

Long-Term Plan for Basic Survey

April 1, 2024

Geospatial Information Authority of Japan,
Ministry of Land, Infrastructure, Transport
and Tourism

TABLE OF CONTENTS

1. Introduction	3
2. Background	5
3. Basic policy and period of the plan.....	11
4. Positioning and surveying based on national coordinates.	12
5. Maintenance of basic map information.....	16
6. Promoting disaster prevention/risk reduction and disaster response through the utilization of surveying technology.	18
7. Provision and promotion of geospatial information.....	21
8. Surveying administration and international activities	23
9. Research and development and human resource development	25
10. Implementation of the plan and follow-up.....	28

1. Introduction

This Long-Term Plan for Basic Survey (hereinafter referred to as “the LT Plan”) is the ninth phase and marks the 70th year since the establishment of first LT Plan which ran from 1953 to 1962. The LT Plan is established based on Article 12 of the Survey Act (Act No.188 of 1949) by the Minister of Land, Infrastructure, Transport and Tourism, and is the plan for basic survey conducted by the Geospatial Information Authority of Japan (hereinafter referred to as “GSI”).

The LT Plan ensures the accuracy of surveys necessary for the utilization of survey results by clarifying in advance the goals of basic survey and the measures required to achieve them. The plan was also developed to prevent the redundancy of investment in surveys by various entities in order to achieve the aim of the Survey Act through the use of basic survey results. In addition, the LT Plan has become increasingly important in recent years, as it also plays a part in setting the direction of the policies that GSI should aim for in the next 10 years.

Furthermore, The Basic Act on the Advancement of Utilizing Geospatial Information (Act No.63 of 2007; hereinafter referred to as the “NSDI Act”) emphasizes the importance of the advanced use of geospatial information to achieve an economic society where people can lead safe and prosperous lives now and in the future. Based on this principle, there is a need to create a society for the advanced utilization of geospatial information (geospatial society) where anyone can utilize the geospatial information they require, anytime, anywhere. In order to achieve this it is necessary to prepare high-quality geospatial information that can be overlaid in terms of position by ensuring accurate surveys.

While the seven-unit Quasi-Zenith Satellite System is nearly complete, and a study of the 11-unit system has been initiated, the focus should be on achieving a society where stable and accurate location information is available without relying on foreign countries, in a High-precision Positioning Society whose advent has been predicted. Moreover, it is necessary to create and maintain an environment where all citizens can freely and inexpensively access accurate maps, and to achieve this in digital form. Therefore, it is important to establish a data provisioning system that accommodates the expanded use of digital data, such as

maps and GPS-based Control Station data, on the Internet. In addition, there has also been an increasing demand in recent years for efficiency in administrative bodies with limited staff and budgets. It is crucial to build a system that can provide more efficient administrative services that meet the needs of users through operational reforms, by utilizing digital technology. To this end, the purpose of the revision in this LT Plan is to clarify the policies that GSI should aim for over the next 10 years.

2. Background

There has been a significant change in social conditions and issues during the eighth LT Plan. The impact of changes in Japan's geopolitical positioning and the severity of natural disasters have increased public awareness of security and disaster prevention. Also, due to the development of surveying technology, the positioning environment has greatly improved. Furthermore, COVID-19 has triggered the acceleration of digitalization throughout society, dramatically changing the social situation, which has led to ongoing progress in digital transformation (DX) and expanded the utilization of geospatial information.

(1) Growing awareness of security and disaster prevention

The importance of the active utilization of ICT (Information and Communication Technology) is being emphasized in various places. On the other hand, Japan faces the challenge of ensuring cybersecurity, as cyber terrorism and high-tech crime become serious threats to the security of nations, organizations, and individuals. Under these circumstances, the Act on the Promotion of Ensuring National Security through Integrated Implementation of Economic Measures (Economic Security Promotion Act) was enacted on May 11, 2022. As the scope of security rapidly expands into the economic field due to complex international situations and changes in the socio-economic environment, this act aims to strengthen and promote efforts to ensure the security of the nation and its citizens from an economic perspective, including cybersecurity.

