# Measures to Formulate Disaster-resilient City in TMG

Disaster Management Urban Development Section
Urban Development Projects Division
Bureau of Urban Development

# Today's Topics

1. Densely-built Wooden House Area
2. District-based Assessment of Vulnerability to Earthquake Disaster
3. Disaster-resilient City Promotional Plan

# Densely-built Wooden House Area

- Distribution and Existing Condition of the Area
- Characteristics of the Area

# Vulnerability to Earthquake

## Fire Spread

## Building Collapse

Great Hanshin-Awaji Earthquake (17 January 1995, M.7.3)

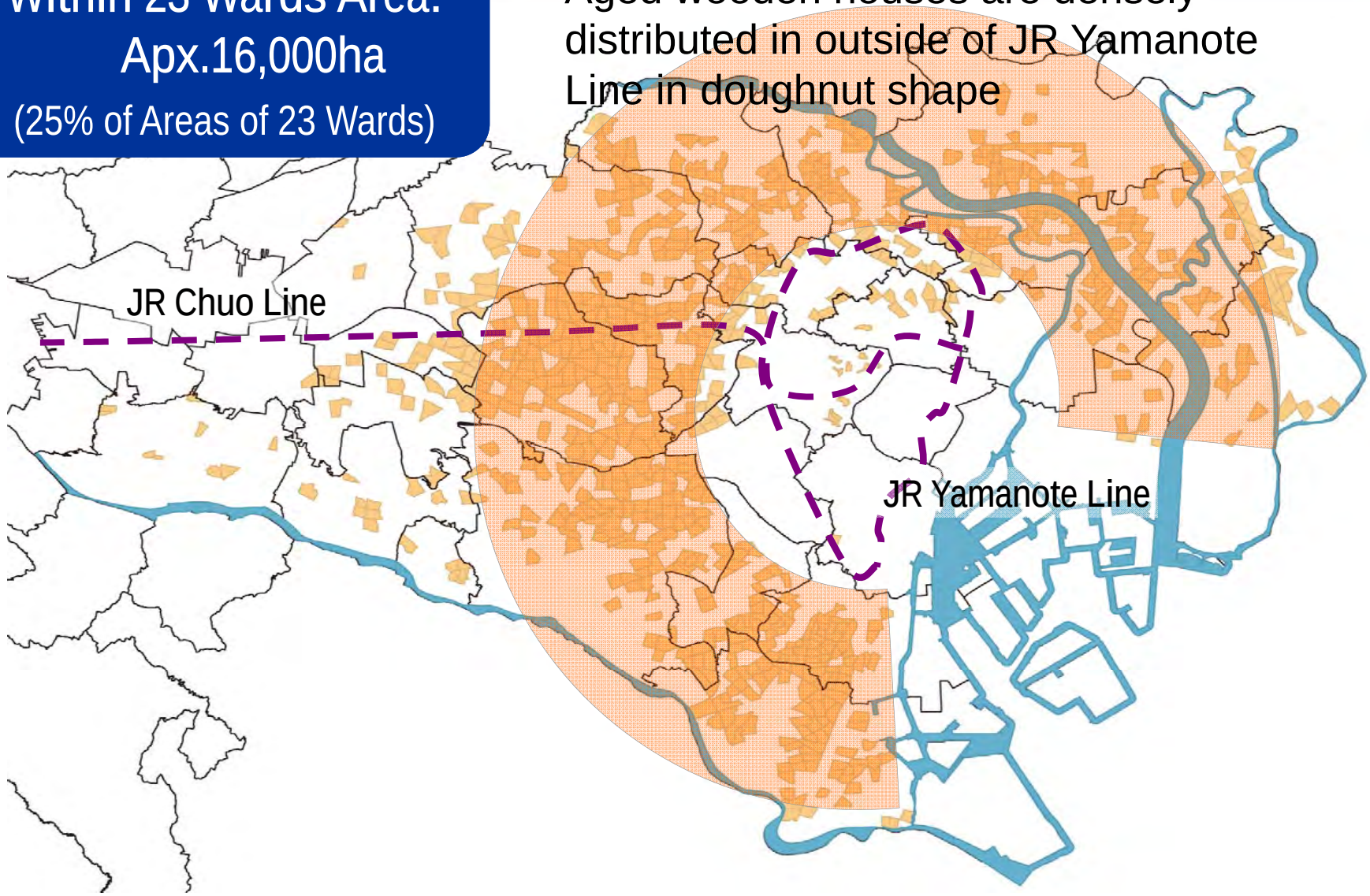
- Missing/Death: 6,437 persons
- Damage of Building: 249,180 buildings

# Distribution of Densely-built Wooden House Area

**Within 23 Wards Area: Apx.16,000ha**

(25% of Areas of 23 Wards)

Aged wooden houses are densely distributed in outside of JR Yamanote Line in doughnut shape



# Existing Condition of Densely-built Wooden House Area

Examples of Existing Condition

# Existing Condition of Densely-built Wooden House Area

Examples of Existing Condition

# Characteristics of Densely-built Wooden House Area

## Densely Built Wooden House Area

Aged Wooden Houses ⋯⋯▶ Time to be Renewed

- Aged owners
- Narrow and small lots
- Impossible to fulfill current building standards law in terms of attachment to the road

➡ Constraints on the Renewal

# District-based Assessment of Vulnerability to Earthquake Disaster

- Damage Estimation for an Earthquake Directly underneath Tokyo
- Survey of District-based Vulnerability to Earthquake Disaster

