Outline and Future Strategies of SABO Works in Japan

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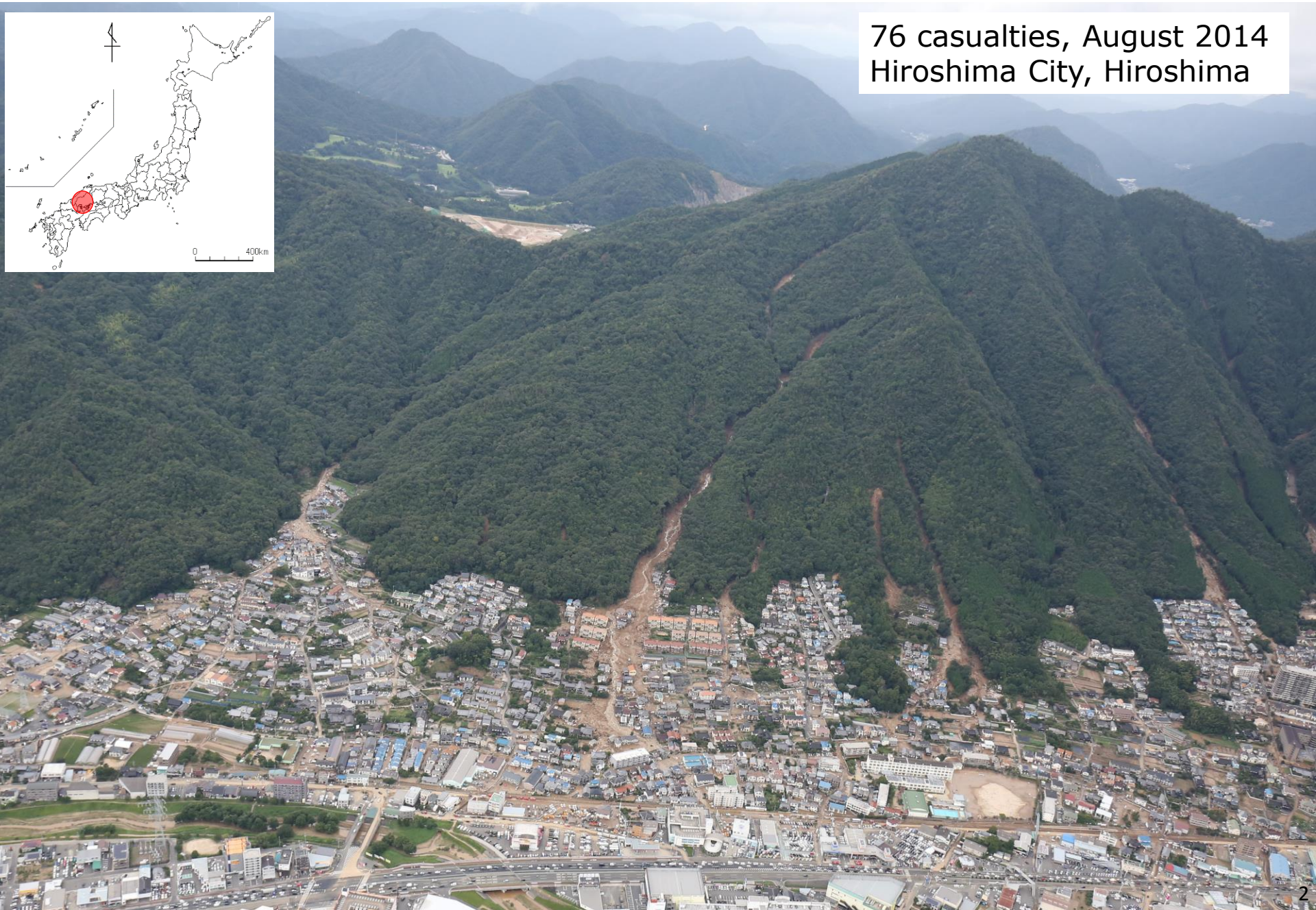
The 10th Japan-Italy Conference on Sediment Disaster Prevention Technology

