Topographic mapping using satellite images

国土地理院
Geospatial Information Authority of Japan

Fundamental maps in Japan

国土地理院

Paper-based maps
- Scale: 1:10,000 ~ 1:5,000,000
- Mainly: 1:25,000 scale topographic map

Digital maps
- Digital Japan Basic Maps (Map Information)
- Map image
- Spatial data framework (2500, 25000)
- Etc.

Providing
- Publishing (paper, CD-ROM, etc.)
- Browse via the Internet
- Download through the Internet (Map Image)

2

1:25,000 scale topographic maps

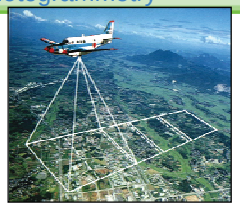
国土地理院

- Largest scale base maps that cover whole land of Japan
- Total: 4,355 sheets
- 1 sheet covers: longitude 7.5 min. latitude 5 min. (about 100km^2)

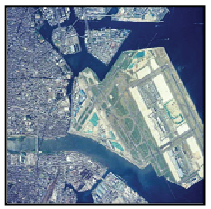
3

Photogrammetry

国土地理院



"Kunikaze III"



Aerial photographs (with 60% overwrapping)

4

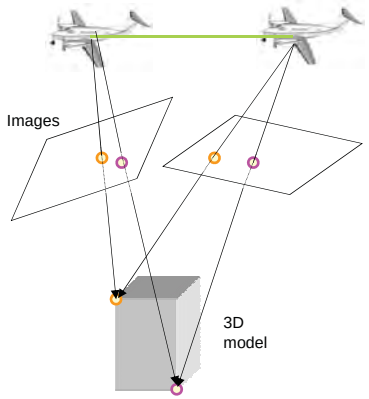
Flight course

60% overwrap between neighboring photo
30% overwrap between neighboring course

5

Photogrammetry -Principle-

Using plotter



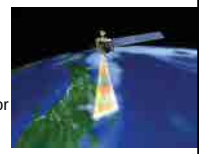
6

Advanced Land Observing Satellite(ALOS)

Launch :
January 24th in 2006

Missions
- cartography
- regional observation
- disaster monitoring
- resource surveying

PRISM
2.5m-spatial resolution
three optical system
Panchromatic sensor



AVNIR-2
10m-spatial resolution
Multi-band(BGRNIR)sensor

PALSAR
10m-spatial resolution
L-band SAR

From JAXA HP

7

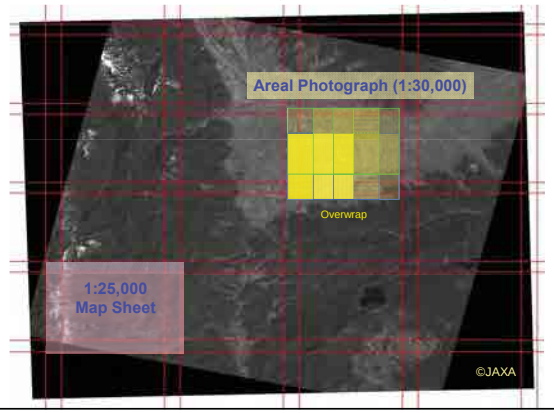
Comparison of aerial photo & satellite image

	Aerial Photograph	ALOS PRISM
Resolution	40cm	2.5m
Interval of Shooting	1-5 year (GSI)	46 days
Shooting Area	5km × 5km (Scale 1:20,000)	35km X 35km 35km X 70km
Others	Hard to take at isolated islands, volcanoes etc.	Hard to interpret small structures & point features (lighthouses, towers, road dividers etc.)

8

国土地理院

ALOS/PRISM（35km×35km）



9

Comparison of cost

国土地理院

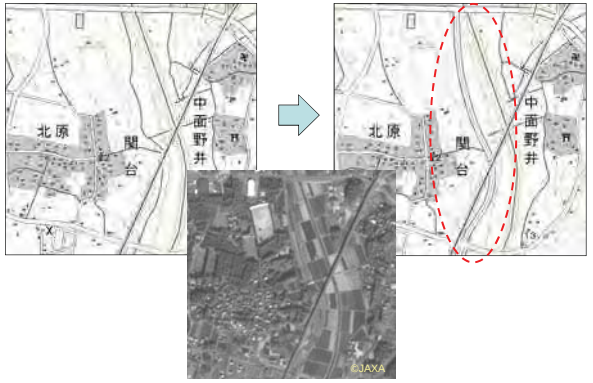
	Cost (US Dollar)	Size (km)	Cost / km2	Resolution (m)
Aerial photo		7	29.00	0.6
QuickBird	2,304	8	36.00	0.6
IKONOS	1,375	5	55.00	0.8
SPOT	10,290	60	2.86	2.5
ALOS	**500**	**35**	**0.41**	**2.5**

※Aerial photo's scale is 1/30,000, scanning pitch is 21μm

10

Example of update: road

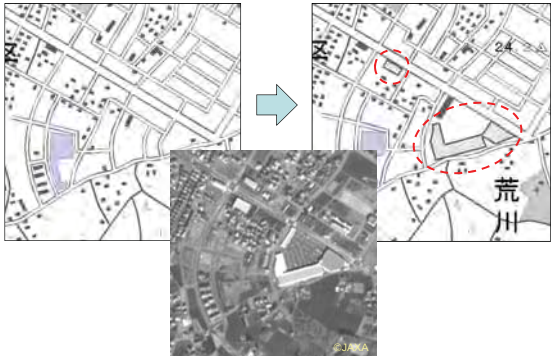
国土地理院



11

Example of update: large buildings

国土地理院



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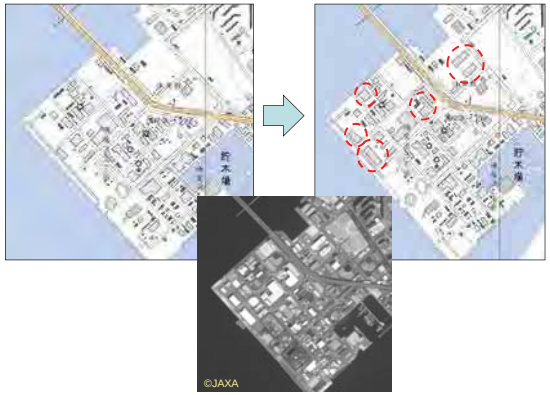
Example of update: large buildings



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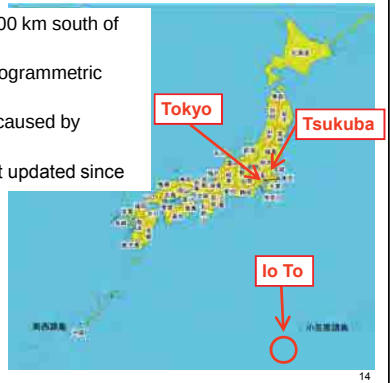
Mapping / Compilation

- Isolate island located 1,200 km south of Tokyo
- Difficult to reach the photogrammetric aircraft
- Many landform changes caused by volcanic activity
- Topographic map has not updated since 1982

Can take full advantage of PRISM image



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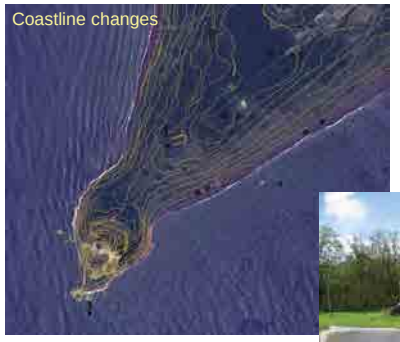
Coastline changes



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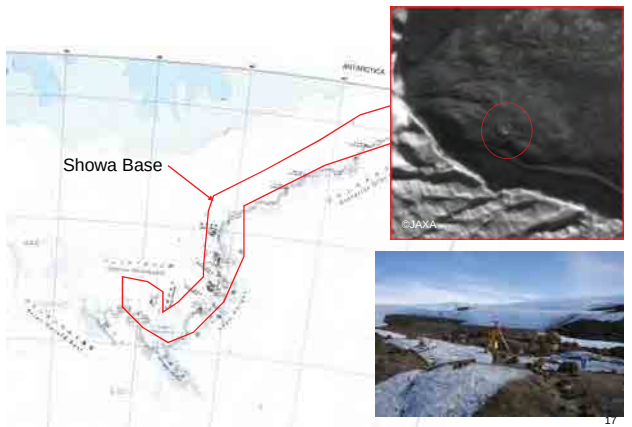
PRISM 60-6100 Sep-2007

Published 1982 Revised 2007

16

Accuracy improvement of Antarctic map



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References

- Bulletin of the GSI Vol.56
  (PDF file can be downloaded at:
  http://www.gsi.go.jp/ENGLISH/Bulletin56.html)
  - Revising 1:25,000-Scale Topographic Maps Using ALOS/PRISM Imagery
    Yuichi UCHIYAMA, Misuzu HONDA, Yoshiyuki MIZUTA, Koji OTSUKA, Takayuki ISHIZEKI, Takaki OKATANI and Eiichi TAMURA
  - Verification of Topographic Road Centerline Data Using ALOS/PRISM Images: Implementation
    Hidenori FUJIMURA, Hidekazu MINAMI, Takenori SATO and Takahiro SHIMONO

18

Global Mapping
地球地図

LOOK AT THE FUTURE
OF OUR EARTH
THROUGH THE MAP.

地図から広がる 未来の地球

International Steering Committee for Global Mapping (ISCGM)

地球地図国際運営委員会

Global Mapping ／地球地図プロジェクト

In order to cope with global environmental problems, reliable geospatial information of the whole globe is indispensable. Global Mapping project was proposed by Ministry of Land, Infrastructure, Transport and Tourism of Japan (former Ministry of Construction of Japan) aiming to develop digital geospatial datasets (Global Map) of the whole globe. The purpose of the Global Map is to accurately describe the present status of the global environment in international cooperation of respective National Mapping Organizations (NMOs) of the world. The developed data are released for a use without cost for non-commercial purposes.

地球環境問題の解明には地球全体の信頼できる地理空間情報が不可欠です。地球地図プロジェクトは国土交通省（当時は建設省）が提唱し、地球環境の現状を正確に表す、地球全体を対象とするデジタル地図データ（地球地図）を世界の国家地図作成機関の協力により整備するものです。また、整備されたデータは非営利目的であれば無料で利用できます。

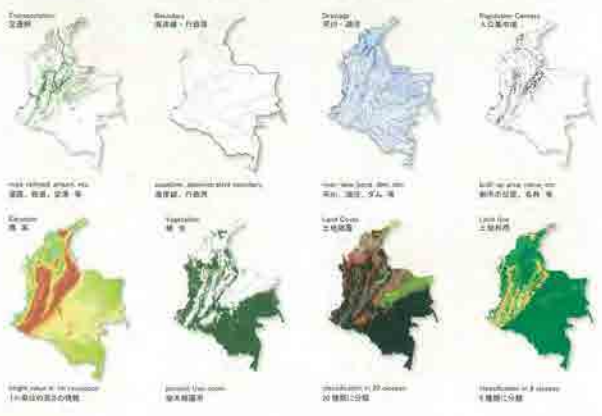
What is Global Map? ／地球地図とは？

Global Map is
1) digital geospatial information in 1km resolution (at approx. 1:1 million scale)
2) covering the whole land area of the globe with consistent specifications.
3) composed of 8 layers

● Global Map data are to be updated in every 5 years.

地球地図は、
1) 解像度 1km のデジタル形式の地理空間情報です（縮尺 100 万分の1相当）
2) 地球の全陸域を統一仕様でカバーしています
3) 8項目で構成されています

●地球地図は、概ね5年ごとに更新することとしています



Sample image of Global Map (Colombia) ／地球地図出力例（コロンビア）

Global Map Download / 地球地図のダウンロード

Web site of ISCGM / ISCGM ホームページ

www.iscgm.org

Global Map data are available for download through the ISCGM Web site. Anyone can use the data freely for non-commercial purposes.

地球地図データは、ISCGMのホームページからダウンロードでき、非営利目的であれば、誰でも無料で利用できます。

Samples of Global Map / 地球地図出力例

Progress of Global Mapping Project
地球地図プロジェクトの歩み

Advocacy of Global Mapping project	1992	「地球地図構想」の提唱
Establishment of International Steering Committee for Global Mapping (ISCGM)	1996	地球地図国際運営委員会の設立
Invitation from ISCGM with UN recommendatory letter to world NMOs to participate in Global Mapping project	1998	ISCGMが国連の推奨状を添えて各国の地図作成機関に宛て地球地図整備への参加を要請
Start developing Global Map data		地球地図データ整備開始
Start releasing Global Map data	2000	地球地図データ提供開始
Inclusion of Global Mapping in "WSSD Plan of Implementation"	2002	国連持続可能な開発に関する世界首脳会議(WSSD)の「実施計画」文書に地球地図が盛り込まれる
Retese of Global Map version 1 Start developing of Global Map version 2	2008	地球地図第1版の公開 地球地図第2版の整備開始
Start releasing Global Map version 2	2010	地球地図第2版の提供開始

What we can get from Global Map

地球地図から分かること

Vegetation (Percent Tree Cover)
植生 （樹木被覆率）

Case of Amazon / アマゾン

Deforestation in Amazon - in the case of Rondonia

The upper left figure shows a tree cover status of Rondonia area, Brazil. In the lower left figure, areas enclosed with thick lines are reserves and thin lines are roads. Deforestation has progressed very much especially outside the reserved areas along with roads.

アマゾンでの森林減少 - ロンドニア州

樹木被覆データ（左上図）に特別区域（太線）、及び道路（細線）を重ねた図（左下図）。特別区以外では道路に沿って森林減少が進んでいることが分かります。

Land Cover / 土地被覆

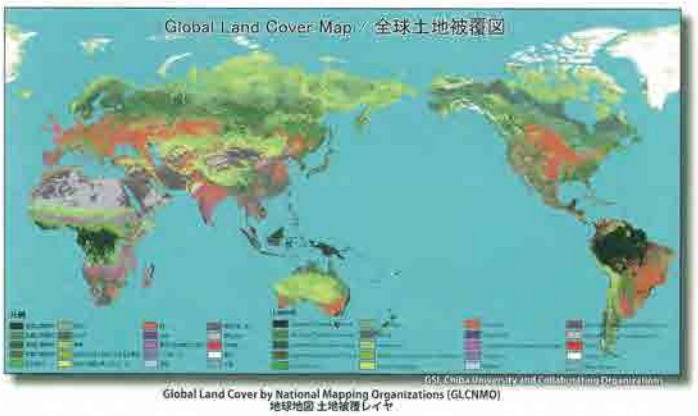
Case of Egmont / エグモント山

Egmont National Park, New Zealand

In 1881, a law which would make the area within the radius of 9.6 km from the summit of the mountain into a forest conservation area was enacted. Therefore, the forest in the conservation area remains like a circle area. On the Global Map (Land Cover layer), the forest is represented as a dark green circle, while surroundings are pale green grassland.

ニュージーランド・エグモント国立公園の自然保護

1881 年に山頂から半径 9.6km 以内を森林保護区とする法律が制定されました。保護区の外では森林を伐採し牧草地などへの転用が進みました。地球地図データからも同心円状に森林が残っている様子が伺えます。左の土地被覆図では、森林は緑色の同心円で表され、薄緑色の草地で周辺を囲まれていることが分かります。



Global Land Cover by National Mapping Organizations (GLCNMO)
地球地図 土地被覆レイヤ

Percent Tree Cover represents the density of trees on the ground. The data show the ratio of the area covered with branches and leaves of trees (tree canopy) to the ground surface seen from the above (vertical direction). Satellite images of the whole globe at every 1km from the MODIS sensor of Terra were used for the data creation. As for deciduous trees, which drop all their leaves during the period of low temperature or dryness, the ratio of the most flourishing period of a year (Maximum Percent Tree Cover) was referenced as the Percent Tree Cover.

地球地図の1つのレイヤとして整備される樹木被覆率は、地球全体を1km²ごとに観測した人工衛星テラの MODIS センサで観測されたデータを使用して作成されました。このデータは樹木の枝や葉の茂っている部分（樹冠）を真上から見下ろした状態（鉛直方向）のとき、地表面に対する樹木の比率を表しています。また、低温や乾燥の続く期間に全ての葉を落として休眠する樹木（落葉樹）は、年間で最も樹木が生い茂っている期間（最大樹木被覆率）をその地域の樹木被覆率としました。

A GLCNMO is the data of 1km grid with 20 land cover items. The data were created by using MODIS data observed in 2003. The classification is based on LCCS (Land Cover Classification System) developed by FAO(Food and Agriculture Organization). Therefore, it is possible to compare and integrate GMLNMO and other land cover data products based on LCCS.

地球地図の1つのレイヤとして整備している全球土地被覆図は 20 の分類項目から成る解像度 1km のデータです。人工衛星テラの MODIS センサで 2003 年に観測されたデータを用いて作成されました。分類は FAO（国連食糧農業機関）が作成した土地被覆分類体系（LCCS）を基にしています。これにより、GLCNMO と他の LCCS を基にする土地被覆成果を比較・統合することが可能になります。

Various Uses of Global Map

地球地図の多様な利用

- Global Map data can be used as basic geospatial information for Environmental Monitoring, Sustainable Development, Mitigation of Natural Disasters, Research, Education and other purposes. In addition, further use of the data is expected.

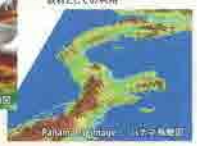
- 地球地図は基礎的な地理空間情報として、環境モニタリング、持続可能な開発、減災、研究、教育などの様々な分野で活用することができます。今後、更なる利用が期待されます。

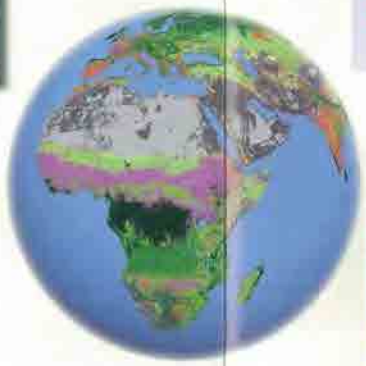
Education / 教育

Global Map School / 地球地図の学校

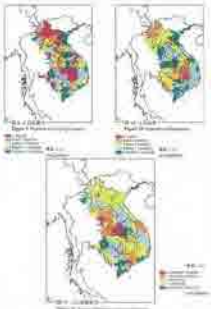
Global Map Contest / 地球地図コンテスト

As Teaching Materials
教材としての利用





Research
研究



Estimation of surplus population carrying capacity

Using data of food production per unit area and land use data of Global Map, population carrying capacity is estimated. By comparing this capacity with the present population distribution, surplus population carrying capacity is estimated.

人口扶養余力の推定

この地域の地球地図土地利用データと単位面積当たりの食料生産量を基に人口扶養力を算出し、この結果を人口データと比較することで人口扶養余力を求めることができます。

- Global Map data are developed in consistent specifications for the whole land area of the globe including Antarctica. The data can be used to predict various global environmental changes by combining with other data such as statistics and environmental indices.

- 地球地図データは、南極を含む世界の全陸域について統一の規格で整備される特徴をもつことから、他の統計、環境指数などと組み合わせることで様々なグローバルな環境変化を予測することができます。

Environmental Monitoring
環境モニタリング

Monitoring across the international boundary
国境を越えた環境モニタリング

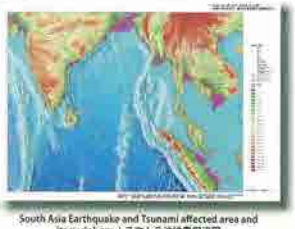
Sustainable Development
持続可能な開発

Basic information for development / 開発の基礎資料
East Africa Map / 東アフリカ周辺図

Mitigation of Natural Disasters
減災

Global Map around Sindh State, Southern Pakistan

Southern Pakistan Torrential rain area
パキスタン南部豪雨周辺図



South Asia Earthquake and Tsunami affected area and its periphery / スマトラ沖地震周辺図

Geographic feature of disaster hit area can be described to evade secondary disaster and to efficiently aid victims. These maps are distributed to all over the world through the Internet, such as the ReliefWeb of UNOCHA.

地球地図を使い、被災地域の地理的特徴を把握することができます。二次災害の予防、救援活動の円滑な実施のために、これらの情報は国連人道問題調整事務所 (UNOCHA) のホームページ（ReliefWeb）などを通じて全世界で共有されます。

- Global Map data are to be updated in every 5 years to make us accurately understand changes of global environment. This will enable application and use of the data for research and study to resolve global environmental problems.

- 地球地図は、概ね5年ごとに更新することとしており、地球環境の変化を的確に把握できます。これにより、地球環境問題を解明する調査・研究への利活用も期待されています。

Participants & Conductor
参加機関と運営機関

National Mapping Organization (NMO) of each country

* NMOs voluntarily cooperate with the project.
* 165 countries and 16 regions participate in the project, covering 95 % of whole land area (as of October 1, 2011).
* In principle, they develop the Global Map of their countries based on the consistent specifications.
* Cooperation among participating countries is expected if it is hard to develop the data by its own country.

International Steering Committee for Global Mapping (ISCGM)

* An international organization to steer the Global Mapping Project
* It conducts policy making on Global Map development and management of progress of data development.
* Established in 1996
* 20 members including representatives of 17 NMOs
* Chair: Prof. D. R. F. Taylor (Carleton Univ. Canada)
* Secretariat: Geospatial Information Authority of Japan (GSI), Ministry of Land, Infrastructure, Transport and Tourism, Japan

各国の国家地図作成機関 (NMO)

・各国の地図作成機関が自発的に協力する
・165ヶ国・16地域(2011年10月1日現在)がプロジェクトに参加し、全陸域の約95%を網羅する
・原則として自国の地球地図を統一仕様に従い整備する
・自国での整備が困難な場合は参加国間で協力する

地球地図国際運営委員会 (ISCGM)

・地球地図プロジェクトを推進するための国際組織
・地球地図整備の方針決定とデータ整備進捗管理を担う
・1996年に設立
・17カ国の国家地図作成機関の代表など20名の委員
・委員長はテイラー教授 (カナダ・カールトン大学)
・国土交通省国土地理院が事務局を務める


The 17th Meeting of ISCGM (Singapore)
第17回ISCGM会合 (シンガポール)

Major activities of ISCGM

* ISCGM Meeting (approx. once a year)
* Global Mapping Forum
* Global Mapping Newsletter (quarterly)
* Technological transfer of Global Map data development and dissemination of the project

地球地図国際運営委員会の主な活動

・ISCGM会合 (年1回程度)
・地球地図フォーラム
・地球地図ニューズレターの発行 (年4回)
・地球地図作成技術移転・普及活動

Secretariat of International Steering Committee for Global Mapping

c/o Geospatial Information Authority of Japan
Ministry of Land, Infrastructure, Transport and Tourism
Kitasato 1, Tsukuba-shi, Ibaraki-ken, 305-0811, Japan
E-mail: sec@iscgm.org URL: www.iscgm.org
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地球地図国際運営委員会事務局

国土交通省 国土地理院内
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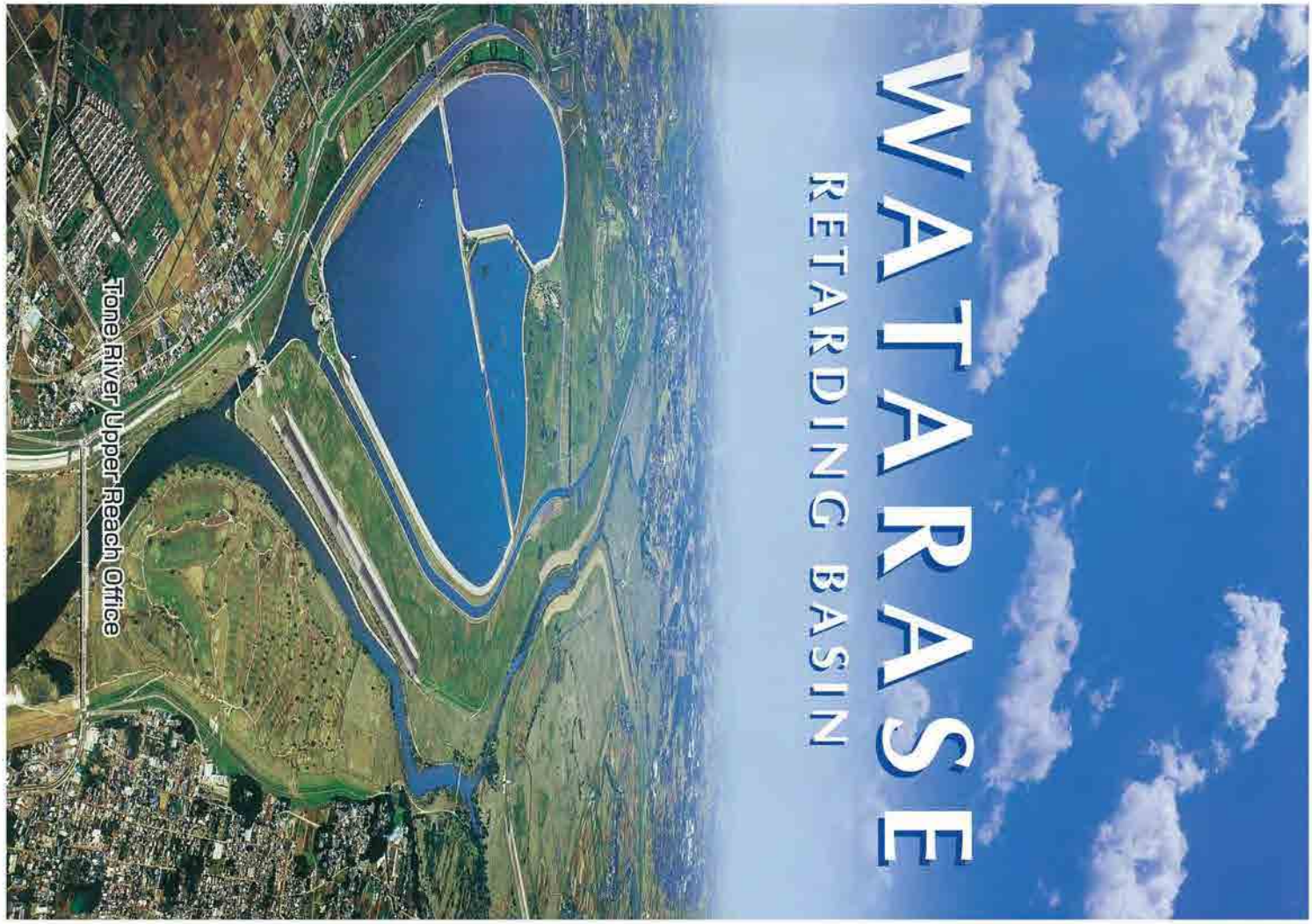
FAX 029-864-8087



Expanding from the Retarding Basin

What is the Watarase Retarding Basin?

The Watarase Retarding Basin is located near the middle reaches of the Tone River. Three rivers, namely Watarase River, Omoi River and Uzuma River, flow into it and then join the Tone River at a point just downstream from there.

The Watarase Retarding Basin is one of the largest of its kind in Japan, stretching over four prefectures, Tochigi, Gunma, Saitama and Ibaraki. It plays an important role for controlling flood in the Tone River System with tremendous quantity of assets concentrated on its lower reaches.

Construction work "to create a retarding basin" was commenced in the 43th year of Meiji (1910) and continued until the 11th year of Taisho (1922).

Thereafter, the following projects have been undertaken up to this date: "project to create regulating reservoirs", conetructing accessing levees and overflow levees; flood control, supply of water to urban areas; "project to create reservoirs (comprehensive development project)" to excavate multi-purpose reservoirs with a view to maintaining normal functions of the running water.

In this way, the Watarase Retarding Basin, taking advantage of its 3,300 ha, the largest area in Japan for its kind, supports the lives of people living along the Tone River, not only by providing preventive functions against floods but also by securing the water for daily life of the inhabitants.

※ See page 3

Mechanism of the Watarase Retarding Basin

1. Under the normal condition, wetland and grassland spread out.

2. As a result of the muddy stream flowing in at the time of a flood and the like, the volume of the water flowing downstream is reduced.

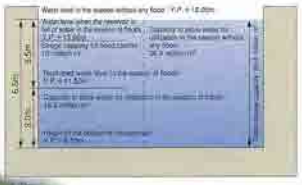
3. Until the flood subsides, the retarding basin recounts the water.

4. After the flood has passed off, the drainage gate is opened to discharge water stored within the retarding basin to the river.

■Comparison with other retarding basins

Name	River	Location	Area (ha)	Capacity (million m³)
Watarase Retarding Basin	In the upper reaches of the Tone River	Ashiko Town, Tochigi Prefecture, etc.	3,300	17,180
Kokaigawa Retarding Basin	In the upper reaches of the Kokaigawa River	Kamisato City, Saitama Prefecture, etc.	1,450	12,450
Hanshima Retarding Basin	The Kokai River	Shinodate City, Ibaraki Prefecture, etc.	160	500
The Tsukuba-Plain Multi-purpose Retarding Basin	The Tsukuba River	Hanishima-gun, Kanagawa Prefecture	100	390

■Various water levels of the reservoir



Retarding basin (whole)
Area : 33km²
Capacity : 171.8 (million m³)

No.1 Regulating reservoir
Area 15.0km²
Capacity 117.1 (million m³)

The largest regulating reservoir within the Watarase Retarding Basin. There is the Lake Yanaka in the southern part, while the northern part is used for a golf course and so forth. Since the area within the reservoir is extensive, two overflow levees, one upstream and the other downstream, have been constructed. Incidentally, the upstream levee is as long as 1,400 m.

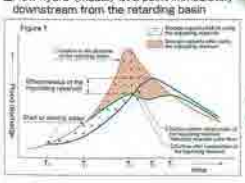
No.3 Regulating reservoir
Area 2.8km²
Capacity : 19.1 (million m³)

The smallest of the three regulating reservoirs. It was provisionally completed in June, 1997 in accordance with the Uzuma River improvement process. High growing Akamegahagi (salix chaenomeloides) in groups and sedges in groups on wetland are seen within the reservoir.

No.2 Regulating reservoir
Area 5.0km²
Capacity : 35.6 (million m³)

The regulating reservoir surrounded by the Watarase, Omoi and Uzuma Rivers. There is an overflow levee facing the Omoi River. A wide field of reed is seen other than the cultivated land forming a part of the reservoir site.

■Flow hydro (model) at a point immediately downstream from the retarding basin



Rich life of Yanaka Village

Yanaka Village was first formed in the 22nd year of Meiji (1889), lying between the Watarase and Omoi Rivers in an area where marsh land and wetland spread out, when three villages in the area merged into one.

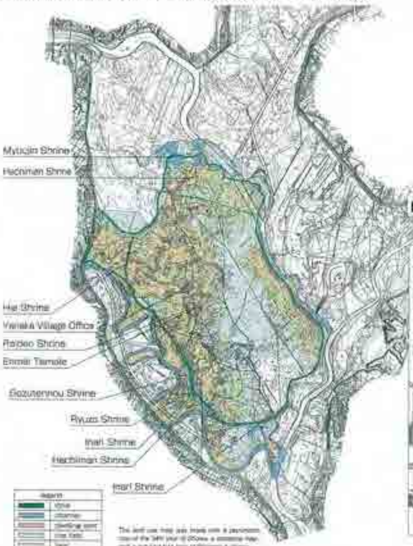
Originally, this had always been the area where marsh land and wetland spread out, located in the zone constantly hit by floods. Therefore, most of the hamlets were located on low hills and natural banks and surrounded by the enclosing banks around these hamlets and cultivated land. Each private house built many water mounds (mounds with soil piled up to raise the foundation of houses in order to contain the flood damages to the minimum) and a forest for guard against flood damages, while keeping always a hung boat (boat to be used for escaping and moving around at the time of a flood). You can still confirm even now almost 50 water mounds scattered in the area.