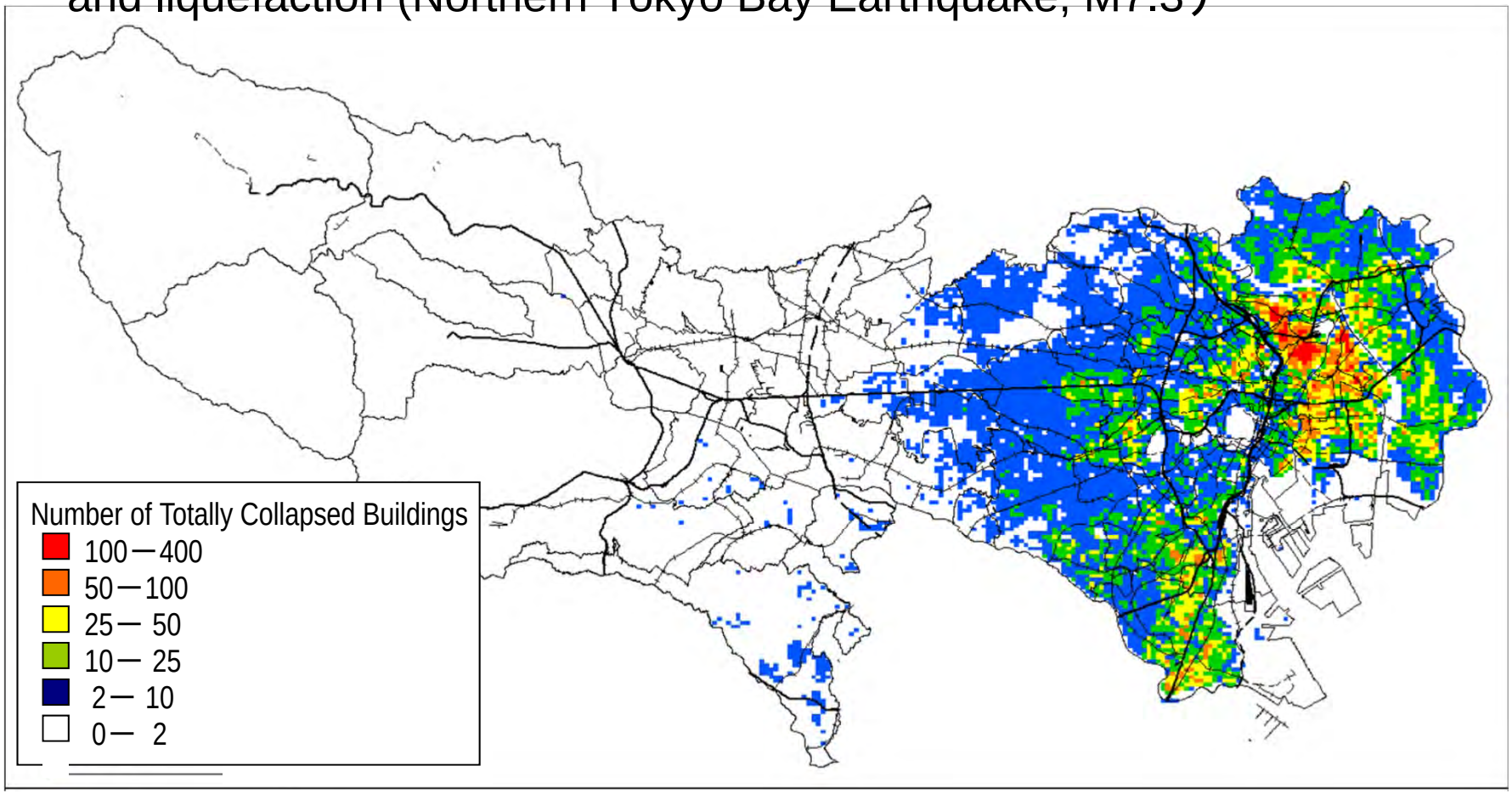
# Damage Estimation for an Earthquake Directly underneath Tokyo

| Scenario | Magnitude | | Northern Tokyo Bay Earthquake, M7.3 | | | Tama Directly underneath Earthquake, M7.3 | | |
|---|---|---|---|---|---|---|---|---|
| | Time & Season | | Winter Morning, 5:00 | Winter Noon, 12:00 | Winter Evening, 18:00 | Winter Morning, 5:00 | Winter Noon, 12:00 | Winter Evening, 18:00 |
| | Wind Speed | | 8m/s | | | 8m/s | | |
| Human Damages (persons) | | Death | **7,649** | **6,296** | **9,641** | **5,115** | **3,546** | **4,732** |
| | Cause | Building Collapse by Liquefaction | 6,927 | 4,972 | 5,378 | 4,489 | 2,840 | 3,220 |
| | Cause | Earthquake Fire | 540 | 1,138 | 4,081 | 403 | 496 | 1,302 |
| | Cause | Others | 182 | 253 | 186 | 223 | 210 | 210 |
| Physical Damages (buildings) | | Building Damage | **136,297** | **166,906** | **304,300** | **90,947** | **99,788** | **139,436** |
| | Cause | Building Collapse by Liquefaction | 116,224 | 116,224 | 116,224 | 75,668 | 75,668 | 75,668 |
| | Cause | Earthquake Fire | 21,240 | 54,417 | 201,249 | 15,707 | 24,811 | 65,770 |

Source: Damage Estimation for an Earthquake Directly underneath Tokyo, TMG Disaster Management Committee, April 2012

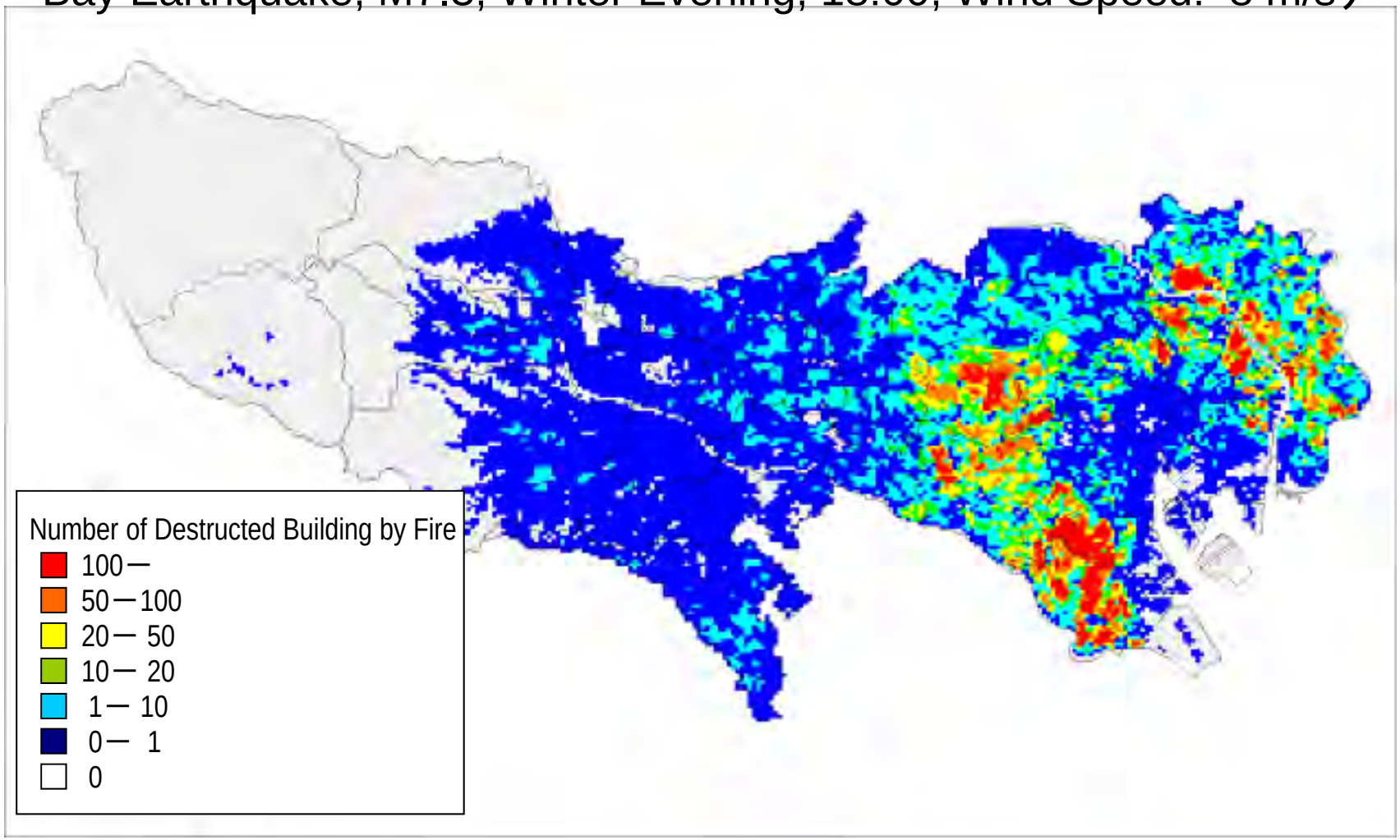
# Damage Estimation for an Earthquake Directly underneath Tokyo

