector Come Together for Measures Against Stranded Commuters

The Great East Japan Earthquake caused railroads and other public transportation to come to a halt, with JR Sendai Station being forced to close. The number of people who congregated at the station reached 11,000. The roads were overflowing with people, and the nearby evacuation centers were also creating havoc. Based on this experience, in 2013 a council to plan measures against the possibility of stranded commuters in future disasters was launched. This council consisted of the City of Sendai, railroad companies, businesses in local shopping arcades, universities, and other organizations and firms, twenty in total. A protocol for dealing with stranded commuters has been put in place, and temporary stay locations have been set up around Sendai Station after the Great East Japan Earthquake.

Stranded commuters:
Workers, students, tourists, and other people stranded and unable to return to their homes after public transit facilities were halted following the disaster.

Temporary stay locations:
Sites used as temporary places for stranded commuters around the station. They also provide traffic information on how to get home. Twelve of these sites have been set up around Sendai Station after the Great East Japan Earthquake.

Accumulative Community Disaster Preparedness Leaders

Evacuation Centers with Their Own Operation Manuals

Collaborating with junior high schools on disaster prevention drills organized by the neighborhood association.

An evacuation center opened in the gymnasium of an elementary school (March 2011)
The Sendai Station bus stop area filled with stranded commuters right after the earthquake
Sendai hosts workshops training Community Disaster Preparedness Leaders

Training held around Sendai Station had 350 participants based on a stranded commuter situation scenario.

Osamu Yokoyama
Council for Countermeasures for Stranded Commuters around Sendai Station
For foreign people in Japan, obtaining accurate information at the time of a disaster can be difficult. Since 2005, Sendai FM Broadcasting has been working with the Sendai Tourism and Convention and International Association (SenTIA 1) to offer space on radio programs where foreign residents discuss their own experiences with the earthquake and with disaster prevention. Since we knew each other, when the earthquake occurred, SenTIA members fluent in other languages came to the studio right away to help us convey disaster-related information in English, Chinese, Korean, and easy Japanese. In this way, these day-to-day efforts helped in the actual event of a disaster. We plan to continue broadcasting the program.

Distributing Disaster Information in Multiple Languages

The Katahira area is located close to the center of Sendai and is where many foreign people such as international students live. During the Great East Japan Earthquake, foreign people came to the evacuation centers, but differences in culture and customs caused some confusion with local residents. What we learned was the need to pursue mutual understanding and interaction on a daily basis in order to prepare for emergencies. Seeking to have international students more actively take part in the disaster prevention drills after the earthquake, we have them engage directly from planning the drills to distributing rice and food on the days of the drills. We would like to keep creating an environment that is open and fosters better communication between residents.

Disaster Prevention in a Multicultural Community

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Elementary school children visit the area devastated by the tsunami.

Active discussion and learning about disaster risk reduction

Playground equipment for children donated from Finland

Children at schools around the city worked together to invigorate the community by volunteering, creating slogans and posters, and crafting original songs to promote the reconstruction. Since 2011, the Tanabata Festival, a signature of summer in Sendai and held every August, has exhibited origami cranes folded by more than 80,000 local children every year, conveying their hopes for reconstruction and the future.

Prior to the Great East Japan Earthquake, I worked in running the Adventure Playground at Kaigan Park, but the park was closed after sustaining damage in the tsunami. Feeling that the children needed a place to play freely to their heart’s content, we visited about 20 affected areas with a colorful van loaded with a range of playground equipment. Through playing, the children heal their psychological trauma by themselves. Seeing the children roll mud, plane wood, roll around on the ground, and find new forms of play cheered up the adults, too. Outdoor playgrounds have the power to bring people together.

Outdoor playgrounds have the power to bring people together.

The Mobile Playground that Tours Around the Affected Areas

We want to raise children who will act as upstanding citizens in the event of a disaster and are able to not only protect themselves, but aid in supporting others. After the disaster, we engaged in a series of talks with educators interested in the idea and created supplementary readers on disaster risk reduction. These readers are used at schools in the city to foster a deeper understanding in children on a range of issues, such as disaster risk reduction at home, the history of disasters in the region, what meals to eat in the event of a disaster, and more. It is important that the experiences and lessons of the disaster not be lost and are passed down to the next generations.