In addition, sericultural industry, fishery and so forth were prosperous with many people making their living by fishing eels, carps, roaches, etc. in the 20s of Meiji Era (decade from 1887). Moreover, they were also engaged in brick manufacturing using soil brought by floods, and all in all, people of Yanaka Village used to lead rich life.

Map of water mounds distributed in Yanaka Village

Raiden Shrine of Yanaka Village

■Image of Yanaka Village About A Hundred Years Ago



■Location map of surrounding banks in the low land along the Omoi River

Scenes reminiscent of Yanaka Village in olden days that are still remaining

Water mounds at Enmein Temple

Enclosing banks in Yanaka Village

Water mound in the place where there used to be the village office

Abolishment of Yanaka Village and Construction of Retarding Basin

Entering Meiji Era, as the copper production was largely increased, many trees were indiscriminately felled down in the mountains of river-heads to obtain charcoals needed for smelting, disabling these mountains to hold water any longer. As a result, the mineral pollution was spread along the Watarase River by the floods hitting the area frequently.

The floods of the 23rd and 29th years of Meiji (1890 and 1896) brought slag along with the flooded water to the farming field of the middle and downstream area of the river. The damage was so extensive that it spurred vehement opposition against the mineral pollution.

In Yanaka Village, people planned to install draining equipment but it did not work well and the village was further left helpless. It was submerged to look like a pond covering the entire village by the flood of the 35th year of Meiji (1902).

In the 36th year of Meiji (1903), the Second Mineral Pollution Survey Conference was set up by the government. The idea of acquiring land for constructing a retarding basin was decided to be realized.

Later on, immigration from Yanaka Village began. Many of them emigrated to neighboring towns and villages, while some fled to go as far as Nasu County or Shioya County of Tochigi Prefecture, or Saroma of Hokkaido.

They had to go through lots of suffering to clear land for cultivation and so forth.

In the course of time, Yanaka Village was abolished in the 39th year of Meiji (1906).

The Watarase Retarding Basin was thus created at the sacrifice of many people.

Ashio Copper Mine <circa the 18th year of Meiji (1885)>

Wheat withered by mineral pollution

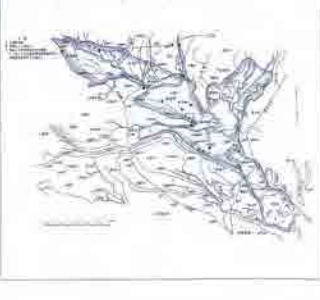
Initial main destination for the relocation of the people in Yanaka Village

(number of houses)

	Shitamiya	Uchino	Egono	Total
Koga City	95	26	2	123
Fujioka Town	23	47	25	95
Nogi Town	14	7	46	67
Itakura Town	9	24	3	36
Kitakawabe Town	11	6	0	17
Mibu Town	3	4	0	7
Nasu Town	14	29	0	43
Shioya County	2	3	0	5
Tokyo	7	2	2	11
Oyama City	0	2	7	9
Hokkaido	4	0	0	4

The table was made in the 61st year of Showa by adding up the names listed on "The Nominal Register of former Yanaka Village Relations" (issued by "Joint Committee for the Remembrance of Former Yanaka Village" and Fujioka City). However in "Tochigi no Ayumi (The advanced of Tochigi)" issued by the Committee for editing the history of names in Tochigi", the 67th year of Showa, the number of the houses that went to Hokkaido was recorded as seventeen.

Extent of the area hit by mineral pollution



Draining equipment still remaining

Shozo Tanaka

- 1841 (12th year of Tempo)
  Born in now Sano City, Tochigi Prefecture.
- 1880 (13th year of Meiji)
  Elected prefectural assembly member of Tochigi.
- 1890 (23rd year of Meiji)
  Elected House of Representatives member.
- 1891 (24th year of Meiji)
  Took up the issue of mineral pollution at the Imperial Diet.
- 1897 (30th year of Meiji)
  Went up to Tokyo with a few thousands of mineral pollution victims to make a petition for the shutdown of the copper mine. (This incident is called "Tokyo Oshi-dashi" or "Extrusion to Tokyo"). The government issued "The Order of Protective Works against the Mineral Pollution" to Ashio Copper Mine.
- 1900 (33rd year of Meiji)
  Kawamata Incident (the farmers encountered a squad of policemen at Kawamata on their way to Tokyo for presenting a petition) occurred, and Shozo resigned as a Diet member the next year, the 34th year of Meiji.
- 1901 (34th year of Meiji)
  Tried to present a petition directly to the Emperor Meiji but in vain.
- 1910 (43rd year of Meiji)
  Government-ruled flood control project started. (attributing the mineral pollution to flooding)
- 1913 (2nd year of Taisho)
  Died

Villagers staying on even after the forceful destruction of their houses

Brief chronological table of Yanaka Village · Retarding Basin	
29th year of Meiji (1896)	Severe damage by the flood
30th year of Meiji (1897)	The First Mineral Pollution Survey Conference was set up by the government.
33th year of Meiji (1900)	A large number of people who suffered from mineral pollution encountered a squad of policemen on their way to Tokyo to present a petition for the fourth time (Kawamata Incident).
33th year of Meiji (1900)	The Tone River Improvement Project was formulated.
34th year of Meiji (1901)	Shozo Tanaka presented the petition directly to the Emperor Meiji
36th year of Meiji (1903)	The Second Mineral Pollution Survey Conference was set up by the government. The idea of acquiring land for constructing a retarding basin was decided to be realized.
37th year of Meiji (1904)	Tochigi Prefecture began acquiring Yanaka Village (with 370 - 380 houses and inhabitants of approx. 2,500, up to the 40th year of Meiji <1907>)
40th year of Meiji (1907)	Forceful expropriation of 16 houses was executed.
43th year of Meiji (1910)	River improvement project was commenced on the Watarase River that came under the direct control. Severe damage by a flood.
44th year of Meiji (1911)	The River Tone Improvement Project was revised, in which the Watarase Retarding Basin was duly positioned.
7th year of Taisho (1918)	Watarase River Shifting Construction was completed.
11th year of Taisho (1922)	The retarding basin was completed.
14th year of Showa (1939)	The Tone River Enlargement and Supplementation Project was formulated.
[illegible] year of Showa (1947)	Severe damage by a flood
22nd year of Showa (1947)	Serious damage by Typhoon Catherine
24th year of Showa (1949)	The Tone River Improvement Project was changed.
[illegible] year of Showa (1963)	The regulating reservoir construction project was started.
[illegible] year of Showa (1970)	No.1 Regulating Reservoir was completed.
[illegible] year of Showa (1972)	No.2 Regulating Reservoir was completed.
[illegible] year of Showa (1976)	Comprehensive Development Works for the Watarase Retarding Basin was started.
March, the 2nd year of Heisei (1990)	Watarase No.1 Reservoir (The Lake Yanaka) was provisionally completed.
April, the 3rd year of Heisei (1991)	The area surrounding the Lake Yanaka was opened to the public.
[illegible] year of Heisei (1995)	Council for Comprehensive Development Works for the Watarase Retarding Basin (Works for TermⅡ)
December, the 8th year of Heisei (1996)	Report on Comprehensive Development Works for the Watarase Retarding Basin (Works for TermⅡ) (suspended)
[illegible] year of Heisei (1997)	No.3 Regulating Reservoir was completed.
March, the 12th year of Heisei (2000)	Proposal, "Grand Design for Nature Conservation of the Watarase Retarding Basin and its Utilization; Making Most of its Nature"
March, the 15th year of Heisei (2003)	Comprehensive Development Works for the Watarase Retarding Basin was completed (Works for TermⅡ was canceled.)
February, the 18th year of Heisei (2006)	Basic Policy for River Development Project of Reservoirs along the Tone River was established.
June, the 18th year of Heisei (2006)	Yanaka Memorial 100 was held to commemorate the 100th year from the abolishment of Yanaka Village on the 30th of June.

Books of reference from which quotations were made

"History of Fujioka Town, Section of Reference Materials · Yanaka Village"
by Committee for Compiling the History of Fujioka Town / Fujioka Town

"Life of Shozo Tanaka" by Tokeji Hayashi / Kodansha Ltd.

"NHK University for Citizens / Shozo Tanaka"
by Masaomi Yui / Japan Broadcast Publishing Co., Ltd.

"Yanaka Village Incident" by Teru Oshika / Shinsensya

As the pivot of flood control for the Tone River System

The flood caused by Typhoon Catherine of the 22nd year of Showa (1947) inflicted an immeasurable damages to many areas of the Kanto Plain. To prepare for any flood to be caused by a typhoon of the magnitude of Catherine, flood control with the dams in the upper reaches, control of river paths, construction of flood control reservoirs, and so forth have been carried out in the Tone River and its tributaries including the Watarase River.

The Watarase Retarding Basin plays an important role of flood control together with 7 dams in the upper reaches of the Tone River. It functions to protect the area in the lower reaches of the Tone River from flood damages by taking care of the flood of the Watarase, Omoi and Uzuma Rivers on its own in the beginning without affecting the planned high water volume (flow volume at the time of a flood) of the main stream of the Tone River.

At the time of Typhoon No. 6 of July, the 14th year of Heisei (2002), the total volume of the stored water reached 78 million m³ (according to a calculation). If Watarase Retarding Basin had not existed, the water level at Kurihashi point downstream would have been 1 meter higher.

However, the heavy rains resulted in the excess of the ※Dangerous Water Level at Omoi River and water leakage at Uzuma River, and some flood prevention measures were taken.

It has been a hundred years since the project for developing the Watarase Retarding Basin began, but the flood-control operation has not yet been completed. Considering the frequent happenings of extreme flood in recent days, it is essential to secure more water control capacity at the Watarase Retarding Basin.

※Dangerous Water Level : When a dangerous water level exceeds, there is a possibility for a river to overflow, or a levee broken.

Kurihashi water-level observing station of the Tone River

The Tone River under the normal condition

The Tone River at the time of the flood (July 11th, the 14th year of Heisei.)

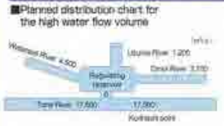
■Effect of Watarase Retarding Basin
(At Kurihashi point,
The flood of July, 14th year of Heisei (2002))

■The Watarase Retarding Basin performed ten water-controlling in the past.

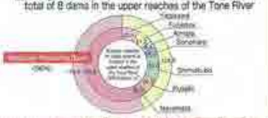
Name of the flood	[illegible]	[illegible]	[illegible]
September, the 47th year of Showa <1972> (Typhoon No. 20)	8,780	148	240
August, the 57th year of Showa <1982> (Typhoon No. 10)	11,420	370	1,908
September, the 57th year of Showa <1982> (Typhoon No. 18)	11,810	1,150	3,335
August, the 3rd year of Heisei <1991> (Typhoon No. 12)	[illegible]	333	658
August, the 10th year of Heisei <1998> (Front)	5,590	435	848
September, the 10th year of Heisei <1998> (Typhoon No. 5)	10,430	1,800	8,333
August, the 11th year of Heisei <1999> (Tropical atmospheric pressure)	6,380	66	517
August, the 13th year of Heisei <2001> (Typhoon No. 11)	5,000	24	56
September, the 13th year of Heisei <2001> (Typhoon No. 15)	8,000	1,140	5,800
July, the 14th year of Heisei <2002> (Typhoon No. 6)	8,500	1,011	7,800
September, the 19th year of Heisei <2007> (Typhoon No. 9)	8,330	1,560	6,300

Outline of the Watarase Retarding Basin

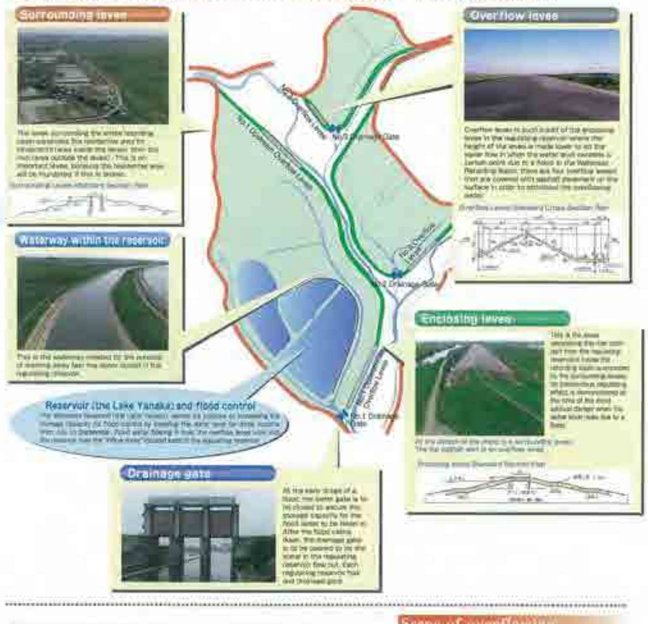
■Planned distribution chart for the high water flow volume



■Storage capacity for flood control as percentage of the total of 8 dams in the upper reaches of the Tone River



Facilities for flood control in the Watarase Retarding Basin



Flood of July, the 14th year of Heisei (2002)

Scene of overflowing


Flood of July, the 14th year of Heisei (2002)
Muddy water flowing into the basin at the overflow levee of the No. 1 Regulating Reservoir. Seen from the upstream.

As the reservoir for the metropolitan district

The Watarase Retarding Basin (Lake Yanaka) supplies water for daily life in concert with 7 dams in the upper reaches of the Tone River.

In the metropolitan district, ※water shortage accompanying restriction on water use happens at a rate of once in every 2-3 years.

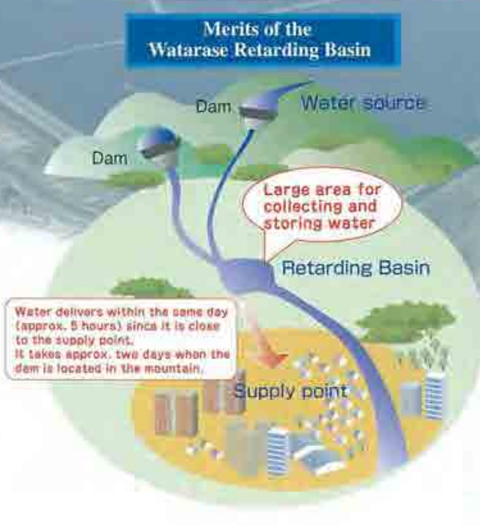
The formal operation of Watarase Reservoir (Lake Yanaka) was started in the 2nd year of Heisei as the first "level land type dam" in Japan.

※Water restriction : to secure a water supply in the dry season, water consumption is adjusted.

■Scale of the Lake Yanaka

Total storage capacity	26,400,000m³	21 times as much as Tokyo Dome
Outer circumference	Approx.9.2 km	Approx. 46 rounds of school yard having 200 m for one circle
Area	4.5km²	100 times as large as Tokyo Dome

Merits of the Watarase Retarding Basin



Facilities for purification by the marsh reed field

Facilities for separating the Yata River

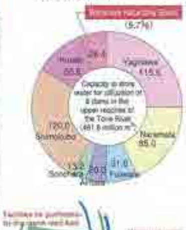
Drying-out treatments

■Extent of water shortage and supplementary supply volume for each year

Year	Water restriction: Period	Maximum restriction rate (%)	[illegible]
47th year of Showa (1972)	[illegible]	18	[illegible]
48th year of Showa (1973)	Aug 11 - Sept 6	30	[illegible]
52nd year of Showa (1977)	Aug 10 - Oct 8	20	[illegible]
[illegible]	July 6 - Aug 13	10	[illegible]
[illegible]	July 4 - July 8	10	[illegible]
[illegible]	[illegible]	10	[illegible]
62nd year of Showa (1987)	June 16 - Aug 25	30	[illegible]
2nd year of Heisei (1990)	[illegible]	20	[illegible]
6th year of Heisei (1994)	July 22 - Sept 19	30	[illegible]
[illegible]	[illegible]	10	[illegible]
	[illegible]	30	[illegible]
[illegible]	Feb 1 - March 25	10	[illegible]
[illegible]	[illegible]	10	[illegible]

Year	Supplementary supply volume
2nd year of Heisei (1990)	1,590
3rd year of Heisei (1991)	0
4th year of Heisei (1992)	880
5th year of Heisei (1993)	140
6th year of Heisei (1994)	800
7th year of Heisei (1995)	1,310
8th year of Heisei (1996)	1,390
9th year of Heisei (1997)	[illegible]
10th year of Heisei (1998)	1,710
11th year of Heisei (1999)	1,490
12th year of Heisei (2000)	2,430
13th year of Heisei (2001)	[illegible]
14th year of Heisei (2002)	1,870
15th year of Heisei (2003)	[illegible]
16th year of Heisei (2004)	1,090
17th year of Heisei (2005)	[illegible]
18th year of Heisei (2006)	[illegible]
19th year of Heisei (2007)	[illegible]
[illegible]	[illegible]

■Capacity to store water for utilization



Mechanism of water intake and replenishment and countermeasure for water quality purification

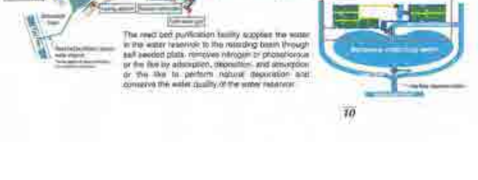
Water intake and replenishment are performed with the pump provided at "water reservoir machine station" connecting the water reservoir and Watarase River (water pumping: 20 m³/sec). Furthermore, the countermeasure for water quality purification is taken at the places marked in red.

Water quality countermeasure at Yanaka Lake

Operation started in 1990, but musty odor caused by phytoplankton (mainly Phormidium) growth was thrown out in replenishing for drought in August, and it had an influence on the city water at the downstream side. Therefore, the Yata River separation facility and read bed purification facility or the like were executed as a water quality remediation measure facility. However, further reduction of musty odor is needed and drying-up has been executed since the fiscal year 2003 (January 2004).

■Generation status (ng/L) of musty odor (2-MIB)

■Reed bed purification facility



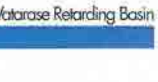
The reed bed purification facility supplies the water in the water reservoir to the retarding basin through self seeded plats, removes nitrogen or phosphorous or the like by adsorption, deposition, and absorption or the like to perform natural depuration and conserve the water quality of the water reservoir.

■Drying-up of water reservoir

"Drying-up" means lowering the water level than the minimum water level (YP+8.5 m) of the water reservoir.

Even in the drying water level YP+8.3 m, since there is a deep place and the water surface remains 20% or so, the fish in Yanaka Lake can inhibit there during the time.

Emergence time of phytoplankton (Phormidium) is retarded by exposing the revetment portion, and the lake bottom portion, and annihilating and reducing phytoplankton (Phormidium) to reduce the occurrence of the musty odor in the spring season.



■Yata River separation facility

Yata River having deteriorated water quality is separated among the intake water river stored in Watarase water reservoir to reduce the intake water load amount of nutrient salts (nitrogen, phosphorous).

Habitat of various plants and animals

Wetland captures the spotlight as a place where vast space, green land and water grow various plants and animals. It seems that decreasing tendency of wetland reported in the world including Japan is further making its preciousness conspicuous.

Under these circumstances, the Watarase Retarding Basin has a precious space, maintaining environment as marsh within a vast site of 3,300 ha., although it is located within a circle of 60 km from Tokyo. Especially, the marsh reed field with 1,500 ha. boasts the largest area of its kind on the Main Island of Japan.

You can see various plants and animals in such rich environment. The place could certainly be called a natural treasurehouse as you can see birds including birds of prey such as marsh harrier and plants amounting to more than 900 species such as pickerelweed.

However, the recent aridification has led to the decreasing of ponds, lakes and emergent plants, and increasing of common reeds community.

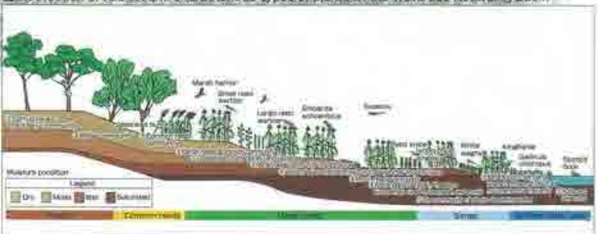
Moreover, such practice as reed burn-off which promotes nature efficiency by human hand is also continued as practiced in ancient times.

We should take various actions to preserve the wetland of the Watarase retarding basin in better way.

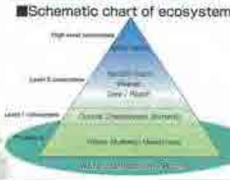
■Main wetlands in Japan

■Area of marsh reed fields

■Distribution of habitat and characteristic types of plants at the Watarase Retarding Basin



■Schematic chart of ecosystem



Lake Yanaka and ducks

Lake Yanaka is a multi-purpose reservoir, created in the 2nd year of Heisei (1990). Many ducks come flying here to pass the winter every year, their number reaching 5,000 to 10,000. Many of them are wild ducks, teals and spotbill duck, while wild geese and whooper swans also come sometimes.

Marsh harrier at the Watarase Retarding Basin

Marsh harrier is a middle-sized bird of prey living in marsh reed fields and 20 to 30 of them fly into the Watarase Retarding Basin every year as winter birds. This basin is the largest place for birds to pass the winter in our country. Almost all the life of marsh harrier depends on the marsh reed field, in which it catches rats or birds and then makes nests. It can really be said that it symbolizes the ecosystem of the Watarase Retarding Basin.

The effect of reed burn-off

"Reed burn-off" is carried out in almost all the areas of the Watarase Retarding Basin in March every year for growing marsh reeds of good quality necessary for producing marsh reed screens. This reed burn-off is watched with keen interest, since it has the following effects to protect natural environment in addition to growing good marsh reeds.

point 1 To preserve a marsh reed field by preventing it from transforming into a forest.

point 2 To secure enough sunshine necessary for sprout of various spring plants which are to grow before marsh reeds grow thick.

point 3 To prevent field fire and so on.

A place transformed into a forest because the reed burn-off was not carried out

Tonemateyasuri (ophioglossum) maintained by the reed burn-off

Precious plants in the Watarase Retarding Basin

There is a lot of untouched nature in the area of the Watarase Retarding Basin since it was purchased for creating a retarding basin in the Meiji Era, and plants different in phase from those in other places can be seen. Over 40 species listed in the Red Data Book (published in 2000) are here as confirmed. Tonemateyasuri, a representative spring plant, grows thick all over the place. Furthermore, it is the only habitat in our country for hatake-fimbristylis.

Active work to create an environment

Besides the work mentioned above, some initiatives are actively taken to create a better environment in the Watarase Retarding Basin.

Facilities for purification by the marsh reed field

It is the main aim to promote the growth of various plants in such a way as excavating the land for waterways and building small hills in the marsh reed field in order to diversify the natural environment from the land to Eco-tone (transition zone from the water zone to land zone) and then to the waterside. In addition, purification of the water quality is also conducted by making use of the nature of marsh reeds to adsorb nitrogen, phosphorus, plant plankton, etc.

Floating islets

The man-made floating islets in the reservoir, planted with rushes and reeds by using nets were created for the purposes of not only providing fish with shelters and birds with nests but also controlling the growth of plant plankton by increasing animal plankton and some kinds of shrimps. They will augment greenery and contribute to improving the scenery.

Greenery planting for the protection of lake shore

This plan aims at diversifying the ecosystem and improving the scenery by planting trees and grasses along the lake shore after covering the concrete blocks with soil.

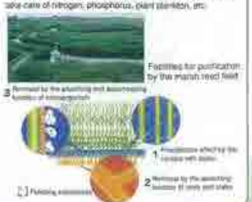
Ponds with diverse natural features

This plan aims at diversifying the ecosystem of plants and animals through adding variety to the geographical features by building ponds and small hills in the marsh reed field almost devoid of undulation and comparatively monotonous in biological phase.

■Facilities for purification by the marsh reed field

Purifying mechanism by the marsh reed field

It is attempted to conduct natural purification of the water quality and preserve the water quality of the reservoir by draining the water of the reservoir into the marsh reed field, since reeds can adsorb, precipitate, absorb and otherwise take care of nitrogen, phosphorus, plant plankton, etc.



■Floating islets

■Greenery planting for protecting the shore of the Lake Yanaka

■Ponds with diverse natural features

Current status of Monotonization of vegetable and aridification of retarding basin

In Meiji era, there were a lot of ponds and marshes including Akasaa-numa and Akashibu-numa or the like in North part of Watarase retarding basin. However, almost all these marshes and ponds were varnished due to relocation of Watarase River and aridification has advanced. Approximately 50 kinds of plants that like the water side have disappeared from the retarding basin in the last 50 years.

Grand design

"Grand design" that makes natural conservation and the most of nature of Watarase retarding basin was proposed in March 2000 in order to consider the image in the feature regarding nature and the utilization of Watarase retarding basin. In the proposal, reduction of the wetland due to aridification was positioned as a problem on the natural environment in the retarding basin, and necessity of the wetland recovery imaging the figure of the retarding basin in 1950" is pointed out.

Wetland recovery test basin ~New movement toward wetland recovery~

"Watarase retarding basin wetland conservation and recovery exploratory committee" was established in 2002, and examination of the concrete measure has been advanced by the specialists. The wetland recovery test in the second regulating reservoir has started by the instruction of the specialists since 2007.

Planning of the wetland conservation and recovery project is aimed through these activities.

Outline of test

In the wetland recovery test basin, the place where there are a few rare species and a lot of foreign species are selected, and restoration status of wet plants or the like is monitored under various conditions (depth of excavation or the like). "Waterside plant recovery experimental basin" for recovering submerged plants or floating-leaved plants or the like was created in the fiscal year 2007, and "Wet grassland recovery experimental land" for recovering the wide and flat wet grassland was created in the fiscal year 2008. In the feature, various types of test basins are created to make use of planning of the wetland conservation and recovery project.

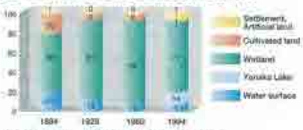
■The second regulating reservoir vegetable recovery experiment

Vision in the future

The wetland conservation and recovery project of the Watarase retarding basin is planned, and the adaptive management is performed in operation. Furthermore, the foreign species counter measure is also advanced.

■Reduction of the water surface

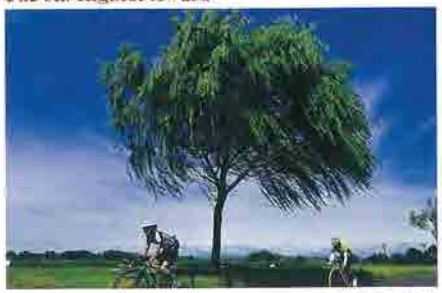
■Transition of land utilization rate (%)



■Change in the spotted species (during the past 50 years)

Watarase Retarding Basin Photo Contest

The 9th Highest Award



"Wind of early autumn" Shigeru Hisamatsu (Tochigi-shi Tochigi)

The 9th Award of Tone River Upper Reach Office Director

"Time of Budding" Hiroshi Takahashi (Ashikaga-shi, Tochigi)

Transportation Guide

By Car

- About 3 km northwestward from Mikuni Bashi of Route 354
- About 20 minutes eastward ride from Tatebayashi IC of Tohoku Expressway

By Tobu Railway

- Tobu Nikko Line
  Exit at Shin Koga, Yagyu, Itakura Toyodai Mae or Fujioka station.
  (From Asakusa to Itakura Toyodai Mae: Approx. 1 hour)
  (From Tobu Utsunomiya to Itakura Toyodai Mae: Approx. 1 hour)

By JR

- JR Utsunomiya Line
  Exit at Koga or Nogi station
  (From Ueno to Koga: Approx. 1 hour)
  (From Utsunomiya to Koga: Approx. 40 min.)

Tone River Upper Reach Office,
Kanto Regional Development Bureau,
Ministry of Land, Infrastructure and Transport

2-19-1 Kurihashi-machi Kita, Kita-Katsushika District, Saitama Prefecture
Telephone : 0480-52-3959 (Regional Partnership Division)

Outline of Musashi Canal Reconstruction Project

Project outline

○ Location: Gyoda City and Konosu City, Saitama Prefecture (Musashi Canal connecting the Tone River and the Ara River)

○ Objectives: • Restoration of the function of steady flow
• Securement and reinforcement of the function of inner drainage
• Improvement of the water quality of the Ara River System

○ Numerical data (on reconstruction)
Main canal: A portion of 14.5 m in length reconstructed
Sections: 43.2 m^3/s from the diversion works (starting point) to Motoarakawa
50.0 m^3/s from Motoarakawa to Arakawa (terminating point)
Siphons: Six
Flood gates: Three (including one new flood gate)
Outlets: Six (including two new outlets)
Drainage pumping station: Up to 50 m^3/s
Other facilities: Drainage sluice pipes (1 natural drainage pipe and 1 forced drainage pipe), administrative facilities, etc.

○ Project cost: About ¥70 billion

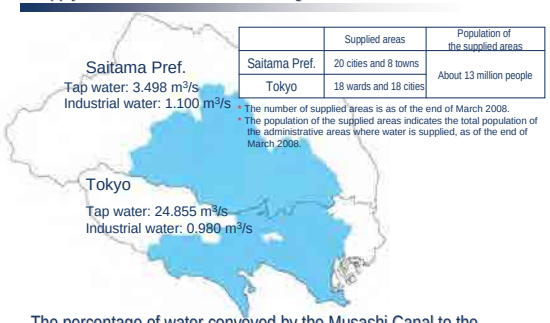
○ Construction period: From 1992 to 2015

○ Current status: Project not required to be verified

Musashi Canal

The Musashi Canal is an open channel of about 14.5 km connecting the Tone River and the Ara River.
The water to be used as city and industrial water in Tokyo and Saitama Prefecture is withdrawn through the Tone Weir, and conveyed to the Arakawa River. The water to be used to improve the quality of the water of the Sumida River is also conveyed.

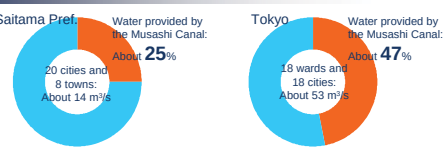
Supply of water for urban areas through the Musashi Canal



	Supplied areas	Population of the supplied areas
Saitama Pref.	20 cities and 8 towns	About 13 million people
Tokyo	18 wards and 18 cities	

* The number of supplied areas is as of the end of March 2008.
* The population of the supplied areas indicates the total population of the administrative areas where water is supplied, as of the end of March 2008.

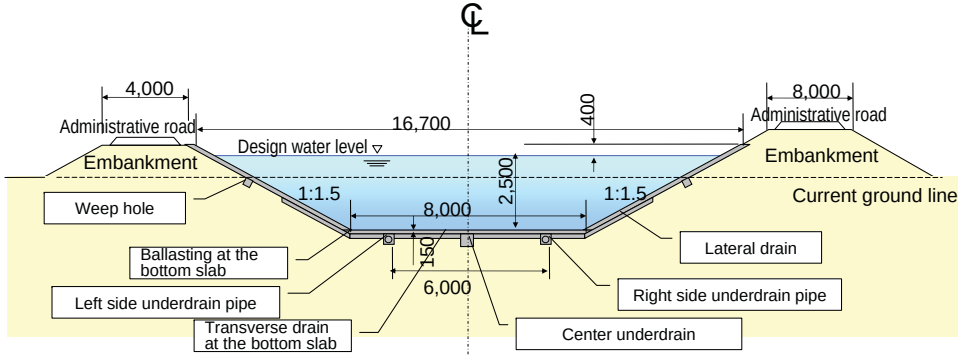
The percentage of water conveyed by the Musashi Canal to the total amount of water supplied in the water supply area



Prepared by the Musashi Canal Reconstruction Office, the Incorporated Administrative Agency Japan Water Agency based on the Water Supply Statistics 2007 (Health Service Bureau, Ministry of Health, Labour and Welfare)

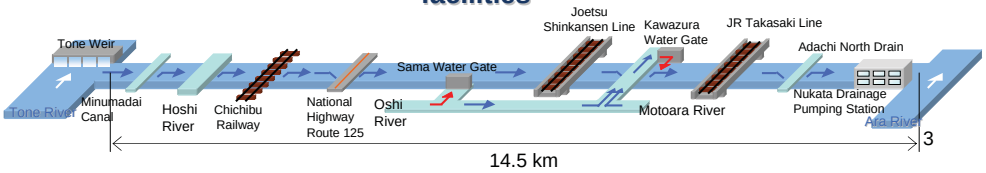
Current Musashi Canal

Typical cross section of the current Musashi Canal



Relation with nearby facilities

* Design section at the time of constructing the Musashi Canal



Current Musashi Canal (dilapidated facilities, etc)

Dilapidation has caused damage to water channels, suspended water conveyance, and increased chances for the occurrence of accidents caused by third parties.