- Distribution of the number of totally collapsed buildings by tremor and liquefaction (Northern Tokyo Bay Earthquake, M7.3）



# Damage Estimation for an Earthquake Directly underneath Tokyo

- Distribution of the number of destructed buildings by fire (Northern Tokyo Bay Earthquake, M7.3, Winter Evening, 18:00, Wind Speed: 8 m/s)



# District-based Assessment of Vulnerability to Earthquake Disaster

- Objectives
  - To grasp the highly vulnerable areas to earthquake
    ⋯⋯▶ To decide priority project areas
  - To deepen the recognition to seismic disaster of the citizen of Tokyo and strengthen awareness of disaster management
- Contents
  - To compare the vulnerabilities by district under same earthquake scenarios
  - To assess by district
  - To implement once a five-years
    - Vulnerability to Building Collapse
    - Vulnerability to Fire
    - Integrated Vulnerability

# District-based Assessment of Vulnerability to Earthquake Disaster

- Survey Work Flow

Vulnerability to Building Collapse

Vulnerability to Fire

Integrated Vulnerability

# Vulnerability to Building Collapse

(1) Characteristics of ground structure

1) Classification of ground structure by district

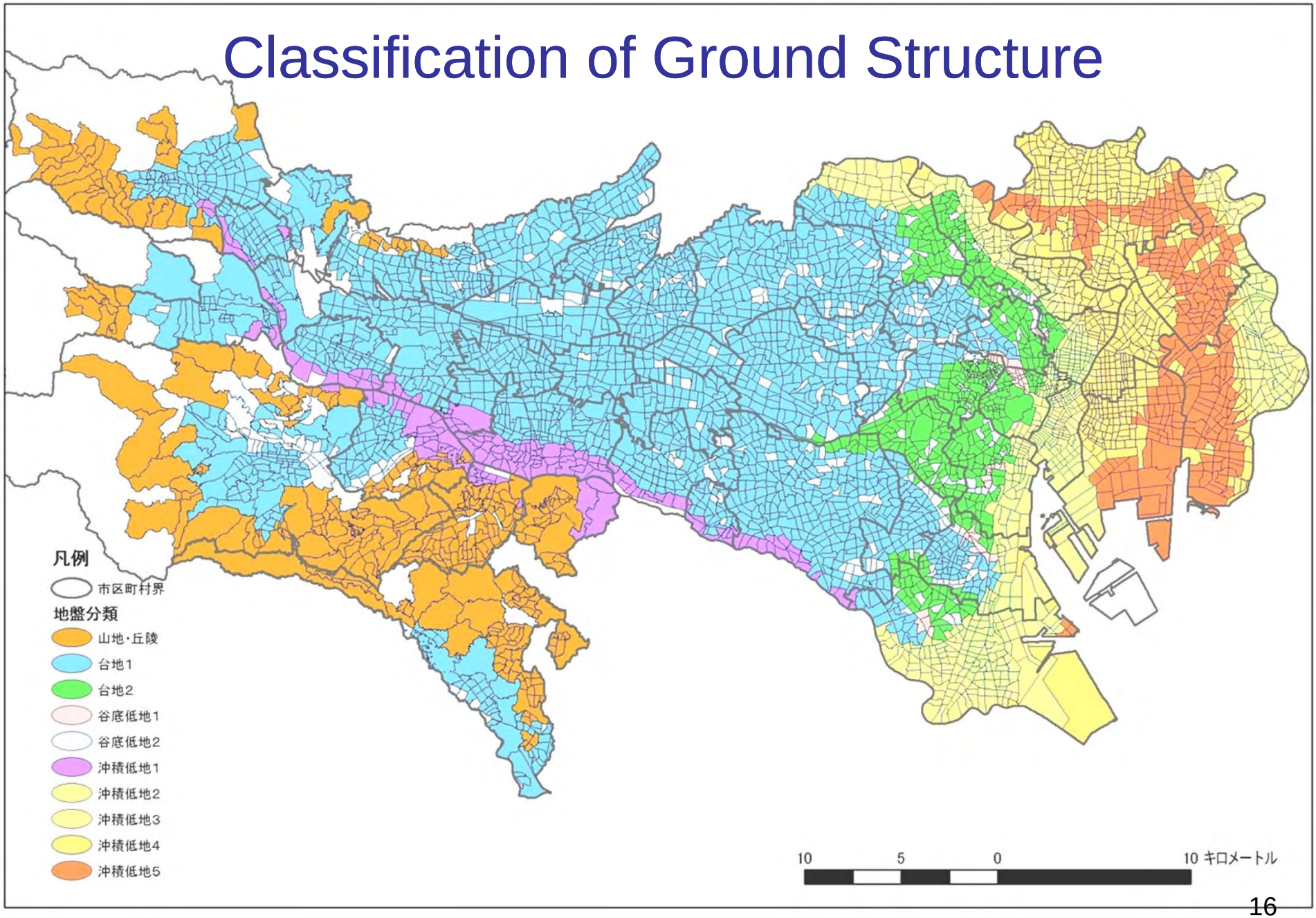
2) Increment ratio by type of ground structure

