

# **Flood Hazard Map Manual for Technology Transfer**

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## **Preface**

This manual describes in brief the background, purpose, production and distribution of Flood Hazard Maps, as well as their verified effectiveness and current usage in Japan. Realistic questions on the evacuation of local residents in the event of flood are clarified, and the practical and effective usage thereafter of Flood Hazard Maps is reviewed in turn.

The features and characteristics of rivers, flooding mechanisms, social framework, viewpoints on flood protection, collaboration of river management and residents, and the background and circumstances of Flood Hazard Maps of Japan might be different from those of other countries.

The experience gained from the use of Flood Hazard Maps in Japan would be of significant use to other countries as well, provided the maps are used according to the specific circumstances of the respective countries.

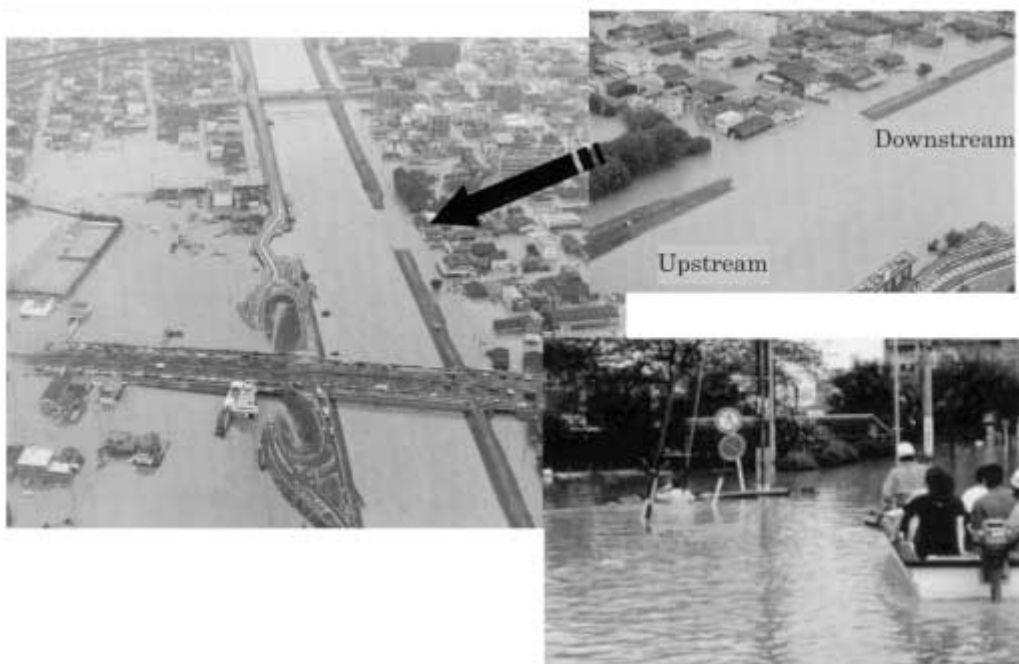
## 1. Background

With economic growth, urbanization and the subsequent concentration of population and property, people who have never experienced a flood are moving in increasing numbers to flood-prone areas in many countries. Conversely, residents are less aware of the threat of floods where flood control facilities have been improved and the frequency and magnitude of inundation are reduced. In such cases, they are hardly prepared for floods and by no means assured of proper actions to take, consequently suffering more serious damage once a flood occurs.

It is time-consuming and costly to thoroughly construct flood control facilities to lower the risk of flood damage. It is advisable to enhance local residents' awareness of the importance of flood protection efforts concurrently with the steady development of flood control facilities so that overall flood damage shall be mitigated. Flood Hazard Maps are essential in achieving this goal and assist local residents in becoming aware of the vulnerability of the area they live in, the important roles that they play in disaster prevention activities and proper evacuation in the event of floods.

In Japan, the rivers generally have steep-gradient beds, and even now several urbanized areas are hit by flood damage every year. For example, Nagoya, the third largest city in Japan, and its outskirts, experienced intensive rainfall of more than 500 mm around the middle of September 2000 and suffered extremely serious damage.

Levee Break of the Shinkawa-river September, 2000 in Nishibiwajima



Flood damage mitigation in Japan thus far has primarily been developed through structural measures such as flood control dams and flood protection levees. As a result of these efforts, the frequency and magnitude of floods have definitely been reduced. The structural measures have so far had a remarkable effect; however, floods and inundations still occur year after year, demonstrating that important issues remain to be tackled:

- 1) Structural measures, such as dams and levees, are primarily time-consuming and costly. Until these structures are fully completed, there is a need for other effective measures for flood damage mitigation.