1. Sediment disaster situations in Japan

2. Summary of sediment disaster management

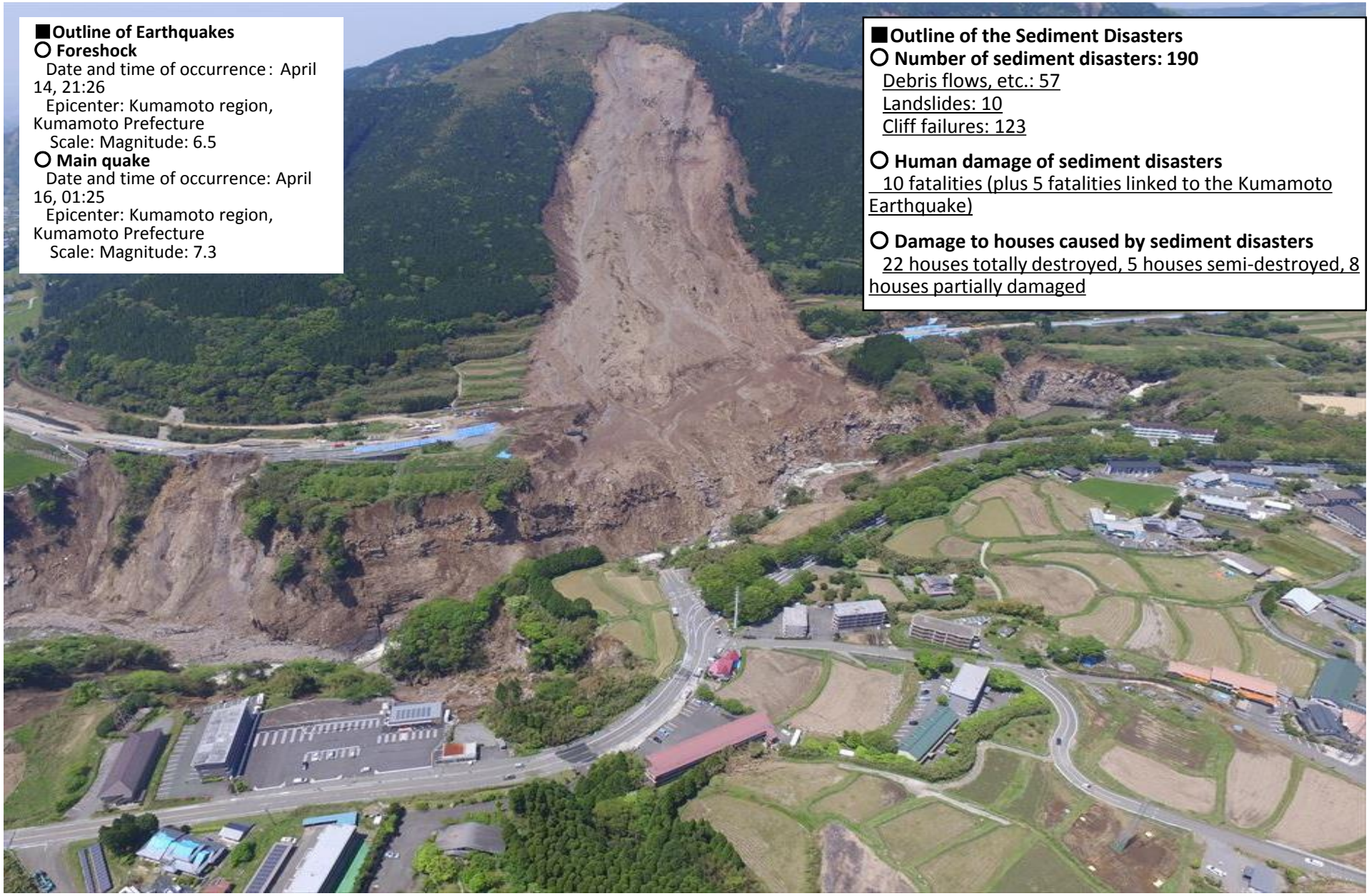
3. Future Perspectives and Strategies

Sediment-related disaster in 2014



76 casualties, August 2014
Hiroshima City, Hiroshima

Disaster Conditions around Aso Ohashi Bridge



■**Outline of Earthquakes**

○ **Foreshock**

Date and time of occurrence: April 14, 21:26

Epicenter: Kumamoto region, Kumamoto Prefecture

Scale: Magnitude: 6.5

○ **Main quake**

Date and time of occurrence: April 16, 01:25

Epicenter: Kumamoto region, Kumamoto Prefecture

Scale: Magnitude: 7.3

■**Outline of the Sediment Disasters**

○ **Number of sediment disasters: 190**

Debris flows, etc.: 57

Landslides: 10

Cliff failures: 123

○ **Human damage of sediment disasters**

10 fatalities (plus 5 fatalities linked to the Kumamoto Earthquake)

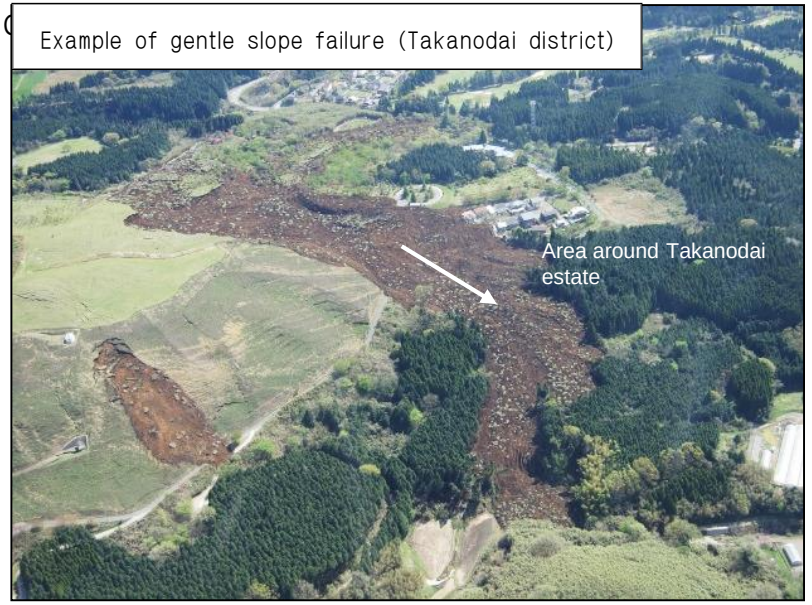
○ **Damage to houses caused by sediment disasters**

22 houses totally destroyed, 5 houses semi-destroyed, 8 houses partially damaged

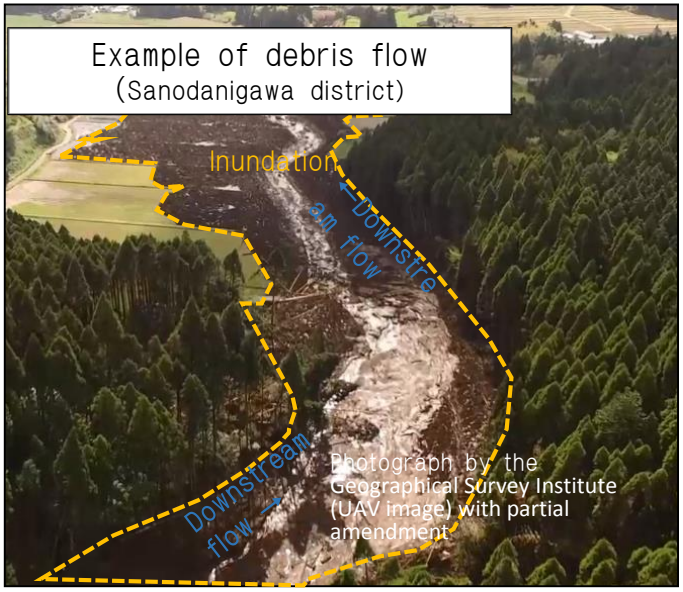
Features of Sediment Disasters caused by Kumamoto Earthquake – Occurrence of various sediment shift phenomena