Fostering the Ability to Think Independently and Make Decisions

Children happily playing with water

Fifth-year elementary school students learn how to interpret weather reports and risk forecasts

A supplementary reader containing details on subjects such as disaster preparation and disaster prevention map creation

A song of reconstruction sung at the Tanabata Festival venue

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Fostering the Ability to Think Independently and Make Decisions

Children happily playing with water

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A song of reconstruction sung at the Tanabata Festival venue

Homeland Reconstruction Project

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People sustained considerable trauma from this unprecedented disaster, and they were doing all they could to bounce back. Amid such chaos, we realized that we need something other than safety, food, lodgings, and money in order to make their daily lives feel normal again. It was music, art, sports, and other cultural activities in various ways, helped to soothe souls and give them strength. This hardship served as an opportunity to take stock of how important these elements of culture are in our daily lives.

Supporting through Music

Two weeks after the earthquake, daily life was at a standstill. Everyone was full of anxiety. It was precisely then that the Center started its musical activities. At the time, the performers had questioned themselves about whether it might be too soon to be engaging in music, but we went forward with the plan out of the conviction that we wanted to support disaster-affected people. When performances began in the midst of towns still being rebuilt, the music stirred the hearts of many, unlocking the emotions they had bottled up within them. The concerts held at evacuation centers and temporary housing, as well as at Disaster Reconstruction Municipal Housing, numbered over 700. We hope to continue delivering music that brings cheer and vitality to the affected areas.
Sendai’s plains area was hit by tsunami damage previously in 869 and 1611. Legends of tsunamis still remain at shrines in eastern Sendai, indicating that those who came before sought to share the history of disasters. Unfortunately, we were unable to fully make use of this knowledge in preparing for disasters in the present. To that end, we are engaging in a range of efforts to pass down our experiences and lessons learned, as well as to share information far and wide throughout Japan and the world to contribute to disaster prevention and risk reduction.

**Valuable Materials Linking People and Conveying the Experience of the Earthquake**

Since 2009, we have been collecting old photographs and videos. Twelve days after the disaster, we drew on that experience to call on local residents on social media to contribute their own content and help us preserve the memory of the earthquake and tsunami at the grassroots level. The content we received included scattered debris and people eating by candlelight. This content was published online, through exhibitions, and in booklets. We also created a project that used footage we collected before the disaster to talk about memories. Seeing nostalgic footage, people opened up and spoke actively with each other. We would like to continue utilizing the strengths of the media we have collected to tie people together.

"Discussing the past society"
—fostering spontaneous interaction

**The Disaster Ruins: A Message for the Future**

Sendai Arahama Elementary School stands about 700 meters away from the coastline. I was an elementary schooler at the time and was at school when the earthquake struck. The tsunami which came after the enormous earthquake reached the second floor of the school building, but we quickly rushed to the top floor and escaped. The school building was the only high and durable building in the Arahama area, which meant the local residents also evacuated there. Amid uncertainty and cold, we supported each other and 320 of us survived, among them children, teachers, and local residents. Our day-to-day training allowed for a smooth evacuation process. Today, the school ruins remain open as a means of preserving and exhibiting the damage of the earthquake. We truly want to convey our experiences and lessons we learned to the rest of the world in order to reduce the impact of disasters.


**Legend of Tsunamis at Religious Facilities**

Namiwake Shrine in the east of Sendai is where legend says that in a tsunami, a sea god riding a white horse parted the sea in two and stopped the tsunami. Takoyakushi in the south of Sendai is where legend says that in a flood, an octopus attached to Bhaisajya-guru was washed ashore.
Earthquake and Tsunami

**Mechanisms**

### Earthquake Generation

Every year, the tectonic plates covering the Earth move a few centimeters. Around Japan, when oceanic plates sink, inland plates are pulled under. When an inland plate cannot withstand this strain anymore, it springs back, causing an earthquake at the boundaries of the plates. Japan is subject to the complex movements of four plates—the Pacific Plate, Philippine Sea Plate, North American Plate, and Eurasian Plate, making it one of the world’s most active earthquake regions.

### Tsunami Generation

When a large earthquake occurs under the sea, the seabed is pushed up and then submerges. The sea level also changes accordingly, causing large waves to move in all directions. This is a tsunami. The commonly observed phenomenon of the tide drawing in before a tsunami is not one that is definite. There are cases where there is an initial large wave which reaches the coast without the tide receding.