Likewise, the security environment of our nation is becoming increasingly severe. The National Security Strategy of Japan (National Security Council on December, 2022 / Cabinet decision) identifies the following issues as part of the security environment surrounding our country and the security challenges: China's intrusion into territorial waters and air around Japan's Senkaku Islands, North Korea's launching of ballistic missiles at an unprecedentedly high frequency and in new forms with rapidly increasing capabilities, Russia's invasion of Ukraine and military expansion in the Northern Territories, an

inherent part of Japan. In this context, the importance of our nation's sovereignty and maintenance of territorial integrity is being reaffirmed.

Japan has traditionally suffered from numerous natural disasters due to the geographical, topographical, and climatic characteristics of the land. In recent years, rainfall has become more localized and extreme, with occurrences of rainfall exceeding 50 mm per hour becoming more frequent. Some researchers say that global warming will lead to more frequent and severe sediment disasters and flood damage.

Moreover, the Headquarters for Earthquake Research Promotion predicts that there is a high probability of the Nankai Trough earthquakes and the Tokyo Inland earthquakes occurring in the next 30 years. Continuous monitoring of crustal deformation is essential in preparing for large scale disasters and recovery and reconstruction after they occur, as “unusual slow slip” is one of the conditions for the release of special bulletins regarding the Nankai Trough earthquakes, and as the significant post-seismic deformation from the 2011 off the Pacific Coast of Tohoku Earthquake continues to this day. Thus, the importance of surveying technology is increasing as the key to this process. Under such circumstances, revisions of the Act on Special Measures for Promotion of Nankai Trough Earthquake Disaster Management, the Special Countermeasures Act Concerning Earthquakes in the Vicinity of the Japan and Chishima Trenches, and laws concerning earthquakes and volcanic hazards such as the Act on Special Measures for Active Volcanoes that establishes the Headquarters for Volcano Research Promotion, are ongoing.

(2) Improvements in the positioning environment with advances in technology

Surveying technology has developed significantly in recent years, especially in the field of satellite positioning, navigation and timing, which has made great progress, and its utilization has expanded dramatically with the enhancement of satellite positioning systems, such as the Quasi-Zenith Satellite System “MICHIBIKI,” and others. While advanced satellite positioning is indispensable technology for achieving a geospatial information society, the

first MICHIBIKI satellite was launched in FY2010. Three additional satellites, two in quasi-zenith orbits and one in geostationary orbit, were launched in FY2017, and service with four aircraft began in FY2018. According to the Basic Plan on Space Policy workflow (revised in FY2022), MICHIBIKI is scheduled to be operating with seven satellites by the end of FY2024. Furthermore, in accordance with the Basic Plan on Space Policy (decided by the Cabinet and the Strategic Headquarters for Space Policy, June 2023), MICHIBIKI will be examined and developed with a focus on reducing costs from the perspective of autonomous positioning, aiming to increase the number of satellites from seven to eleven, and strengthening satellite positioning functions by enhancing its functionality and reliability. While the necessary environment for surveying using positioning satellites is being cultivated, the Performance Standards and Registration Procedures for Private Sector GNSS CORS were established in October 2019. It has enabled the use of GNSS data that conforms to the national coordinates with a certain level of accuracy, by using GNSS CORS reference stations (Private Sector GNSS CORS) registered with the Geospatial Information Authority of Japan (GSI). In addition, space geodetic techniques, such as satellite positioning systems and Very Long Baseline Interferometry (VLBI), form the foundation of high-precision positioning services and are essential for the establishment and maintenance of the Global Geodetic Reference Frame (GGRF) for Sustainable Development, which serves as the foundation of geospatial information, as per the resolution of the UN General Assembly. They are also essential for understanding the global environment such as the precise observation of sea level changes. In order to enable highly accurate elevation determination using GNSS satellites, including MICHIBIKI, GSI has acquired detailed national gravity data through aerial gravity surveys over the past five years, starting from FY2019, and combined it with other available data such as ground gravity, satellite gravity, and marine gravity, to construct a precise gravity geoid (accurate to within three centimeters) with higher accuracy than ever before. GSI plans to establish a new system for determining elevation based on the precise gravity geoid and the GEONET (GNSS Earth Observation Network System) by FY2024. Due to the expansion

of the utilization of quantum gravimeters and optical lattice clocks in the geodetic field, continuous observation of absolute gravity values and direct measurement of gravity potential differences have been achieved with a high degree of accuracy, leading to the possibility of monitoring geoid changes with greater precision, by combining these with GNSS observations. Furthermore, preparations for the establishment and launch of the International Height Reference Frame (IHRF) by the International Association of Geodesy (IAG) are currently underway.