1. Large-scale slope failure

2. Slope failure and landslides on gentle slo



3. The collapsed sediment moved downstream as debris flow



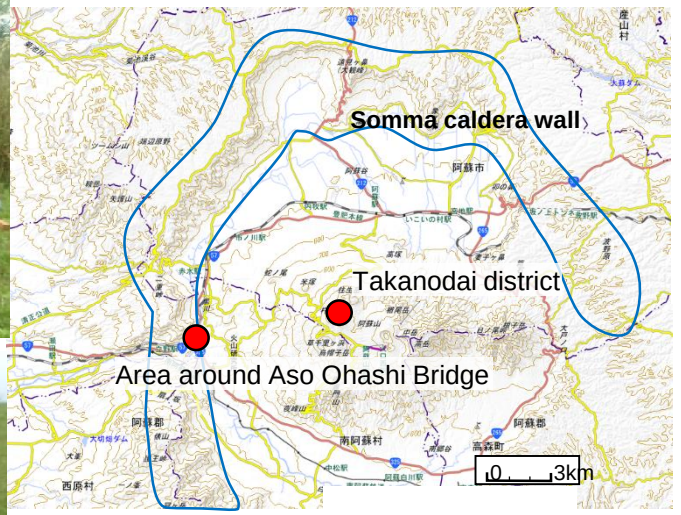
4. Multiple cliff failures

Natural slope failure (Mashiki Town, Kumamoto Prefecture)

Artificial slope failure (Mashiki Town, Kumamoto Prefecture)

Numerous Cracks Caused by Kumamoto Earthquake

Slope failures on the west side of Aso Ohashi Bridge: conditions of upper slope cracking



From the Geographical Survey Institute HP

(http://maps.gsi.go.jp/)

Cracks in Takanodai district, Minamiaso Village, Kumamoto Prefecture (installation of an extensometer for measuring the width of cracks)

Steps to Prevent Secondary Disasters Immediately Following Occurrence of Disasters

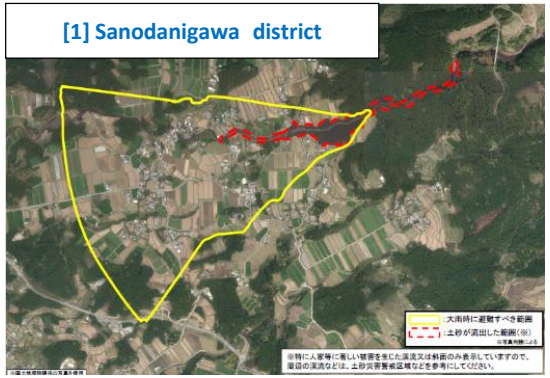
①Lowering of the standard for issuing sediment disaster warnings

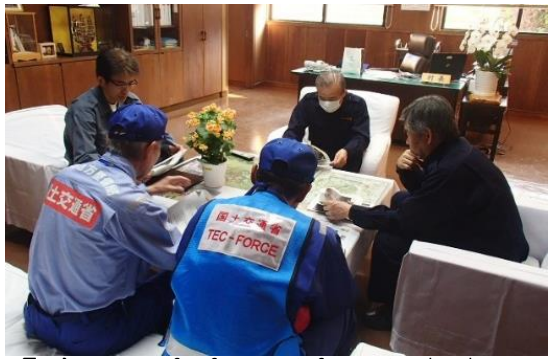
- **The standard was lowered in 45 municipalities in 6 prefectures in consideration of the fact that ground had been loosened by the earthquake.**

②Urgent notification to the Mayor of Minamiaso Village of the scope of evacuation

Direct explanation to the mayor on April 20, the day before heavy rain was forecast

[1] Sanodanigawa district





Explanation of reference information by the liaison staff to the mayor

③TEC-FORCE has finished inspections of 1,155 high-risk areas

131 spots requiring emergency countermeasures and vigilance were reported to Kumamoto Prefecture and 13 municipalities

Report to the Governor of Kumamoto Prefecture on April 28

Report to heads of municipalities, etc. on April 28 (Nishihara Village)

④Establishment of an advisory team on sediment disaster countermeasures

Through locally offering advice in response to requests by municipalities and related agencies, the alert and evacuation setup was bolstered and efforts to secure safety in search activities were supported (April 22~)

Meeting with disaster relief team

Field survey

1. Sediment disaster situations in Japan

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Laws related to disaster risk management

Sabo Department

- Sabo Law
- Landslide Prevention Law
- Steep Slope Failure Prevention Law
- Sediment Disaster Prevention Act

MLIT

- River Law
- Act on Specified Multipurpose Dams
- Coast Act
- Flood Control Act
- Building Standards Act
- City Planning Act
- Meteorological Service Act

etc.

Other ministries

- Disaster Countermeasures Basic Act
- Act on Special Measures concerning Countermeasures for Large-scale Earthquakes
- Act on Special Measures against Tokyo Inland Earthquake
- Act on Special Measures for Active Volcanoes
- Fire Service Act
- Disaster Relief Act
- Act on Special Financial Support to Deal with the Designated Disaster of Extreme Severity

etc.

Enactment and amendments of Sediment Disaster Prevention Act

Hiroshima debris flow disaster in 29th Jun 1999

May 2000 Enactment of Sediment Disaster Prevention Act

- Announcement of the design of sediment disaster warning area based on the basic investigation
- Establishment of warning and evacuation system in the sediment-related warning area
- Land use and house building regulation in the sediment disaster warning area

May 2005 Partial amendment

- Requirement of distribution of sediment-related disaster hazard map

Nov. 2010 Partial amendment

- Operation of emergency investigation when a large-scale sediment-related disaster is about to happen

Nov. 2014 Partial amendment

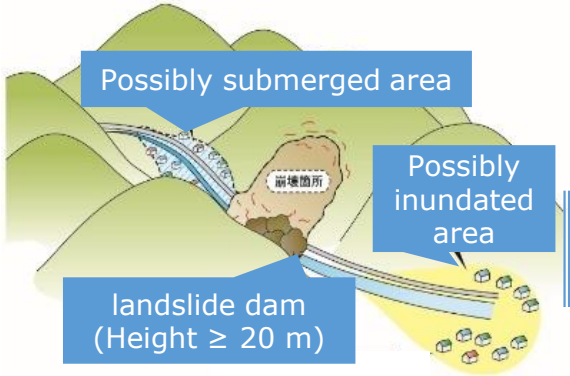
- Requirement of the publication of the basic investigation result
- Requirement of the announcement of sediment-related disaster alert for municipality and residents