Damaged lining panels
(point of 8,885 m, below the left band of the Namiki Bridge)

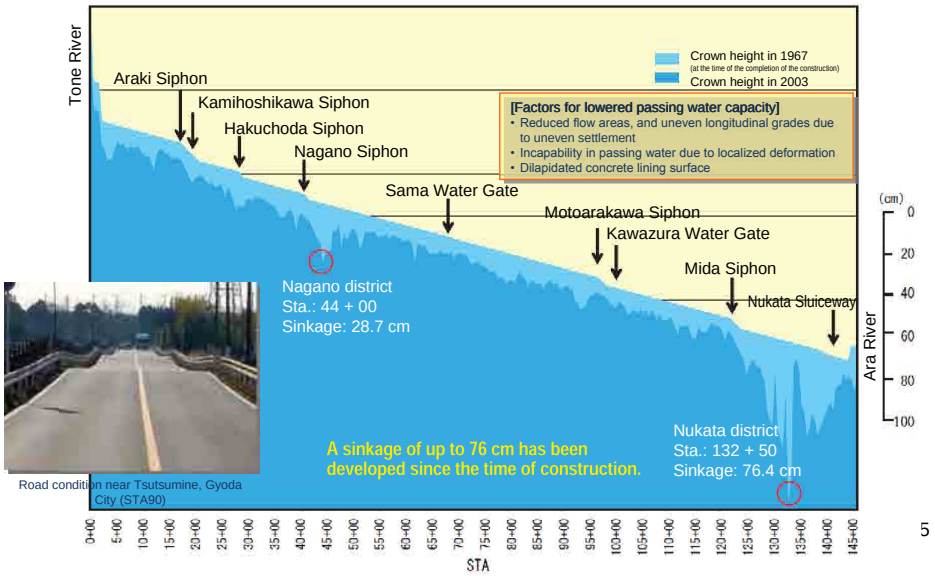
Leakage through the joints of lining panels
(near the point of 2,500 m, left bank side)

Raised bottom slab due to uneven settlement
(point of 13,250 m, under the Sanmai Bridge)

Deformation caused by sinkage
(near the point of 13,200 m, left bank side)

Current Musashi Canal (lowered passing water capacity due to sinkage)

A survey conducted in 1999 confirmed that the passing water capacity has lowered from 50 m³/s to about 37 m³/s since the time of the construction.

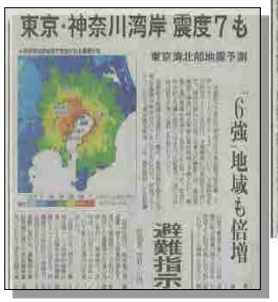


Road condition near Tsutsumine, Gyoda City (STA90)

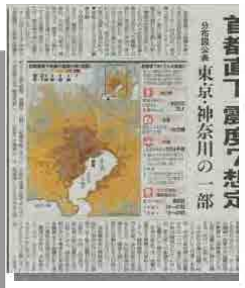
Current Musashi Canal: Insufficient quake resistance

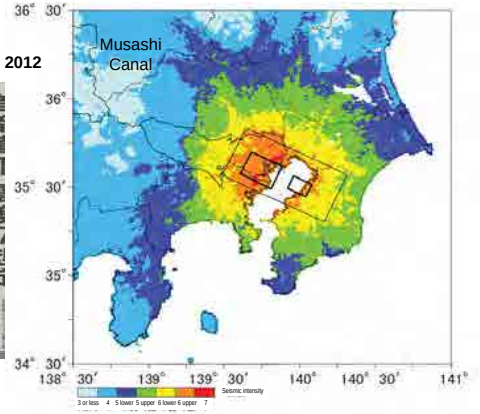
The existing Musashi Canal was completed in 1967 but recent seismic design in preparation for a major earthquake has not been incorporated. Under the Musashi Canal Reconstruction Project, the canal will be reconstructed so that it will withstand the possible largest earthquake ground motions (Level 2 earthquake ground motions) in the future, and that the flowing and inner drainage capacities of the canal will be secured even when a large earthquake occurs.

Yomiuri Shimbun, March 31, 2012



Asahi Shimbun, March 31, 2012





Case 1: Seismic intensity of the Tokyo-wan Hokubu Earthquake with shallow plate borders incorporated

The predicted distribution of seismic intensity of an inland earthquake that may occur in the future was released by a research team with the Ministry of Education, Culture, Sports, Science and Technology, and the Earthquake Research Institute, University of Tokyo on March 30, 2012.

Current Musashi Canal (flood damage to the area near the water channel)

There is an urgent need to reinforce flood control in the area around the Musashi Canal.

In June 1966 immediately after the temporary start of the Musashi Canal with running water, 4,044 buildings were inundated above or below floor level by Typhoon No. 4.

Since April 1971, the water has been conveyed from the Oshi River and the Motoara River to the Musashi Canal 70 times, and a total of more than 1,000 buildings were inundated above or below floor level in a total of 38 times from 1971 to 2010.

There is a need to increase flowing and drainage capacities.

Typhoon No. 17 in Sep. 1996 (Nagano, Gyoda City)

Torrential rain in Aug. 2004 (industrial park in Gyoda City)

Objectives of the Musashi Canal Reconstruction Project

1. Restoration of the function of steady flow

To restore facility functions that have been declining due to dilapidation. To secure quake resistance and minimize damage caused by earthquake.

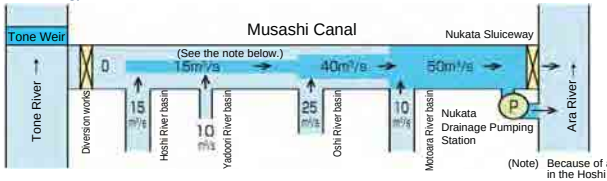
○ City water: Under normal conditions, the water is taken from the Tone Weir to the Musashi Canal so that up to about 35 m³/s of water is conveyed to the Ara River.

Tap water of Tokyo:	30.274 m³/s
Industrial water of Tokyo:	0.980 m³/s
Tap water of Saitama Pref.:	2.700 m³/s
Industrial water of Saitama Pref.:	1.100 m³/s
Total:	35.054 m³/s

2. Securement and reinforcement of the function of flood control

To secure and reinforce the function of drainage, and reduce flood damage to the area near the canal.

○Inner drainage: A total of up to 60 m³/s of flood water from the Hoshi River, Yadoori River, Oshi River, and Motoara River is drained to the Ara River
(50 m³/s of flood water is handled by facilities in consideration of time difference in the peak of flooding) .



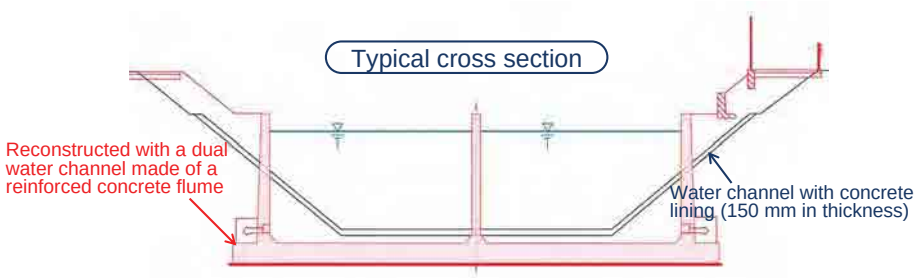
(Note) Because of a time lag in reaching the peak flow in the Hoshi River basin and the Yadoori River basin, the quantity of flow in the section reaches to the maximum of 15 m³/s.

3. Improvement of the quality of the water of the Ara River System

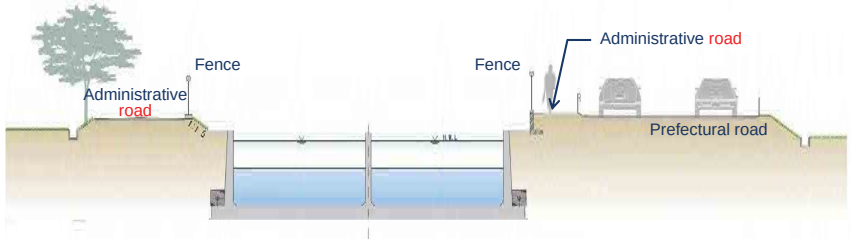
To convey the water for purification from the Tone River in order to contribute to improvement of the quality of the water of the Ara River System.

○ Water for purification: To contribute to improvement of the quality of the water of the Ara River System, up to about 8 m³/s of water is conveyed to the Ara River.

Typical cross section through the water channel after reconstruction

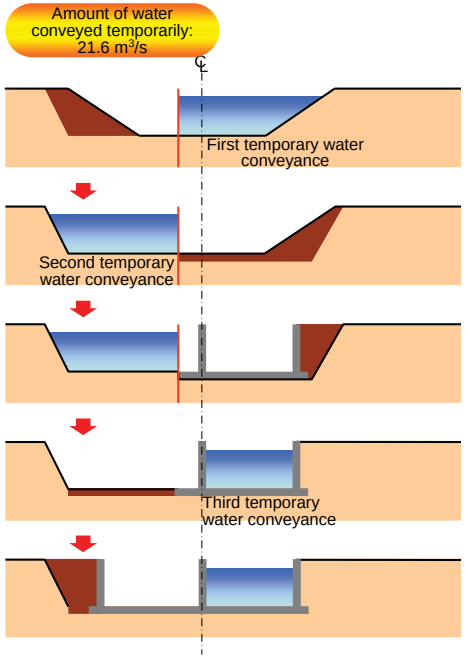


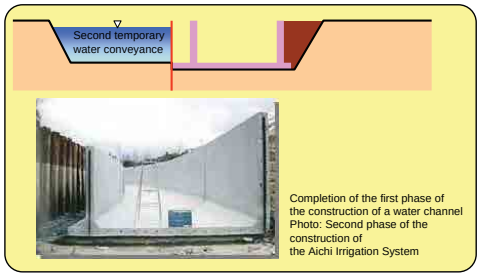
Section	Quantity of flow (m³/s)	Water channel grade	Planned water depth (m)	Water channel width (m)	Flow speed (m/s)
Upstream section	43.2	1/3,000	2.5	5.8 x 2	1.492
Midstream section	43.2	1/2,800	2.5	5.65 x 2	1.532
Downstream section	50.0	1/3,000	2.3	7.1 x 2	1.533

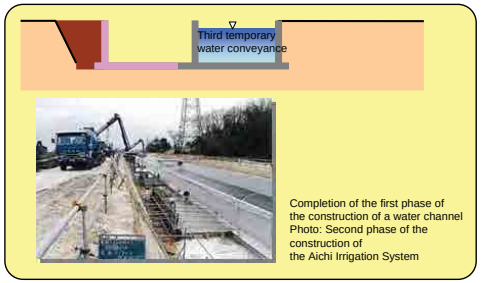


9

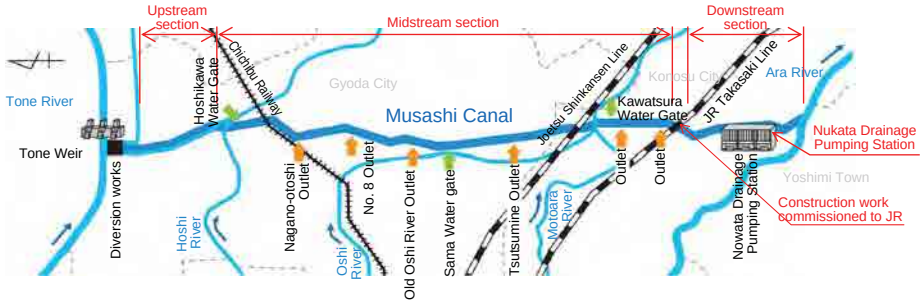
Construction procedure with a half of the river closed







Overall project schedule



Overall project schedule for reconstruction of the Musashi Canal

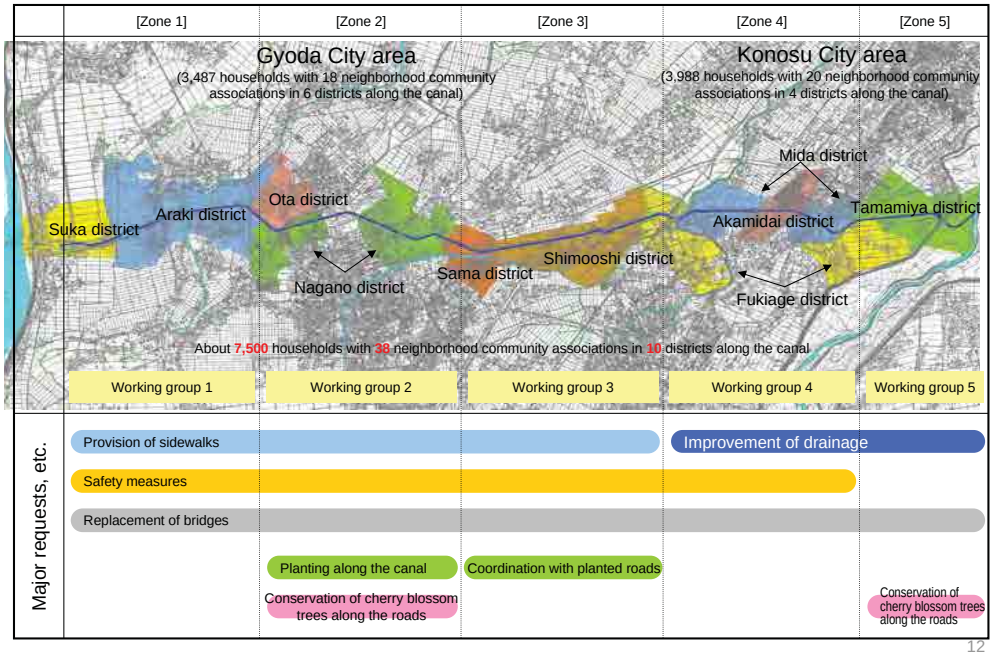
Main construction work, etc. — Temporary work, subsidiary work, etc.

		Fiscal 2010	Fiscal 2011	Fiscal 2012	Fiscal 2013	Fiscal 2014	Fiscal 2015
Reconstruction of Musashi Canal — Open channel	Upstream						
	Midstream and downstream						
	Inflow facilities						
Reconstruction of Nukata Drainage Pumping Station							
Administrative facilities							

* The main work of the water channel is conducted during the period of limited water conveyance from December to May in the following year. Placement of sheet steel piles is scheduled in around October.

11

Efforts to draw up an improvement plan with residents' participation



Efforts to draw up an improvement plan with residents' participation

In the Musashi Canal Reconstruction Project, a conference with the participation of residents was organized to facilitate consensus-building among local residents with varied opinions with regard to the provision of safety facilities and landscaped facilities along the reconstructed Musashi Canal. All the relevant parties including neighborhood community associations and government offices have been working together so that the Musashi Canal will become attractive.

Activity of the working group

Reconstruction work (construction season in fiscal 2011)

Difference of about 30 cm between the top of sheet piles, and the water surface

Construction work with excavated surfaces being protected

Construction work in the area with rapid water flows (flow rate of about 2 to 3 m/s)

Construction with a large number of workers (maximum number of workers per construction area: about 100)

Reconstruction work (construction season in fiscal 2012)

Concrete placement by a concrete pump

Construction work in a residential area (permanent provision of acoustic barriers)

Construction work for oil protection above the water

Construction work in a residential area (provision of a school road)

Reconstruction work (construction season in fiscal 2012)

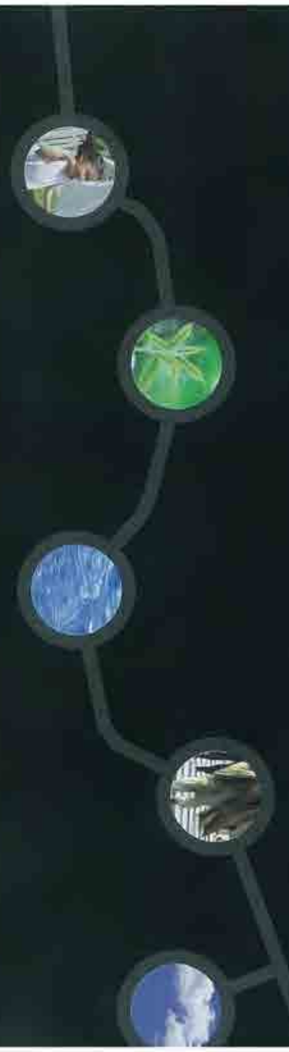
Construction of the administrative road

Water passing along both sides of the banks

Water passing along both sides of the banks

Water passing along both sides of the banks (under the bridge)

Water Discharge Tunnel on The Outskirts of The Metropolitan Area



Large Underground Discharge Channels Provide Safety and Reassurance for People Living in the Metropolitan Area

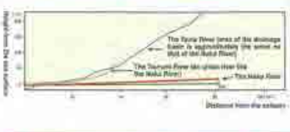
"Sairyu no Kawa"

Why were the Naka, and Ayase River basins Repeatedly Devastated by Rain-related Flooding?

◆ A Bowl-like Ground Surface Tends to Accumulate Water

The Naka River drainage basin had been devastated since early times due to its changed flow channel caused by flooding of the Tone and Ara Rivers. Being surrounded by large rivers like the Tone, Edo and Ara Rivers, it has topography like a bowl that easily accumulate water. And since the water level inclines gradually, the area remains in a dangerous state after heavy rains fall because water levels do not fall quickly.

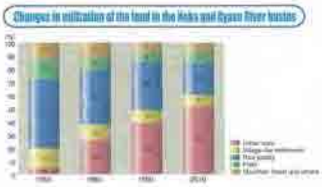
The Naka and Ayase Rivers showing gradual inclination



◆ Rapidly Upcoming Waves of Urbanization

The recent sprawling development of the metropolitan area (disorganized expansion of the urban area) is accelerating the concentration of population and assets from downstream to the mid and upstream drainage basins despite a risk of potential flooding. In particular, the rate of urbanization of the area within 20 to 40 km of Tokyo is approaching 50%, suggesting that development of the midstream drainage basin will, together with the upgrading of transportation facility and the promotion of the urbanization improvement plan, advance significantly.

Changes in utilization of the land in the Naka and Ayase River basins



The Naka and Ayase River basins being urbanized

◆ Repeated Flood Damage

The low lying ground easily accumulates water. This area suffered flood damage many times because the river and sewage projects designed to prevent flood damage were not able to keep up with rapid urbanization. If urbanization continues, damage to this area will be incomparably greater than in the past.

List of Major Floods of Recent Years

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	282.0	41,544	27840
[illegible]	211.6	26,428	17550
[illegible]	198.6	22,882	6541
[illegible]	189.8	21,401	9938
[illegible]	180.4	16,977	5862
[illegible]	152.4	2,832	2469
[illegible]	109.6	230	700
[illegible]	172.6	834	635
[illegible]	152.6	826	1107
[illegible]	163.8	88	45
[illegible]	168.2	1,279	1059
[illegible]	171.6	246	85
[illegible]	158.9	2,118	674

* Total average volume of rainfall in the Naka, Ayase River basin
* Flooded houses and area in the Naka, Ayase River basin

July 1985
Upstream of the Niigata River

October 1981 Ukizuka, Yashio City

September 1982 Teshiro-cho, Soka City

September 1991 Higashi Iwatsuki, Iwatsuki City (now Iwatsuki-ku, Saitama City)

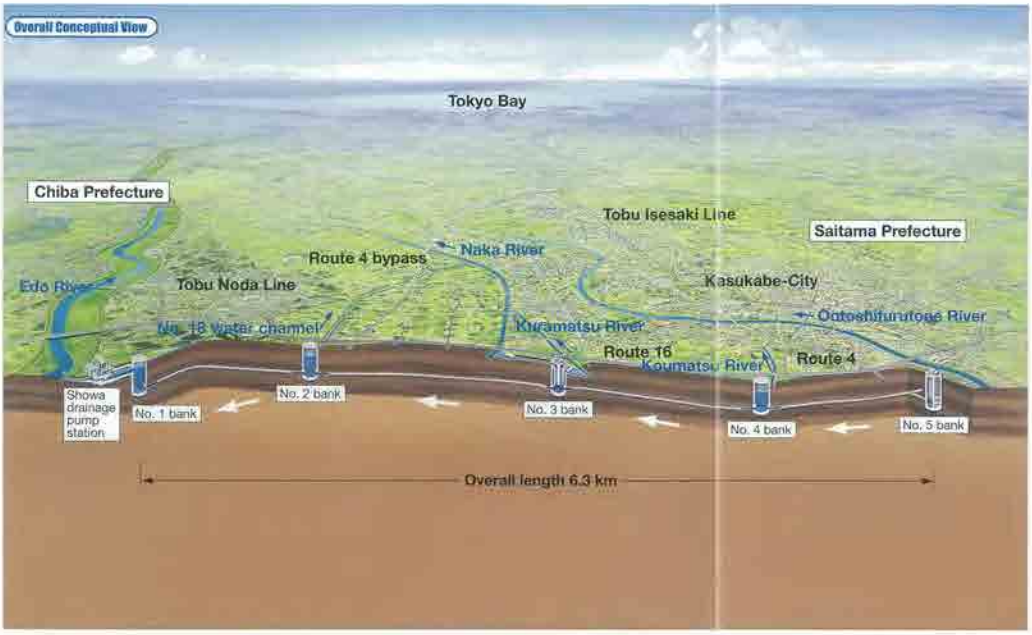
◆ "The Naka and Ayase Rivers' Comprehensive Flood Control Measures" for Developing a Town Less Vulnerable to Flood Damage

In order to protect the area from flood damage, it is necessary, in addition to improving flood control facilities being carried out so far, to restore the water-retaining and flood control functions the original river lost due to the development, through an integrated effort carried out in the area. We must develop such drainage basin measures to prevent rain water from running into and bursting rivers. "The Naka and Ayase Rivers' Comprehensive Flood Control Measures" are aimed at making the town resistant to flood damage based on the integrated effort of everyone living in the drainage basin. The Metropolitan Area Outer Underground Discharge Channel is, in particular, expected to be the main pillar of the measures.

- Comprehensive Flood Control Measures
  - Measures planned along the rivers
    - The embankment will be improved
    - Discharge channels will be constructed
    - Drainage pump station will be constructed
  - Measures planned for the drainage basins
    - Unnecessary earth filling will be avoided
    - Measures will be developed to have rainwater soak into the ground
    - Facilities for storing rainwater will be built
  - Other software-based measures
    - Evacuation places will be located and you will be informed
    - Your cooperation with flood prevention and other activities will be requested
    - Pump operation method will be determined
    - Construction of buildings resistant to flood damage will be promoted

One of the World's Largest Underground Discharge Channels at 50 Meters Below Ground

Overall Conceptual View



The Metropolitan Area Outer Underground Discharge Channel is one of the world's largest underground discharge channels, which takes water overflow underground from small- to mid-size rivers such as the Naka, Kuramatsu and Otoshifurutone and directs it to the Edo River through a 6.3 kilometers long tunnel that runs 50 meters below ground. Construction was started in March 1993 utilizing world-class Japanese civil engineering technologies. After a construction period of 13 years, in June 2006 it became possible to direct water from the Otoshifurutone River into the Edo River.


No. 5 bank (State of inflow)

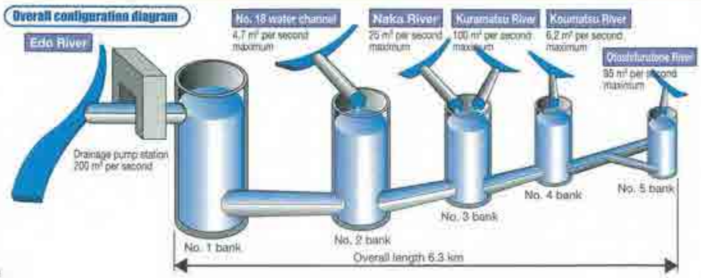

Showa Drainage Pump Station


No. 2 bank


No. 1 bank


No. 4 bank (Overflow levee)

Overall configuration diagram




No. 3 bank (State of inflow)


Pressure-adjusting water tank

Major Facilities of the Metropolitan Area Outer Underground Discharge Channel

The Metropolitan Area Outer Underground Discharge Channel consists of the "Inflow facilities" and "Banks" for taking water from the rivers, the "Tunnel" of the underground water channel for directing flood water downstream, the "Pressure-adjusting water tank" for reducing the water flow in the underground area and securing a smooth flow, and the "Draining pump station" and "Drainage sluiceway" for draining flooding from underground areas.

Bank

Maintains and Controls Inflow Flooding and Discharge Channel

The five "banks" from No. 1 to No. 5 are interconnected to each other through the underground tunnel and used for taking in flood water from the rivers including the Naka, Kuramatsu and Otoshifurutone. On top of that, they play an important role in the maintenance and management of the Outer Underground Discharge Channel, by being intake areas for vehicles and by installing ventilation systems, for example. These are gigantic cylindrical facilities. Each of them is approximately 70 meters deep and has an inner diameter of approximately 30 meters. They are large enough to accommodate a space shuttle or the Statue of Liberty.


No. 5 bank

Specification of Bank

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
No. 1 bank	⌀31.6 m Wall thickness 2.5m	⌀30.0 m Wall thickness 3.0m	GL-72.1m	[illegible]
No. 2 bank			GL-71.5m	
No. 3 bank			GL-73.7m	
No. 4 bank	⌀25.1 m Wall thickness [illegible]	⌀22.5 m Wall thickness [illegible]	GL-69.0m	
No. 5 bank	⌀15.0 m Wall thickness [illegible]	⌀15.5 m Wall thickness [illegible]	GL-74.5m	[illegible]

Inflow Facility

Takes in Water from "Overflow Levee" during Flooding.

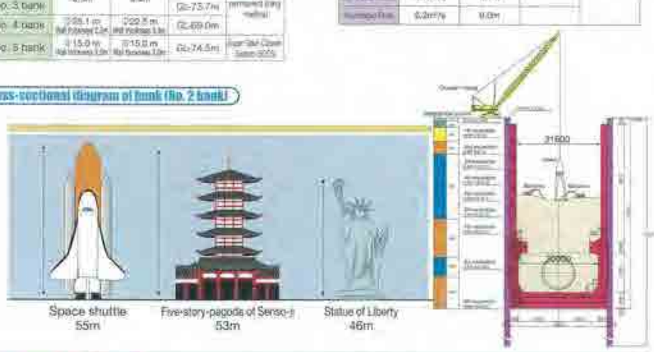
Flood waters are taken into the Outer Underground Discharge Channel at the "overflow levee" provided on the embankment of the rivers including the Naka, Kuramatsu and Otoshifurutone. If the water level of each river surpasses the height of the overflow levee, flood water will go into the inflow facility on its own. The height of the overflow levee is set to much the same height as that of the lowest nearby ground so that it can function sufficiently to cope with even small- to mid-size floods.


Inflow facility
(Kuramatsu River inflow facility)

Specification of inflow

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Naka River	25m³/s	17m	250m³/s	Overflow levee method
[illegible]	100m³/s	33m	150m³/s	
[illegible]	85m³/s	30m	366m³/s	
[illegible]	4.7m³/s	4.7m		
[illegible]	6.2m³/s	9.0m		

Cross-sectional diagram of bank (No. 2 bank)



New attempt at this Project

No. 3 bank and No. 5 bank (vortex drop shaft)

All-out Recycling

Tunnel

"Underground River" that Runs a total Distance of 6.3 km at 50 m below Ground

This is an "underground river" constructed to lead flood water flowing in from the Naka, Kuramatsu, Otoshifurutone Rivers and others to the Edo River. The tunnel connecting five banks is constructed along Route 16 at a depth of 50 meters below ground level. It has an inner diameter of approximately 10 meters, and an overall length of 6.3 kilometers. It can drain flood waters at a speed of up to 200 m³ per second.


Section 4 tunnel

Shield Tunnel

Employing the Shield Method for the Tunnel (Underground river)

Shield tunnel

The hermetic slurry shield method has been employed for the construction since it must be carried out at greater underground depths (50 meters below ground level) and a large caliber (inner diameter of the tunnel is 10.6 meters) is required. The excavator installed on a cylindrical steel tube digs the soil while protecting the machine from the earth and sand at the front and pushing the shield machine forward. Behind the pushed out shield machine, "segments" are automatically assembled into a cylindrical form. This work is continued sequentially to build the tunnel. Sections 1 to 4 in the tunnel built in the areas from the No. 1 bank to the Otoshifurutone River broke through in 2002, and the connecting tunnels built in the areas from the No. 5 bank to the Section 4 tunnel broke through in 2005.


Shield machine

Specification of tunnel

Section	Tunneling section	Extension of tunneling	Inside diameter of tunnel
No. 1 tunnel	From No. 1 bank to No. 2 bank	1,396m	10.6m
No. 2 tunnel	From No. 2 bank to No. 3 bank	1,920m	10.6m
No. 3 tunnel	From No. 3 bank to No. 4 bank	1,384m	10.6m
No. 4 tunnel	From No. 4 bank to Ootoshifurutone River	1,235m	10.9m
Connecting tunnel	From No. 5 bank to No. 4 tunnel	380m	6.5m

Development of New Type of Segments

The Metropolitan Area Outer Underground Discharge Channel is an internal water pressure shield tunnel of a large caliber, and new technologies have been employed for its construction. A new type of segments have been developed using a state-of-the-art technology, so that the work carried out utilizing them is made easier and so that the intended finish is achieved.

Features

Supports internal water pressure — Safe not only against the outer pressure of the shield but also against internal pressure
Inner surface smooth — A segment free from concavities and convexities resulting from coming in contact with flowing water
High rigidity — Enhancement of bonding force of segments by employing "wedge structures" for the joint
High-speed automatic assembly — Wedge effect-based management of fastening and elimination of supplementary work

Horizontal Cotter Type RC segment (Section 1 tunnel)

DRC Segment (Section 4 tunnel)

Major Facilities of the Metropolitan Area Outer Underground Discharge Channel

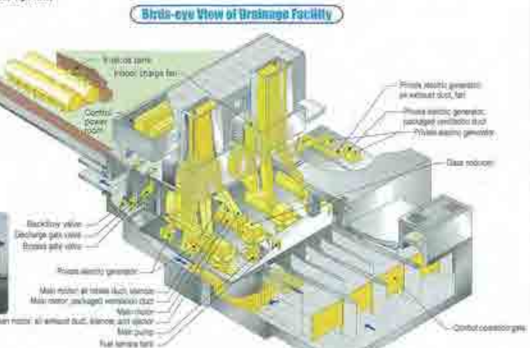
Drainage Facility

The "Heart" for Controlling a Gigantic System

The Showa Drainage Pump Station is the "heart" of the Metropolitan Area Outer Underground Discharge Channel, and has two roles. One role is to drain the flood water that ran down from underground tunnels, from the pressure-adjusting water tank through giant pump and drainage sluiceway to the Edo River. The other role is to operate and centrally monitor each inflow facility.