(2) Characteristics of building

1) Number of buildings by structure and age

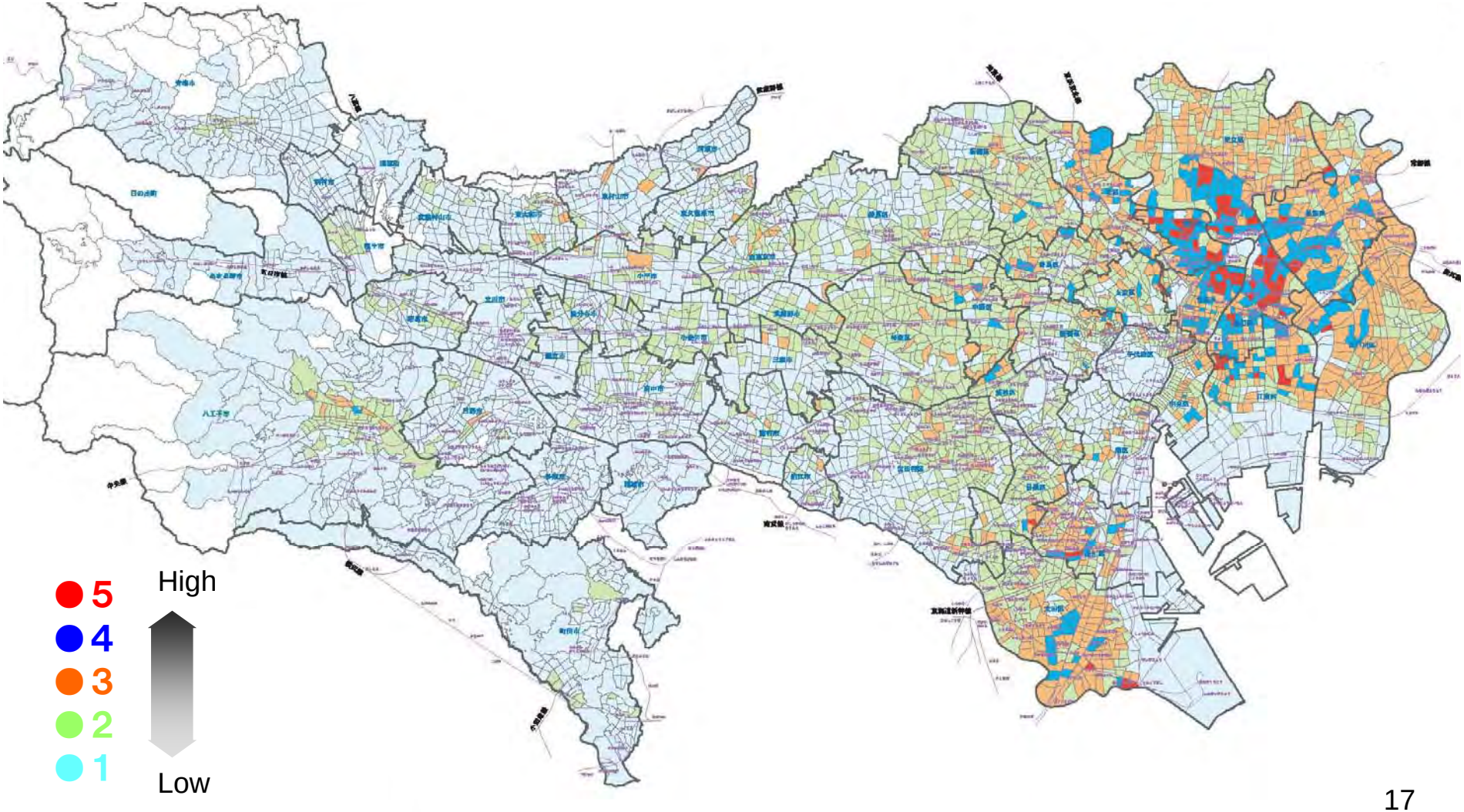
2) Damage ratio by type of building

# Classification of Ground Structure



# District-based Assessment of Vulnerability to Earthquake Disaster

- Vulnerability to Building Collapse



# Vulnerability to Fire

(1) Vulnerability to fire breakout

1) Maximum number of fire breakout by season and time

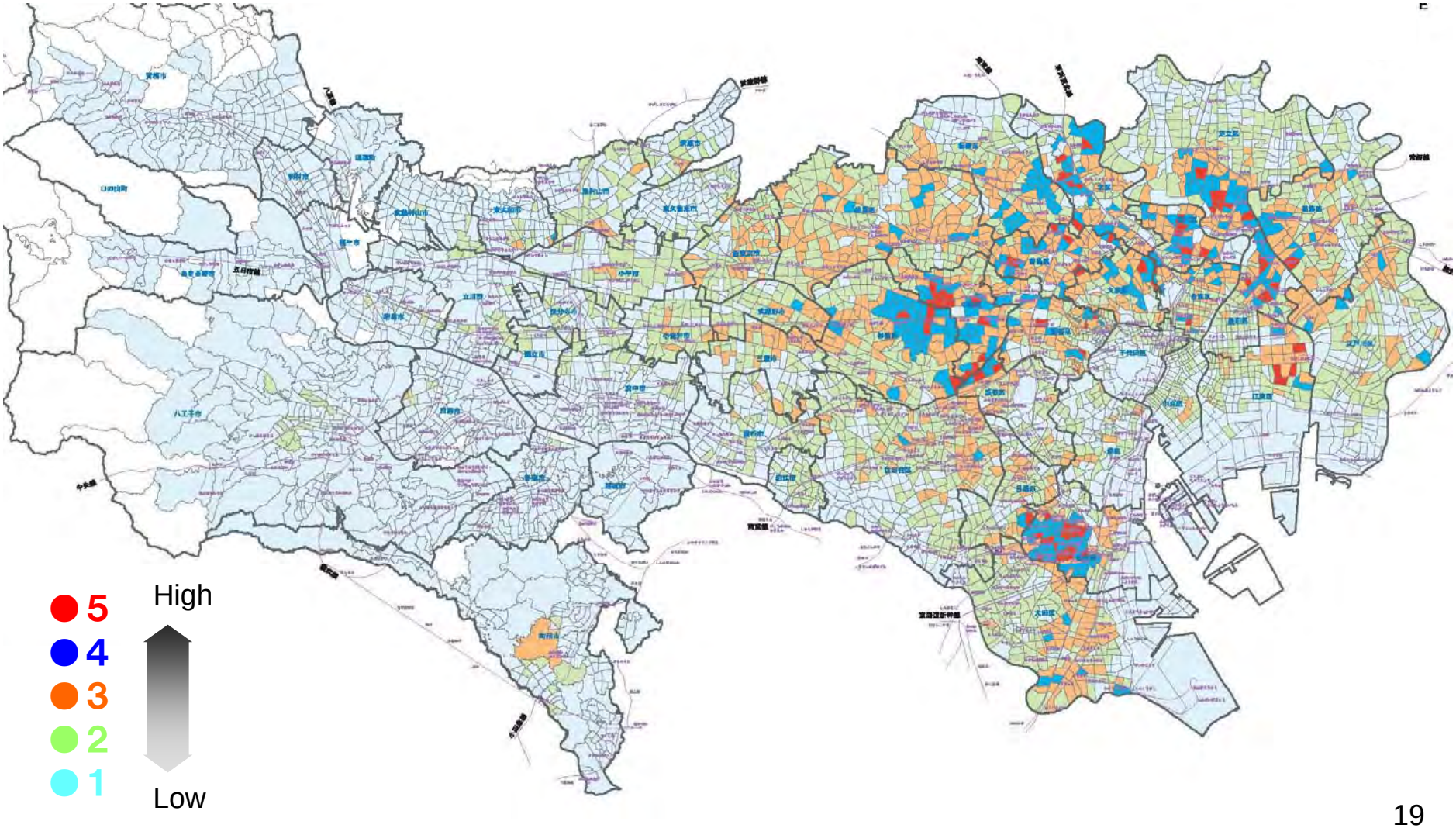
(2) Vulnerability to fire spread (fire spread simulation)

1) Number of totally destructed buildings within 6 hours

2) Number of catch fire from neighboring districts

# District-based Assessment of Vulnerability to Earthquake Disaster

- Vulnerability to Fire

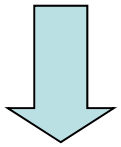


# Integrated Vulnerability

Vulnerability to Building Collapse (Rank)