May. 2017 Partial amendment is decided by the cabinet

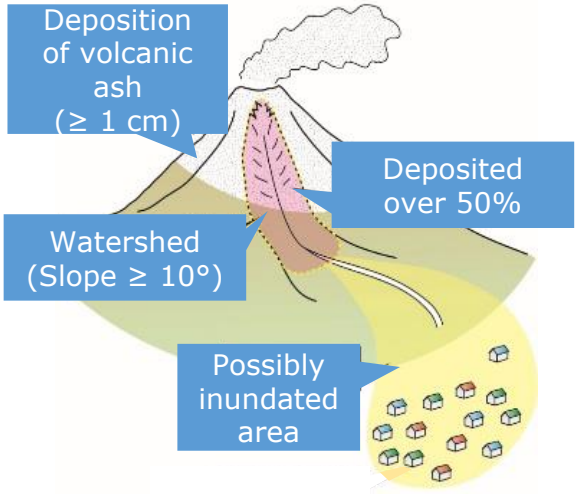
- Requirement to operate evacuation drill and to prepare evacuation scheme at facilities used by people who needs assist (ex. Elders who need care, the physically challenged, students under 18)

Emergency investigation when large scale sediment-related disasters are about to happen

Debris flow and impoundment due to landslide dam



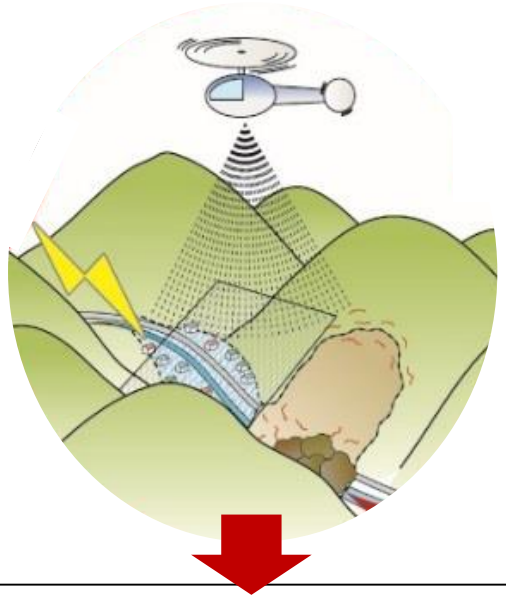
Debris flow following deposition of volcanic ash on steep slope



Operation of emergency investigation

In the case of landslide dam

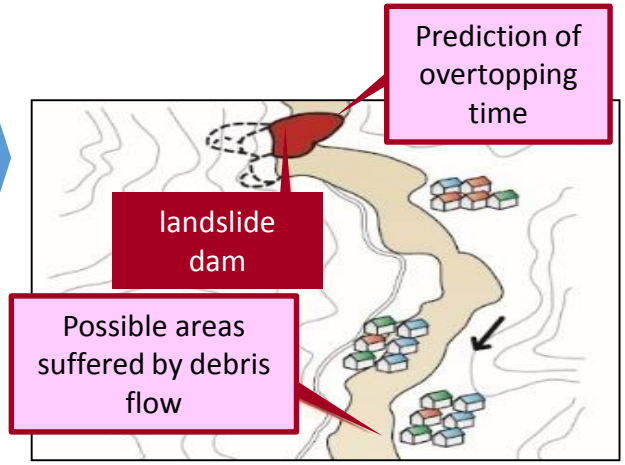
Automatic observation of water level	Investigation by experts of NILIM etc.