Showa Drainage Pump Station

Birds-eye View of Drainage Facility



Drain Pump

Specification

1. Installation location

Chisaki, Kamikanasaki, Kasukabe City, Saitama Prefecture

2. Drain pump facility

(1) Pump specification
Pump model: Neutral axis vortex diagonal pump (high-flow rate type)
Planned drainage capacity: 50 m³ per second (per pump)
Planned total pump head: 14 meters
Flow control: Pump speed-based 0 to 100% control of flow
Number of installed pumps: 4 units

(2) Motor specification
Motor model: Two-shaft transverse gas turbine (converted from the one for aircraft)
Rated output: 10300 kW (14000 PS)
Fuel: Bunker A

(3) Gear reducer specification
Gear reducer model: Orthogonal axis gear reducer (locked train structure)
Reduction ratio: 1/27.6

3. Operation control

Offers the machine side control in each facility and centralized monitoring and operation control from the central operation room

Drains Water Full of 25-meter Swimming Pool per Second

Four gigantic pumps, the largest of their kind in Japan with 50 m³/sec. of discharge capacity, have been installed. Using the power of the gas turbine, they rotate the bladed wheel called an "impeller" at a high speed to give energy (lifting and centrifugal forces) to water and generate water flow. The gas turbine used is the modified version of the one designed for aircraft. Its key characteristics are its compact size and reduced noise and vibrations. The maximum drainage capacity is 200 m³ (equivalent to water in a full 25-meter swimming pool) per second.

View of pump room

Gear reducer

the bladed wheel

Pressure-adjusting Water Tank

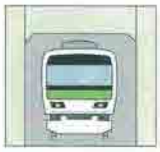
Colossal Space is the "Underground Parthenon"

This is an enormous water cistern built at a position approximately 22 meters below ground level to reduce the flow of water and drain it smoothly into the Edo River. It is 177 meters long, 78 meters wide and 18 meters high. It is responsible for stable operation of the pumps and adjusting radical water pressure changes that can result from an emergency. Fifty nine pillars, each 7 meters long, 2 meters wide and 18 meters high and weighing 500 tons, are supporting the ceiling of the cistern, creating a towering Parthenon-like structure underground.

Drainage Sluiceway

Drains Flood Water into the Edo River

This facility is used for draining flood water from the Metropolitan Area Outer Underground Discharge Channel. Flood water sucked up by the pump at the drainage pump station is drained into the Edo River through six drainage sluiceways, each 5.4-meter x 4.2-meter. It has another function of preventing backwater coming from the Edo River.



A single carriage of [E231 series] (2.95 meters wide and 3.98 meters high) of the JR Yamanote line can be easily housed in a drainage sluiceway.

Won "2002 OCEA Award" of Japan Society of Civil Engineers!

The Metropolitan Area Outer Underground Discharge Channel project won the "2002 OCEA Award" from the Japan Society of Civil Engineers. The OCEA Award is presented to an epochal project that has achieved distinguished contribution to civil engineering development. The following points are recognized in the project:

① Employment of New Type of Segments
② Segments were used that can be dispensed the secondary lining to reduce costs. They were used effectively for construction work over a long distance and for embankments that set high standards in terms of soil resulting from excavation.
③ Downsizing of drainage pump station
④ As part of the efforts to create an open construction site, a celebration event was held involving approximately 5,000 people every time a new facility was constructed. In addition, an average of approximately 30,000 residents observed the actual construction sites.
⑤ In June 2002, test conduction of water to half of the total sections was carried out, and six simulations of inflows of flood waters were observed. The flooded area of the test section for conduction of water decreased 96% compared with the 1999 flood and 98% compared with the 2000 flood. The effects were affirmed to reduce the damage.

It has been recognized that the pioneering designs of the underground river technology and the construction work used in the Metropolitan Area Outer Underground Discharge Channel project will make a great contribution to the development of future civil engineering technologies.

Flood Control Effects of Water Discharge Tunnel on The Outskirts of The Metropolitan Area

Water Discharge Tunnel on The Outskirts of The Metropolitan Area is making a significant contribution in reducing damages due to immersion in the Naka River and Ayase River basins.

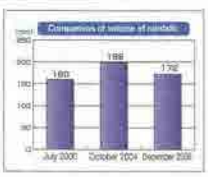
Water Discharge Tunnel on The Outskirts of The Metropolitan Area has the record of adjusting floods 60 times from the partial conduction of water in 2002 to November 2010. The flood control effect obtained from the test conduction of water was remarkable, substantially reducing in damage due to immersion in the Naka River and Ayase River basins.
According to past flood control records, Typhoon No. 3, that hit in July 2000 and dropped 160 mm of rain, devastated the Naka River and Ayase River basins.
Approximately 137 ha was flooded including 248 houses. However, with Typhoon No. 22 in October 2004, when conduction of water to the Kuramatsu River had already started, flood-related damage was substantially reduced, even though the amount of rainfall reached 199 mm. Approximately 73 ha was flooded, including 126 houses. And with the flood caused by atmospheric depression hit the area in December 2006, when conduction of water up to the Otoshifurutone River had already been completed in June of the same year, flood related damage was still more reduced, the flooded area was approximately 33 ha and the number of flooded houses was 85, even though the amount of rainfall reached 172 mm.
In addition, in August 2008 when heavy rainstorms were caused from the atmospheric depression, a time when the highest ever volume of inflow was recorded, flood control of approximately 11.72 million m³ was available thanks to Water Discharge Tunnel on The Outskirts of The Metropolitan Area. Damage to the drainage basin, which had been devastated by floods over the years, was significantly reduced.

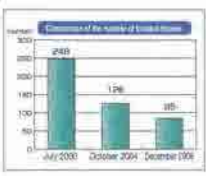
* The flooded area and the number of flooded houses are calculated based on data obtained from neighboring 7 cities and towns of Water Discharge Tunnel on The Outskirts of The Metropolitan Area (Kasukabe City, Satte City, Sugito-machi, Miyashiro-machi, Shiraoka-machi, Matsubushi-machi, and Goka-machi)

State of inflow during flood in August 2005 (No. 3 bank)

This figure shows the flood damage anticipated in the Naka and Ayase Rivers Development Project that can result from rain that may occur approximately once every 10 years (average amount of 48 hours of rainfall in the drainage basin: 217 mm). Flooded locations are simulated in this figure based on the rainfalls of 1980, when the Overall Flood Control Measure Council was launched, and 2006 (current), as well as the future point in time when the Development Project of the Naka and Ayase River drainage basin will be completed.

* Average volume of rainfall over 48 hours in this drainage basin: 217 mm. The rainfall waveforms are formulated based on the data collected by the Kumagaya Precipitation Station in the flood of September 1958.





River Environment Improvement in collaboration with Neighboring Areas

Mizube No Oka Consortium

The "Mizube No Oka Consortium" has started to plan and develop the area surrounding Water Discharge Tunnel on The Outskirts of The Metropolitan Area and the Showa Drainage Pump Station as the new asset of regional culture of Kasukabe City (formerly the Showa-machi district) to be loved by the community residents and others for many years to come. "Mizube No Oka" will comprise many facilities including the underground space, Ryu Kyu Kan, multipurpose plaza, log houses, water park and revetment, cycling road and an iris pond.
The consortium is exploring how to effectively operate the facility through fair and open meetings while constantly sharing information with community residents so that it becomes a new cultural asset for the community and a forum of interchange for the people. The consortium seeks how to promote the regional development utilizing Water Discharge Tunnel on The Outskirts, a rare underground complex. It is studying how to operate the facility to ensure the positive participation of community residents.

● Members of the consortium: Edo River Office of Ministry of Land, Infrastructure, Transport and Tourism; Kasukabe City and community residents (citizen groups)

"Ryukyukan" for Underground Exploration Museum of Water Discharge Tunnel on The Outskirts of The Metropolitan Area

"Ryukyukan" exhibits and introduces projects related to the Edo River and the natural environment surrounding it with emphasis on Water Discharge Tunnel on The Outskirts of The Metropolitan Area, which is working out of sight underground. This facility also functions as a place of integrated and lifelong learning in collaboration with the local community.

● Citizen Gallery
It introduces diverse cultural activities of the community residents who have lived with the Edo River and fostered the history, culture and climate of the region.

● Underground Experience Hall
You can have a virtual experience of the immense power of Water Discharge Tunnel on The Outskirts of The Metropolitan Area [illegible] inflowing water, etc. Through light, sounds and images, you can experience the horror of flooding and how Water Discharge Tunnel on The Outskirts of The Metropolitan Area is working to protect against it.

● My Town and My River
This is a workshop station to help people rediscover their towns and rivers from a different perspective. It is also used as a place of integrated learning in coordination with neighboring elementary schools.

● Technology BOX
Through miniatures and others, you can see the building process of "Water Discharge Tunnel on The Outskirts of The Metropolitan Area", one of the world's largest artificial rivers, and the state-of-the-art technologies supporting its operation.

Growing Hometown Forest

June 2006
(Festival of Complete Conduction of Water Discharge Tunnel on The Outskirts of The Metropolitan Area)

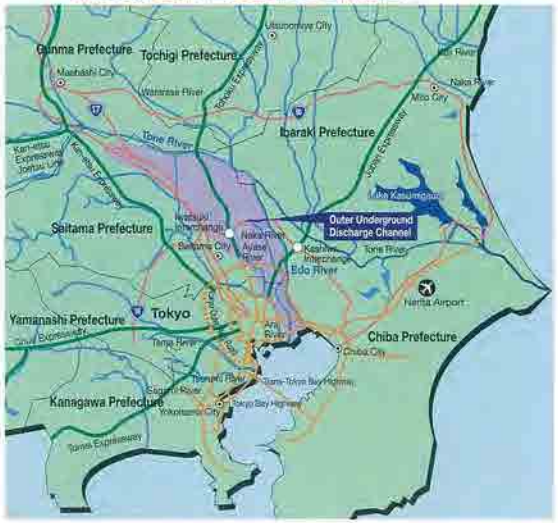
March 2007
(Second Hometown Forest Tree-Planting Festival)

The "Growing Hometown Forest" project is promoted at the Showa Drainage Pump Station of Water Discharge Tunnel on The Outskirts of The Metropolitan Area. Its purpose is to develop a "Forest of River" to provide various benefits, such as providing relaxing shade from trees, alleviating the heat-island phenomenon by providing a place where wind can breeze through, securing an evacuation area in case of disaster, and creating a beautiful landscape.
So far, trees have been planted twice in the area, in June 2006 and March 2007. Twenty five species comprising 25,000 nursery trees have been planted in the Showa Drainage Pump Station. Different species of nursery trees have been planted next to each other. Planting tall trees and shorter trees in combination (mixed planting and dense planting) prompts their competitive coexistence and helps them grow strongly. These trees grow into bountiful forests and foster a wide variety of forest inhabitants. Twenty five different species of nursery trees were selected from the groups of tree species of potential natural vegetation surrounding the Showa Drainage Pump Station.

Birth of the "Sairyu no Kawa"!

The name "Sairyu no Kawa" was selected from among names submitted by the public, a name that will remind people of the role of the "Water Discharge Tunnel on The Outskirts of The Metropolitan Area" and encourage people to become familiar and loved by community residents.

Location of the Metropolitan Area Outer Underground Discharge Channel



Announcement on the general excursion to the Metropolitan Area Outer Underground Discharge Channel

Prior reservation is necessary to take part in the general excursion to the Metropolitan Area Outer Underground Discharge Channel. To apply, please contact the Outer Underground Discharge Channel Information or visit the web site of the Edo River Office

● Phone Reception
TEL 048-747-0281
Reception time: Monday - Friday,
9:00 to 16:30

■ **Metropolitan Area Outer Underground Discharge Channel Information Branch Administration Office (Second floor of Showa Drainage Pump Station)**
Phone: 048-746-7524

■ **Ryukyukan (On the premise of Showa Drainage Pump Station)**
Open: 9:30 to 16:30 (Entry by 16:00)
Closed: Mondays/Year-end and new year holidays
No admission fee required
Post code: 344-0111
720 Kamikanasaki, Kasukabe City, Saitama Prefecture
Phone: 048-746-0748

By train: 30 minutes walk from Minamisakurai Station, the Tobu Noda Line (about 2.2 km)
By car: 30 minutes' drive for Noda on Route 16, from Iwatsuki IC of Tohoku Expressway (about 17 km)
40 minutes' drive for Noda on Route 16, from Kashiwa IC of Joban Expressway (about 20 km)

Showa Drainage Pump Station of the Metropolitan Area Outer Underground Discharge Channel is selected as one of the "A hundred Mt. Fuji viewing spots in Kanto".

"A hundred Mt. Fuji viewing spots" selects the spots that command a fine view of Mt. Fuji. Its purpose is to improve the scenery of the selected areas by supporting conservation and utilization of the neighboring landscape. The Showa Drainage Pump Station of the Metropolitan Area Outer Underground Discharge Channel, where "Ryukyukan" situates, has been selected as one of these 100 spots.

From "Ryukyukan", a typical viewing spot in the town, you can see Mt. Fuji with the buildings of Saitama New Urban Center in the foreground.

Edo River Office, Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transportation and Tourism
Post code: 278-0005
134 Miyazaki, Noda City, Chiba Prefecture Phone: 04-7125-7311 (Main switchboard)
Web site address http://www.ktr.mlit.go.jp/edogawa

2010 First edition
2011 Second edition

About XRAIN (X-band MP Radar Information Network)

Reference material

○ Implement high-frequency, high-resolution X-band MP radar in urban areas for real-time rainfall observations to mitigate damage from localized heavy rains (known as guerrilla rains) and torrential rainfall.
○ Higher frequency (5x) and higher resolution (16x) than conventional radar (C-band radar). Cut delivery time from 5-10 minutes to 1-2 minutes.

[Conventional C-band radar]
(Minimum size: 1-km grid cell, Data update interval: 5 minutes, Time to delivery: 5-10 minutes)

[X-band MP radar]
(Minimum size: 250-m grid cell, Data update interval: 1 minute, Time to delivery: 1-2 minutes)

Hanno City
Okutama-cho
Okutama-cho municipal government office
Oume train line
Oume City
Hinode-cho
Hinode-cho municipal government office
Hinohara-mura municipal government office
Hinohara-mura
Metropolitan Inter-City Expressway

・High-frequency (5x)
・High-resolution (16x)

Hanno City
Okutama-cho
Okutama-cho municipal government office
Oume train line
Oume City
Hinode-cho
Hinode-cho municipal government office
Hinohara-mura municipal government office
Hinohara-mura
Metropolitan Inter-City Expressway

* While the C-band radar (radius for quantitative precipitation estimation: 120 km) is suitable for wide-area rainfall observations, the X-band MP radar (radius for quantitative precipitation estimation: 60 km) is capable of gathering detailed data on localized heavy rain in real time despite its smaller area of coverage.

Features of X-band MP radar

1. High resolution (characteristic of X-band)

・X-band radar operates on a shorter wavelength and allows for higher resolution imagery than C-band.
(X-band: 8-12 GHz, C-band: 4-8 GHz)

2. Superior real-time capability (characteristic of MP radar)

・Transmits two types of polarized waves (horizontal/vertical) to detect the shapes and other properties of rain particles and estimate precipitation based on how flat, etc. the raindrops are.
・Able to send accurate rainfall data in real time without the need to calibrate with ground rain gauge data

3. Capable of wind observation (Doppler radar function)

・Measures rainfall velocity using Doppler effect for wind observations

Full view of X-band MP radar (Nomi Site)

Radar antenna (Saitama Site)

Vertically polarized waves

Horizontally polarized waves

Transmits 2 types of waves

Detects changes in the shape of raindrops

Radio waves transmitted

Radio waves received

Z_H: reflectivity factor、V_D: Doppler velocity

Advantage of Multiple Radar Observations

○ X-band MP radar sometimes misses precipitation echoes behind heavy rainfall due to attenuation and dissipation of radio waves. These missed echoes can be picked up by using multiple radars.

Observation in Kanto Area (Rainfall on August 19, 2011)

Rainfall detection via radar in the Kanto area alone

Heavy precipitation

Shin-yokohama

Unable to detect

Radar station

The Shin-yokohama Radar Station could not detect anything behind the area of heavy precipitation.

Rainfall detection via combined use of Kanto and Shizuoka radar stations

Shin-yokohama

Mt. Kanuki

Able to detect rainfall via radar in neighboring Shizuoka area

Radar station

Multiple radar observation caught previously missed area.

XRAIN in Operation (Including stations to go on line in FY2013)

[Legend]

Currently in operation

Newly implemented

To be put into operation in FY2013

*Each circle indicates a radar range of 60 km in radius for quantitative observation.

Kita-hiroshima

Wakuya
Iwanuma
Date
Tamura
Ujiie
Yattajima
Funabashi

Ichinoseki
Ichihasama
Kyogase
Nakanokuchi
Mizuhashi
Nomi
Mt. Jubu
Taguchi
Kanto
Fujinomiya
Shinyokohama
Mt. Kanuki
Shizuoka Kita
Bisai
Anjo
Suzuka
Rokko
Katsuragi
Kumayama
Tsuneyama
Mt. Ushio
Nogahara
Mt. Kazashi
Mt. Furutsuki
Sugadake
Kusenbu
Sakurajima

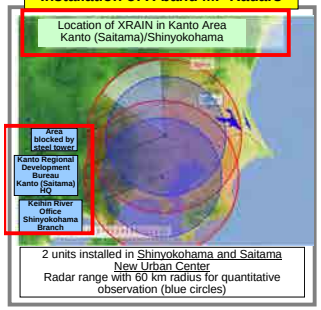
Installation of XRAIN (X-band MP Radar)

Ministry of Land, Infrastructure, Transport and Tourism
Kanto Regional Development Bureau

○ Recent years have seen increasing localized heavy rains and torrential rainfall, requiring enhanced rainfall monitoring.
○ High-frequency X-band MP radars that provide high-resolution rainfall measurements were installed in FY2009 (2 in Kanto area).

-> Use radar network to facilitate optimal river and disaster management with an eye to minimizing damage

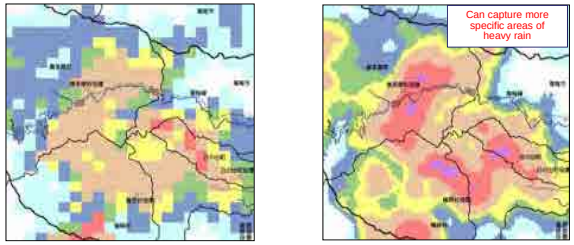
Installation of X-band MP Radars



C-band and X-band Radar Rainfall Image

[Existing (C-band) Radar]
Minimum size: 1-km grid cell,
Data update interval: 5 minute,
Time to delivery: 5-10 minutes

[X-band MP Radar]
Minimum size: 250-m grid cell,
Data update interval: 1 minute,
Time to delivery: 1-2 minutes

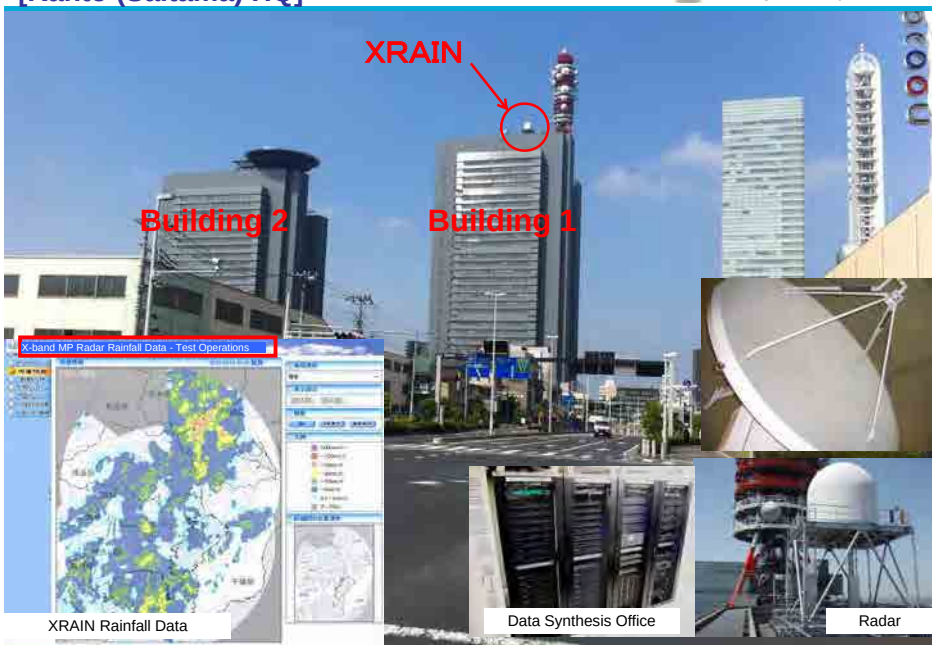


・Higher frequency (5x) and higher resolution (16x) than conventional (C-band) radar.
Cut delivery time from 5-10 minutes to 1-2 minutes.
・While the C-band radar (quantitative precipitation estimation radius: 120 km) is suitable for wide-area rainfall observation, the X-band MP radar (quantitative precipitation estimation radius: 60 km) is capable of gathering detailed data on localized heavy rain in real time despite its smaller area of coverage.

XRAIN: X-band polarimetric (multi parameter) RAdar Information Network

Photos of XRAIN (X-band MP Radar) [Kanto (Saitama) HQ]

Ministry of Land, Infrastructure, Transport and Tourism
Kanto Regional Development Bureau



NHK Digital Terrestrial Broadcasting Service

Ministry of Land, Infrastructure, Transport and Tourism
Kanto Regional Development Bureau

■ **Background**
○ **Recent increase in torrential rainfall (guerrilla rain) hazards have been a major concern (River water level rises rapidly) -> (Need to get evacuation info., etc. out ASAP)**

○ **Disaster information for rivers, etc. (water levels, rainfall) is provided via the integrated river information system.**

(Conventionally via PC, mobile phones, telephone information service, etc.)

○ **TV, used by people of all ages, is the most appropriate means of conveying disaster information.**

Information on river water levels and rainfall is provided by NHK via its digital terrestrial broadcasting service.

[River Water Levels]

[Rainfall]

July 2011 Digital terrestrial broadcasting launched
April 2012 River water level and rainfall information service launched via NHK 's digital terrestrial broadcasting

Press this button to switch between rainfall and water level information

THE RIVER INFORMATION SYSTEM : TO BE PREPARED FOR FLOOD WITH INFORMATION NETWORK

KANTO REGIONAL DEVELOPMENT BUREAU,
MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT

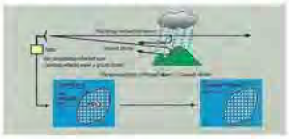
For the purpose of keeping secure life, various facilities have been constructed to observe rain precipitation, water level and so forth to collect / distribute information on rivers.

Japan, having steep mountain areas and hit by typhoons all the time, is placed under the condition where it has to be always prepared against natural water damages, such as flood damages, landslide disaster, drought and so forth, due to its topographic features and weather conditions. In particular, it is necessary and indispensable for realizing rich and original national life to manage and utilize information on water.

For this purpose, it is important to know in real time information on the rainfall and water levels along the rivers, in order to conduct prompt flood fighting activities and appropriate river management. The river information system promptly collects / analyzes data observed at rain gauges and water gauges installed at various places by using radio and so on to grasp the situation of the rain precipitation and water levels in the areas to be observed in real time and provide information to individuals, enterprises or flood fighting institutions of prefectures, cities, towns, villages and so forth.

Radar rain gauge

Observation of rain precipitation is conducted by emitting electric wave in pulse state. Emitted electric wave hits objects located in the space concerned, such as raindrops and snowflakes and returns as the reflected wave. Drawing on the fact that a certain proportional equation (Radar equation) is formed between the intensity of the reflected wave (received power) and that of the rain (rain precipitation intensity), the phenomenon of decreasing rainfall is observed continuously on the flat surface.



Dam infomation

Capacity of the dam to store water, rain precipitation along the rivers flowing into the dam and so forth are grasped in real time to be prepared for the crisis that is managed to prevent flood damages from occurring.

Kawaji Dam

Water level observatory

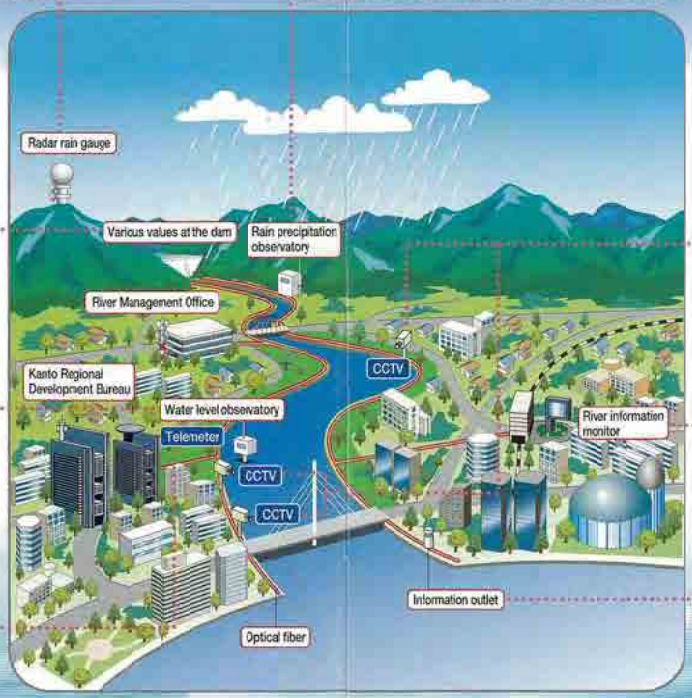
Among techniques to observe water level, there are a method in which people directly read the water level by applying a board (water level indicator), something like a ruler on the horizontal section of the river, float using method, method using a self-recording super sonic type water gauge and so on.

Kurihashi Water Level Observatory (The Tone River)

Telemeter

Data of rain precipitation/water level/water quality and so on, automatically observed at the observatory are automatically transmitted to the office and so forth by radio. The system like this, whereby observation/ trasemission are automatically conducted is called "Telemeter System".

Center of the Lake (Lake Kasumigaura)



Rain precipitation observatory

At a rain precipitation observatory the rainfall stored in a metal cylinder generally called [reversed measuring box], of 20 cm diameter (internal diameter) is measured. The reason why it is called a reversed measuring box is there is a triangular measuring box inside the cylinder, which is automatically reversed and vacated, when it is filled with the rain. Through repetition, the volume of the rain is measured, counting how many times the measuring box has been reversed. Goserally the measuring box is reversed with the rain precipitation equivalent to 1 mm.

CCTV camera

This is a camera installed along the river for the purpose of monitoring the flowing state of the river. Using optical fibers laid down, it is made possible for the office and so forth to grasp the situation directly.

CCTV Camera (The Ara River)

River information monitor

An information monitor is installed in a place such as a roundabout in front of a train station, where many people gather, as a facility to provide information on water level / flood warning / images on CCTV to inhabitants to urge them to be careful.

A river information monitor installed in front of the Koga Station in Koga City

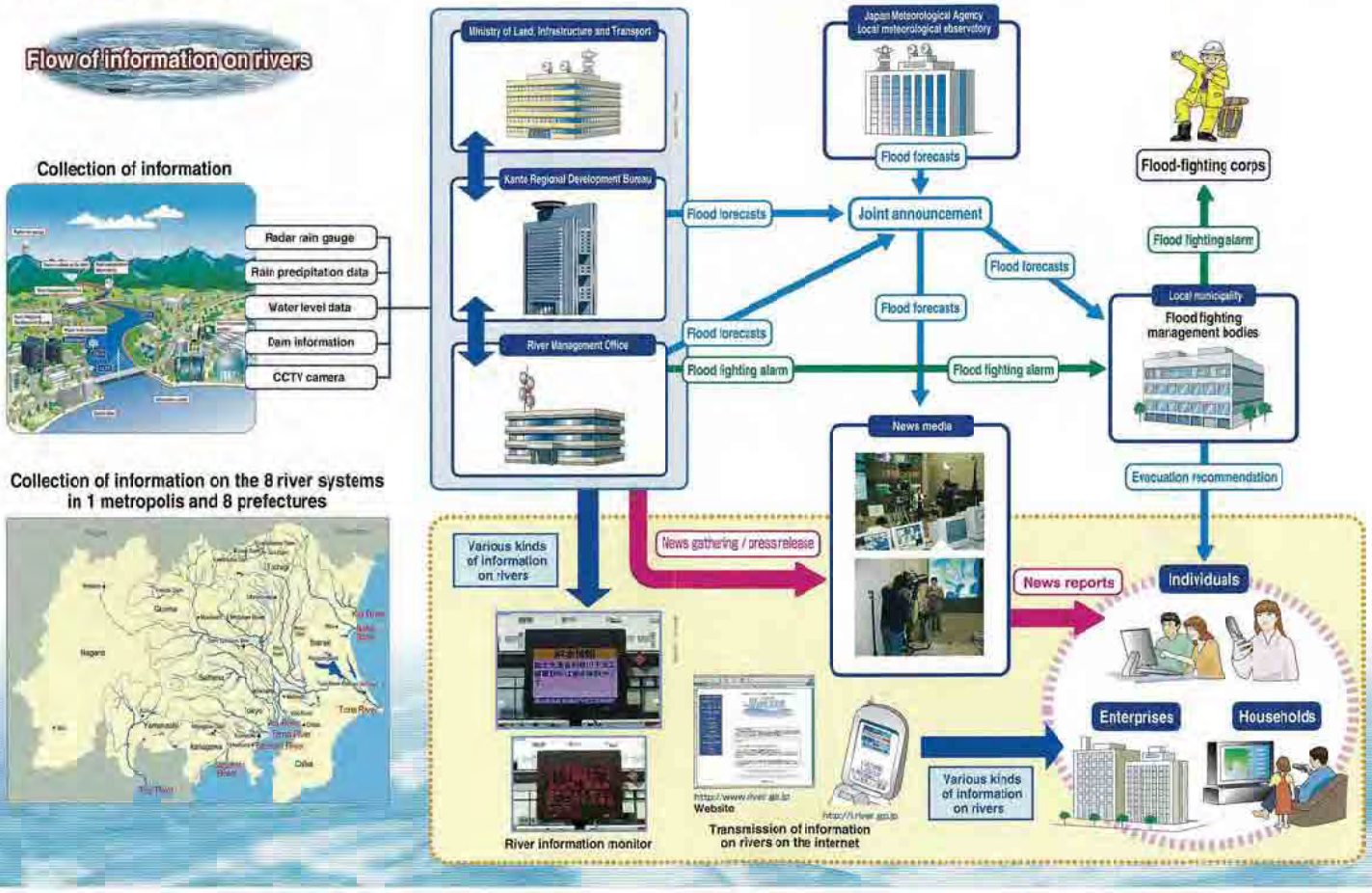
Information outlet

It is an outlet installed along the river that can transmit or receive information, using optical fibers. It is made possible to transmit and receive images, voices, etc. with the office and so forth by having a portable terminal connected to it.

At the time of a flood, support is provided to the flood fighting activities and information is provided to the inhabitants along rivers.

At the time of a disaster by a typhoon and so on, data of rain precipitation and water level from rain precipitation and water level observatories are gathered at river management offices and dam management offices where they are processed and provided to inhabitants and so on through televisions, personal computers, mobile phones and at river information monitors so that they can obtain the latest information.