**+**

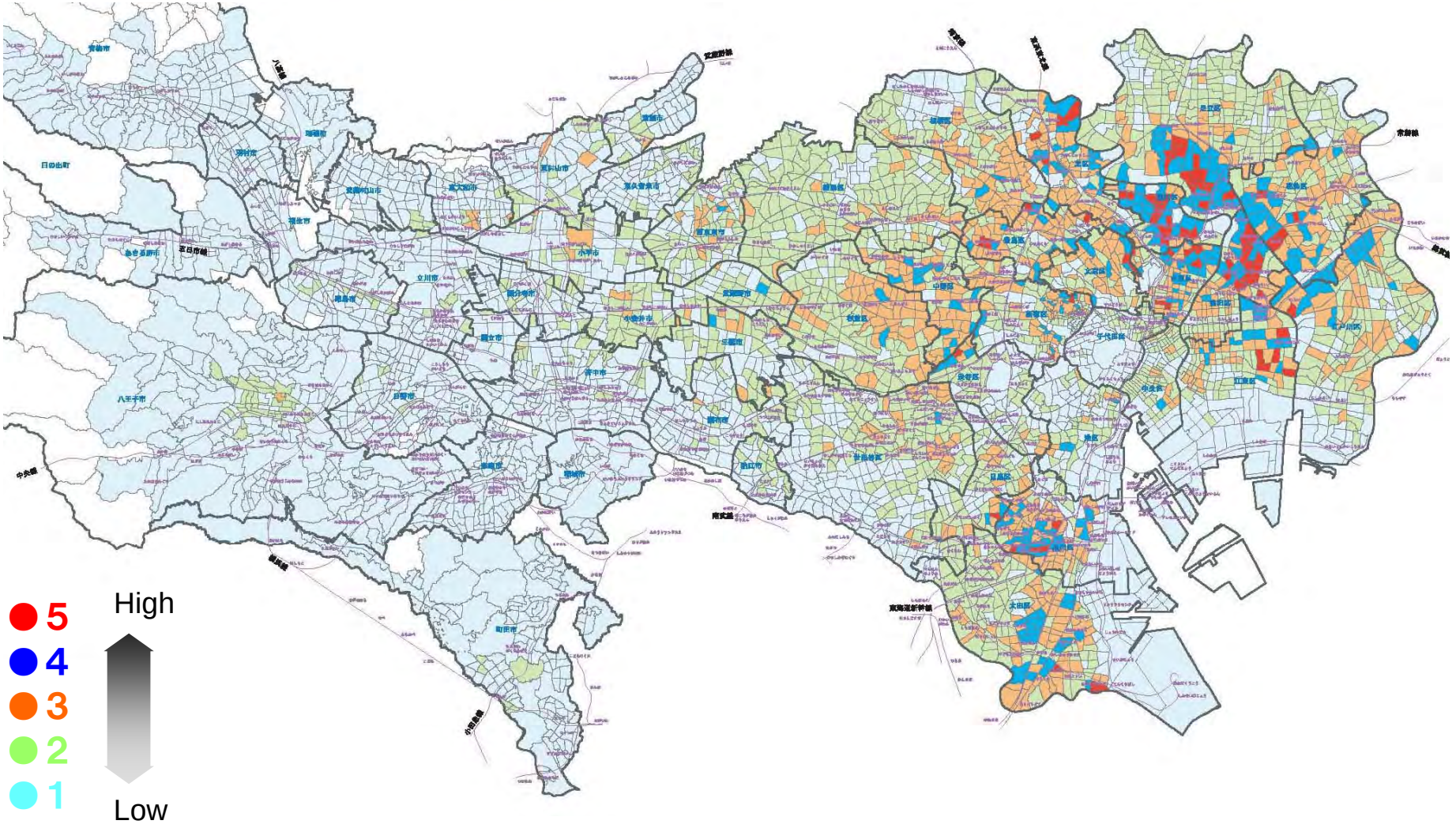
Vulnerability to Fire (Rank)



Relative rating on a scale of 1 to 5

# District-based Assessment of Vulnerability to Earthquake Disaster

- Integrated Vulnerability



# Disaster-resilient City Promotional Plan

- Basic Concept of Disaster-resilient City
- Formation of Fire Spread Prevention Belt
- Fire-resistant of Urban Area

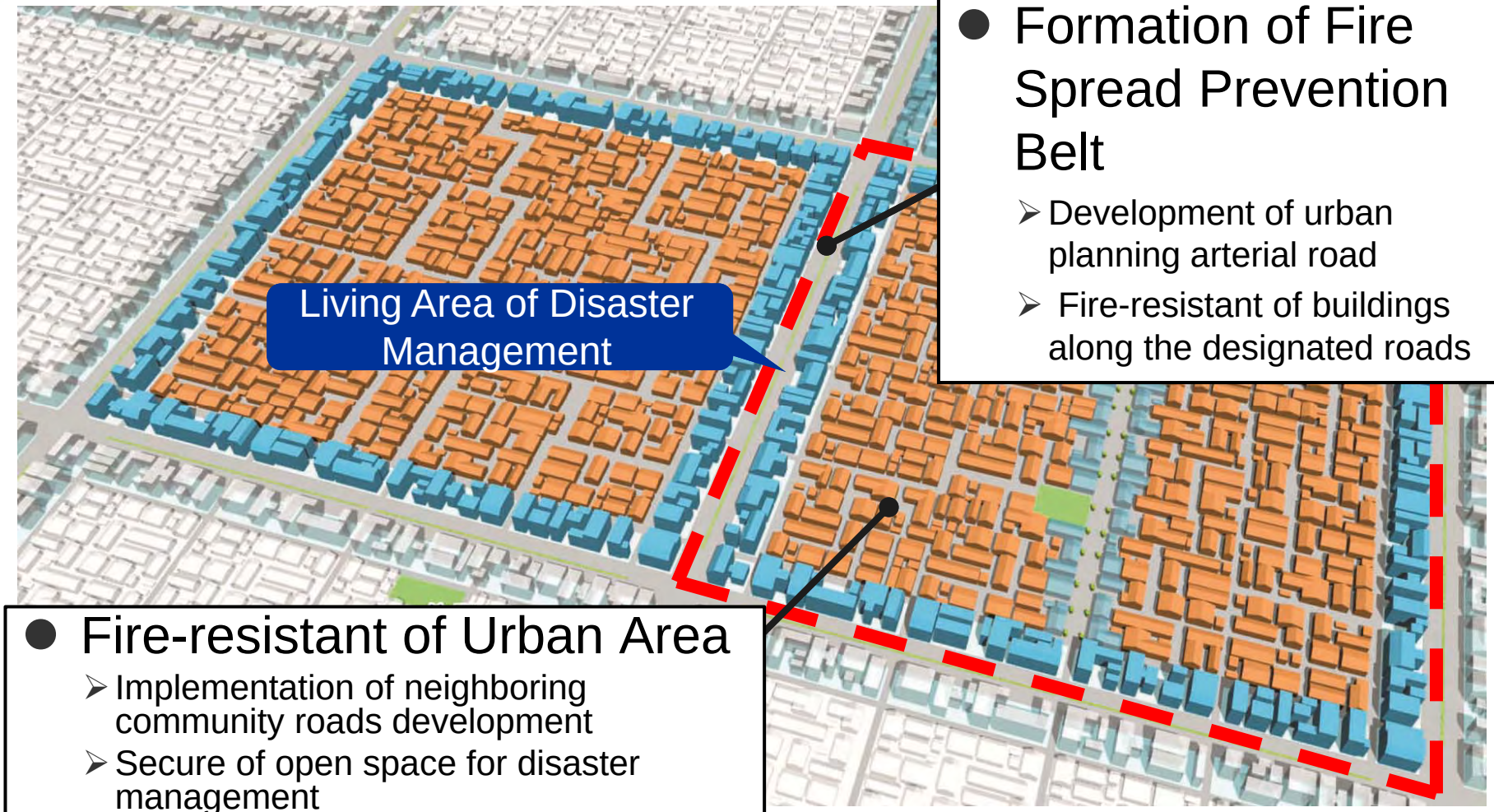
# Disaster-resilient City Promotion Plan