- 2) The structural measures for large rivers in Japan are based on the assumption of very heavy rain occurring, in principle, once in 100 years. In a case where heavy rain exceeds this target rain level, the structures could not prevent the occurrence of flood damage, even if they were completed. There is a need for another measure for whenever heavy rains exceed the target level.
- 3) Where the construction of levees has been developed, the frequency and magnitude of flooding are reduced, and accordingly, factories and dwellings will certainly be set up. In such a case, the flood damage would be even more formidable if inundation occurs even once in these areas. Although the structural measures reduce the frequency and magnitude of floods, they increase the potential damage. This issue needs to be solved.
- 4) The residents who live in those areas where flooding has been reduced due to the improvement of levees, might be overconfident in the structural measures, and less conscious of the potential danger. They are not able to take proper action in the event of flood occurrence, and so the extent of damage would even be greater.

To cope with these issues in Japan, non-structural mitigation measures are currently under development, hand in hand with the structural measures. Flood hazard mapping is a good example of such non-structural measures.

## **2. Definition of Flood Hazard Map**

The "Flood Hazard Map" herein referred to is a map that graphically provides information on inundation (predicted inundation areas, inundation depth, etc.), as well as on evacuation (location of evacuation refuges, evacuation routes, dangerous spots on evacuation routes, etc.) in an easy-to-understand format. The goal is to quickly evacuate local residents in a safe and proper manner in the event of floods. The map is produced and publicized through a joint effort by those in charge of disaster prevention and those in charge of rivers and hydrology in the respective local municipalities.

## **3. Map Preparing Body**

Flood Hazard Maps shall be prepared principally by the local disaster prevention division of the respective municipalities, in close cooperation with the local residents, qualified experts, NGOs and other pertinent bodies.

In Japan, the head of the respective local municipality, such as the city mayor, town headman, or village headman, is stipulated as the executive official in charge of the local disaster prevention division, and is authorized to issue evacuation warnings and orders. The evacuation activities in the event of flood are thereby implemented on the level of the respective cities, towns and villages. The Ministry of Land, Infrastructure and Transport, together with the Prefectural government concerned, provide the flood-related information (predicted inundation areas, inundation depth, etc.) to the respective local municipalities. They produce the Flood Hazard Maps on the basis of the presented information on the inundation.

## **4. Scope**

This manual applies to areas that have rivers with steep stream-gradient and suffer flash floods within several hours to several days from start to peak.

## **5. Purpose**

Flood hazard mapping in Japan commenced in 1994, when the Ministry of Construction

(currently the Ministry of Land, Infrastructure and Transport) circulated an official notice to all local municipalities on the preparation of the maps.

The Government officially publicized "Past Inundated Area Maps" for about 500 rivers that historically inflicted flood damages, as well as "Flood-prone Area Maps" through 1993 into 1994 for the rivers under their ministerial jurisdiction. Since 1995, taking these opportunities, flood hazard mapping has been positively implemented by local municipalities, and as of June 2002, 173 Flood Hazard Maps had been produced.

Flood analysis results have been publicized since 1999 through such media as CD-ROMs and Internet homepages. Furthermore, the publicity of "Flood-prone Area Maps" became obligatory in 2001 under the Amendment to the Flood Fighting Law, consecutively with the Amendment in 1996 to the River Law and the Enactment in 2001 of the Sediment-related Disaster Prevention Law. Whereas structural flood mitigation measures are aimed at preventing flooding and inundation, the Flood Hazard Maps are based on the premise that flooding will inevitably occur, and are aimed at minimizing loss of life by intensively expediting the evacuation of local residents.

The purpose and advantageous effects of producing Flood Hazard Maps are summarized below:

- 1) For local residents (Publicizing effects of flood information)
  - Local residents receive various types of information on potential flood damage and become aware of the importance of voluntary disaster prevention efforts and proper evacuation.
  - When flood warnings are issued and a flood occurs, local residents are able to evacuate promptly and smoothly to avoid injury.
  