(3) Development of digital transformation (DX) in society and expanded use of geospatial information

The acceleration of digitalization triggered by COVID-19 has drastically changed social conditions, and the use of geospatial information is expanding with the development of digital transformation (DX).

The introduction of technologies such as automated driving and automated construction (i-Construction) using rapidly advancing satellite positioning technology is being energetically promoted, contributing to efficient construction by reducing working hours and labor. In addition, the combination of location information and various types of data will enable more sophisticated analysis and efficient planning in various fields such as logistics and urban planning. In this way, the utilization of location information is expanding in various fields.

In the Basic Policy on Economic and Fiscal Management and Reform 2023 (cabinet decision of June 2023), the enhancement and advanced utilization of geospatial information, which also contributes to security, is registered as a necessary measure to accelerate Green Transformation (GX) and digital transformation (DX). The importance of geospatial information in promoting digital transformation (DX) has been widely recognized.

On the other hand, the Basic Act on the Advancement of Public and Private Sector Data Utilization, which came into effect in 2016, obliges the national and local governments to work on open data. Through these efforts, it is expected that various problems will be solved, the economy will be revitalized, and

administrative sophistication and efficiency will be enhanced by promoting public participation and public-private partnerships.

The Cabinet Office formulated the AI Strategy 2019, with the aim of presenting a comprehensive policy package on AI, to contribute to overcoming Japan's own social challenges, improving industrial competitiveness, as well as solving global issues through the attainment of a Super Smart Society (Society 5.0). In the AI Strategy 2022 formulated in 2022, a strategic policy was presented that reflects various risk factors, such as the COVID-19 pandemic and large-scale disasters, and it was expanded to align with the current status of existing AI strategies.

In May 2021, the cabinet decided on the fifth Priority Plan for Social Infrastructure Development. In this fifth plan, a new goal for the “Digital Transformation of the Infrastructure Sector” was added in light of recent changes in social conditions. The efforts of GSI are identified as priority measures to achieve the goals for the “Digital Transformation of the Infrastructure Sector”, such as the development of elevation data as a foundation for 3D maps, monitoring of crustal deformation using GNSS CORS and the Advanced Land Observing Satellite-4 (ALOS-4) to the highest global standard, as well as supporting centimeter-level high-precision positioning. GNSS CORS are subject to the “Emergency Inspection of Critical Infrastructure,” which is being conducted in response to the Ministerial Meeting on Emergency Inspection of Critical Infrastructure held in September 2018. This inspection aims to ensure that priority infrastructure, which supports the national economy and daily life, and protects the lives of citizens, can continue to function in the event of any natural disaster.

In March 2022, the cabinet decided on the fourth Basic Plan for the Advancement of Utilizing Geospatial Information. In this plan, which is formulated based on the Basic Act on the Advancement of Utilizing Geospatial Information, the government has consistently aimed to create a geospatial society since the first phase of the plan (cabinet decision of April 2008). In the fourth phase of the plan, the goal is to achieve the creation and provision of various services that fully utilize the potential of geospatial information, toward

the creation of a society where everyone can live life their own way, anytime, anywhere. As a priority policy related to GSI, “Promotion of ‘National Coordinates,’ a common infrastructure for positional information indispensable in the age of high-precision positioning” has been registered.

In FY2021, the Cabinet Office Information Technology (IT) Comprehensive Strategy Office designated the GSI Digital Japan Basic Map as the “Base registry.” The base registry is a database of the basic social data of people, corporations, land, buildings and qualifications that is registered and published by public organizations and referred to in various situations, and it is the foundation of a society that ensures accuracy and up-to-date information. The Digital Japan Basic Map continues to be designated as the base registry in the 12th Digital Agency public notices (July 2023) based on the Act on the Establishment of the Digital Agency. In the Priority Policy Program for Realizing Digital Society (cabinet decision of June 2023), regarding the Digital Japan Basic Map, it is stated that the efforts will be made to increase the update frequency and machine readability, and to achieve three-dimensional mapping of the entire national land area, taking into account its status as a base registry.