Great Hanshin-Awaji Earthquake (Jan. 1995)
→ Established in 1995
→ Amended in 2003
→ Amended in 2009

| | |
|---|---|
| (1) Objective | ● To prepare for the earthquake disaster and to prevent the expansion of damages, the buildings and urban facilities should be secured their resilience to earthquake and fire, and various measures regarding improvement of urban structure should be promoted. |
| (2) Target Area | 23 Wards and 7 Cities in Tama Region (Densely-built Wooden House Areas)<br>* Including all the emergency transportation roads within TMG |
| (3) Structure and Planning Period | Basic Plan : 2009～2025 (17 years)<br>Implementation Program: 2009～2015 (7 years) |

# Promotion Plan of a Disaster-prepared City

- Basic Concept of Disaster-resilient City

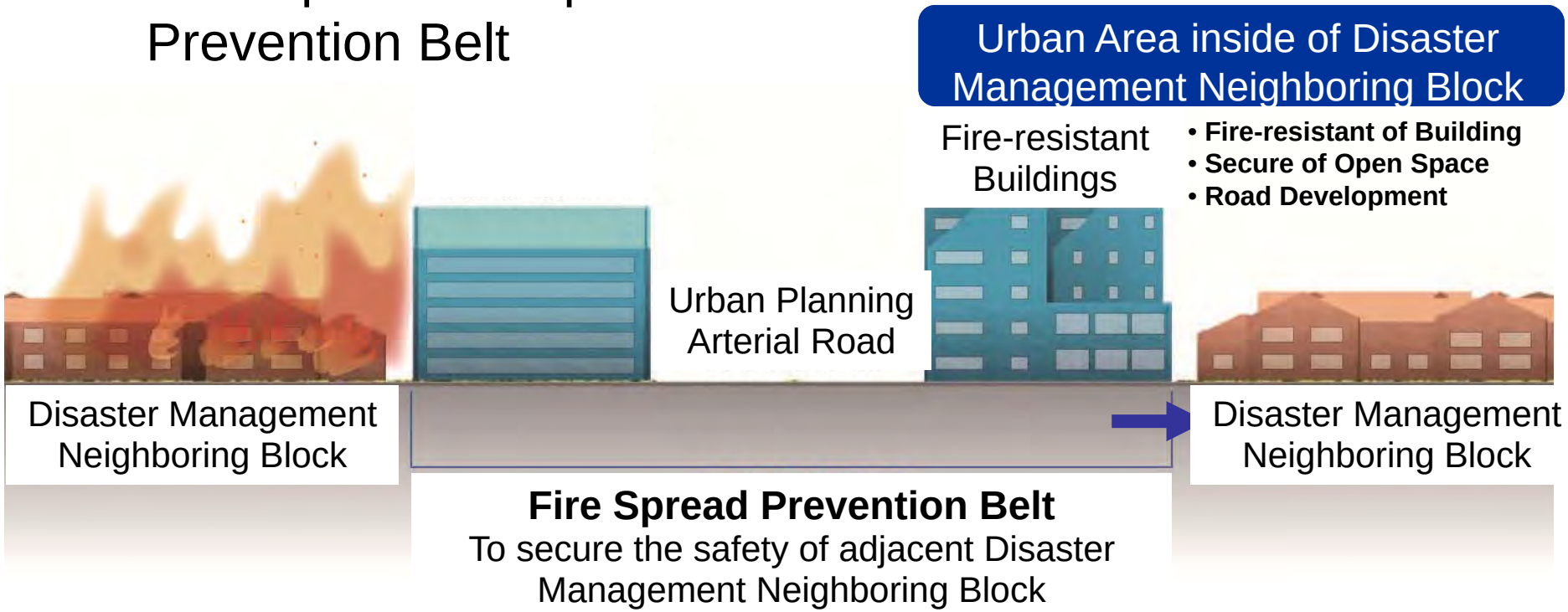



- Formation of Fire Spread Prevention Belt
  - Development of urban planning arterial road
  - Fire-resistant of buildings along the designated roads

- Fire-resistant of Urban Area
  - Implementation of neighboring community roads development
  - Secure of open space for disaster management
  - Fire-resistant and retrofit of buildings

# Formation of Fire Spread Prevention Belt

- Concept of Fire Spread Prevention Belt




**Secure the safety inside of Disaster Management Neighboring Block**

**Prevention of largely spread fire in the urban area at the disaster event**

# Formation of Fire Spread Prevention Belt

- Criterion of Fire Spread Prevention Belt

| Road Width (m) | Fire-resistant Ratio of Buildings along the Designated Roads |
|---|---|
| More than 27 | --- |
| 24 – 27 | More than 40% |
| 16 – 24 | More than 60% |
| 11 – 16 | More than 80% |

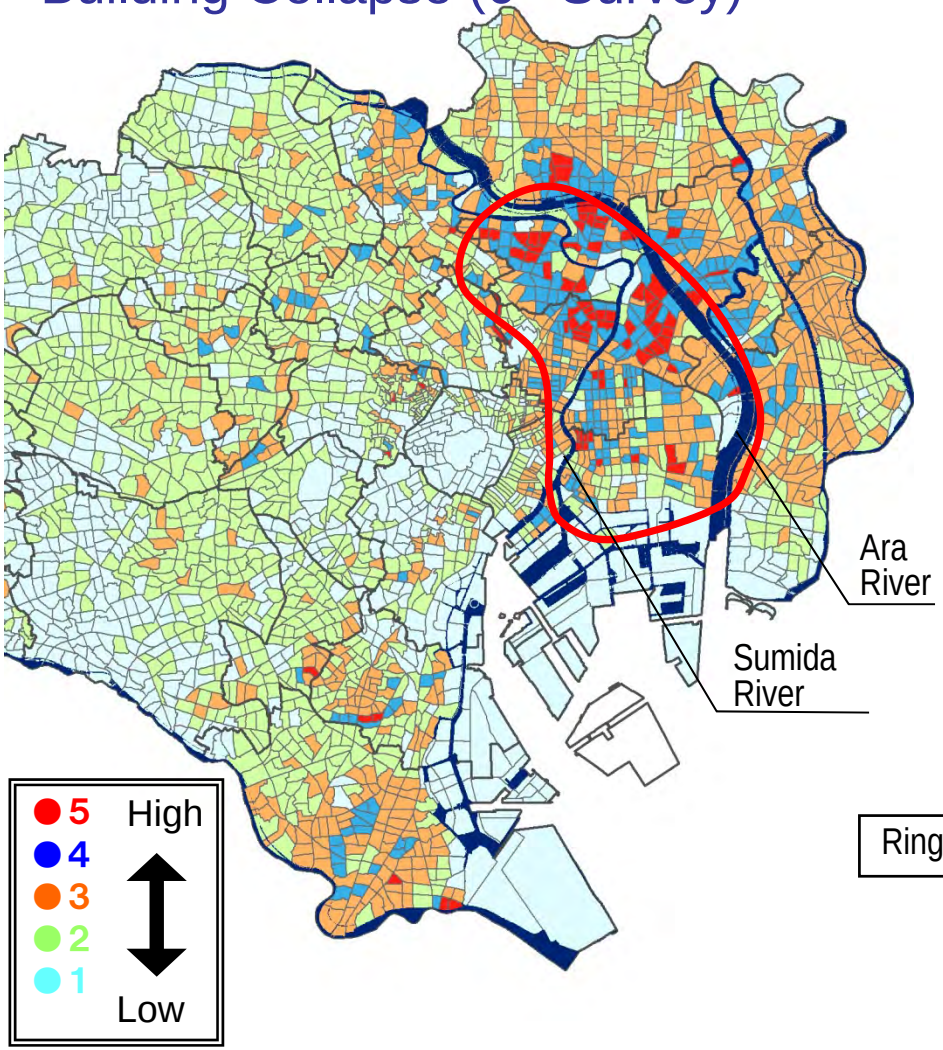
# Formation of Fire Spread Prevention Belt