Flow of information on rivers



Flood countermeasures of the Kanto Regional Development Bureau

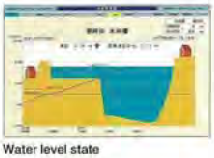
Disaster countermeasures of the Kanto Regional Development Bureau cover a wide range, including countermeasures against flood (storm and flood damages), damages by earthquakes, volcanic eruptions and snow, disasters at sea, on the road and at nuclear power plants, disasters by water quality deterioration, disasters by dangerous articles at ports and harbors, large-scale fire and so on. When these disasters are anticipated to occur or have occurred, prompt and accurate response is required. For this purpose, Disaster Countermeasures Room and Disaster Countermeasures Office are located on the 14th floor and Wide Area Water Control Headquarters, etc. on the 16th floor, so that various kinds of operation for disaster countermeasures including communication of information can be carried out in combination.

In flood countermeasures, all pieces of information on rivers, including the rain precipitation, water levels, dam information, images taken by CCTV cameras and so forth in the 8 river systems of 1 metropolis and 8 prefectures are collected by the Development Bureau from each river management office through optical fiber networks, micro radios and satellite telecommunications. The "network of information on disaster prevention" has been constructed to collect at one place and distribute integrated information, including the aforesaid information plus state of radar rain precipitation, weather, roads and so on. The anti-disaster information can be viewed on large multi-visions and plasma displays in the Wide Area Water Control Headquarters, each executive office and so forth as well as on personal computers of employees. Members engaged in the implementation of flood countermeasures promptly and accurately carry out comprehensive flood countermeasures, based on such information.

Information collection / analysis


Rain precipitation data


Water level data


Water level state

16F Wide Area Water Control Headquarters

Wide Area Water Control Headquarters

It controls water of rivers, dams and so on in 1 metropolis and 8 prefectures. It grasps and confirms the state and scale of the disaster and change in state, displaying the data on the rain precipitation, water level of rivers, water quality, volume of water stored in dams and so forth at each point concerned seen in at the time of flood or drought, all enlarged on the large screen, to respond to them and issue orders. At the time of a flood, relay broadcasting from this room is also carried out.

14F Disaster Countermeasures Office Disaster Countermeasures Room

Disaster Countermeasures Office

This is the room where various kinds of data, information on the state of disaster along the rivers, on the roads and elsewhere and images on the spots concerned are collected to display on the screen, information on the disaster is put in order / analyzed, disaster countermeasures / emergency rehabilitation, etc. are studied, and operation is conducted mainly for communication and coordination among disaster prevention-related institutions of prefectures, cities, towns villages, etc., by the personnel of the Disaster Countermeasures Office.

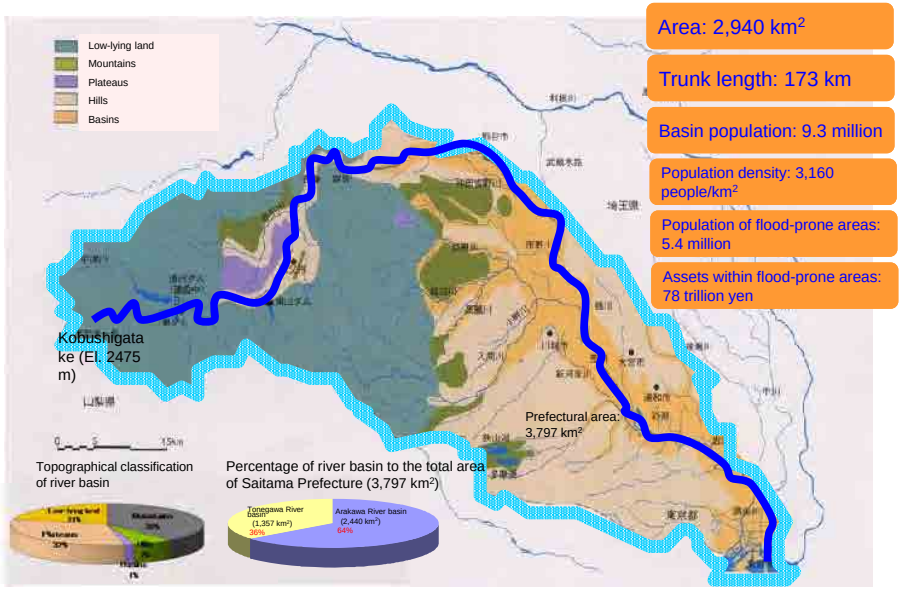
Disaster Countermeasures Room

State of damages and anti-disaster activities, countermeasures, etc. put in order and drawn up in the Disaster Countermeasures Room are reported, and, at the same time, coordination among different disaster prevention-related institutions as well as discussion / deliberation / decision on emergency rehabilitation measures are made.

About the Site

December 14, 2012

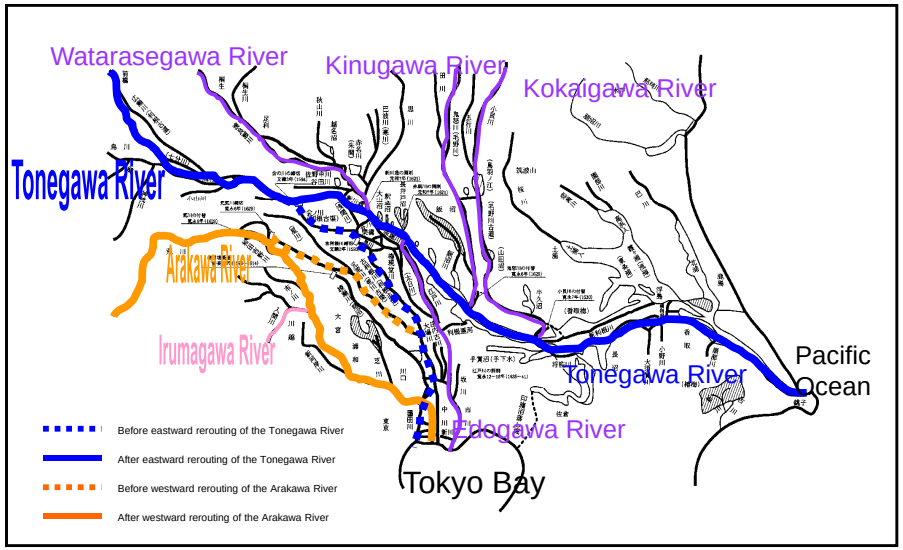
Overview of the Arakawa River Basin



- Area: 2,940 km²
- Trunk length: 173 km
- Basin population: 9.3 million
- Population density: 3,160 people/km²
- Population of flood-prone areas: 5.4 million
- Assets within flood-prone areas: 78 trillion yen

Rerouting of the Arakawa River

Eastward rerouting of the Tonegawa and westward rerouting of the Arakawa



Rerouting of the Arakawa River

Late 12th Century - Early 17th Century

- ***Araburu*** **(Stormy) River**

  The course of the river below the alluvial fan (near Kumagaya City) frequently changed.

- **Ina Tadatsugu's rerouting project**

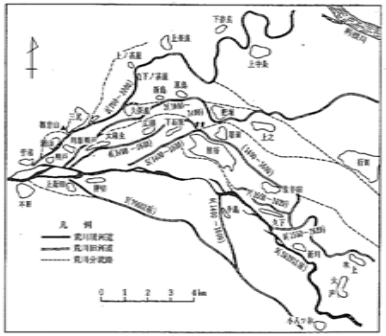
  (1629) (Motoarakawa -> Wadayoshinogawa)

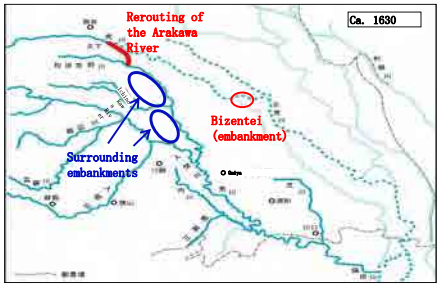
  Known as the westward rerouting of the Arakawa River, the project set the current course of the river.

- **New inundation-prone area**

  -> Right bank of the Arakawa River

- **Large embankments constructed around the fiefdoms of Yoshimi and Kawashima by the Edo government**





Rerouting of the Arakawa River

Early 17th Century - Late 19th Century

Nihon-zutsumi and Sumida-zutsumi were constructed to flood the river upstream from Edo.

○ **Nihon-zutsumi (1693)**

A funnel-shaped embankment was constructed along with the Sumida-zutsumi (Sumida embankment), designed to flood the river upstream to protect Edo.

○ **Riverside development**

With the growth of river transportation businesses, river docks were built to serve as transport hubs for goods and materials.

Location of docks along the Arakawa and Shinkashigawa Rivers (ca. 1700)

Rerouting of the Arakawa River

River Improvements during the Modern Era (Late 19th Century - Late 20th Century)

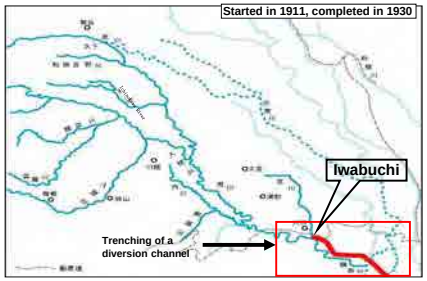
Downstream Improvements by the National Government

○ **Factories were built along the Sumida River during the early 1900s. They suffered major damage due to frequent flooding.**

○ **After the toll from the devastating 1910 flood, the Japanese government implemented a national project dubbed the Arakawa River Improvement Plan.**

○ **Arakawa Diversion Channel (1911 - 1930)**

- **Area of land purchased: approx. 1,089 ha**
- **Number of houses relocated: 1,300**



Rerouting of the Arakawa River

Midstream Improvements by the National Government

○ **Midstream improvements (1918 - 1954)**

- **Ensured the river's original function as a flood control basin**
- **Straightened meandering course of the river**
- **Constructed levees**

New levees were constructed using the existing levees (surrounding embankments, etc.).

The project made the middle course of the river 1.5 km to 2.5 km wide.

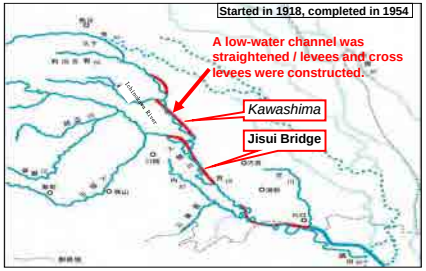
- **Constructed 26 cross levees to enhance flood retarding effect.**
- **Reducing flood discharge downstream (Tokyo) / constructing flood control reservoirs and levees midstream were required in later river improvement projects.**

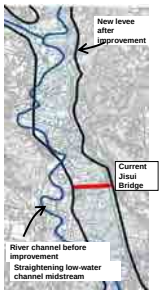
○ **Improvement at the confluence of the Irumagawa and Arakawa Rivers (1931 - 1942)**

- **4.5-km separation levee**

○ **Work on 3 diversion rivers (1931 - 1954)**

- **Separation of the Oppegawa, Koazegawa, and Irumagawa Rivers**





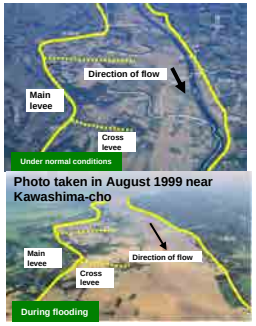
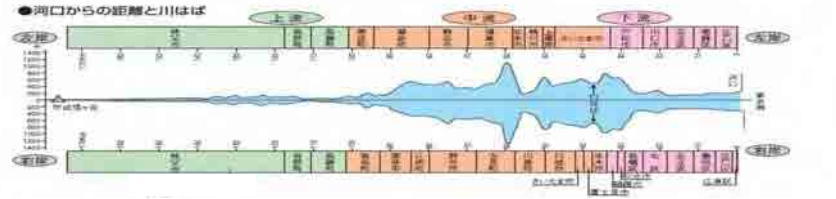


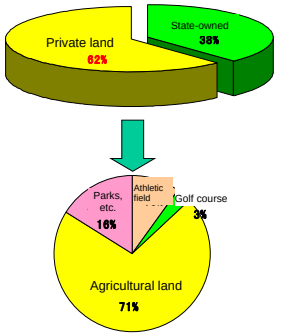
Photo taken in August 1999 near Kawashima-cho

Characteristics of the Arakawa River



◎ Widest in Japan (2.5 km)

◎ About 60% of the high-water channel is private land



◎ Cross levees for flood retarding

Past Major Floods

明治以降の水害一覧

Flood of 1910

- 24% of Saitama Prefecture was inundated.
- Tokyo was flooded for two weeks.

Levee breach	178 locations
Casualties	324
Housing damage	84,538 units

Typhoon Kathleen (1947)

- 568 mm in Mitsumine, 611 mm in Chichibu
- The levee broke in Kugejisaki, Kumagaya. The muddy overflow from the Arakawa reached Tokyo Bay.

Levee breach	2 locations
Casualties	16
Housing damage	28,520 units

September 7, 2007 Typhoon Fitow

Flooding near Onari Bridge in Yoshimi-cho (61.4 k)

Flooding near Jisui Bridge in Saitama City (42.0 k)

Under normal conditions

During flooding

Arakawa River Flood Control Reservoir No. 1

A section of the high-water channel is surrounded by a levee that serves as a flood control reservoir. This enhances flood retarding effect and mitigates flood damage downstream.

<Flood Control Reservoir No. 1>

View from downstream

Flooding in April 1999

Functions and Roles

- Controls floodwater and mitigates flood damage
- Ensures drinking water supply for the Tokyo metropolitan area
- Protects natural environment and serves as a venue for outdoor activities

Total area	5.8 km2
Length	8,100 m
Flood control capacity	39,000,000 m^3
Water supply capacity (Lake Saiko)	10,200,000 m^3

If the August 1999 flood occurred today, the reservoir would store approximately 20,000,000 m^3 of stormwater and reduce the peak discharge at the downstream control point (Sasame Bridge) to about 560 m^3/s, lowering the water level by 30 cm.

Stormwater flowing into Lake Saiko via an intake levee located at the lake's upstream section.

Reservoir Facilities

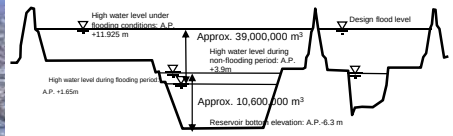
Arakawa-Joryu River Management Office, MLIT http://www.ktr.mlit.go.jp/arajo/

1. Overview of Arakawa River Flood Control Reservoir No. 1

[Flood control reservoir]
Area: Approx. 5.8 km²
Flood control capacity: Approx. 39,000,000 m³
Year completed: 2004
[Reservoir (Lake Saiko)]
Storage capacity: 11,100,000 m³
Depth: 8.5 m (flooding period), 10.7 m (non-flooding period)
Year completed: 1997

Before the project (mid 1970s - mid 1980s)

Cross section



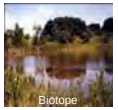
Flood control ■ Controls 850 m³/s beyond design flood level

Water supply

■ The reservoir (Lake Saiko) with a water supply capacity of 10,600,000 m³ and purification facility make it possible to supply up to 300,000 m³/day of drinking water to the Tokyo metro area.

Environment

■ Popular spot for recreation, environmental learning activities, etc.



2. Flood Control Function

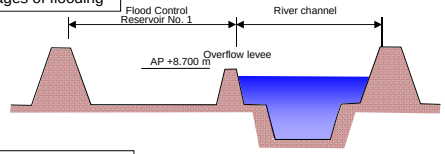
■ Overview

・The Arakawa River Flood Control Reservoir No. 1 is designed to control flooding of the Arakawa River in stages.
・The overflow levee is designed for an influx of floodwater once every ten years. Once the water level of the river exceeds A.P. +8.700m, flood control is initiated.
・When the reservoir is used for flood control, all of its floodgates are fully closed so that they serve as a containment levee.

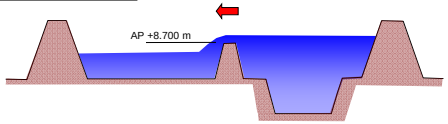
Sakuraso Floodgate

Drainage gate

(1) During the early stages of flooding

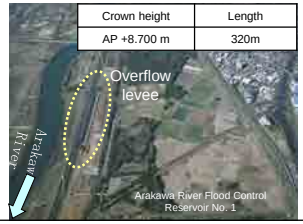


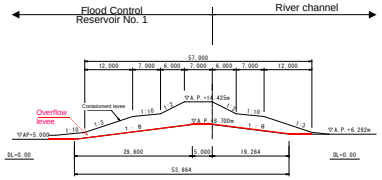
(2) During flood peak



■ Overflow levee specifications

Crown height	Length
AP +8.700 m	320m





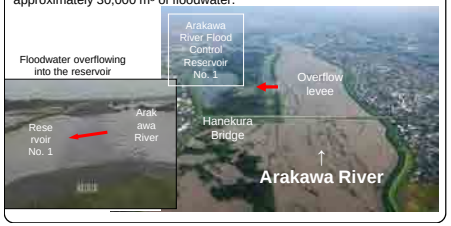
3. Effect of Arakawa River Flood Control Reservoir No. 1

■Flooding caused by August 1999 tropical storm

Although the reservoir was still under construction, floodwater poured into the reservoir from 10:00 p.m. on August 14 to 10:00 a.m. on August 15 (approx. 12 hours).

■Flooding caused by September 2007 Typhoon Fitow

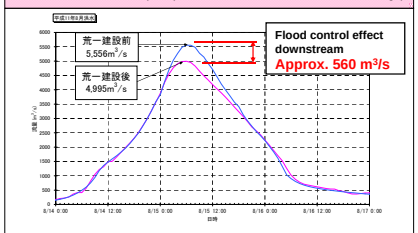
Floodwater poured into the reservoir via the overflow levee from 3:45 p.m. to 6:40 p.m. on September 7 (approx. 3 hours). The reservoir held approximately 30,000 m³ of floodwater.



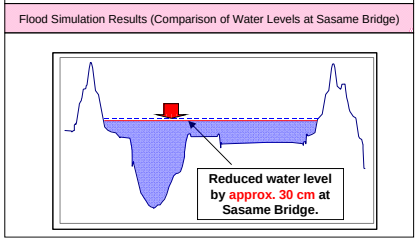
■Effect against August 1999 flood

If the August 1999 flood occurred today, the reservoir would store approximately 20,000,000 m³ of stormwater and reduce the peak discharge at the downstream control point (Sasame Bridge) to about 560 m³/s, lowering the water level by about 30 cm.

Flood Simulation Results (Comparison of Inflow Volumes at Sasame Bridge)



Flood Simulation Results (Comparison of Water Levels at Sasame Bridge)



4. Arakawa Reservoir (Lake Saiko)

■ **Objectives of the Arakawa River Comprehensive Flood Control Reservoir Development Project**

● Flood control
Build Arakawa River Flood Control Reservoir No. 1 to control a flow of 850 m3/s. beyond design flood level.

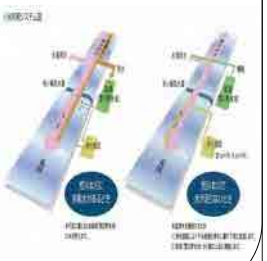
● Drinking water supply
The Arakawa Reservoir, with an active capacity of 10,600,000 m³, and the river purification facility are used to supply 2.1 m³/s (max. 181,400m³/day) of drinking water to Saitama Prefecture and 1.4 m³/s (max. 121,000 m³/day) of drinking water to Tokyo.

■ **Years implemented**
1980 - 1996

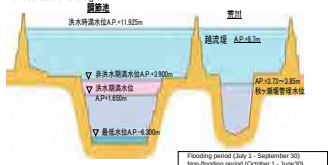
■ **Water replenishment**
In the event of a shortage of water supplied from the Arakawa River, the Arakawa River Comprehensive Flood Control Facility will supplement water in the following ways:
(1) Siphon off water from the Arakawa Reservoir (Lake Saiko) and deliver it upstream from the Akigase Intake Weir to secure a supply of drinking water
(2) Use treated wastewater that has been purified by the river purification facility for the maintenance flow downstream from the Akigase Intake Weir to secure a supply of drinking water

平成22年9月5日現在

年	①【水道用水の補給】荒川貯水池の補給実績			②【維持用水の振り替え】浄化施設の振り替え実績		
	取水量（千m3）	補給日数	補給時間	取水量（千m3）	補給日数	振り替え運転時間
平成7年度	6,369.0	36	488	11,411.6	131	3,158
平成8年度	3,037.0	11	144	4,854.8	102	2,378
平成9年度	—	—	—	28,664.7	178	4,137
平成10年度	—	—	—	12,870.1	84	1,952
平成11年度	—	—	—	7,461.0	42	951
平成12年度	—	—	—	—	—	—
平成13年度	—	—	—	11,126.8	52	1,185
平成14年度	—	—	—	—	—	—
平成15年度	—	—	—	453.6	3	42
平成16年度	—	—	—	4,136.4	18	383
平成17年度	—	—	—	—	—	—
平成18年度	—	—	—	—	—	—
平成19年度	65.0	28	678	—	—	—
平成20年度	—	—	—	1,731.6	18	289
平成21年度	3,709.0	26	453	—	—	—
平成22年度	428.0	3	50	—	—	—
計	13,608.0	104	1,813	82,710.6	628	14,475



Cross-sectional diagram

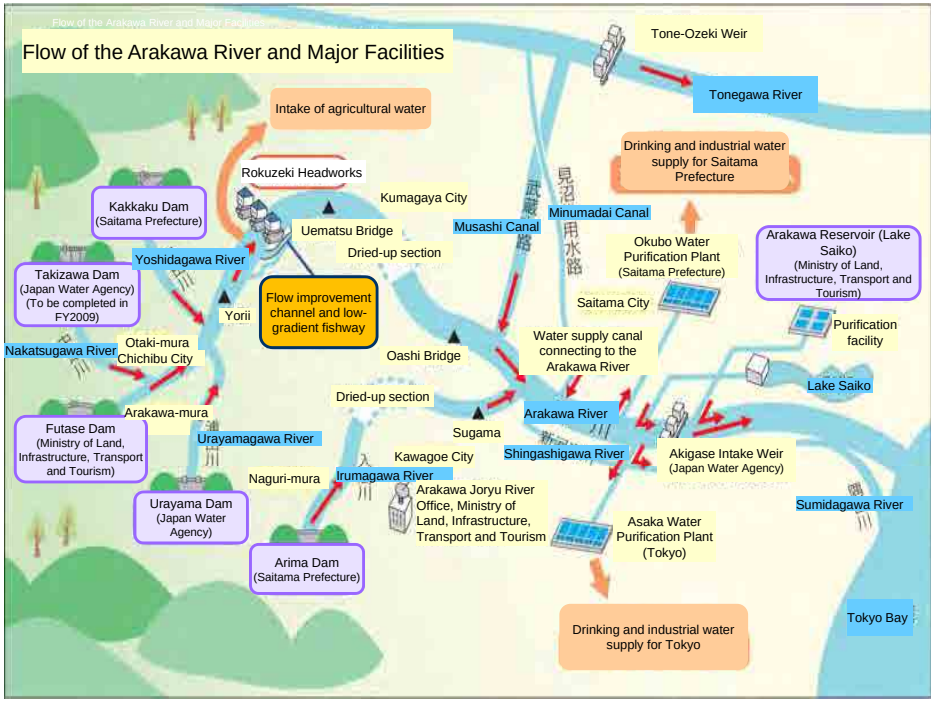


<Specifications>

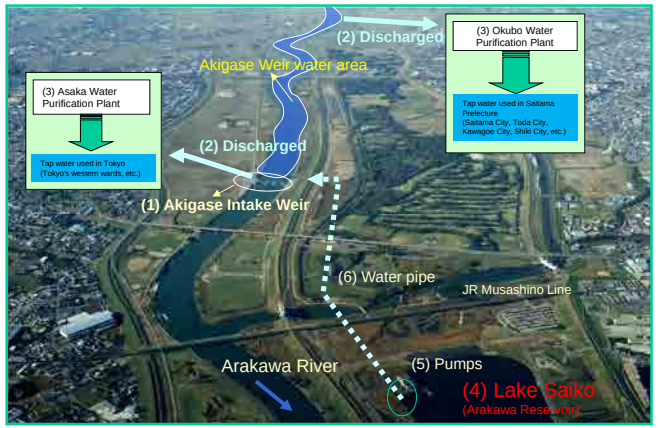
Type of dam: Weir, excavated reservoir, river purification facility
Levee length: 8,500 m (outer levee)
Drainage area: 2,440.0 km²
Total storage capacity: 11,100,000 m³
Active capacity: 10,600,000 m³
Location: Toda City, Saitama City, Wako City

Drinking water supply (population/areas served)
[Saitama Prefecture]
・Population: Approx. 3.8 million
・Areas (Okubo Water Purification Plant)
16 cities and 1 town in south central and western areas of the prefecture, including Saitama City (excluding Iwatsuki Ward), Kawagoe City, Kawaguchi City, etc.

[Tokyo]
・Population: Approx. 11.2 million
・Areas (Asaka Water Purification Plant)
A portion of 16 wards, including Chuo, Bunkyo, Chiyoda, Kita, Itabashi and Toshima Wards, and some areas of Tama and Machida Cities.



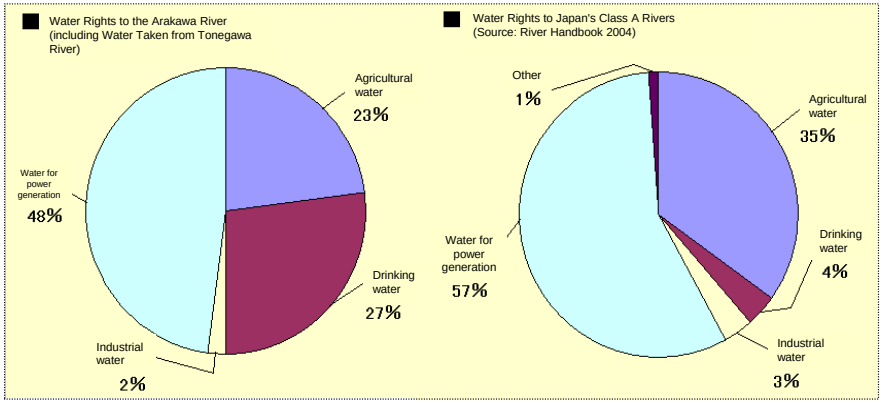
Role of Lake Saiko (Supplying Water to Tokyo and Saitama)



◆ Water is <2. discharged> upstream from the <1. Akigase Intake Weir> on the Arakawa River and purified at the <3. water purification plants> to produce drinking water, etc. to be supplied to Tokyo and Saitama Prefecture.
◆ When the river's water level recedes, water is discharged from upstream dams or water is <5. pumped> from <4. Lake Saiko> and discharged into the river upstream from the Akigase Intake Weir via the <6. water pipe> to secure drinking water, etc.

Using the Arakawa's Water

- River water has long been used for agriculture and hydropower generation.
- Today it is increasingly used for urban drinking and industrial water.
- Approx. 80% of the urban water supply comes from the Tonegawa River.

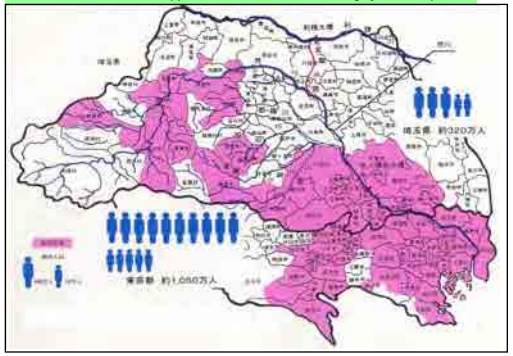


Urban Water Supply

- Increasing use as drinking and industrial water
- Water from the Tonegawa River is conveyed via the Musashi Canal and taken at the Akigase Intake Weir.
- Supplying drinking water to approx. 15 million people

Supplying drinking water to approx. 15 million people
(11.2 million in Tokyo and 3.8 million in Saitama)

* The above figure for Tokyo is the number of people living in the area where water can be supplied. The actual number is roughly 5 million.)




Musashi Canal

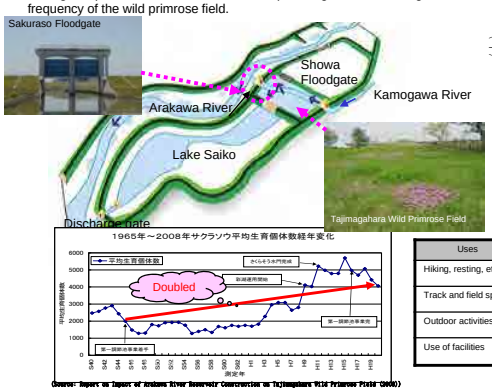

Akigase Intake Weir

5. Environmental Measures and Uses after Completion

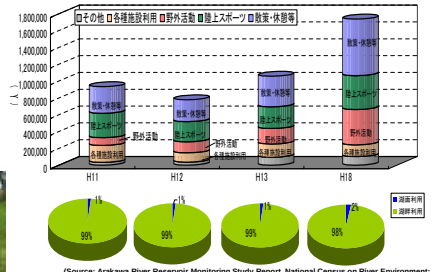
- **The Tajimagahara Wild Primrose Field, which is designated as a "special natural monument" by the Japanese government, is located within the flood control reservoir.**
- **To ensure that the construction of the containment levee does not have any adverse effect on the water environment of the wild primrose habitat, environmental conservation measures are implemented in cooperation with the Agency for Cultural Affairs, Saitama Prefectural Government, etc., including developing rules for operating the Sakuraso Floodgate.**
- **The number of primrose plants has doubled since the beginning of reservoir construction.**
- **Built within the Arakawa River Flood Control Reservoir No. 1, Lake Saiko, Doman Green Park, Akigase Park, etc., attract about 1.7 million visitors annually (estimate for 2006).**

■ Sakuraso Floodgate protecting the environment

The Sakuraso Floodgate is designed to discharge water from the Kamogawa River into the Arakawa River. Fully closed during flooding, it serves as a containment levee.
Floodgate operation rules have been developed in light of the flooding frequency of the wild primrose field.



■ Uses of Arakawa River Flood Control Reservoir No. 1



(Source: Arakawa River Reservoir Monitoring Study Report, National Census on River Environment: Waterfront Space Use Survey)

Uses	Examples of uses
Hiking, resting, etc.	Walking, resting, etc.
Track and field sports	Jogging, cycling, etc.
Outdoor activities	BBQ, nature observation, etc.
Use of facilities	Learning center, etc.

Lake Saiko, an urban oasis visited by 1.7 million people annually

Tajimagahara Wild Primrose Field

Lakeside teeming with hikers

People enjoying wind surfing on the lake

Toda Marathon at Lake Saiko

Lake Saiko Nature Center

First floor exhibit room
Underwater Wonders

10 aquarium tanks of various sizes reflect the water environment and inhabitants of the nearby Arakawa River as well as its related ponds and tributaries.

Fourth floor exhibit room
Forest Wonders

Here enlarged models give visitors an up-close look at the forest ecosystem as they learn about the woods surrounding Lake Saiko and the woodland homesteads that dot the area.

Second floor exhibit room
Waterfront Wonders

A diorama of waterfront plants and other displays illustrate the waterfront environment and its inhabitants. The Waterfront Theater is a video showcase introducing visitors to Lake Saiko's seasonal changes and ecological food chain.

Fifth floor exhibit room
Arakawa River Environment and People

This exhibit looks at the history of flood control along the Arakawa and use of its waters as well as how the river has shaped cultures and lifestyles over the ages. There is a large diorama showing the important role Lake Saiko plays as well as a video (Arakawa Theater) all about flood control and water uses.

Third floor exhibit room
Grassland and Marshland Wonders

The exhibit introduces visitors to various plants and animals living along the river bank including the grasslands and levees that are their habitats. The field observation station provides tips for doing field work around Lake Saiko as well as information and materials that aid environmental education.

Orientation Room

Here computers are used to brief groups of visitors, students, and others on the highlights of the facility.