Recently, the number of young surveying engineers who support the future development and utilization of geospatial information has been decreasing in the industry. On the other hand, along with the spread of surveying equipment which allows a small number of people or non-experts to conduct surveys, low-cost equipment is also becoming available.

In high school study courses, “Geography” has been mandatory since FY2022 with the aim of fostering the qualities and abilities necessary for citizens to become effective contributors to a peaceful, democratic nation and society with a broad perspective, while actively engaging in a globalized world. This is achieved through activities that seek out and solve problems by utilizing geographical perspectives and approaches to social phenomena. In addition, the effective utilization of digital textbooks, taking into account the GIGA (Global and Innovation Gateway for All) School Program, is also being considered. Support for promoting the use of disaster prevention and geospatial information in geography education is also expected.

3. Basic policy and period of the plan

(1) Basic policy of this plan

In response to the rapid development of information technology, changes in social conditions, and the increasing use of positional information, the following three basic measures will be adopted:

- 1) Focus on measures related to the development of fundamental data that will serve as a basis for the digitization of society, including digital transformation (DX) in the infrastructure sector.
- 2) Focus on measures that address the increasing role of basic survey in the field of positioning as well as surveying.
- 3) Focus on measures to improve the up-to-dateness of map information and promote three-dimensional mapping to meet the needs of a digital society by utilizing new technology.

(2) Period of the plan

It is necessary for a plan related to basic survey to be continuously implemented over a certain period, so that the various types of surveys, such as public surveys, can be accurately and efficiently carried out based on the basic survey results. In addition, the dissemination and evaluation of measures require certain periods. This is why the period of this LT plan is 10 years, from FY2024 to FY2033.

4. Positioning and surveying based on national coordinates

(1) Promoting the maintenance and preservation of national coordinates as a common position reference

As a national geospatial information authority, which plays a central role in surveying administration, GSI has a responsibility to conduct a basic survey that forms the basis of all surveys, and to maintain and preserve national coordinates which are common standards for making positional information coherent, and which serve as a reference for the position of our country, thereby supporting social activities. As a result of the collision of multiple plates causing complex forces on the crust, crustal deformation of various scales is occurring around the Japanese Archipelago. GSI will support a High-precision Positioning Society through national land surveys which are essential for demonstrating and conserving our territory and territorial waters, and by accurately capturing crustal deformation through geodetic observations using varied technology, thereby improving the quality and usability of the crustal deformation information necessary for accurate positioning and surveying. To this end, the following measures will be implemented:

- GSI will participate in international joint observation projects such as the Global Geodetic Observing System (GGOS), International VLBI Service for Geodesy and Astrometry (IVS), International GNSS Service (IGS) and geodetic observation in the Antarctic region, and as a core site for space geodetic technology which determines the shape, rotation, and gravity field of the earth promoting the establishment and maintenance of the ‘Global Geodetic Reference Frame,’ the foundation for worldwide positioning as per the resolution of the UN General Assembly,.
- In terms of national security, GSI will create an environment that enables the quick and stable acquisition of accurate positions using satellite positioning without relying on overseas sources. This will be achieved by calculating accurate orbital information for GNSS satellites independently within Japan and providing it in a stable manner.
- GSI will maintain an environment where accurate national coordinates are available anywhere in the country through Satellite Positioning by

maintaining GNSS CORS, which serve as the foundation of the national coordinates. In addition, to ensure the stable distribution of real-time GNSS CORS, GSI will also improve the safety and disaster resilience of the GNSS CORS-based high precision positioning and surveying environment, by enhancing redundancy and endurance of the GEONET, as well as introducing Precise Point Positioning (PPP) for the maintenance of national coordinates.