- 2) For local municipalities concerned (Administrative crisis-management effects for flood prevention and preparedness planning)
  - Producing Flood Hazard Maps demands that the administrative staff in charge of disaster prevention simulate emergency drills, and thus urges local municipalities to develop disaster prevention and preparedness countermeasures.
  - Local municipalities are able to promptly and smoothly accomplish the evacuation of local residents, using information on the Flood Hazard Maps.

Table 1 shows several examples of the effective use of Flood Hazard Maps.

**Table 1** Use of Flood Hazard Maps

Category	Local Residents	Local Municipalities
Everyday life	- Consider proper land-use patterns and water-resistant buildings suited to the flood vulnerability of the area	- Review urban planning and land-use patterns that are resistant to flood
	- Prepare emergency kits, emergency food, etc. - Prepare boats and other appropriate means of evacuation	- Update disaster-prevention and flood-fighting plans of the area - Review refuges and evacuation routes - Update specific assistance plan to evacuate or rescue the vulnerable (elderly, handicapped, sick, injured, etc.)
Everyday life	- Identify proper communication channels and systems for information on evacuation - Organize voluntary disaster prevention units	- Update communication channels and systems for information on evacuation - Develop voluntary disaster prevention units

Category	Local Residents	Local Municipalities
Everyday life	<ul style="list-style-type: none"> <li>- Learn about past inundation history and risks of inundation of the local area</li> <li>- Organize educational sessions on potential flood damage, preparedness and evacuation</li> </ul>	<ul style="list-style-type: none"> <li>- Promote education on disaster prevention and conduct evacuation practice drills</li> <li>- Publicize importance of disaster prevention and preparedness</li> </ul>
Emergency situations	<ul style="list-style-type: none"> <li>- Confirm proper refuges, evacuation routes, emergency kits, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Identify flooded areas, inundation depth, location of refuges, and evacuation routes</li> </ul>
	<ul style="list-style-type: none"> <li>- Evacuate independently, following weather forecast, flood-related information, emergency warnings, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Provide information on weather forecast and flood forecast</li> </ul>
	<ul style="list-style-type: none"> <li>- Assist in evacuation of those vulnerable to floods</li> </ul>	<ul style="list-style-type: none"> <li>- Support and rescue those vulnerable to floods</li> </ul>
	<ul style="list-style-type: none"> <li>- Evacuate to proper refuges through safe routes, following advisory and imperative evacuation warnings</li> </ul>	<ul style="list-style-type: none"> <li>- Provide continuous flood-related information on evacuation</li> <li>- Set up refuges</li> <li>- Issue advisory and imperative evacuation warnings</li> <li>- Direct evacuation</li> </ul>

The information incorporated in Flood Hazard Maps shall be those items that are practical and useful in the event of flooding, ensuring the safety and proper evacuation of local residents. Items such as predicted inundation areas and location of refuges, are termed “Evacuation-use Information,” and items that will be helpful in everyday life, by notifying the residents of potential flood damage and enhancing their awareness of the importance of flood disaster preparedness, are termed “Educational-use Information.”

To make efficient use of Flood Hazard Maps, local residents must be thoroughly convinced of the real danger of flooding. The indispensable information on evacuation and, accordingly, the evacuation-use information, shall be incorporated in the hazard maps. Educational-use information shall be appropriately incorporated or not, depending on the purpose of preparing the Flood Hazard Maps in the respective municipalities.

The key items to be incorporated in the maps are listed below:

**Table 2** Key Items to be Incorporated in Flood Hazard Maps

Evacuation-use Information	Educational-use Information
<ul style="list-style-type: none"> <li>- Predicted inundation area, inundation depth, flood concentration time</li> <li>- Historical inundation records</li> <li>- Areas to be evacuated</li> <li>- Location of evacuation refuges</li> <li>- Evacuation routes</li> <li>- Dangerous spots on evacuation routes</li> <li>- Rules to follow in the event of evacuation</li> <li>- Communication channels and systems for information on evacuation</li> <li>- Issuance criteria for evacuation warnings</li> <li>- Map preparing body, date of preparation</li> </ul>	<ul style="list-style-type: none"> <li>- Flooding mechanism</li> <li>- Topographic features, flood types</li> <li>- Real danger of flood, predicted extent of damage</li> <li>- Meteorological information</li> <li>- Past flood records (rainfall, inundation and damage)</li> <li>- Rules to follow in the event of flood</li> <li>- Explanation and directions to use-up Flood Hazard Maps</li> <li>- Preparedness against flood</li> </ul>

Note:

- The more detailed items are stated later.