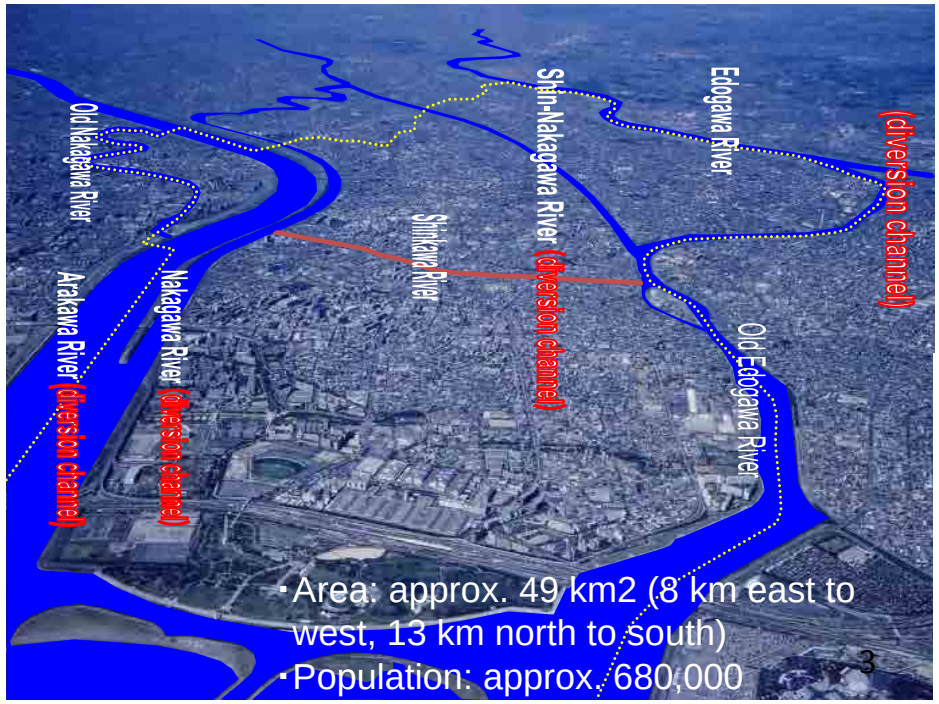
Edogawa City Flood Control and Flood Information Management

Thailand's Chao Phraya River Basin Flood Control Project
Counterpart Training

December 17, 2012

Edogawa City

1. Edogawa, a Sea Level City
   - Geographic Features
   - The Fight against Floods (History)
2. Structural Measures
   - Super Levee Construction Integrated into Community Development
3. Nonstructural Measures
   - Creating and Distributing Flood Hazard Maps
   - Evacuation Advisory Standards
   - Evacuation Guidance for Residents
   - Challenges and Tasks Ahead (Wide-area Evacuation)
   - Information Gathering and Delivery Tools



- Area: approx. 49 km2 (8 km east to west, 13 km north to south)
- Population: approx. 680,000

Typhoon Kathleen (1947)

1947 Typhoon Kathleen Shinkoiwa - Koiwa Station, Edogawa City

People fleeing

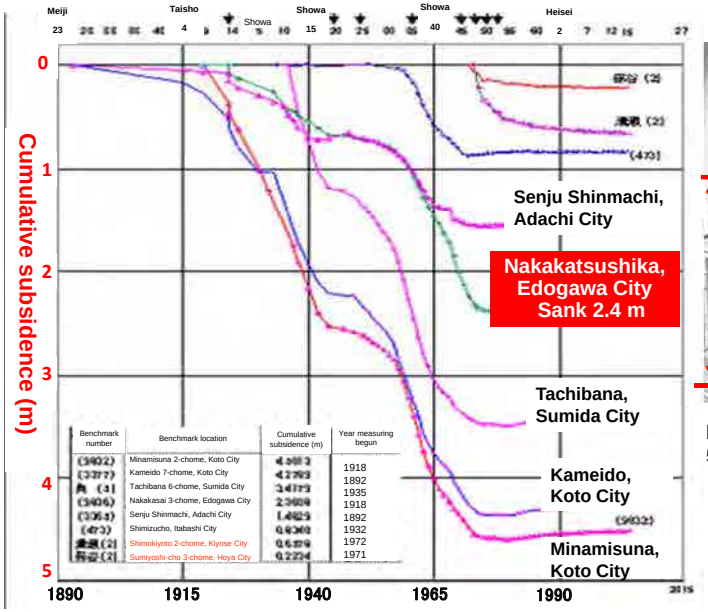
Seawall Destroyed by Typhoon Kitty (1949)

South Exit of Hirai Station after Typhoon Kitty (1949)

August 31, 1949 Typhoon Kitty
Near South Exit of Hirai Station

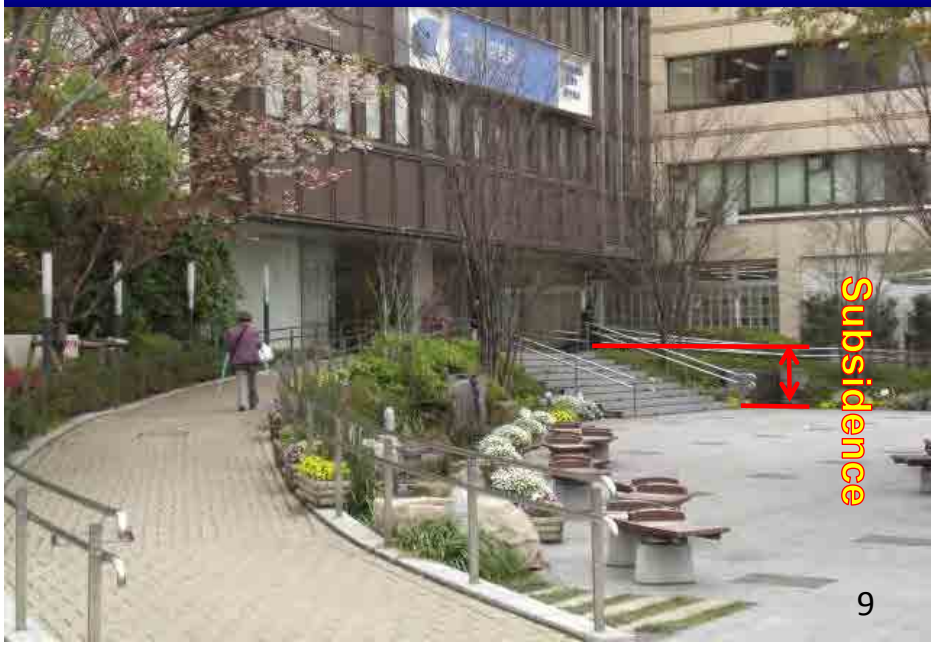
Typhoon Kitty Inundation Map (1949)

Ground Subsidence due to Pumping of Groundwater

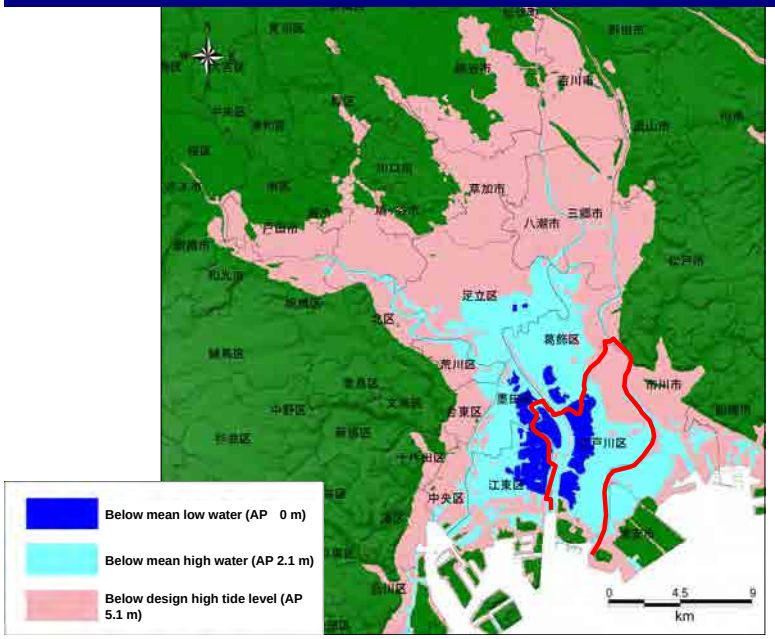


Exposed well casing
5th Construction Office, Tokyo Metropolitan Government
(Shinkoiwa 1-chome, Katsushika City)

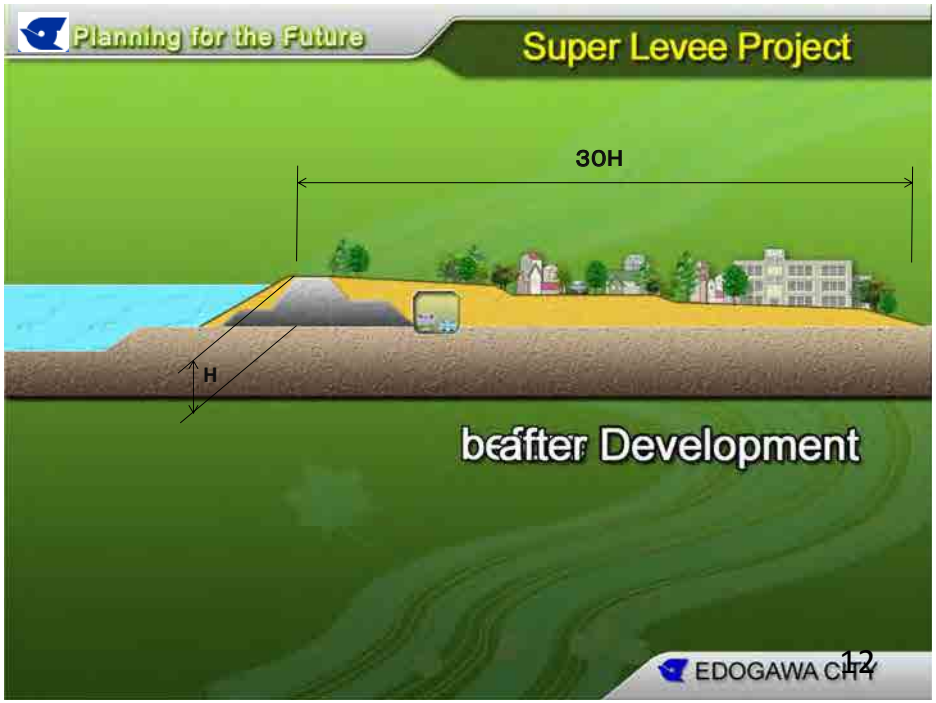
Impact of Subsidence (Main Entrance of Edogawa City Office)



Ground Height of Low-lying Land in Eastern Tokyo



Nakagawa River (Matsushima District)



江戸川区

Evacuation Information Provided by Local Governments

Creating/distributing flood hazard maps

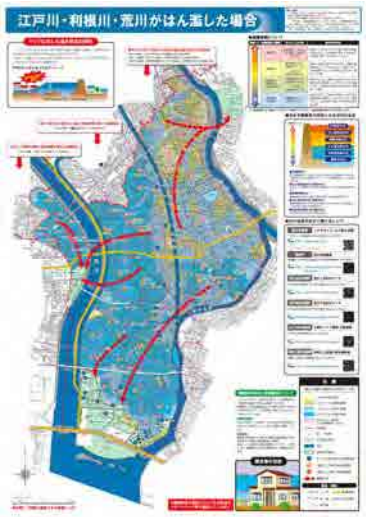
Issuing evacuation advisories and orders

Evacuation sites, routes, etc.

Means of conveying information to residents

江戸川区

Creating and Distributing Flood Hazard Maps



■By law

・The Flood Control Act requires municipal governments to create and distribute flood hazard maps.

■Flood hazard maps should include:

1. Flood zone and types of damage (extent, inundation depth)
2. Evacuation sites (names and locations of evacuation facilities)
3. Means of communicating evacuation information such as flood forecasts, etc. (channels and means for communicating evacuation advisories, etc.)
5. Where to get weather information, etc. (names, locations, URLs, etc. of river and rain gauging stations)

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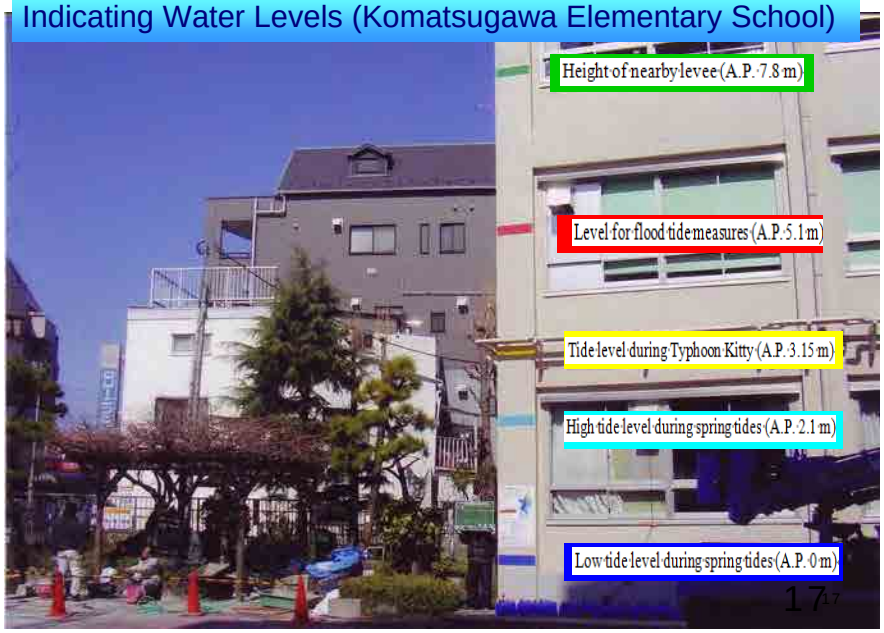
Indicating Water Levels (Komatsugawa Elementary School)



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Arakawa River Water Level Display Tower (in Front of Edogawa City Office)

Flood forecasts conducted soley by the Japan Meteorological Agency

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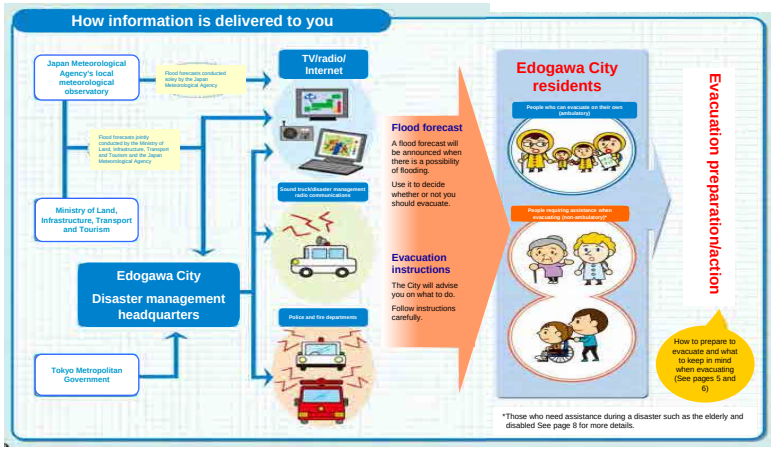
Issuing Evacuation Advisories and Orders



- Issuer of advisories/orders
  As a general rule, the mayor issues evacuation advisories/orders (Article 60, Basic Act on Disaster Control Measures)

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Issuing Evacuation Advisories and Orders

(1) Types of evacuation instructions and criteria for issuing evacuation instructions

- Types

Risk level	Type	Action		Conditions
		Ambulatory	Non-ambulatory	
High	Evacuation order	Complete evacuation		There is a likelihood of a levee breach, due to a major leak, cracks, etc., posing a significant threat to public safety.
	Evacuation advisory	Start evacuating	Complete evacuation	Flooding is imminent, posing a clear threat to public safety. Everyone able to evacuate on their own (those who are ambulatory) must start evacuating at this stage.
	Evacuation advisory for the non-ambulatory (Evacuation preparation for the ambulatory)	Evacuation preparation	Start evacuating	Flooding is imminent, posing a clear threat to public safety. Anyone needing more time to evacuate (those who are non-ambulatory) must start evacuating at this stage.
Low	Evacuation preparation for the non-ambulatory		Evacuation preparation	Flooding is likely to occur, posing a possible threat to public safety. Anyone who is non-ambulatory must start preparing to evacuate at this stage.

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Issuing Evacuation Advisories and Orders

(2) When to issue evacuation advisories/orders

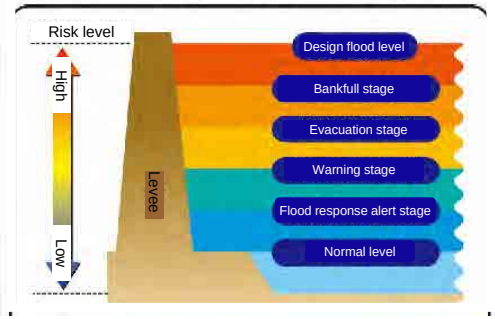
- River water level criteria for determining when to issue an evacuation advisory/order

  Advisories and orders are issued in light of river water levels (for the Arakawa, Edogawa and Nakagawa Rivers).

[For Reference] Water Levels and Forecast Points

River name	Gauging station	Flood response alert stage (m)	Warning stage (m)	Evacuation stage (m)	Bankfull stage (m)	Gauge zero point
Arakawa River	Iwabuchi	3.0	4.1	7.0	7.7	AP.0.0m
Edogawa River	Nishiseki yado	4.5	6.1	8.5	8.8	YP.+8.5m
	Noda	4.6	6.3	8.9	9.2	YP.+3.4m
Nakagawa River	Yoshikawa	3.3	3.6	3.9	4.2	AP.0.0m

● River water levels for issuing flood forecasts



Non-ambulatory	Ambulatory
	Evacuation order
	Evacuation advisory
Evacuation advisory	Evacuation preparation
Evacuation preparation	

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Evacuation Sites, Routes, etc.

(1) Evacuation sites

Before flooding has started, local disaster management bases are the evacuation sites of first recourse (①). Once flooding begins, nearby shelters are the evacuation site of first recourse (②).

① Before flooding begins

■Local disaster management bases
- Oshima Komatsugawa Park (design occupancy: 197,000)
- Kasai Nanbu area (design occupancy: 270,000)
- Konodai Danchi housing complex (design occupancy: 200,000)

② After flooding begins

■Emergency shelters
- 33 junior high schools
- 73 elementary schools

*Note that floors where people can evacuate to are specified at each facility.

③ When there is not enough time to get to an emergency shelter

■Sturdy nearby building that is three or more stories high
(When you have to act quickly in a life threatening situation)

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Evacuation Sites, Routes, etc.

(2) Where to go

When evacuating, people should flee in the direction shown on the existing hazard map.

Oshima Komatsugawa Park (design occupancy: 197,000 people)

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Evacuation Sites, Routes, etc.

(3) Challenges

Since the elevation is below sea level, people may be cut off for a long period of time if the area is flooded.

■Local disaster management bases

These are outdoor locations without roofs where evacuees will have to put up with inconveniences.

■Emergency shelters

Since lower levels will be submerged, floors that can accommodate evacuees are limited.

■Sturdy nearby building that is three or more stories high

Evacuees may be cut off for a long period of time.

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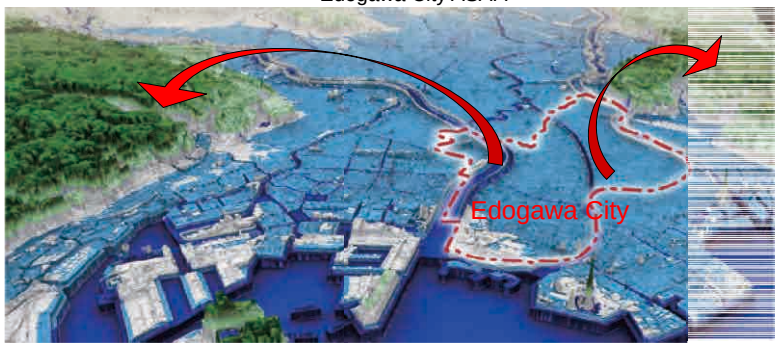
Evacuation Sites, Routes, etc.

(4) Future tasks

Wide-area evacuation plan is needed to allow people to flee to high ground outside Edogawa City ASAP.



- Develop a criteria that will help people to quickly decide whether they should evacuate or not
- Ensure safe evacuation facilities outside the city
- Develop long-distance evacuation guidance strategies
- Get guidance from officials who issue evacuation orders (national government, governor, etc.) when damage is extensive

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Means of Conveying Information to Residents

Gathering information

- River information system
- MCA radio communication system
- Meteorological information collection system
- Disaster management information system
- Surveillance cameras

Providing information

- City's disaster management radio communication system
- Twitter
- Edogawa e-mail news
- FM Edogawa

  Emergency broadcasting system

All communication tools are managed by the Disaster Management Headquarters

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Means of Conveying Information to Residents

- River information system

Gives access to river basin rainfall data, water level data and live camera images provided by River Offices in Kanto. (Dedicated lines from River Offices)

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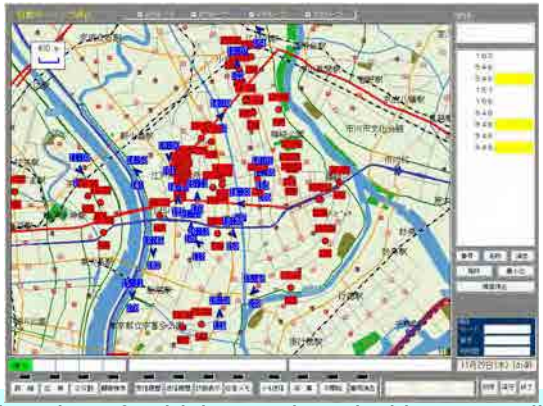
Means of Conveying Information to Residents

- MCA radio communication system (vehicle tracking system)



Displays location of vehicles equipped with MCA radio communication system.
Lets headquarters personnel track vehicles on screen and dispatch them where needed.

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Means of Conveying Information to Residents

- Meteorological information collection system

November 29, 2012, 4:50 p.m.

	Edogawa City Office	Komatsugawa Branch	Koiwa Branch	Shishibone Branch	Tobu Branch	Shinkawa underground parking lot	Kasai Branch	Shin-Sakongawa River floodgate
10-minute rainfall	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm
Cumulative rainfall	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	2.5 mm	0.0 mm	0.0 mm
Average wind speed	1.0 m/s	1.4 m/s	1.2 m/s	0.5 m/s	2.0 m/s	0.5 m/s	1.5 m/s	1.0 m/s
Maximum wind speed	1.9 m/s	2.3 m/s	1.9 m/s	1.4 m/s	3.0 m/s	0.9 m/s	2.6 m/s	1.9 m/s
Wind direction at maximum wind speed	North	Northeast	Northeast	West	North-northeast	North-northwest	North-northeast	North-northeast
Temperature	13.2 ℃	13.2 ℃	12.6 ℃	12.8 ℃	13.0 ℃	13.0 ℃	13.4 ℃	13.5 ℃
Local atmospheric pressure	1017.8 hPa	1016.8 hPa	1016.1 hPa	1016.3 hPa	1016.8 hPa	1017.8 hPa	1015.7 hPa	1016.0 hPa
Inland water level								1m99cm
River water level								1m98cm

November 29, 2012, 4:50 p.m.

Collects/displays data from rain gauges and anemometers installed in 8 locations (mainly branch offices) throughout Edogawa City.
It also collects water level data at the Shin-Sakongawa River floodgate managed by Edogawa City.

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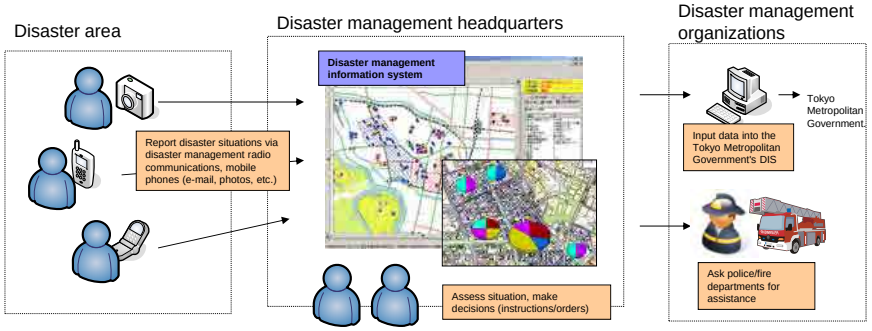
Means of Conveying Information to Residents

- Disaster management information system



Information from the disaster area (fires, building damage, etc.) is centrally managed to facilitate quick decisions at disaster management headquarters and speed up emergency response operations.

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Means of Conveying Information to Residents

- Surveillance cameras

Tower Hall Funabori

Edogawa City Office

Disaster Management Headquarters

Cameras

Media converter

Controllers

Can be controlled remotely from the disaster management headquarters

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Means of Conveying Information to Residents

- City's disaster management radio communication system

272 units installed
(covering the entire city)

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Means of Conveying Information to Residents

- Twitter
- Edogawa City official website

Residents have to seek out the information they want

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Means of Conveying Information to Residents

- Edogawa e-mail news

Used by people of all ages and delivered automatically

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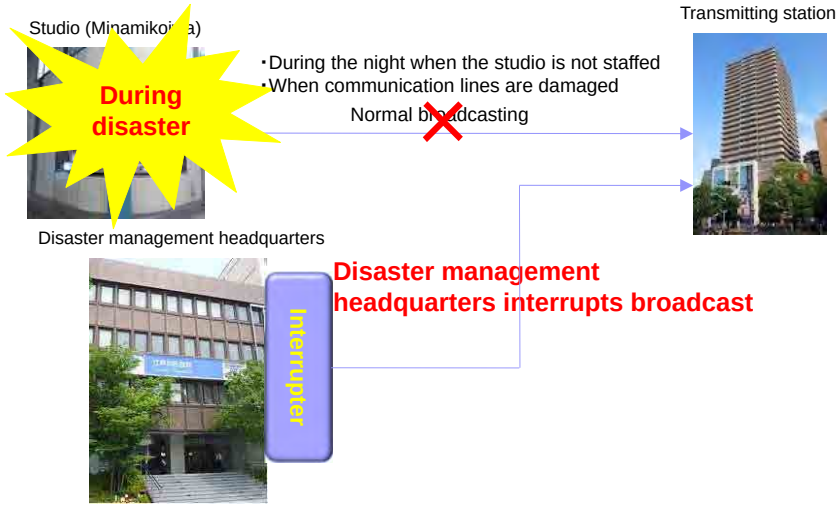
Means of Conveying Information to Residents

- FM Edogawa emergency broadcasting system



Contents

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3. Diverting the Arakawa
4. Downstream Flood Control
5. Great East Japan Earthquake (Arakawa River Tsunami)
6. Disaster Management Facilities Use Plan

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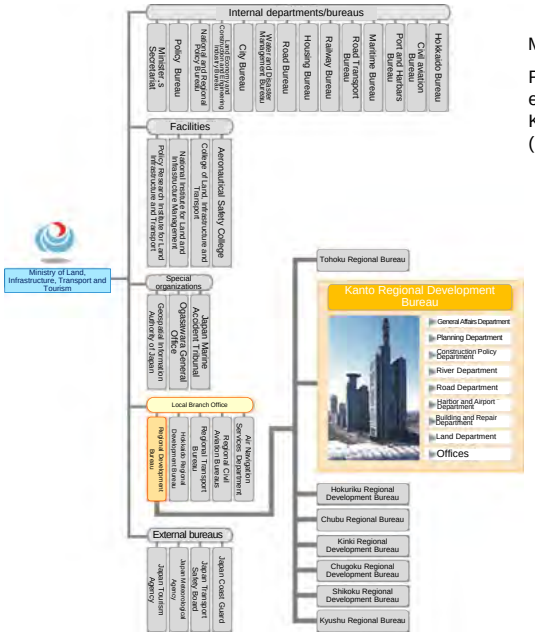
MLIT Organization



Number of employees: as of December 31, 2007

MLIT (number of employees: approx. 150,000)

Regional Development Bureaus (number of employees: approx. 22,000)
Kanto Regional Development Bureau (number of employees: approx. 4,000)

Kanto Regional Development Bureau (New Urban Center)

Coverage by Regional Development Bureaus

Contents

Arakawa River Basin

Comparison of Basins

Chao Phraya River

River head	Northern mountainous region of Thailand
Course length	980 km
Basin area	157,900 km2

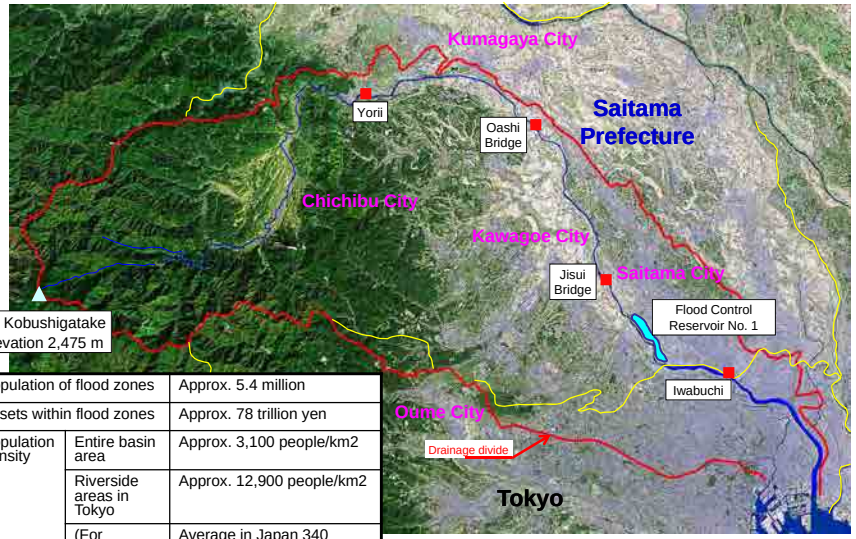
Tonegawa River basin

River head	Mt. Ominakami
Course length	322 km (No. 2)
Basin area	16,840 km2 (No. 1)
Basin population	Approx. 12.14 million (No. 1)

Arakawa River basin

River head	Mt. Kobushigatake
Course length	173km (No. 15)
Basin area	2,940 km2 (No. 19)
Basin population	Approx. 9.3 million (No. 3)

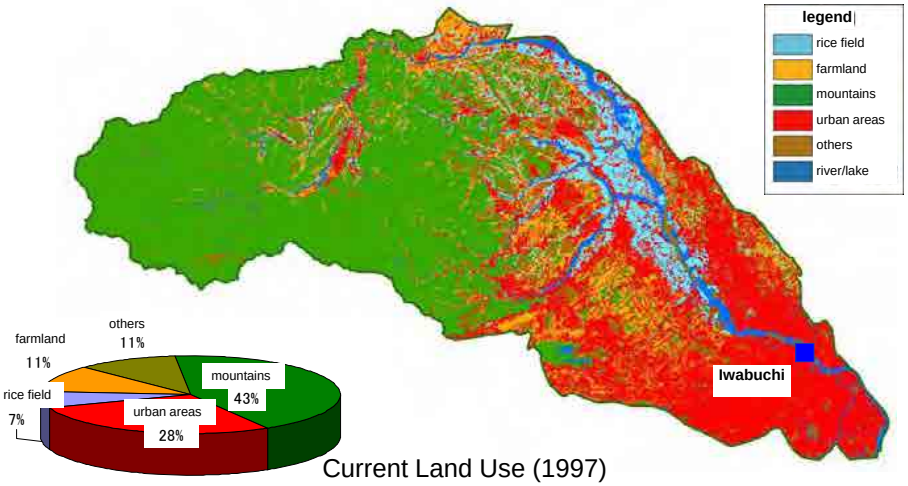
Basin Overview - Big River Running through Japan's Capital -



Population of flood zones		Approx. 5.4 million
Assets within flood zones		Approx. 78 trillion yen
Population density	Entire basin area	Approx. 3,100 people/km2
	Riverside areas in Tokyo	Approx. 12,900 people/km2
	(For reference)	Average in Japan 340 people/km2 In Tokyo 5,460 people/km2

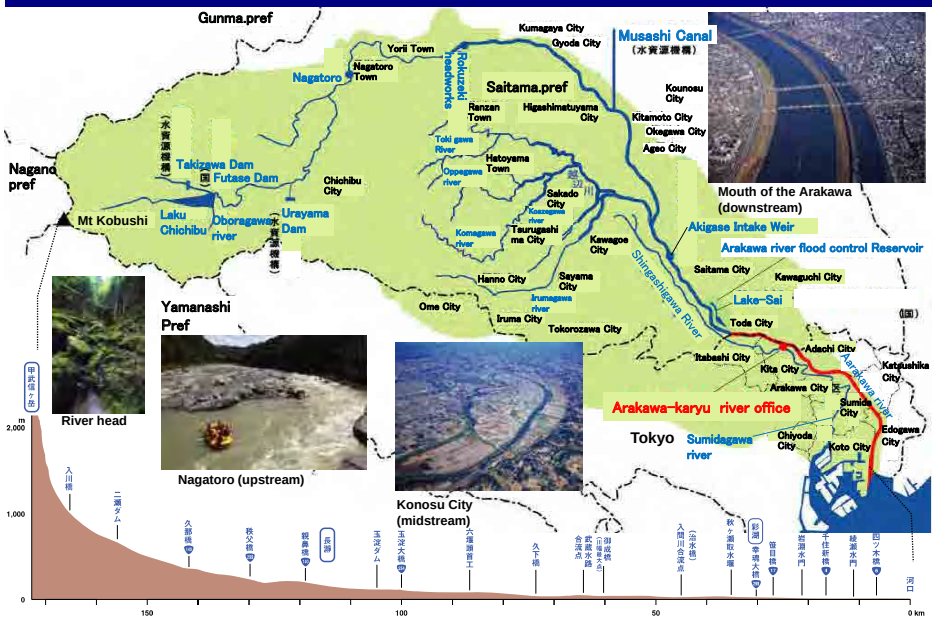
Basin Land Use

◆43% of the basin is mountainous. 28% is urban.
◆Assets within the basin (approx. 32% of entire Kanto Region) total about 150 trillion yen. (*Total assets in Kanto equal approx. 462 trillion yen.)