- Definition of Fire Spread Prevention Belt

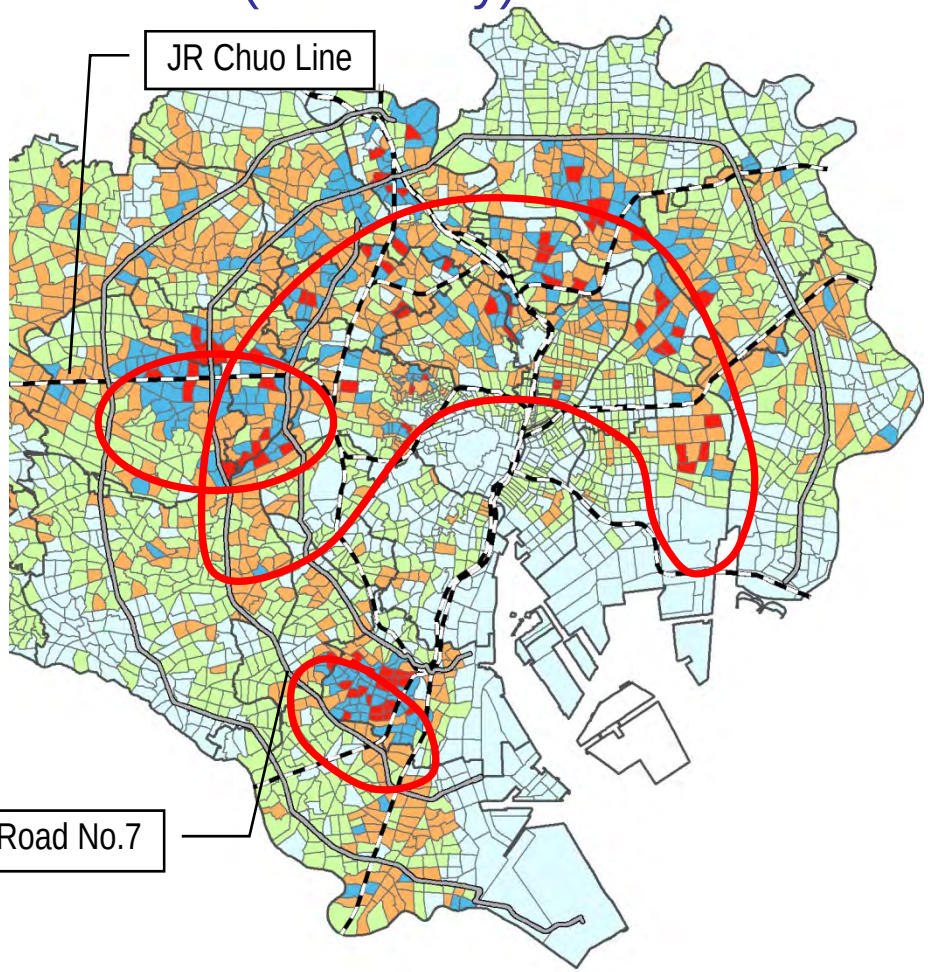

- **Main Axis of Disaster Management (3~4 km mesh)**
  Major Arterial Roads, River with Wide River Width
- **Major Fire Spread Prevention Belt (2km mesh)**
  Arterial Roads
- **General Fire Spread Prevention Belt (1km mesh)**
  The other roads and rivers

# Fire-resistant of Urban Area

- Ranking Map of Vulnerability to Building Collapse (6th Survey)




- Ranking Map of Vulnerability to Fire (6th Survey)



# Fire-resistant of Urban Area

- Fire-resistant Area Ratio (FPAR)

FRAR = Open Space Ratio + (1-OSR/100) x Fire-resistant Building Ratio (%)

Building Part

OSR: { (S+R)/T} x 100 (%)

S: Area of open space which has narrow side or radial length of more than 10m and area of more than 100m$^2$

R: Area of road with its width of more than 6m

T: Total area of target urban area

FRR: (B/A) x 100 (%)

B: Area of fire-resistant building + Area of semi-fire-resistant building x 0.8

A: Total area of building area

# Fire-resistant of Urban Area

- Fire-resistant Area Ratio (FRAR) is the indicator showing fire-resistant ability of urban area

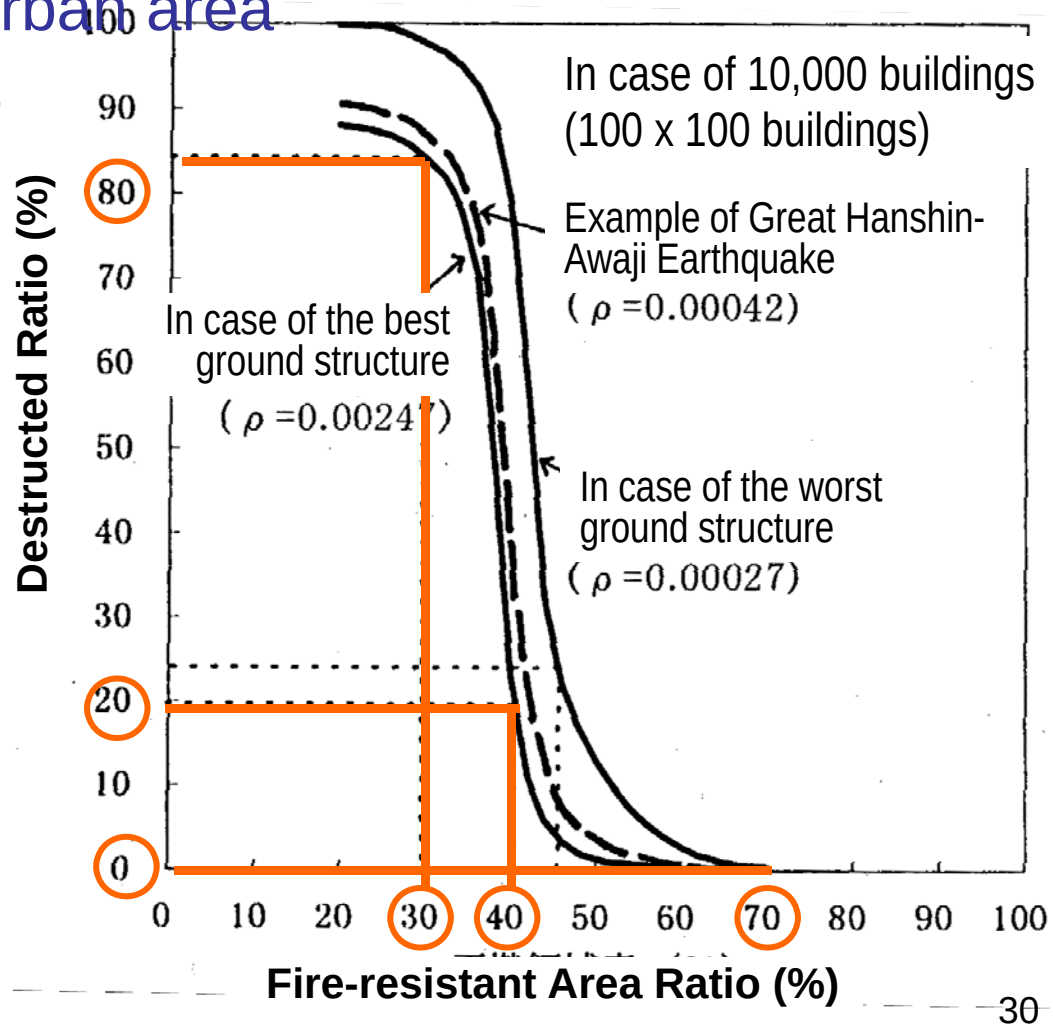
In case of urban area with FRAR 30%,
destructed ratio by fire exceeds 80%