### Speed and Force of Tsunamis

The deeper the ocean, the faster the tsunami will travel. As the wave nears the shore, the subsequent waves catch up and amplify the wave height, increasing the wave force. In a tsunami, the waves become a single mass capable of sweeping away homes and vehicles.

### Course of the Tsunami

How did the tsunami occur and travel during the 2011 Great East Japan Earthquake? Simulations conducted by the International Research Institute of Disaster Science (IRIDeS), Tohoku University are used to model the movement of the waves during the disaster (Simulations show the waves higher than their actual height).

**Simulated images of the tsunami reaching the coastal regions of Tohoku**

Approximately 20 minutes after the earthquake. The first large tsunami hit Japan.

Approximately 43 minutes after the earthquake. The large waves approached the coastline. The maximum estimated height was 16.7 meters.

Approximately 70 minutes after the earthquake. The estimated height of the tsunami in Sendai was about 7.1 meters. Not only around the coastline, but a wide area of the sea surface fluctuated, conveying the tsunami.

**Simulated images of the tsunami traveling across the Pacific Ocean**

Approximately 7 hours and 45 minutes after the earthquake. The tsunami had reached as far as Hawaii.

Approximately 13 hours and 20 minutes after the earthquake. The tsunami had reached as far as New Zealand.

Approximately 22 hours after the earthquake. The tsunami had reached the southern tip of the South American continent.

Overseen by: International Research Institute of Disaster Science (IRIDeS), Tohoku University
**Road to Recovery**

**Evacuees and Evacuation Centers (2011)**
- April 11: 288 Locations
- April 14: Applications for temporary housing opened
- July 31: The last evacuation center closed

**Ratio of Recovery of Essential Utilities (2011)**
- Water supply: 99.6% (in March 2011)
- Gas supply: 99.6% (in March 2011)

**Ratio of Earthquake-resilient Water Pipes and School Facilities (in March 2017)**
- Water pipes: 86.8% (in March 2011)
- Gas pipes: 85.5% (in March 2011)
- School facilities: 100%

**Estimated Population of Sendai (at October 1 of every year)**
- 2010: 1,046,000
- 2011: 1,050,000
- 2012: 1,060,000
- 2013: 1,070,000
- 2014: 1,080,000
- 2015: 1,090,000
- 2016: 1,100,000
- 2017: 1,115,000

**Breakdown of Counseling Related to the Disaster**

**NPOs (Registered in Sendai)**

**Processing of Debris**
- Debris: 2.72 million tons (2011)
- Recycling rate: 0.37 million tons
- Ordinary years' worth of waste processed: 7 ordinary years' worth (2011)

**Trees Planted by Citizens in the Eastern Coastal Area**
- 4,009 trees (2011)

**Donations Raised by Sendai, the City of Trees Kizuna Donation Campaign**
- 3,933 donations (2011)

**Data**

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Sendai Reconstruction
Sendai Reconstruction

Chronology

2011

March 11
Great East Japan Earthquake (magnitude 9.0) struck, and tsunami hit the area
Evacuation centers opened

March 15
Disaster Volunteer Centers opened (until Aug.10)

March 28
Construction of prefabricated temporary housing began

April 1
Sendai City Basic Policy for Earthquake Disaster Reconstruction announced

April 7
Largest aftershock struck (magnitude 7.2)

April 11
Applications for primary recruitment of emergency temporary housing opened

April 16
Gas utilities fully recovered (excluding evacuation advisory areas, etc.)

April 22
Debris treatment and disposal completed (tsunami-flooded eastern area)

May 23
Applications accepted for demolition and removal of destroyed houses

May 30
Sendai City Earthquake Disaster Reconstruction Vision formulated

June 1
Reception of personnel from local governments nationwide on long-term assignment began

June 12
Opinions exchanged on reconstruction and community building (seven meetings through Jun.26)

June 15
All 1,505 prefabricated temporary housing units completed

July 11
Great East Japan Earthquake Memorial Service held in Sendai

July 16
Tohoku Rokkun Festival held in Sendai (until Jul.17)

July 31
Debris removal in tsunami-flooded residential area completed (tsunami-flooded eastern area)
All evacuation centers in Sendai closed

October 1
Debris incineration began with temporary incinerators

November 30
Sendai City Earthquake Disaster Reconstruction Plan formulated

December 16
Disaster Risk Areas designated (tsunami-flooded eastern area)