Simulation of overtopping and failure of landslide dam
Simulation of inundation

Announcement of emergency information

Possible areas and timing are announced

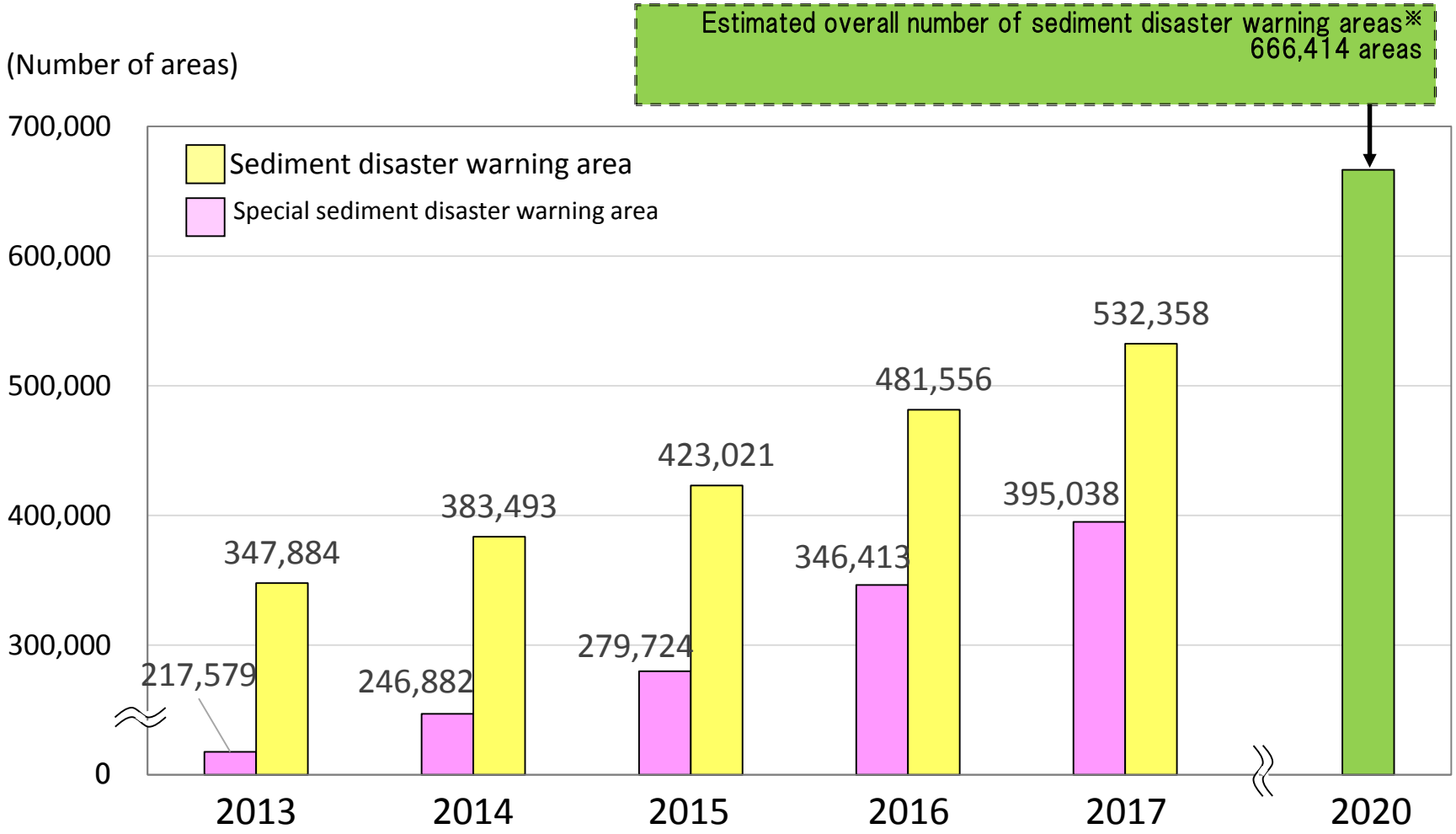


Evacuation advised / ordered by mayor of municipality

Evacuation of residents

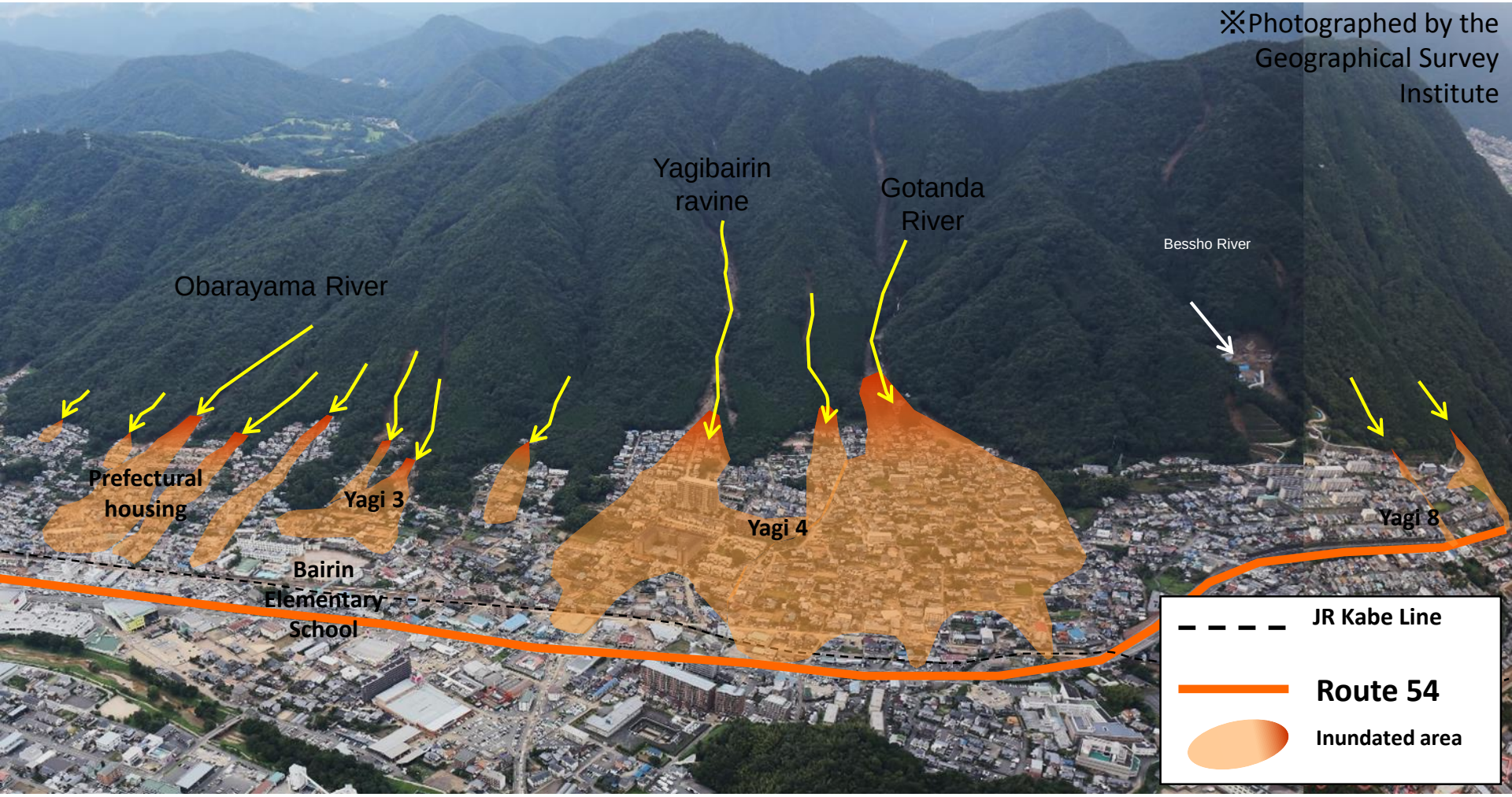
Movements in the Number of Areas where Basic Survey has Finished based on the Sediment Disaster Prevention Act (past 5 years)

- There are approximately 532,000 sediment disaster warning areas based on the Sediment Disaster Prevention Act, and survey has finished on approximately 400,000 special sediment disaster warning areas.