↓

In case of urban area with FRAR 40%,
destructed ratio by fire is reduced rapidly

↓

In case FRAR exceeds 60%,
destructed ratio by fire become close to 0,
In case FRAR exceeds 70%,
destructed ratio by fire is almost 0.



# aster-resilient City Promotion Plan

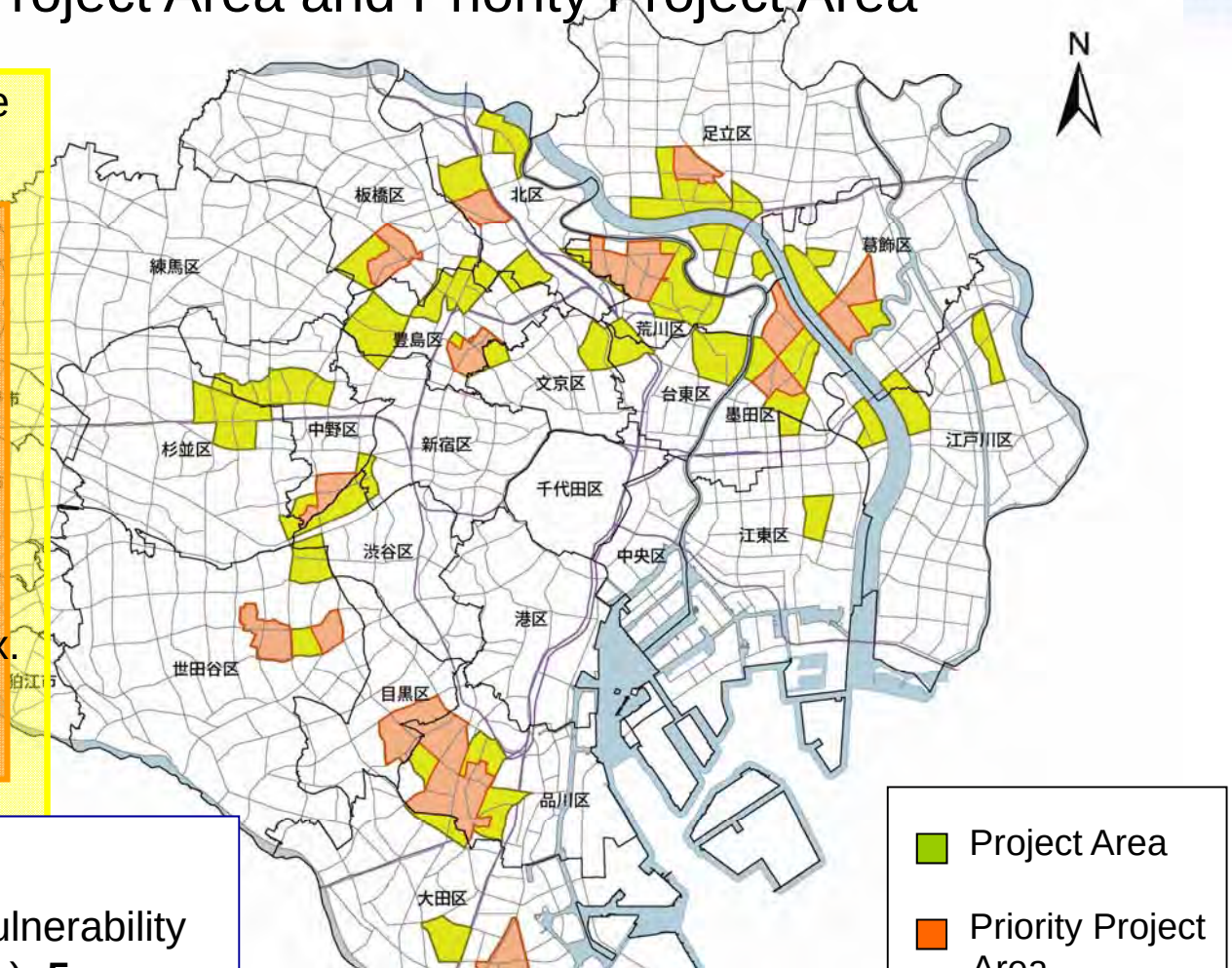
## Designation of Project Area and Priority Project Area

ly-built Wooden House
ngs Area: 16,000ha

oject Area

Priority Project
Area: 2,400ha

Area: 7,000ha
1% of 23 Wards Area)
Population: 1.8 mil. pax.
0% of 23 Wards Area)




**on of Project Area**

ng rate of integrated vulnerability

# aster-resilient City Promotion Plan

## Change of Fire-resistant Area Ratio/Completion Ratio of Fire Spread Prevention Belt

[Fire-resistant Area Ratio](%)

| | 1996 | 2006 | Increase of 1996-2006 | Target | |
|---|---|---|---|---|---|
| | | | | 2015 | 2025 |
| 3 Wards | 65.0 | 69.8 | 4.8 | — | — |
| **roject Area** | **48.9** | **56.2** | **7.3** | **—** | **70** |
| iority Project Area | **48.2** | **55.7** | **7.5** | **65** | |

[Completion Ratio of Fire Spread Prevention Ratio] (%)

| | Length (km) | Completion Ratio | | Increase 0f 1996-2006 | Target |
|---|---|---|---|---|---|
| | | 1996 | 2006 | | 2015 |
| tal of Fire Spread evention Belt | **1,680** | **55** | **62** | **7** | **—** |
| Main Frame Axis | 537 | 90 | 93 | 3 | 95 |
| Major Fire Spread Prevention Belt | 312 | 49 | 61 | 12 | — |