December 17
Briefing sessions began for the Disaster Prevention Collective Relocation Promotion Project (until Dec.26, tsunami-flooded eastern area)

December 28
Debris removal in farmland completed (tsunami-flooded eastern area)

2012

January 10
Consultation desk for recovery in affected inland hilly residential areas opened

March 11
Great East Japan Earthquake Memorial Service held in Sendai

April 1
Sendai City Post-Disaster Reconstruction Bureau established

May
Farming restarts on farmlands where recovery work and desalination was completed

June 5
Applications accepted for residential reconstruction aid for eastern Sendai (tsunami-flooded eastern area)

September 3
Minami-Gamo Wastewater Treatment Plant repairs began (groundbreaking ceremony)

October 10
Elevated road project started on Shioigawa-Watari Prefectural Road

November 11
Applications accepted for residential areas for Disaster Prevention Collective Relocation (tsunami-flooded eastern area)

December 21
Applications accepted for 12 units in first Disaster Reconstruction Municipal Housing

2013

March 11
Great East Japan Earthquake Memorial Service held in Sendai

April 1
Sendai City Regional Disaster Prevention Plan revised (general information, earthquake and tsunami measures)

September 17
Applications accepted for 661 units in Disaster Reconstruction Municipal Housing

September 29
Debris (combustible) incineration completed

October 25
National Eastern Sendai Land Improvement Project (farmland development) groundbreaking ceremony

December 27
Debris treatment and disposal completed

2014

March 11
Great East Japan Earthquake Memorial Service held in Sendai

March 16
Road elevation work on Shioigawa-Watari Prefectural Road began

March 31
Program for the Reconstruction of Disaster Victims’ Lives formulated

May 10
Applications for residential land in seven areas for Disaster Prevention Collective Relocation (tsunami-flooded eastern area)

July 10
Applications accepted for 2.447 units in Disaster Reconstruction Municipal Housing

November 18
Damage recovery work began in Kaigan Park

2015

February 14
Construction completed on the first Tsunami Evacuation Tower

March 11
Great East Japan Earthquake Memorial Service held in Sendai

March 14
The Third UN World Conference on Disaster Risk Reduction took place in Sendai (until Mar.18, adaptation of Sendai Framework for Disaster Risk Reduction 2015-2030)

March 23
Program for the Speedy Rebuilding of Disaster Victims’ Lives formulated

March 26
Residential land for seven areas of Disaster Prevention Collective Relocation Land Handing-Over Ceremony and all residential land completed (tsunami-flooded eastern area)

August 10
Northern Gamo Disaster-Affected Area Urban Redevelopment Project started (tsunami-flooded eastern area)

August 12
Construction started on Kaigan Park Evacuation Hill

December 6
Sendai Subway Tozai Line began operation

2016

February 3
Concept for use of land after collective relocation announced (tsunami-flooded eastern area)

February 13
Sendai 3/11 Memorial Community Center fully opened

March 11
Great East Japan Earthquake Memorial Service held in Sendai

March 12
2016 Sendai Symposium for Disaster Risk Reduction and the Future held

March 31
Sendai City Post-Disaster Reconstruction Bureau closed in connection with the end of the Sendai City Earthquake Disaster Reconstruction Plan

April 1
Minami-Gamo Wastewater Treatment Plant repairs fully completed

April 19
Agriculture and Horticulture Center is renovated and reopened

May 20
Open call for ideas for use of land after collective relocation began (tsunami-flooded eastern area)

June 30
All 3,206 houses for Disaster Reconstruction Municipal Housing completed

September 20
Construction began to preserve the Disaster Ruins of Sendai Arahama Elementary School

September 30
Four Kaigan Park Evacuation Hills completed

October 15
Part of Kaigan Park reopened for use

October 28
Provision of prefabricated temporary housing completed

2017

March 11
Great East Japan Earthquake Memorial Service held in Sendai

March 12
2017 Sendai Symposium for Disaster Risk Reduction and the Future held

March 28
All 13 Tsunami Evacuation Facilities completed

March 31
Provision of temporary housing for disaster-affected households in Sendai completed

April 30
Disaster Ruins of Sendai Arahama Elementary School opened to the public

June 10
Tohoku Kizuna Festival held in Sendai (until Jun.11)