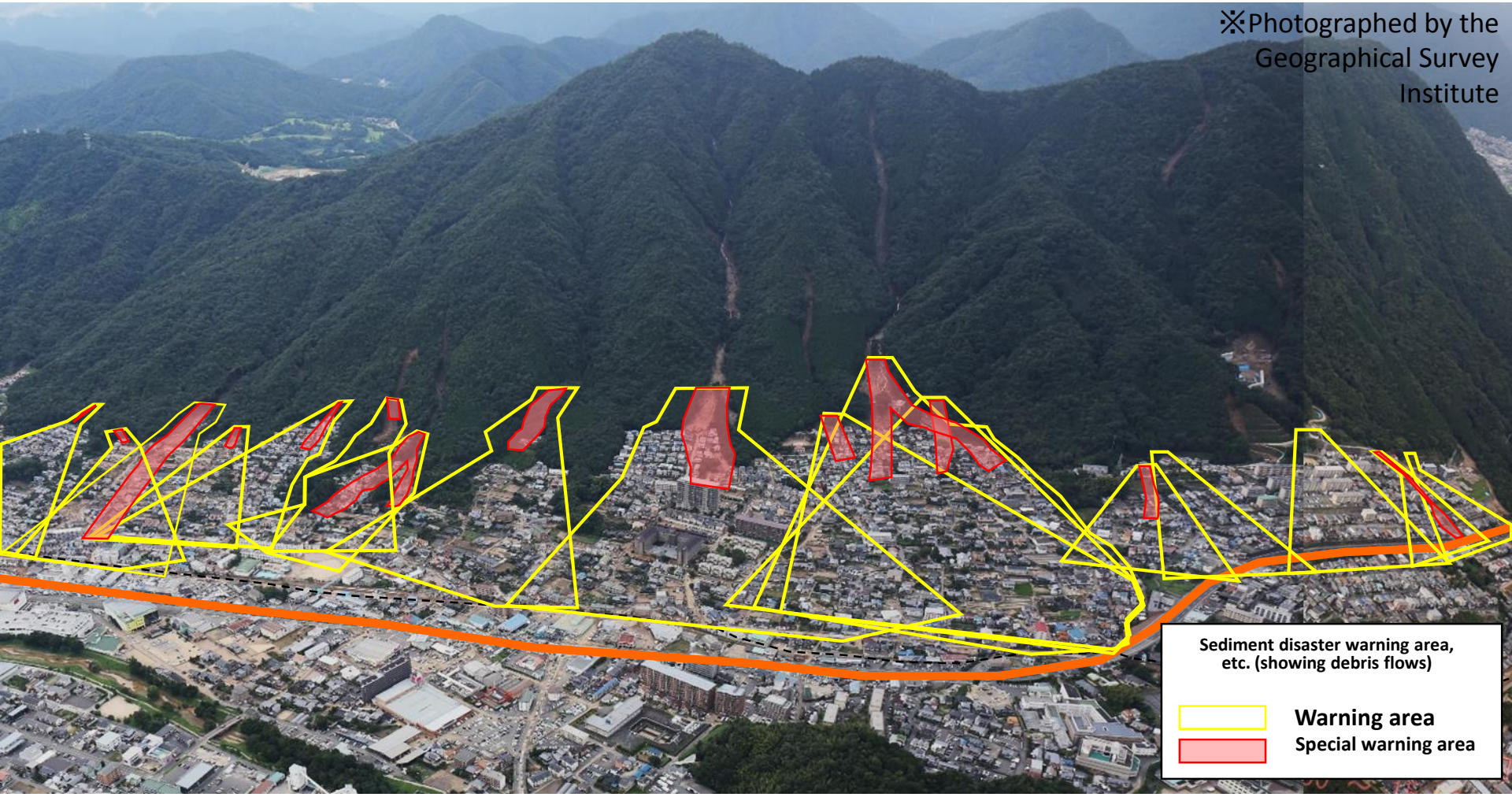


※ Estimated overall number of sediment disaster warning areas
Total number sediment disaster warning areas estimated by prefectural governments
Figures are current as of the end of March 2017 and may change in line with progress of basic surveys.

Damage Casued by Sediment Disaster in Hiroshima



Damage Casued by Sediment Disaster in Hiroshima



Partial Revision of the Sediment Disaster Prevention Act (draft) ※Combined revision with the Flood Prevention Act)

Promulgation of revised Law: March 31, 2017
※Law to partially amend the Flood Prevention Act, etc.

Obligating of managers of facilities for people with special needs to compile evacuation plans, etc.

Evacuation plan	Amended ↑	Facilities managers, etc. obliged to compile
Evacuation practice based on plan	Amended ↑	Facilities managers, etc. obliged to implement

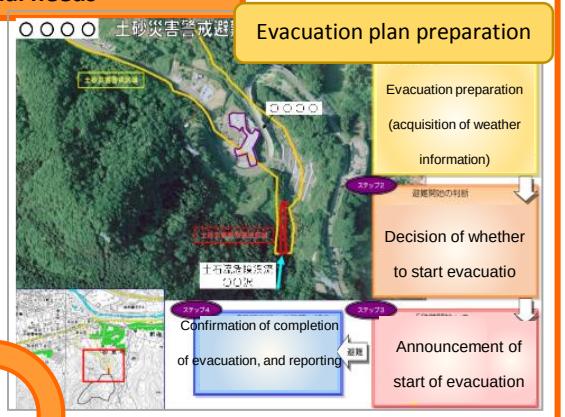
Collateral measures in plan preparation

- Municipality heads can give the necessary directives to facilities managers, etc. that don't prepare plans.
- If managers, etc. do not follow directives without good reason, the municipality heads can disclose that fact.

Construction of a warning and evacuation setup for facilities for users with special needs