- GSI will maintain highly accurate precise gravimetric geoid model and update the elevation values nationwide based on this data. It will also aim to achieve the smooth implementation of the elevation revision, for example, by promptly and appropriately providing information to the relevant organizations. In addition, GSI will create an environment that enables the quick acquisition of precise elevation at a specific reference date (epoch), by introducing GNSS elevation surveys which determine the elevation based on a precise gravimetric geoid model. Moreover, the trial of dynamic positioning base (dynamic geodetic system) will be launched, enabling the use of daily-changing coordinate values due to crustal deformation. This will streamline daily surveying operations and enable the prompt revision of survey results, leading to rapid restoration and reconstruction in the event of large-scale crustal deformation caused by earthquakes, etc.
- GSI will enhance the accuracy of crustal deformation transformation and conduct continuous observation and analysis to update the precise gravity geoid. In addition, by conducting research and studies on the introduction of efficient gravity surveying using the latest technology such as quantum gravimeters, GSI will steadily maintain and manage the precise gravity geoid, which is the foundation for sustaining highly precise elevation determination through satellite positioning.
- GSI will improve the spatial and temporal resolution of crustal deformation information by combining the monitoring steady-state crustal deformations by GNSS CORS with Interferometric SAR (InSAR) techniques.

- By introducing time management for national coordinates, the four-dimensional national coordinates, which serve as the foundation enabling the nationwide use of precise location information with corrected crustal deformation at any given time, will be established. As a result, the utilization of national coordinates in a wide range of fields dealing with positional information will be promoted, and an environment that ensures the productivity and safety of all of society will be created.
- GSI will investigate the ways to represent 4D spatial information and improve accessibility to 4D national coordinates.
- The resolution of crustal deformation transformation will be improved by using Private Sector GNSS CORS.
- By conducting control point surveys and gravity surveys, GSI will maintain and manage the national coordinates of the remote islands which form the basis of Japan's territorial waters, contributing to the management of Japan's territory.
- GNSS surveys have become mainstream due to their efficiency in the maintenance and management of national coordinates. In light of this, triangulation points are maintained and managed as markers indicating local mutual positional relationships on the ground surface. In particular, GSI will steadily maintain and manage the following points: those contributing to the preservation of remote islands, those designated by laws and regulations, and those with cultural and historical importance serving as landmarks connected to the land, such as major mountains. Moreover, national coordinates will be maintained by using control points, which are denser than GNSS CORS, as reference points to link positional information before and after crustal deformation caused by earthquakes etc.

(2) Promoting the generalization of high-precision positioning technology

In the Fourth Basic Plan for the Advancement of Utilizing Geospatial Information, the following examples of goals are indicated: promotion of i-Construction as part of the digital transformation (DX) in the infrastructure field,

promotion of the social implementation of UAV logistics, and acceleration of the on-site implementation of smart agriculture technology, such as automatic driving in agricultural machinery. It is essential to achieve these goals by improving the positioning environment through the creation of a seven-satellite Quasi-Zenith Satellites System, and moreover, by enhancing the accuracy of correction information that enables more precise satellite positioning and providing it in a more convenient manner. The following measures will be implemented:

- Based on the “Basic Act on the Advancement of Public and Private Sector Data Utilization” and the “Basic Principles on Open Data,” GSI will maintain and expand as necessary the environment which enables the use of GNSS CORS-related data, such as its observation data.
- By anticipating the development of various services using Private Sector GNSS CORS and continuously evaluating them accurately, GSI will create an environment where users can confidently use these services in a stable manner.
- In order to expand the use of GNSS CORS, GSI will maintain an environment where users can easily obtain high precision positioning results in accordance with the national coordinates, such as by providing precise ephemeris.

5. Maintenance of basic map information

(1) Measures to develop and update information on national territory

GSI has been developing map information, which serves as the foundation of the national territory, as the only national geospatial information authority in Japan since its establishment in 1869. The map information maintained by GSI also serves as an external indicator of our territory, and its reliable maintenance and updating are indispensable for internationally communicating our country's view on territories and place names. The following measures will be implemented:

- Basic geospatial information, which accurately identifies our territory both domestically and internationally, will be reliably maintained and updated.
- Basic geospatial information on remote islands, which form the basis of our territory, will be reliably maintained and updated.

(2) Measures for developing and providing geospatial information to serve as the foundation of society

GSI will maintain and update highly precise geospatial information, based on surveys such as the Fundamental Geospatial Data, the Digital Japan Basic Map (map information, ortho images, place name information) and three-dimensional data (height data), continuously and efficiently without delay. This will lead to the creation of a society including the private sector, where highly accurate and reliable geospatial information can be used by citizens, referred to for various forms of administrative planning, decision-making and disaster response, and used as the basis of a variety of geospatial information. The following measures will be implemented:

- The management of 3D data (height data) for the entire national territory will be outlined.
- In response to the development of digital transformation (DX) in society, GSI will shift methods for preparing and providing basic survey results over to those that contribute to the expanded use of digital data more than ever before. To achieve this, the basic geospatial information that should

be maintained by GSI, will be redefined, and then maintained and updated. Meanwhile, GSI will sufficiently coordinate with the Ministry of Defense, the Self-Defense Forces, and other relevant organizations, considering its use as information related to national security.