Current Land Use (1997)

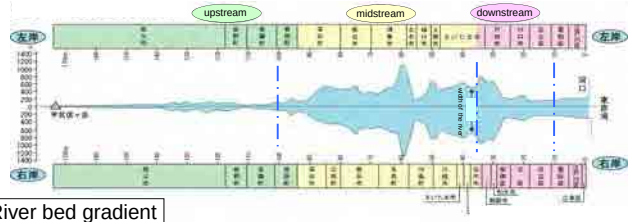
Overview of Flow Path



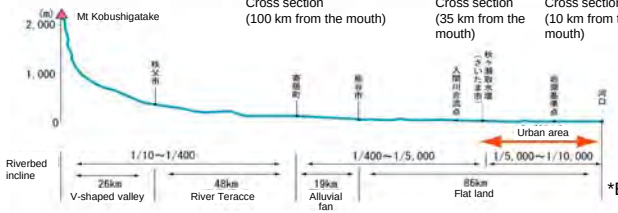
River Channel Characteristics

◆The midstream high-water channel measures 2.5 km at its widest point. The diversion channel located 21 km downstream has a width of about 0.5 km.
◆The upstream section leading to Yorii is very steep at 1/10 to 1/400. The midstream section from Yorii to Akigase is sloped at 1/400 to 1/5,000. The downstream slope gradient, from Akigase to the mouth (estuarine basin), ranges from 1/5,000 to 1/10,000.

Distance from the mouth and width



River bed gradient



Cross section

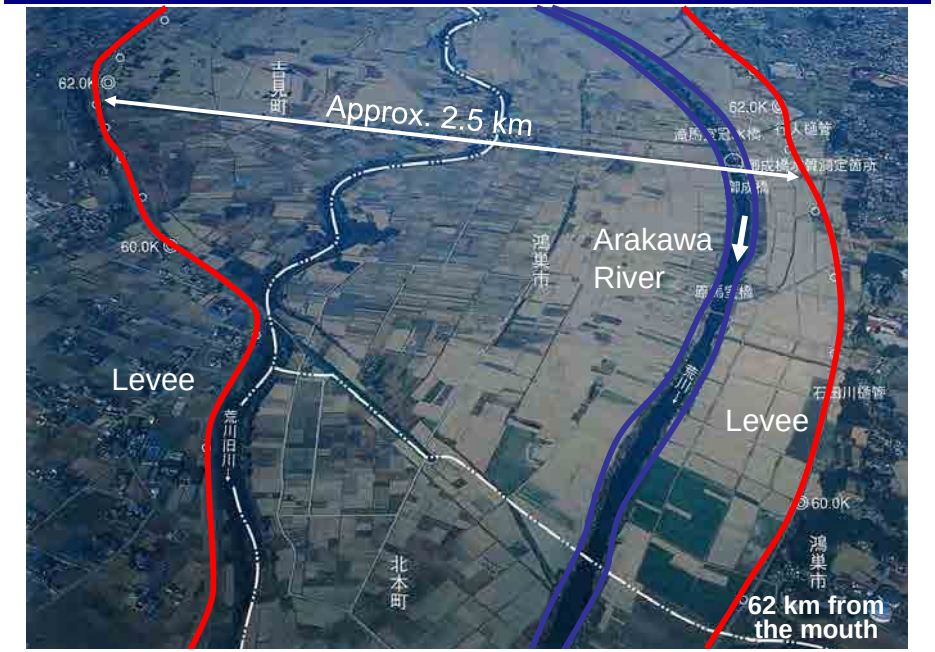
Fluvial terrace (100 km from the mouth)

Flatland (35 km from the mouth)

Urban areas (10 km from the mouth)

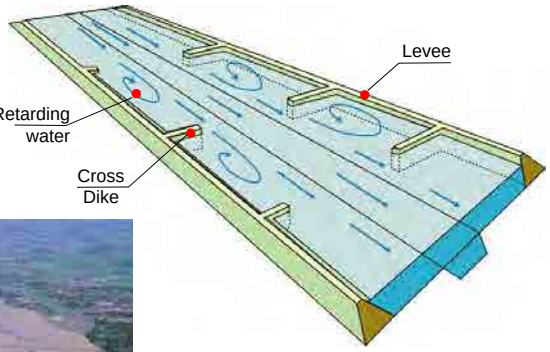
*Based on "Arakawa River Report"

Middle Section with Wider Channel



Flood Control via Cross Levees

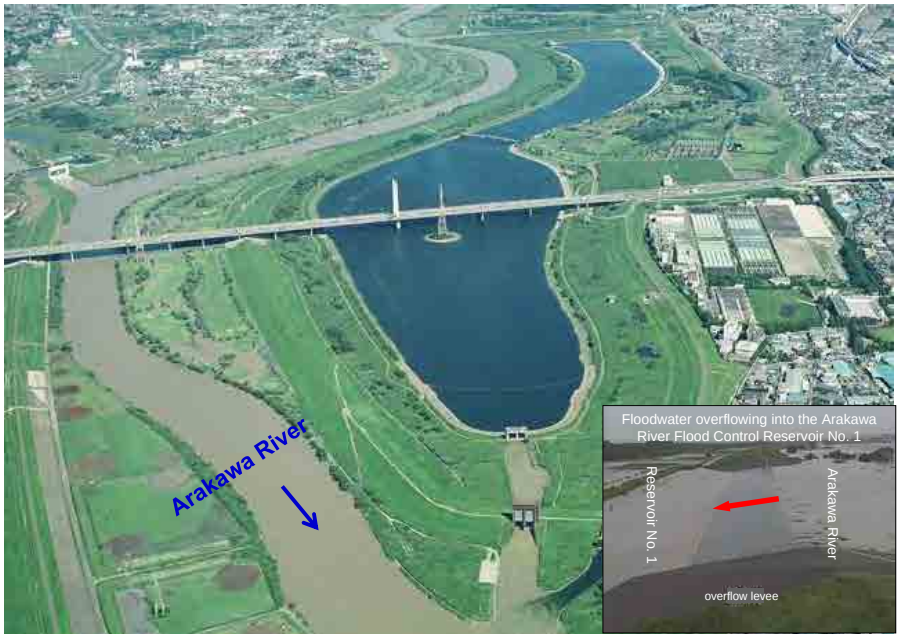
26 **cross levees** have been built along the wide reach of the river between Nukata Bridge in Yoshimi-cho and Sasame Bridge in Toda City for better flow diversion to control flood downstream.



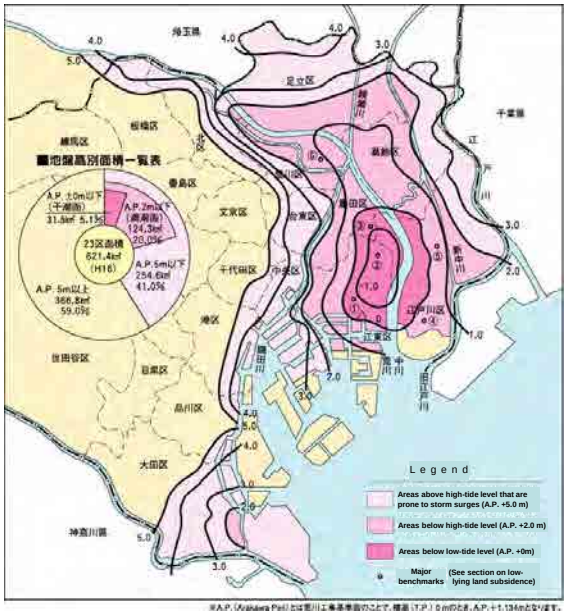
↑During flood (Yoshimi-cho, Konosu City), photo taken in September 1982

Under normal conditions (Yoshimi-cho, Konosu City) →

Flood Control via Arakawa River Flood Control Reservoir No. 1



Extensive Zero-meter Zone



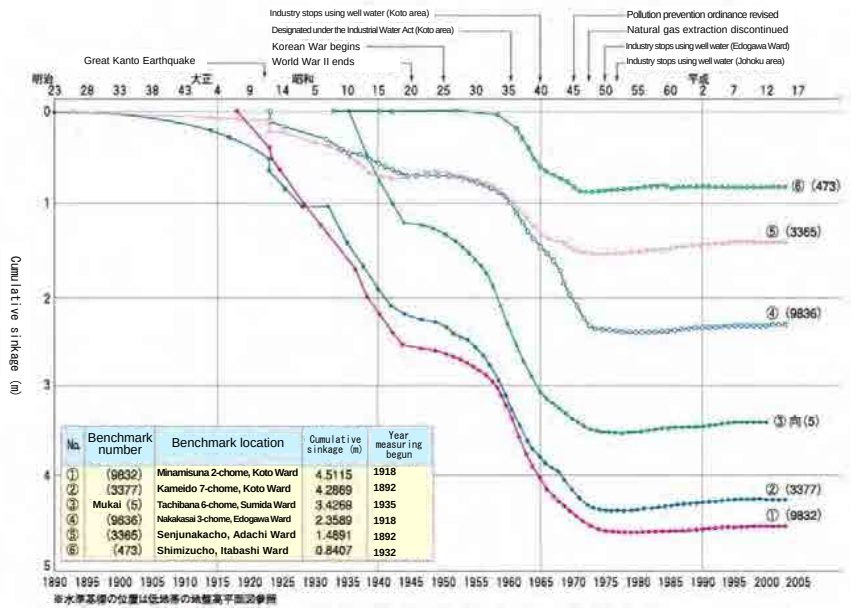
Below high-water level: 124.3 km2

(Population: Approx. 1,760,000)

Below low-water level: 31.5 km2

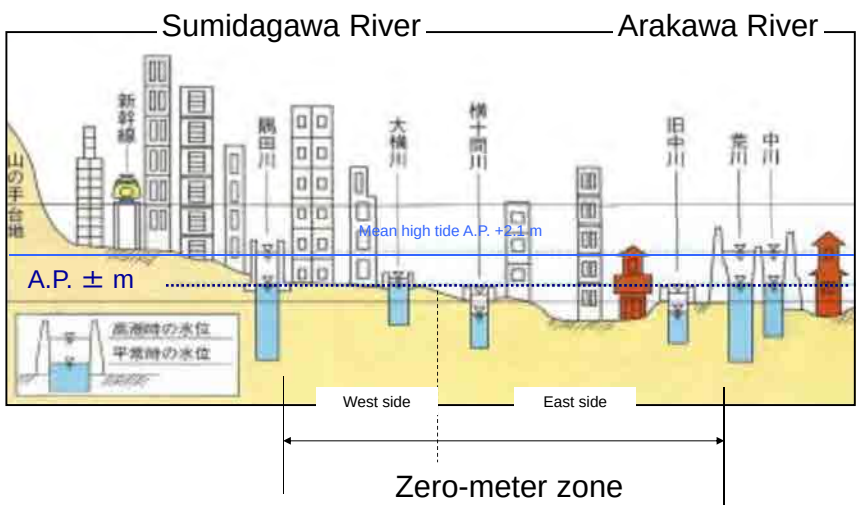
(Population: Approx. 400,000)

Ground Subsidence due to Pumping of Groundwater



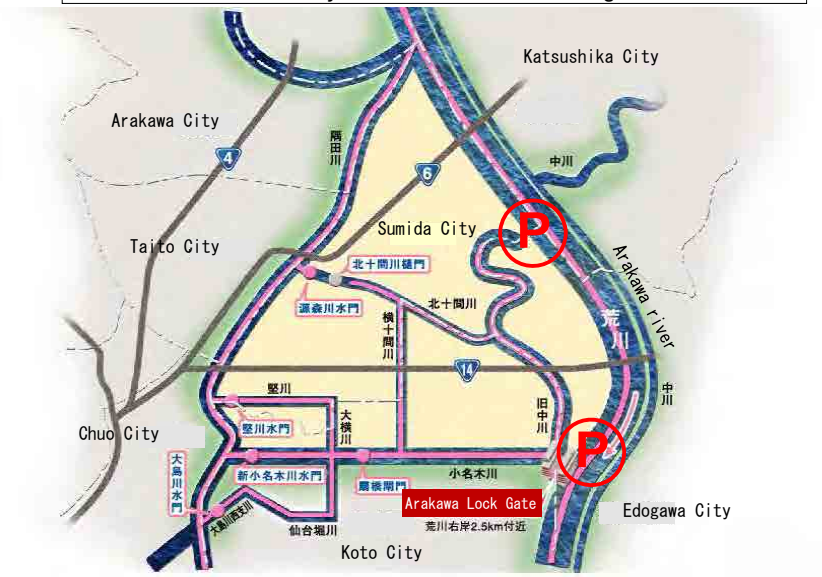
No.	Benchmark number	Benchmark location	Cumulative sinkage (m)	Year measuring begun
①	(9832)	Minamisuna 2-chome, Koto Ward	4.5115	1918
②	(3377)	Kameido 7-chome, Koto Ward	4.2869	1892
③	Mukai (5)	Tachibana 6-chome, Sumida Ward	3.4268	1935
④	(9836)	Nakakasai 3-chome, Edogawa Ward	2.3589	1918
⑤	(3365)	Senjunakacho, Adachi Ward	1.4891	1892
⑥	(473)	Shimizucho, Itabashi Ward	0.8407	1932

Pumping Keeps Water Level below Sea Level in Zero-meter Zone



Koto Delta

●There is up to a 3.1 m difference in water levels in the area of the Koto Delta sandwiched by the Arakawa and Sumidagawa Rivers.



Arakawa Lock Gates

●The Arakawa Lock Gates were completed in October 2005.
●Serving as part of a wide-area disaster management network, the lock gates enable transport of relief supplies and disaster victims during emergencies to aid relief activities.
●In normal times the lock gates provide opportunities for water activities such as sightseeing cruises, canoeing, boat regattas, etc.


Aerial view of the Arakawa Lock Gates


Front lock gate

Anti-storm Surge Projects

☆ History of storm surge planning

- Storm surge preparedness plans were developed by municipalities throughout Japan after Typhoon Vera left a path of destruction along Ise Bay in 1959.
- Specifics of the preparedness plan for Tokyo Bay were finalized in 1960.

☆ Overview of anti-storm surge projects

- Projects were initiated in 1961 based on the master storm surge preparedness plan for Tokyo Bay.
- The plan for the Arakawa River Diversion Channel included constructing a right bank storm surge barrier (from the river's mouth to Sumida Floodgate) by FY1965 and a left bank storm surge section by 1970.


Anti-storm surge facilities constructed

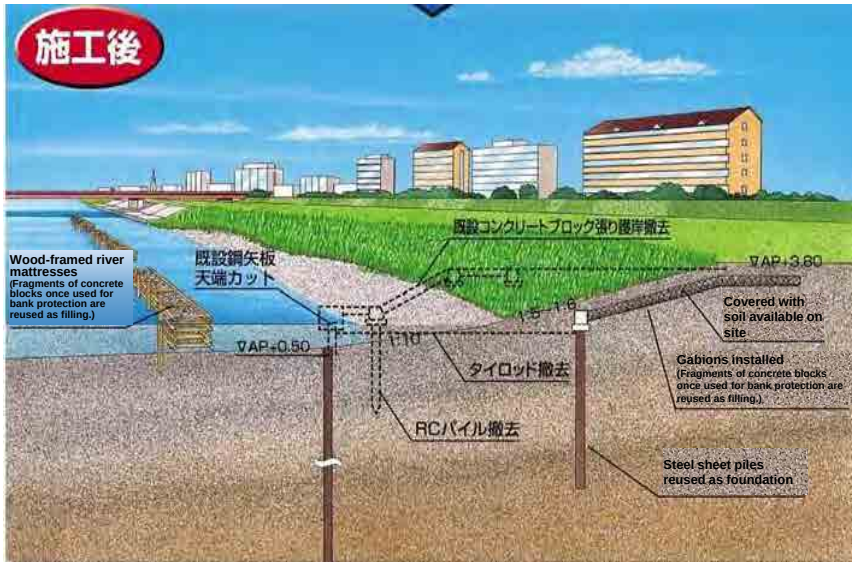

Arakawa River's storm surge barrier

Overview of Riparian Restoration Project

Example of implemented project: Komatsugawa area [Vertical river wall was removed and gradually sloped river front was built.]

- The existing river wall separating the river and its bank by sheet piles and concrete blocks was removed, and the river front was gently sloped to restore reed field and tidal flat.
- Wood-framed river mattresses were laid to test how well they would dissipate waves generated by boats and prevent erosion of the reed field/tidal flat.

Riparian Restoration/Conservation (Komatsugawa Area Test Site)



Existing river wall was removed to restore reed field and tidal flat.

River Stations (Emergency Docks)

- Designed for rescue ops and loading/unloading of supplies, machinery, food, etc. during an emergency.
- Can be used as public docks for boarding/disembarking water taxis, etc.

<12 under the plan, 9 constructed, 1 under construction>

Emergency River Bank Road

- The emergency river bank road connecting river stations serves as an emergency supply route.
- The road stretches from the river mouth to Hanekura Bridge (about 37 km).

The Tokyo leg is completed. 57.0-km (98%) of the 58.2 km road has been constructed.
The remaining 1.2-km section will be constructed on the river's left bank in Kawaguchi City, Saitama Prefecture in step with construction of the super levee project.

Seismic Strengthening of River Structures (Level 2)

- Preparing for Earthquakes -

☆ Earthquake-proofing river structures (L2-resistant)

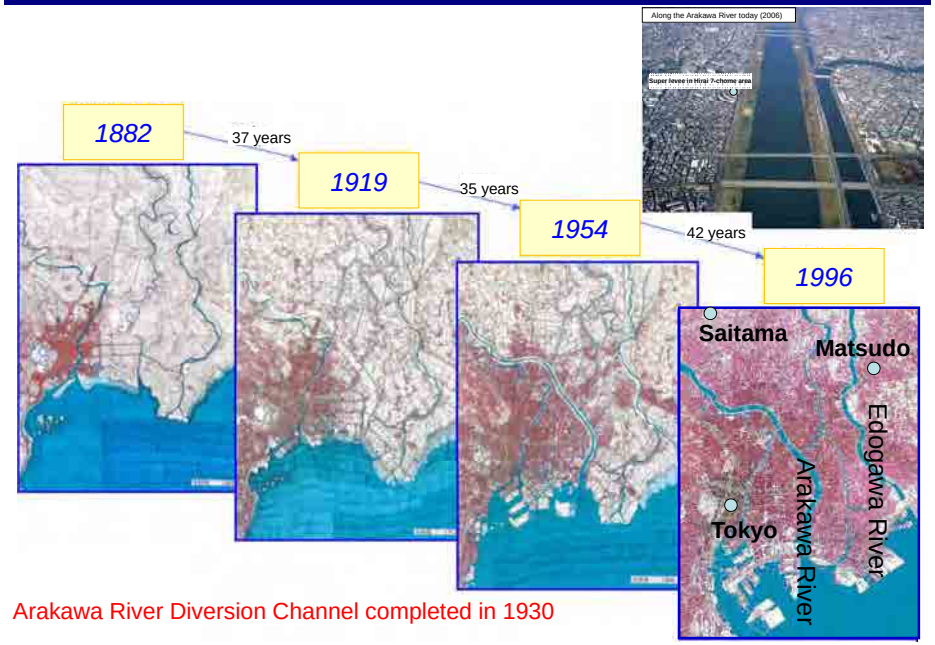
River structures (floodgates, pipes, pumping stations, docks, etc.) are being reinforced to make them resistant to Level 2 earthquake motions (the largest possible).

Earthquake-proofing of the Ayasegawa Pumping Station began in FY2010. Earthquake-proofing of the Sumida, Sanryo and Sasame Sluicegates began in FY2012.

Reinforcing a river structure against bending and shear failure (Steel-plate lining)

River structures requiring seismic strengthening (sluicegates)

Rapid Urbanization during Economic Boom



Arakawa River Diversion Channel completed in 1930

Contents

The Big Flood of 1910

In addition to the continual rain beginning in early August, there were heavy rains ranging from 300 mm to 400 mm in the mountains of Chichibu from August 8 to 10.

Area affected by the flood of 1910

Levee breaches: more than 10 locations

Deaths: 369 (including fatalities in areas along the Tonegawa River)

Victims: 1.5 million

Houses washed out/destroyed: 1,679 units

Houses inundated: approx. 270,000 units

Total damage accounted for approx. 4.2% of gross national income

Honjominamiwari (now Kinshicho)

Inundation depth approx. 1.5 m

Damage Caused in 1910

Flooded Asakusa Park (photo courtesy of Rinnosuke Shimokawa)

Houses submerged in muddy water (Sumida-mura)

Devastation in Honjominamiwari (now Kinshicho) Inundation depth approx. 1.5 m

Construction of Arakawa River Diversion Channel

Arakawa River Diversion Channel constructed

Following the devastating flood of August 1910, the Arakawa River Diversion Channel (today's Arakawa River) was constructed to protect Tokyo.

Length: 22 km

Width: 500 m

Cost: Approx. 230 billion yen

(Construction period: 20 years)

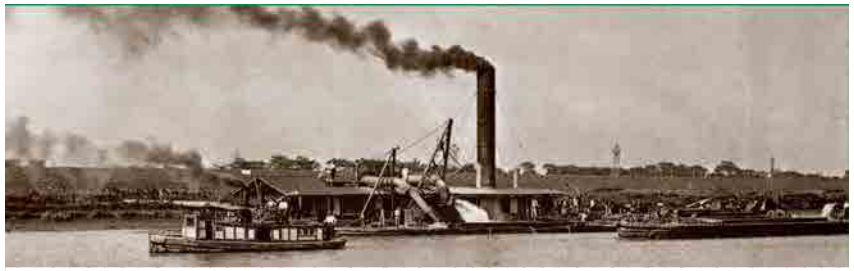
Started in 1911

Completed in 1930

Photos of Arakawa River Diversion Channel Construction

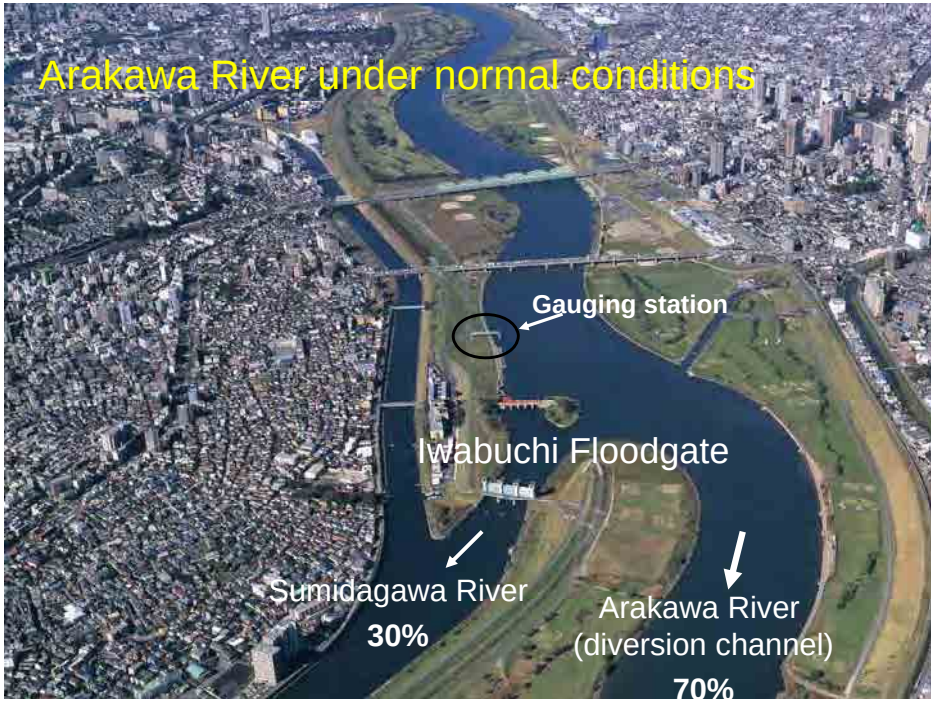
1. River banks were leveled by human and horse power.

2. A channel was excavated using a steam excavator.



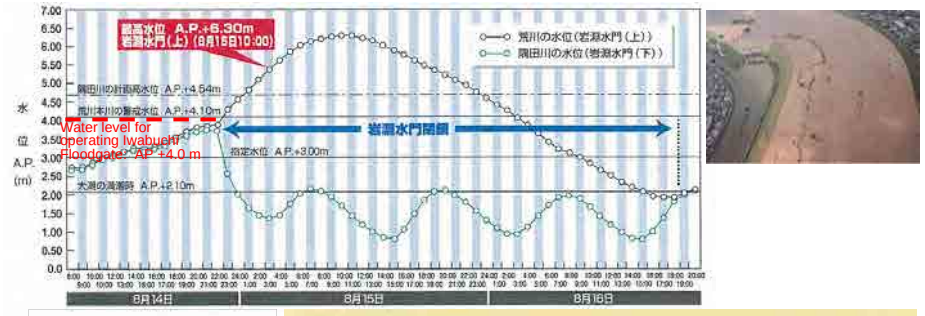
3. After water had been drawn into the channel, the channel bed was dredged.

Contents

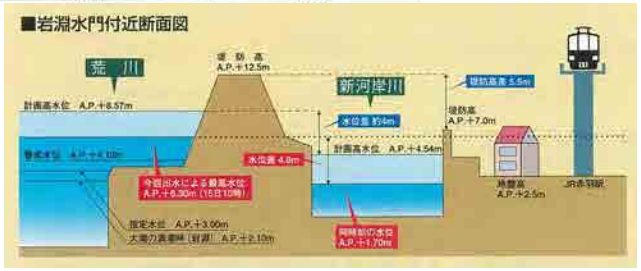


August 1999 Flood

Peak flow (at Shin-arakawa Ohashi Bridge) 4,700 m3



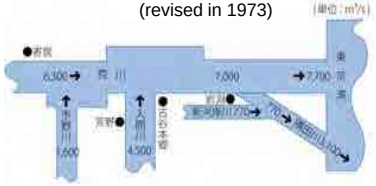
Iwabuchi Floodgate (AP +4.0 ｍ) fully closed



Standard Downstream Water Levels and Discharges

at Iwabuchi (Upstream) Gauging Station

Distribution of design flood discharges (revised in 1973)



Peak basic flood discharge (revised in 1973)

河川名	基準地点	基本高水のピーク流量	ダム等による調節量	河道への配分流量
荒川	岩淵	14,800	7,800	7,000

Levee height A.P. +12.5 m

1947 Typhoon Kathleen (8.60 m)

1958 Typhoon Ida (7.48 m)

1999 tropical storm and heavy rain (6.30 m)

2007 Typhoon Fitow (5.09 m)

Design flood level A.P. +8.57 m

Bankfull stage A.P. +7.70 m

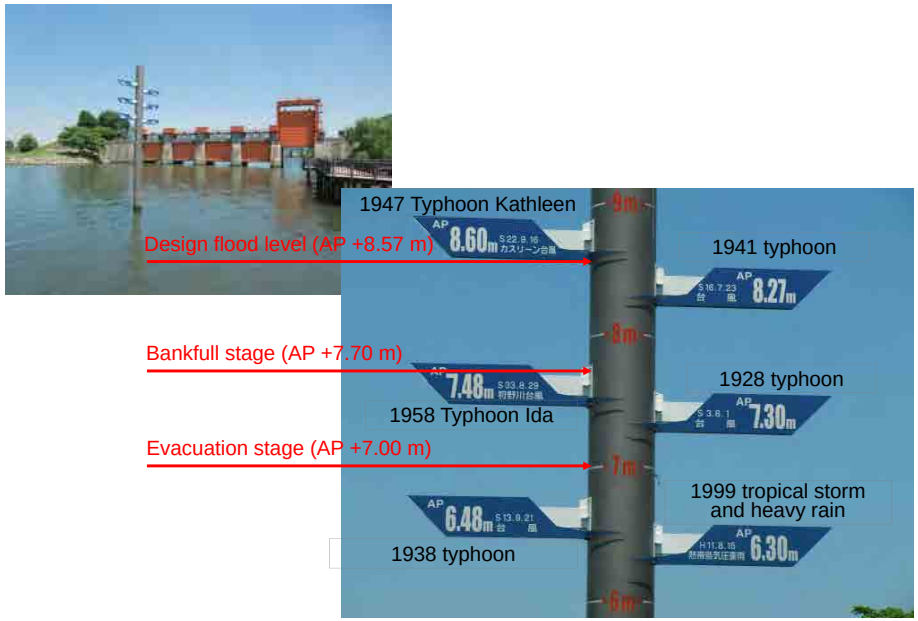
Warning stage A.P. +4.10 m

Flood response alert stage A.P. +3.00 m

At spring tide A.P. +2.10 m

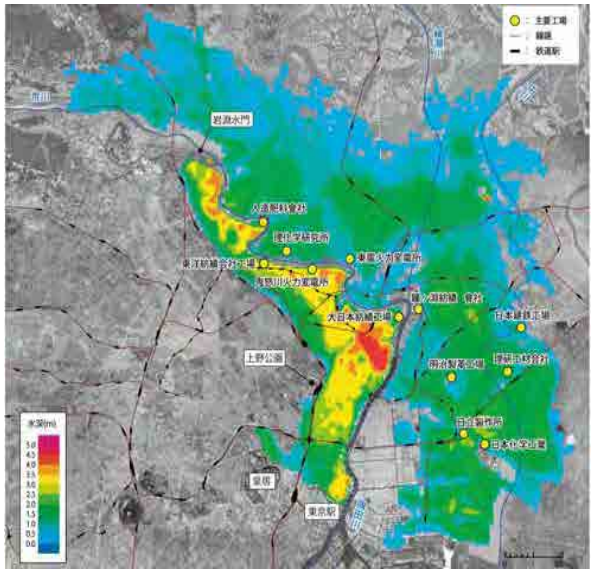
Normal level at Iwabuchi Floodgate (Upstream)

Major Typhoons after Completion of Diversion Channel



Without Arakawa River Diversion Channel

- 1947 Typhoon Kathleen -



Distribution of maximum inundation depths

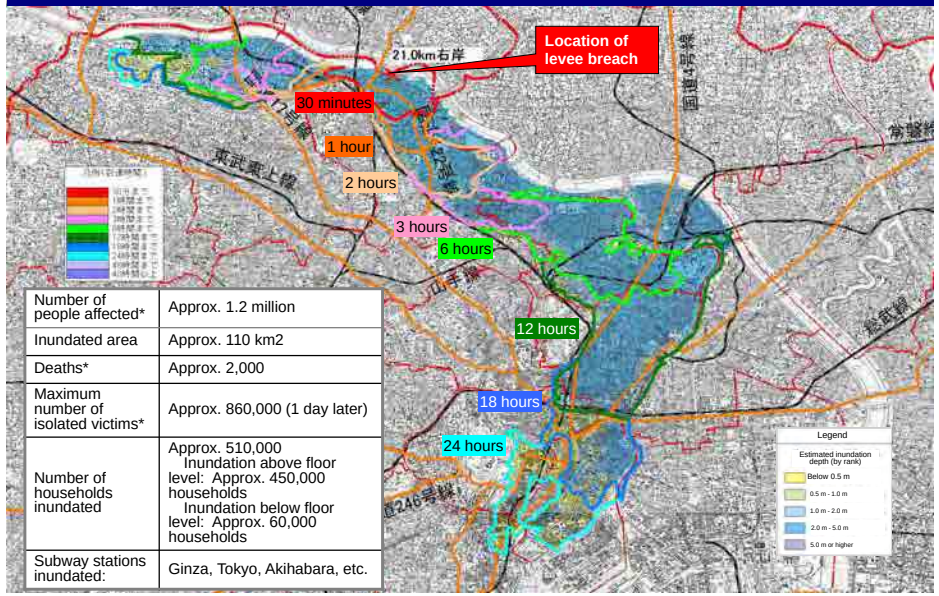
Levee Breach

<Example> If the water level remains high for a long time, water starts to seep into the levee.