Confirmation of disaster prevention setup

Evacuation plan preparation



Evacuation training

Seminar for employees and users

Example of disaster affecting a facility for users with special needs

Typhoon Lionrock, August 2016
Iwaizumi Town, Iwate Prefecture

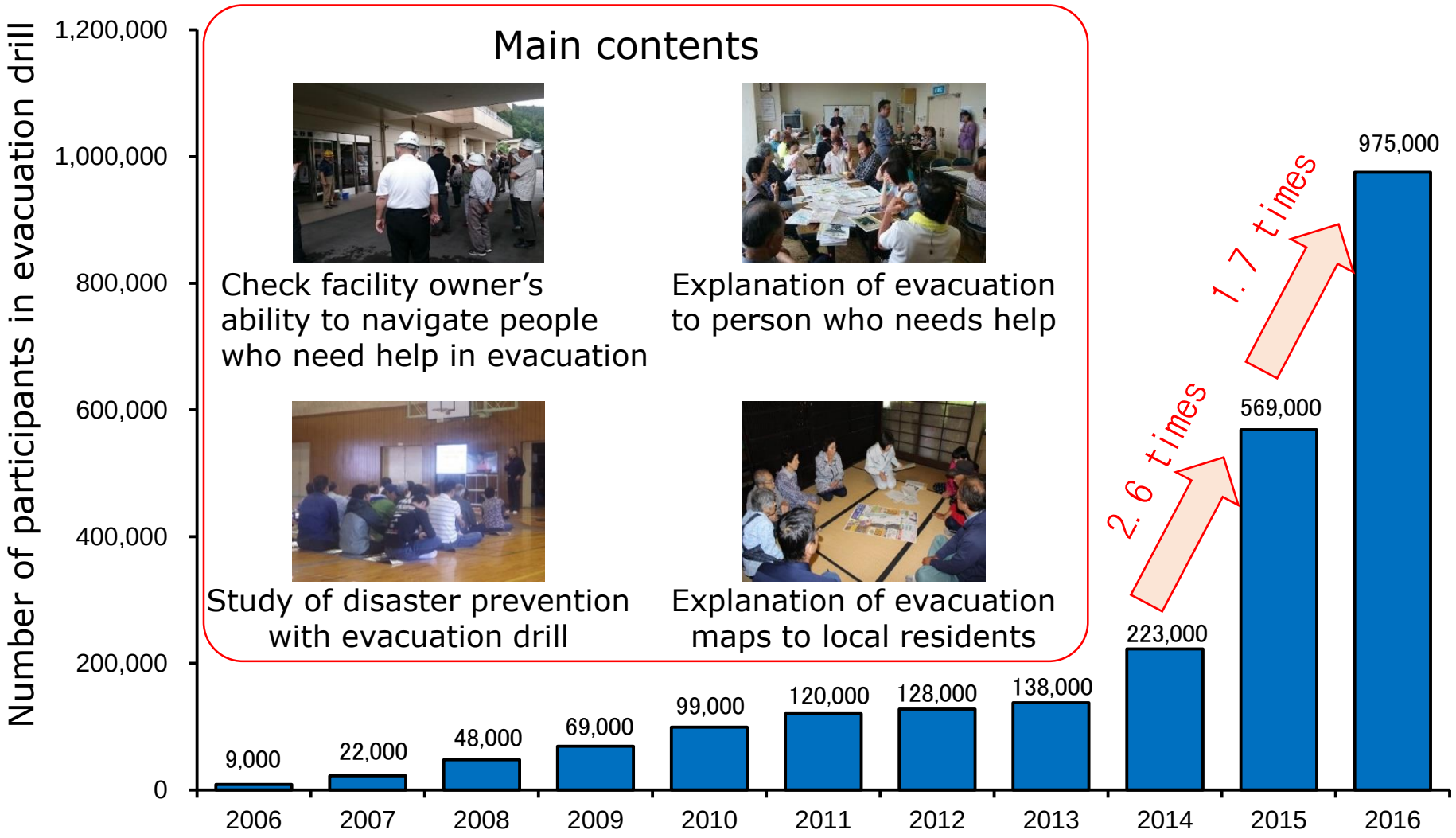
9 people die in a group home for the elderly

【Goal】

Prepare evacuation plans and implement evacuation training in 100% of facilities for people with special needs by 2021.

Sediment-related disaster evacuation drill

To enhance the warning and evacuation system and disaster preparedness, evacuation drill is conducted in municipalities of all over Japan. Number of participants reaches a record high of about 975,000 in 2016.

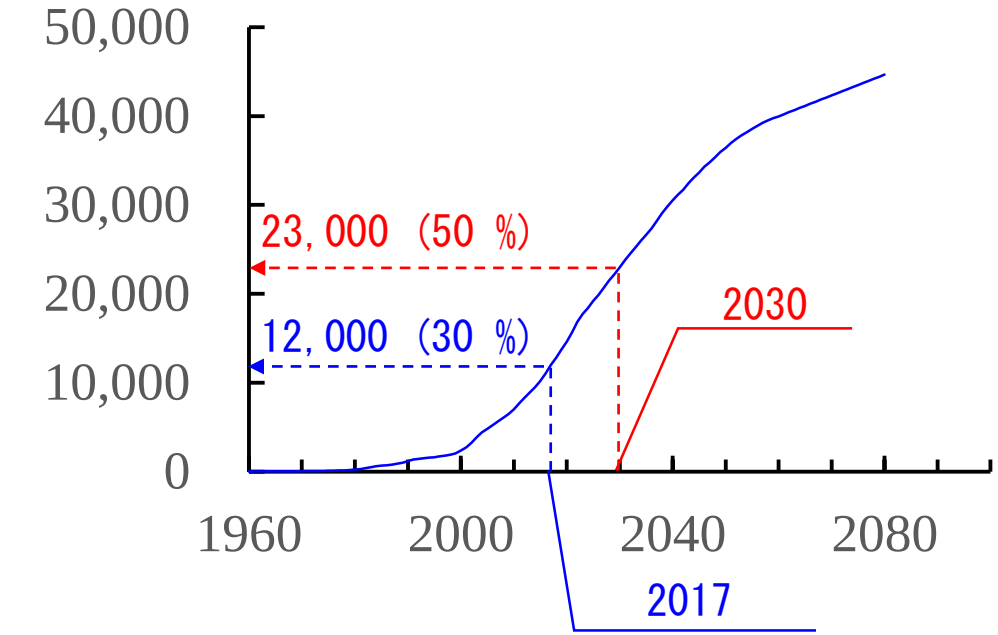


Increase in the number aging check dams

- The number of check dams has grown to about 42,000 in 2017.
- The number of check dam over 50 years old is about 12,000 in 2017.
- It is estimated that the number is going to be about 23,000 in 2030.

Cumulative number of check dam over 50 years old

[number of check dam]



Example

Erosion of the crown of check dam

Life Extension Plan for Sabo facilities

Life Extension Plan

Plan to prolong the function of SABO facilities thorough maintenance activities in an early stage of deficiencies

Contents of Life Extension Plan for Sabo facilities

- ○Preparation of daily operation and maintenance plan
- ○Soundness assessment based on inspection results
- ○Preparation of priority ranking for maintenance activities (repair, reconstruction, etc.) and annual plan
- ○Observation technique (survey, observation)
- ○Detail of countermeasure (repair, reconstruction, etc.) etc.

Life extension plan for government-owned facilities has been developed until March 2017.

Life extension plan for municipality-owned facilities will be developed until March 2021.

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Recent SABO construction technologies

Open check dam

Encouraging the open check dam to effectively trap debris and driftwood

Unmanned construction technologies

- Used for dangerous sites
- Excavator, bulldozer, and dump truck were controlled from an operator's room over 1 km away from construction site

Construction using "Sabo soil cement"

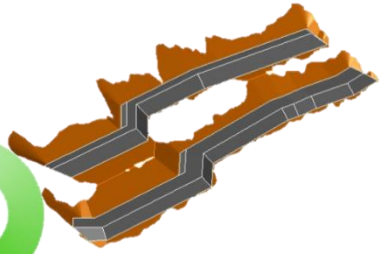
Encouraging the use of surplus soil to make concrete;
Leads to reduction of soil emission and construction cost

Progress of i-Construction

○Construction control using UAV and ICT(Information and communication technology) construction equipment