- Amid the development of a High-precision Positioning Society, inexpensive and easy-to-use high-precision positioning methods have emerged. To address the spread of services and applications utilizing geospatial information obtained by these methods, as well as the recent changes in social conditions, such as the expansion of real-time data utilization and the promotion of digital transformation (DX) across society, GSI will maintain and update geospatial information. This will be carried out in line with the High-precision Positioning Society, through redefining the role of basic map information and the items of geospatial information to be maintained. Meanwhile, GSI will sufficiently coordinate with the Ministry of Defense, the Self-Defense Forces, and other relevant organizations from the perspective of its utilization as information related to national security.
- In order to improve productivity in the maintenance and updating of the Digital Japan Basic Map, the base registry, GSI will strengthen the utilization of traditionally conducted public survey results and introduce the latest technology, such as satellite data and AI, while also reviewing business processes, including digital transformation (DX).

6. Promoting disaster prevention/risk reduction and disaster response through the utilization of surveying technology

(1) Measures for preventing disasters and reducing damage in the event of a disaster

As natural disasters have become more severe and widespread in recent years, disaster prevention and risk reduction are becoming increasingly important. In the Basic Disaster Management Plan (National Disaster Management Council decision of May 2023), GSI is expected to maintain geospatial information for disaster risk reduction, as well as to enhance and strengthen observation preparations and facilities that contribute to disaster prediction and forecasting, as measures to prevent disasters and minimize damage in the event of a disaster. In order to play the necessary role in disaster prevention and risk reduction, the following measures will be implemented:

- Geospatial information for disaster risk reduction, related to the disaster risks caused by earthquakes, volcanic eruptions and torrential rains, including information on geographic disaster risks related to natural landforms and artificial fills, will be efficiently developed and provided. This will be carried out by utilizing surveying technology such as the Airborne LiDAR Bathymetry (ALB), basic surveying results including 3D point cloud data, and public survey results.
- GSI will achieve the risk reduction of disaster damage by providing easy-to-understand information on the use of geographic information for disaster risk reduction, and by enhancing the ability of administrative agencies and citizens to use geographic information for disaster risk reduction.
- GSI will promote measures to raise disaster awareness among local residents in order to protect residents' lives from natural disasters by maintaining and promoting the utilization of information on Natural Disaster Monuments in cooperation with administrative agencies.
- GSI will routinely monitor crustal deformation associated with earthquakes and volcanic activities and provide the necessary deformation

information for evaluating these events by using InSAR technology and Satellite Positioning (such as GNSS CORS).

(2) Measures for prompt recognition of damage information to enable rapid rescue, restoration, and recovery

It is necessary to quickly determine damage information for emergency measures in the event of a disaster and for post-disaster recovery. To promptly provide the necessary geospatial information for lifesaving efforts and the emergency restoration of facilities, the following measures will be implemented:

- By monitoring crustal deformation using InSAR technology and Satellite Positioning (such as GNSS CO RS), GSI will rapidly identify the areas where the ground surface has significantly changed due to seismic or volcanic activity. GSI will also provide accurate post-disaster positional information that contributes to the recovery and reconstruction.
- By emergency aerial photography using basic survey techniques, facilities and devices, GSI will assess the scale of the damage, and also conduct crustal deformation observation. Furthermore, GSI will conduct damage investigations through aerial photointerpretation, providing results as easy-to-understand documents such as disaster situation maps.
- GSI will enable integrated viewing of disaster related information observed and maintained by GSI from the GSI's web map service and provide the information in a usable form for various disaster information aggregation sites by offering an API. In addition to sharing from the web map service, GSI will aim to provide data in an analyzable form, enabling sophisticated analysis and use by third parties.
- GSI will improve the system durability and stability for determining magnitude, etc., based on the crustal deformation in the event of a large earthquake (REGARD, the Real-time GEONET Analysis System for Rapid Deformation Monitoring), and will continue to provide necessary information for highly accurate tsunami predictions to the relevant administrative agencies.