Model structure

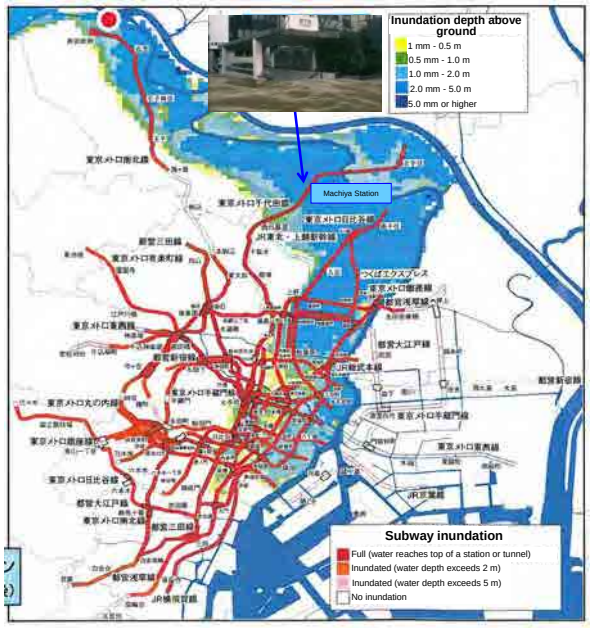
Slope on residential area side: about 30 degrees (1:2)
Slope on river side: about 30 degrees (1:2)
Levee material: coarse sand
Scale: about 1/50

Levee Breaks Produce Quick Flooding - Plans needed to Evac Crowded Areas



Number of people affected*	Approx. 1.2 million
Inundated area	Approx. 110 km2
Deaths*	Approx. 2,000
Maximum number of isolated victims*	Approx. 860,000 (1 day later)
Number of households inundated	Approx. 510,000 Inundation above floor level: Approx. 450,000 households Inundation below floor level: Approx. 60,000 households
Subway stations inundated:	Ginza, Tokyo, Akihabara, etc.

Subways and Underground Malls Flood First



If the Arakawa River flooded, 19 subway lines (about 110 stations) and underground malls located within the flood zone would be inundated.

Major underground facilities likely to be inundated:
Tokyo Metro Ginza, Marunouchi, Tozai, Hibiya, Chiyoda, Yurakucho, Hanzomon, and Nanboku Lines; Toei Shinjuku, Oedo, Asakusa, and Mita Lines;
JR Yokosuka, Sobu, Keiyo Lines;
Keisei Oshiage Line;
Tobu Isezaki Line;
Saitama Rapid Railway;
Tsukuba Express;
Yaesu and
Asakusa underground shopping malls

What Would Happen If a Levee Broke?

Super Levees

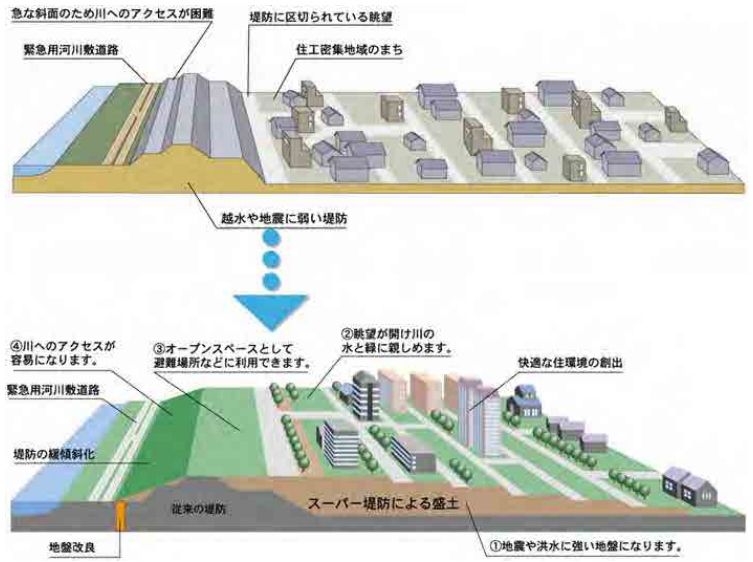
☆ What is a super levee?

A levee whose width is about 30 times its height (10 m high = 300 m wide)

☆ Features

- Earthquake-resistant
- Resistant to overflow
- Resistant to seepage

Construction of Super Levees



Super Levee Construction in Komatsugawa

[About the project]

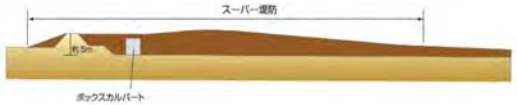
A super levee is being constructed in tandem with the Tokyo Metropolitan Government's urban redevelopment project and Edogawa Ward's cherry tree planting project.

[Location] Edogawa Ward, Tokyo

[Project details]
- **Construction period: FY1990 - FY2014**
- **Area: Approx. 25 ha**
- **Length: Approx. 2,380 m**

[Related projects]
- **Class 2 urban redevelopment project in Kameido, Oshima and Komatsugawa (Tokyo Metropolitan Government)**
- **One thousand cherry tree planting project in Edogawa Ward (Edogawa Ward)**
- **Renovation of Komatsugawa Daini Elementary School (Edogawa Ward)**
- **Public housing construction project (Tokyo Metropolitan Government)**
- **Construction of Komatsugawa Junior High School (Edogawa Ward)**

[Standard cross-section]



Super Levee Construction in Komatsugawa (Photos)

<Before construction>

<After construction>

The Future of Super Levee Construction

☆ In October 2010, the national government's Government Revitalization Unit asked that the plans for building super levees be revised due to the enormous time and money they required.

☆ [A group of experts who reviewed the super levee construction plans made the following proposal]

Construction of overflow-resistant super levees should focus on protecting lives. They should be built only along densely-populated areas to prevent the massive death and destruction that could result from a levee failure. Measures to reinforce existing levees along other sections should be actively implemented in order to make them resistant to seepage and erosion (not overflow) and enhance the level of safety in these areas ASAP.

[Criteria for building super levees]
Sections where a levee failure would result in:
1. inundation of land below sea level before people there could evacuate
2. inundation up to the second floor of buildings in densely built-up areas
3. destructive flooding, resulting in damage to densely built-up areas along the river
Sections where super levees should be built shall be determined on the basis of the above criteria in light of flooding and topographical conditions, etc.

Sections of the Arakawa River include:
- Right bank: Tokyo Metro Tozai Line bridge (Koto Ward) - Sasame Bridge at National Route 17 bypass (Itabashi Ward)
- Left bank: Tokyo Metro Tozai Line bridge (Edogawa Ward) - confluence with the Shobugawa River (Kawaguchi City)

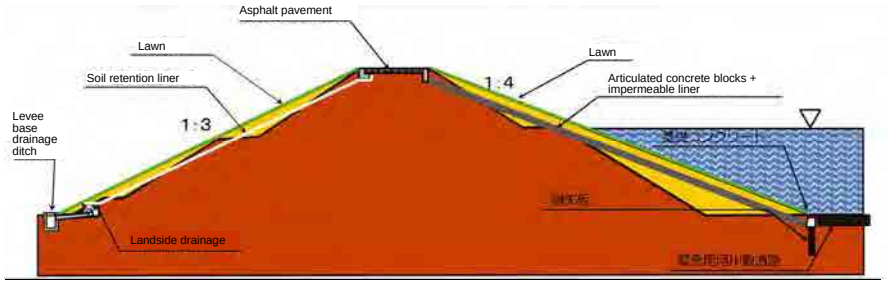
Levee Reinforcements


Section bordering Toda Park in Toda City

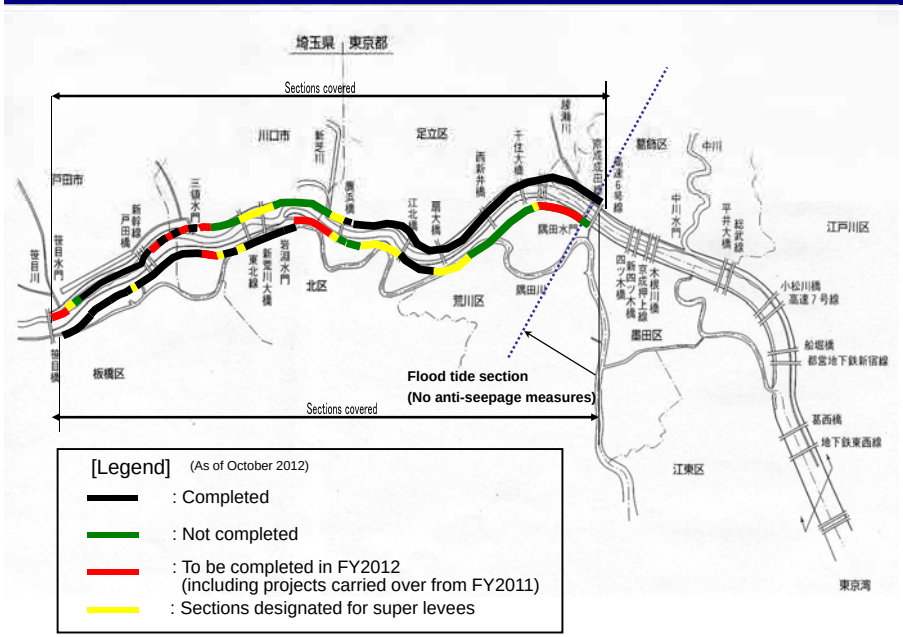

Section bordering Shingashi, K


Section bordering Kohoku, Adachi Ward

Before reinforcing | During reinforcing | After reinforcing



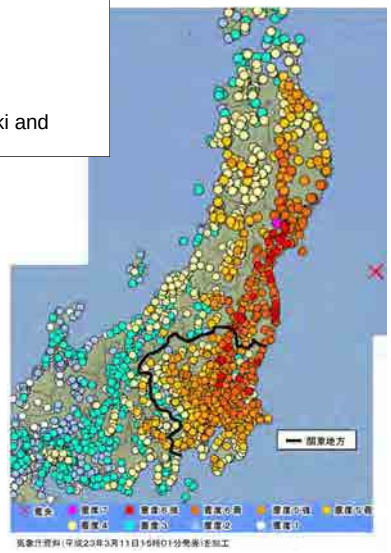
Levee Reinforcement Sections



Contents

Overview of Great East Japan Earthquake

Date/time: 2:46 p.m., Friday, March 11, 2011
Epicenter: Off the coast of Sanriku (about 130 km ESE of Ojika
Peninsula)
Magnitude 9.0
Maximum seismic intensity (Japanese shindo scale):
7 (Kurihara City, Miyagi Prefecture)
Seismic intensity of 6+ was recorded in 28 municipalities in Miyagi, Fukushima, Ibaraki and Tochigi Prefectures.



■ 7wards and 2 cities along the river

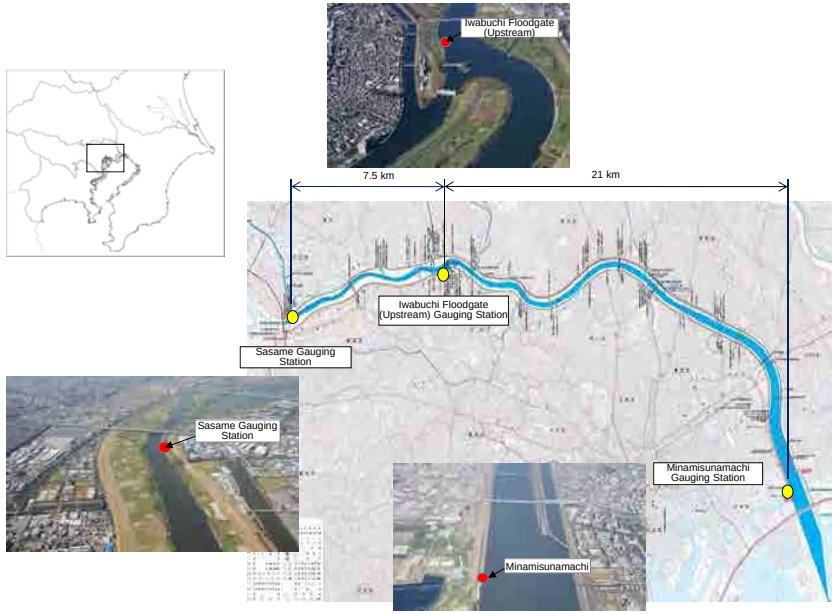
【main shock】 March 11 14:46	
5-upper	【Saitama Prefect.】 Kamitoda, Toda-shi / Nakaaoki-bunsitu, Kawaguchi-shi 【Tokyo】 Chuo, Edogawa-ku / Senjyunakai-cyo Shinmeiminami, Adachi-Ku / Takashimadaira, Itabashi-Ku Touyou Ojima(Onagi River Branch Office), Koto-ku / Shimo, Kita-ku(Arakawa-karyu River Office)
5-lower	Kanamachi Tateisi, Katsushika-Ku / Higashimukoujima, Sumida-Ku / Akabaneminami, Kita-Ku

【After shock】 March 11 15:15	
5-lower	Cyuo, Edogawaku

Earthquake-triggered Tsunami

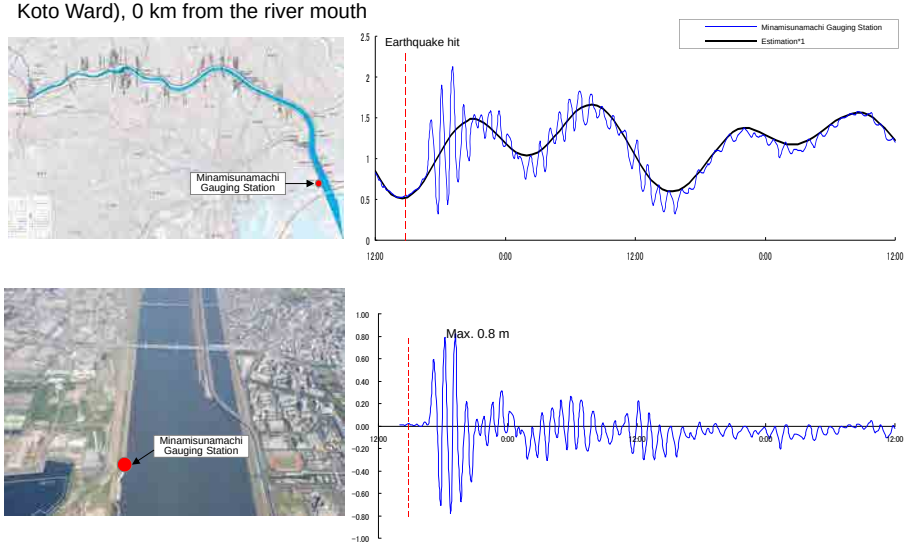
Source: Prof. Takashi Furumura and Takuto Maeda (project researcher), Earthquake Research Institute, University of Tokyo

Impact of the Earthquake (Arakawa River Water Levels)



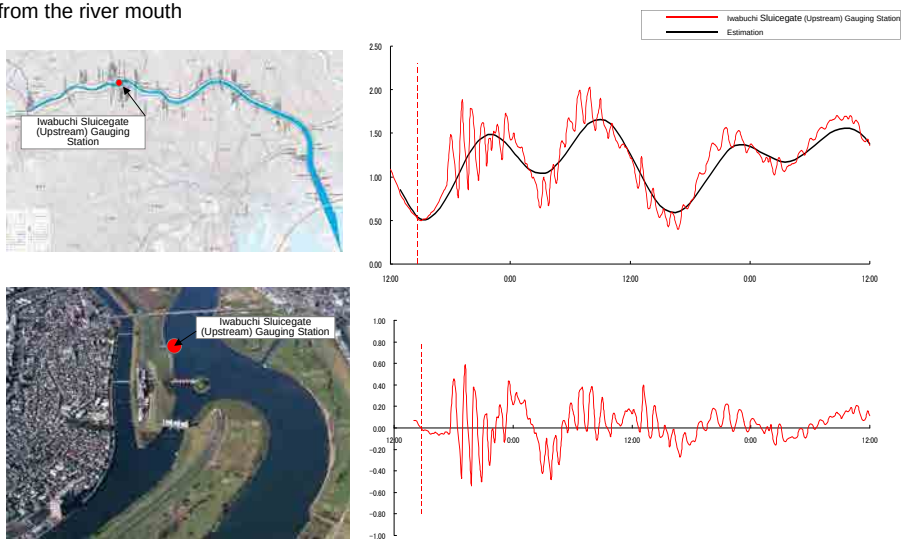
Change in River Water Levels Due to Tsunami (Minamisunamachi)

■ Minamisunamachi Gauging Station (Minamisunamachi, Koto Ward), 0 km from the river mouth



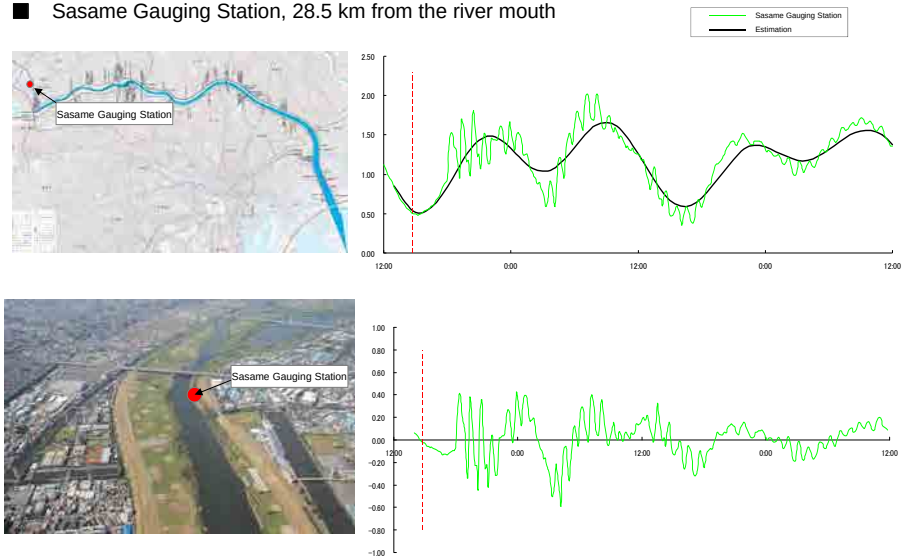
Change in River Water Levels Due to Tsunami (Iwabuchi Sluicegate)

■ Iwabuchi Sluicegate (Upstream) Gauging Station, 21 km from the river mouth



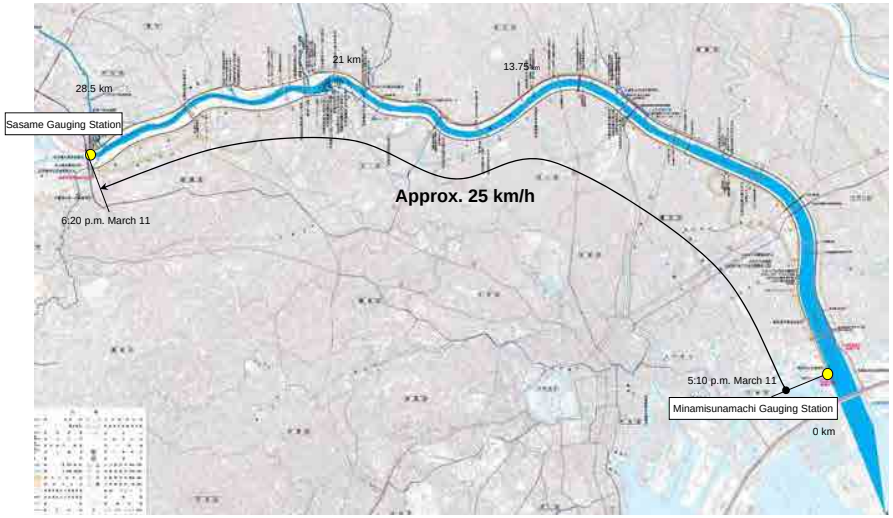
Change in River Water Levels Due to Tsunami (Sasame)

■ Sasame Gauging Station, 28.5 km from the river mouth



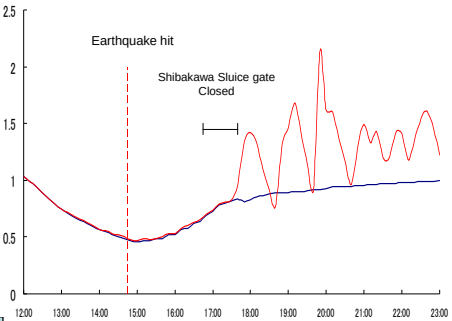
Tsunami Propagation Speed (River's Mouth to Sasame)

■ Tsunami finally reached the Akigase Intake Weir located about 35 km from the river's mouth.



What the Floodgate Did

■ **Shibakawa Floodgate (Kawaguchi City, Saitama Prefecture), about 20 km from the river's mouth**



Floodgate operation

	Operation start	Operation completion	Status
Ayase Sluice gate	11日15:20 12日14:00	11日15:47 12日14:30	shut-off Fully opening
Nakagawa Sluice gate	11日15:18 12日14:00	11日15:30 12日14:30	shut-off Fully opening
Sumida Sluice gate	11日16:40 12日14:00	11日16:50 12日14:10	shut-off Fully opening
Shibakawa Sluice gate	11日16:45 12日14:00	11日17:40 12日17:30	shut-off Fully opening
Iwabuchi Sluice gate	No operation	No operation	Fully opening
Arakawa Lock gate	〃	〃	shut-off

Contents

Now and in the Future

Current status

- The Arakawa River's banks are designated as evacuation sites by local municipalities. In Tokyo alone, these sites are expected to be used by up to 600,000 evacuees in the event of a major earthquake.
- An emergency river bank road and river stations (docks) have been constructed along the river. These facilities are included in Tokyo's regional disaster management plan and serve as an emergency transport route. The river's high water channel is positioned as one of the candidate sites for emergency operations in the Central Disaster Prevention Council's plans for measures against inland earthquakes in the Tokyo metropolitan area.

Tasks ahead

Since no specific rules for using these facilities have been developed, congestion or confusion may occur and hinder their effective use, especially during the initial stages of a disaster when river administrators are unable to perform on-site control.

River bank

Emergency river bank road

River station (dock)

Planning Overview

Objective

➢Develop a plan for using disaster management facilities in the event of a major earthquake in the northern Tokyo Bay area or other areas in order to ensure that disaster management facilities under the jurisdiction of the Arakawa-Karyu River Office will be effectively used by disaster response organizations and to ensure emergency transportation, recovery operations, etc. for quick disaster response.

Agenda

1. Locations and ways to use the Arakawa River banks → Zoning
2. Basic rules for using disaster management facilities → Operations manual
3. Sharing of information about damage to disaster management facilities and how facilities are being used → Information sharing organization

Be as prepared as possible!

Develop a plan for using disaster management facilities along the Arakawa River's downstream reach.

Planning Method, Members, etc.

Planning method

➢ Planning via workshops with disaster management officers from organizations in charge of relevant disaster management facilities under their regional disaster management plans and organizations that are expected to use these facilities.

➢Workshops provide opportunities to freely express opinions outside the confines of particular occupational responsibilities.

Members (FY2010 and onward)

➢Disaster management officers from the Tokyo Metropolitan Government, Saitama Prefectural Government, municipal governments of 2 cities and 7 wards along the river (Kawaguchi and Toda Cities, Sumida, Koto, Kita, Itabashi, Adachi, Katsushika and Edogawa Wards), police departments, fire departments, Self-Defense Forces (JSDF), and Arakawa-Karyu River Office

Experts, etc.

➢[Chief] FY2010

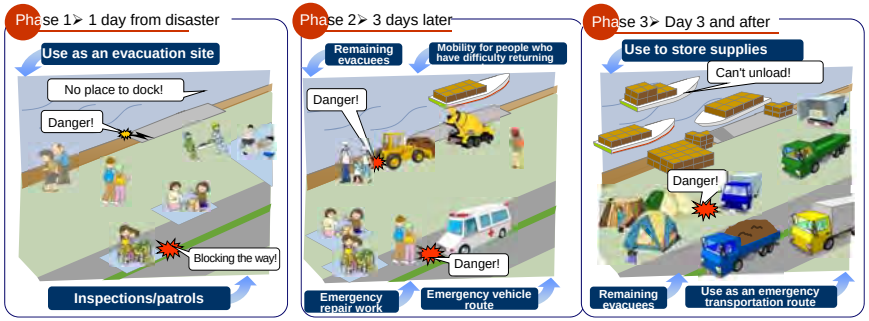
- Toshiyuki Shikata (Professor, Teikyo University, Advisor to the Tokyo Metropolitan Government)

➢[Facilitators] FY2008 - FY2012

- Takaaki Kato (Associate Professor, International Center for Urban Safety Engineering, Institute of Industrial Science, University of Tokyo)
- Hitoshi Nakamura (Professor, Architecture and Environment Systems Department, College of Systems Engineering and Science, Shibaura Institute of Technology)
- Tadahiro Yoshikawa (President, Laboratory of Urban Safety Planning Co., Ltd.)
- Akihiko Nunomura (Visiting Professor, Kansai University) *Starting in FY2011

Council to Implement Downstream Arakawa River Disaster Management Facilities Use Plan

● The council was formed in FY2011 with an aim to facilitate the effective use of the Arakawa-Karyu River Office's disaster management facilities in the event of a major earthquake. Making the emergency river bank road and emergency docks (river stations), as well as the river's high-water channel, etc. available to local governments, police and fire departments, the JSDF, etc. will speed up disaster response.



Downstream Arakawa River Disaster Management Facilities Use Plan (Draft) developed

Includes basic policies for emergency response organizations to effectively use the Arakawa River facilities as well as examples of specific emergency responses.

Outline of Operations Manual <For reference>

Priority use

➢Determine priority use of facilities in advance. This should be done in light of the nature of the emergency response activities and when they are conducted in order to help users coordinate use of the facilities on site during an emergency.

➢Regardless of the priority, the safety of the evacuees always comes first when using areas designated as evacuation sites.

High priority

Low priority

Top priority: Emergency care and rescue

➢ Give priority to firefighting operations when water is needed to prevent fire from spreading.
➢ Give priority to emergency vehicle traffic in order to transport the injured, sick, medicine, etc.

1. Recovery of river facilities

➢When river disaster management facilities are damaged by an earthquake and cannot be used, give priority to river administrator's recovery operations.

2. Mobility of wide-area relief/rescue teams

➢Uses by wide-area relief/rescue teams from the JSDF, police and fire departments entering the affected area.

3. Transport of emergency relief supplies

➢Use the emergency river bank road for emergency vehicle traffic when it will speed up delivery of relief supplies to affected area.

4. Transport of disaster recovery materials/equipment

➢Use the emergency river bank road and emergency docks when it will speed up the transport of disaster recovery materials/equipment.

5. Other uses

➢When water is needed for firefighting purposes after fires are put out or if there is a need for using the river facilities for other purposes, their use will be coordinated by the users.

Revision to Downstream Arakawa River Disaster Management Facilities Use Plan

Downstream Arakawa River Disaster Management Facility Management Council established

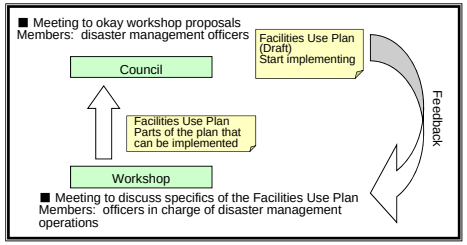
- The council oversees the workshops.
- Matters discussed in the workshops are brought to the council. The council then decides what to incorporate into the plan, which is then put into operation on a trial basis.

- Council meeting held
  - Wednesday, February 22, 2012 (held annually)
- Council members
  - Tokyo Metropolitan Government (disaster management department head), Saitama Prefectural Government (disaster management department head), municipal governments of 2 cities and 7 wards (risk management/civil engineering department heads), police departments (disaster management department head), fire departments (disaster management department head), JSDF (First Division G-3 chief), Arakawa-Karyu River Office (director)

Revising the Facilities Use Plan

- Workshop participants continue to discuss outstanding issues, problems that arise after implementation of the draft plan, areas that need to be revised due to changes in relevant organizations' plans (for accepting relief assistance, emergency road networks, etc.) and so on.

- Ongoing discussion to keep the plan alive
  - Disaster management personnel meet face to face (Build stronger ties)



Disaster Drills Using Arakawa River Facilities

Tested during 24JXR (joint ops including Japan Ground Self-Defense Force, MLIT and police)

- JSDF conducted joint disaster drills (command post exercises) based on a metropolitan earthquake scenario. The drills were designed to test the proposed revisions to the JSDF's metropolitan earthquake response plan and to maintain/enhance the JSDF's ability to respond to earthquakes.

- Drills included:
  - Use of alternative transport routes in Tokyo while disaster-affected roads are being cleared
  - Transport routes to quickly deliver heavy equipment to disaster area

Use of the Arakawa River as an emergency transport road/channel

▲ Police officers handing over operations to MLIT after leading emergency vehicles through town

▲ Police car leading emergency vehicles along the river bank.

▲ Connecting boats for transporting heavy machinery

▲ Transporting heavy machinery