1. 3D land surveying using UAV

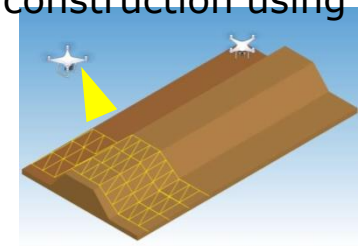
2. 3D model of design



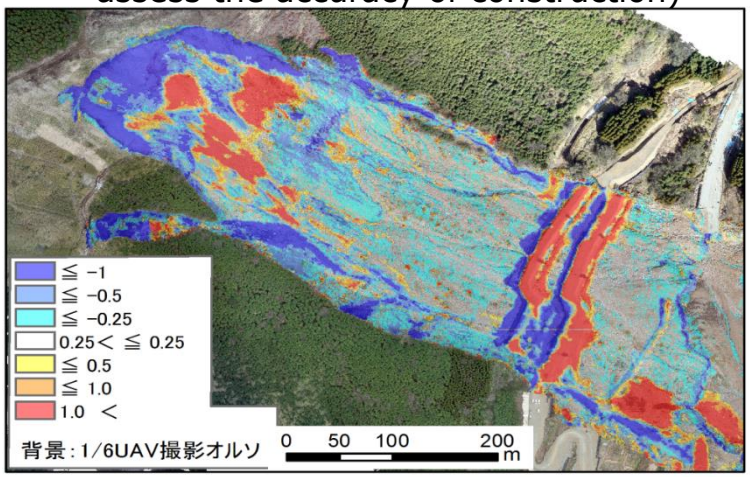
3. Construction with 3D data

Introduce Machine Guidance* and Machine Control

4. Assessment of accuracy of construction using UAV



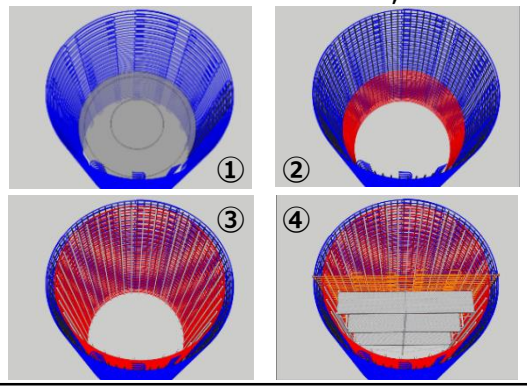
Elevation change due to the construction (used to confirm movement of slope and assess the accuracy of construction)

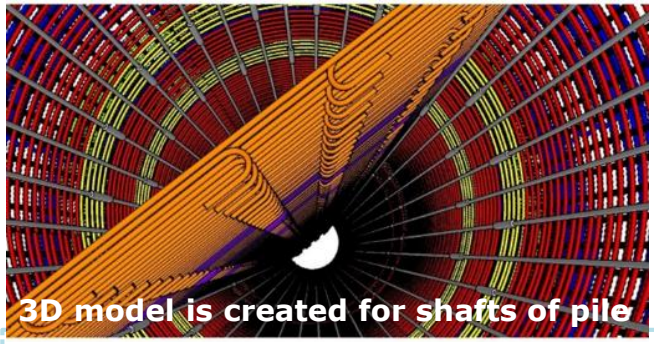


* A technique to provide information to operators through visual displays installed on machines about the heavy machine's position obtained using TS and GNSS and the difference between actual condition and 3D design of construction.

○Construction control using 3D data

3D data is created to design facilities (ex. Shafts of pile). By Checking the ideal construction process through animation, mistakes in the process are prevented and the construction period is shortened. Moreover, the data are used for maintenance.





Construction at Yui district No.SC7(2014)

○Application of UAV to facility inspection

Using UAV, time and labor for inspection of Sabo facility are substantially saved.

Unmanned Construction in Kumamoto PrefectureArea around Aso Ohashi Bridge

Unmanned construction technologies

- Used for dangerous sites
- Excavator, bulldozer, and dump truck were controlled from an operator's room over 1 km away from construction site

Recent topics for study

①Monitoring of sediment dynamics in mountainous watershed using hydrological and sediment transport observation

②Detection of possible slope failure using InSAR and Estimation of possible area suffered from high-volume sediment transport

③Development of rainfall index for improvement of the accuracy of rainfall-induced sediment-related disaster prediction

④Development of early warning system and identification of early-stage of sediment-related disaster using SNS (ex. Twitter)

⑤Study on deep-seated landslide(1. Prediction of possible site, magnitude of, types of suffering, 2. Estimation of possible suffered area, 3. Establishment of countermeasure)

⑥1-dimensional calculation of bed deformation considering transition from debris flow to bed material load

National Land Toughening Basic Plan (Basic Law on National Land Toughening Article 10)

Used in a speech in Kure on May 30, 2017

○ 4 Basic Goals

1) Protection of human life
2) Protecting important functions of the state and society without letting them suffer critical damage
3) Minimization of damage to citizens' property and public facilities
4) Rapid rehabilitation and reconstruction

"Situations where large-scale volcanic eruptions or sediment disasters (deep-layer collapse), etc. cause multiple fatalities and heighten the vulnerability of national land in later years" are worst-case scenarios that must not be allowed to occur.

Disruption of importance transportation (Yui District, Shizuoka Prefecture)

Volcanic eruption (Mt. Ontake in Gifu and Nagano Prefectures, 2014)

Large-scale earthquake (2016 Kumamoto Prefecture, area around Aso Ohashi Bridge)

○Important Achievement Indicators for National Land Toughening

Implementation rate of sediment disaster countermeasures at points in important transportation networks
Approximately 48% (2013)→ Approximately 49% (2015) → Approximately 54%[2020]

Implementation rate of sediment disaster countermeasures for protecting facilities for people with special needs, disaster prevention centers, and human lives
Approximately 37%(2014)→ Approximately 38%(2015)→ Approximately 41%[2020]

National Land Toughening Basic Plan (Basic Law on National Land Toughening Article 10)

○ 4 Basic Goals

Used at the promotion convention on November 15, 2015

1) Protection of human life
2) State and social important functions are sustained without suffering critical damage
3) Minimization of damage to citizens' property and public facilities
4) Rapid rehabilitation and reconstruction

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○ National Land Toughening Basic Plan (Basic Law on National Land Toughening Article 13)

Current Situation as of October 1, 2016

Plans already compiled 32 prefectures
Still planning (including scheduled) 15 prefectures

All 47 prefectures have either already compiled or are compiling plans

To obtain the safety against sediment-related disasters