- GSI will contribute to rapid initial response to earthquake disasters by improving the estimation accuracy of the Seismic Ground Disaster Assessment System (SGDAS), which estimates the possibility of ground disasters based on the terrain data from GSI and the estimated seismic intensity distribution map from the Japan Meteorological Agency, and by providing the estimation results to the relevant administrative agencies.
- GSI will provide various disaster prevention information systems, including those of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the government's disaster information aggregation system, with the basic map information and GSI's disaster-related information, such as aerial photographs. GSI will also cooperate in the collection and transmission of disaster prevention information to promote the utilization of geospatial information.

7. Provision and promotion of geospatial information

(1) Provision of geospatial information based on the Surveying Law

As the progress of digital transformation (DX) and expanded utilization of geospatial information continue in society, an environment where geospatial information is widely and reliably accessible and usable by the public as digital data is essential. Therefore, the following measures will be implemented:

- GSI will focus on providing basic survey results as digital data and strengthening its online provisioning capabilities.
- GSI will constantly re-evaluate its provision methods for basic survey results and implement them in a sustainable manner.

(2) Promotion of geospatial information utilization through public-private partnerships

In order to promote the utilization of geospatial information, cooperation among the national government, local governments, related businesses, and research institutions such as universities is necessary. With limited human and budgetary resources, the cooperation of various entities is essential to efficiently provide the geospatial information maintained by GSI in a stable manner. Additionally, it is crucial to maintain an environment where the public can effectively utilize the information. Thus, the following measures will be implemented:

- GSI will cooperate organically with government agencies, local governments, the private sector, academic circles, and other relevant entities by utilizing the frameworks of the Committee for Advancing the Utilization of Geospatial Information, the Geospatial Information Utilization Promotion Office, the Cabinet Secretariat, and the Geospatial Information Industry-Academia-Government Collaboration Council.
- To ensure that basic survey results are used in a stable manner as a "reliable primary source of information", user's convenience and service

sustainability will be enhanced through public-private partnerships, including community building with various entities.

- The Geospatial Information Library, including GSI Maps, will be made available for distribution and deployment by being continuously maintained, and its accessibility to data will be improved.
- To promote the distribution and utilization of geospatial information such as surveying results maintained by public and private sectors, the government will take appropriate measures such as the development of guidelines regarding personal information, secondary use, and national security, which should be taken into consideration when utilizing such information.

8. Surveying administration and international activities

(1) Efficiency and sophistication of surveying administration and management

In terms of eliminating survey duplication as is the aim of the Survey Act, it is important to coordinate public surveying, consolidate the information, provide results for public inspection, and make the geospatial information maintained by GSI, including basic survey results, widely available. As technological innovation in the field of surveying is expected to continue in the future, it is also necessary to enable efficient and effective surveying by utilizing new technology. For this reason, the following measures will be implemented:

- By adjusting and consolidating the information based on the digital principles set forth in the Priority Policy Program for Realizing Digital Society (cabinet decision of December 2021), and by providing copies of the results for public inspection, the value of public surveying provision will be enhanced.
- Standard operational methods related to public surveying will be improved in response to the technical progress and social changes. These improvements include the development of manuals on new surveying techniques that contributes to digital transformation (DX) in the infrastructure sector and the incorporation of operational regulations into the standards.
- GSI will promote the utilization of geospatial information based on the aforementioned digital principles, taking into account the Basic Principles of Open Data (decided by the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society and the Strategic Council for the Promotion of the Use of Public Data by the Private Sector, May 2017).

(2) International activities

To internationally disseminate our view of territory and place names, and to share our stance and basic values while cooperating with the Ministry of Foreign

Affairs, GSI should raise its international status in the field of geospatial information and build and strengthen trusting relationships with partner countries through international cooperation. Thus, the following activities will be carried out:

- GSI will contribute to discussions and initiatives in multilateral forums, such as the United Nations Committee of Experts on Global Geospatial Information Management.
- GSI will promote bilateral cooperation in areas related to geospatial information, such as geodesy and mapping.

9. Research and development, and human resource development

(1) Technological development that contributes to the construction and maintenance of 4D national coordinates

To contribute to the further advancement of national coordinates and high precision positioning techniques, as well as to disaster prevention by crustal deformation monitoring, GSI will undertake the following research and development:

- GSI will conduct research and development related to the construction of a crustal deformation model that enables the acquisition of positional information at any given time and location, developing and maintaining techniques to maintain 4D national coordinates appropriate for a High-precision Positioning Society.
- GSI will conduct research and development on space geodetic techniques and crustal deformation analysis technology to determine the Earth's shape and its variation. GSI will also develop and upgrade GNSS and SAR observation and analysis technology, which measures ground surface deformation under normal and disaster conditions, with high resolution and high accuracy. Additionally, GSI will advance technology related to the geoid, which is necessary for the maintenance and management of the geodetic reference system.
- GSI will continue to investigate research and development aimed at the practical application of optical lattice clocks and examine the possibility of using them to efficiently maintain high-precision national coordinates.
- Research and development on the elucidation of the causes and mechanisms of Earth's shape variations will be conducted. Modelling the fluctuation mechanisms will contribute to improving spatial resolution in the maintenance of national coordinates.
- By developing and implementing technology that automatically estimates slow slip and afterslip on the plate boundary surface and monitors their transition, it becomes possible to automatically detect unusual slip occurrences that may lead to large earthquakes, contributing to the evaluation of the possibility of subduction zone megathrust earthquakes.

- GSI will develop the technology to provide dense ground deformation information utilizing the results of InSAR time series analysis and support the development of plans to streamline the surveying necessary to determine land subsidence.

(2) Research and development to increase the efficiency and precision of map and topographic data creation

The following research and development will be undertaken in order to contribute to the efficient maintenance and updating of geospatial information and to the advancement of geographic information for disaster risk reduction:

- By utilizing AI technology such as automated image analysis and big data, GSI will develop technology to improve the efficiency of the mapping process and promote automatic mapping.
- GSI will enhance the accuracy and efficiency of methods for understanding nationwide feature variation using satellite images and map updating technology in areas where aerial photography is difficult.

To contribute to disaster prevention and risk reduction measures, the following research and development will be undertaken:

- GSI will achieve the enhancement of information accuracy that contributes to the creation of hazard maps, such as information on topographic classification, and improve the efficiency of their creation.
- Through comprehensive analysis of topographic and geological information, GSI will examine methods to quantitatively evaluate land vulnerability related to natural disasters and enhance the accuracy of disaster hazard prediction.
- GSI will research and develop methods for efficient automated data analysis, contributing to a rapid understanding of a given damage situation.

(3) Dissemination of human resource development and knowledge

To promote continuous and proper implementation of basic survey, and the maintenance and utilization of geospatial information including surveying results, it is essential to train experts and engineers with higher-level knowledge,

and measures for improving public literacy are necessary. The following measures will be implemented:

- Taking into account the technological advancements in the fields of surveying and geospatial information, it is necessary to develop human resources with the knowledge and skills to properly utilize new technology, and who can perform quality control to ensure the accuracy of surveying results. To this end, GSI will work to improve the qualities of surveyors and assistant surveyors and reform the qualification system by cooperating with continuing education in surveying and reskilling support initiatives conducted by industry, academia, and government entities.
- To enable citizens to acquire the ability to understand natural and social phenomena by focusing on location and spatial extent, GSI will develop, inform, and provide content for disaster prevention and geography education support, tailored to each curriculum in elementary, junior high and high schools. This will be done by cooperating with and supporting geography education organizations, looking ahead to the development of the GIGA school program.
- GSI will support university students and employees in acquiring techniques such as surveying and geospatial information utilization by collaborating with universities and administrative agencies.
- GSI will aim to support disaster prevention and geography education for the public, including education on the necessity of national coordinates and geospatial information, as well as the importance of publishing and sharing geospatial information.

10. Implementation of the plan and follow-up

For the implementation of individual policies and measures based on this LT Plan, GSI will develop a short-term implementation plan with a planning period of three to four years, proceed with periodic updates as necessary, and conduct regular follow-ups to evaluate its effectiveness. Furthermore, this LT Plan will undergo a mid-term review in the fifth year and be regularly followed up as necessary, to maintain high effectiveness and ensure compatibility with ongoing changes in social conditions.