Enriching and Protecting Communities through Flood Water Storage

The case of Tsurumi River

Tokyo Development Learning Center

Japan Project Brief

Background and Objectives

Rapid urbanization occurred from the 1950s to the present along the Tsurumi River in Japan. The ratio of urban areas in the river basin increased from 10% in 1958 to 85% at present, and the surrounding population has also increased by 1.4 million over the same period[1]. Tsurumi River was historically known as flood-prone river due to its winding and low gradient nature. However, it became even more flood-prone, because runoff volume into the river increased and the time for the river to reach peak discharge shortened mainly due to urbanization causing a decrease in the amount of land that can infiltrate and store rainfall temporarily (Figure 1). In the 20th century alone, the basin has experienced eleven large floods.

The most serious damage was observed in September 1958. The rainfall during Typhoon Ida caused devastating floods which affected more than 20,000 households in the region. If the same amount of rain were to fall again today in this most highly populated river basin in Japan (8000 people/km^2), it would likely flood over an area of 664 hectares, affect approximately 90,000 people, and the estimated economic damage would be around JPY400 billion (approximately USD4 billion)[2].

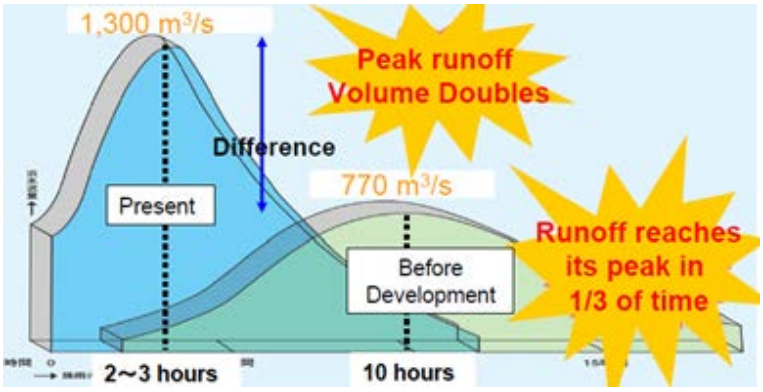

Figure 1: Quick and increased peak discharge after urbanization

Source: Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism. Introduction on adaptation measures in Tsurumi river. http://www.mlit.go.jp/river/basic_info/english/pdf/conf_02-7.pdf

This area was the pioneer in Japan for formulating comprehensive flood control measures to address the increased risk of flooding. One of the prime measures was the Tsurumi River Multipurpose Retarding Basin Project. The project did not only provide a flood control function to the target area, but also a recreational function taking into account how valuable public land is for this area.

Project Overview

The Tsurumi River Multipurpose Retarding Basin project was implemented as a joint project between Ministry of Land, Infrastructure, Transport and Tourism, and the City of Yokohama. The retarding basin was constructed at the intersection of the Tsurumi River and the Toriyama River in the Kozukue and Toriyama areas of Kohoku-Ward, Yokohama City and it has been operational since 2003 (Photo 1). The Tsurumi River Flood

Control Plan originally set a target for the flood protection to be able to respond to once-every-150-year floods. However, the current protection system can respond to discharge at a rate of 260 m3/sec, which is larger than once-every-150-yearfloods and can safely respond to the discharge rate during the largest flood since the end of the World War II (that occurred during the Kanogawa Typhoon in 1958).

Photo 1: Areal view of the retarding basin

Source: Ministry of Land, Infrastructure, Transport and Tourism. White Paper on Land, Infrastructure, Transport and Tourism in Japan 2015.
http://www.mlit.go.jp/common/001113570.pdf

In order to overcome the limitation of available land for flood control measures, the site was designed to be multi-functional dependent on the situation, i.e., the site provides a flood control function during flooding, while it serves other purposes during normal times. Therefore, the project included the construction of International Stadium Yokohama (or Nissan Stadium), which has an economic impact and also provides citizens with sports and recreational activities.

Flood Protection Mechanism

The retarding basin is designed to regulate the amount of water flowing into the river during a flood and can hold a maximum of 3.9 million liters of flood water. The entire system is comprised of a surrounding levee, separation levee, overflow embankment, land for flood water storage, and a sewage gate. The elevation of the basin is lower than the surrounding area and surrounded by embankment. Two levees play a role in enabling the retarding basin. The surrounding levee is built between the retarding basin and neighboring land, while the separation levee is built between the retarding basin and the river. The overflow type levee, which is a portion of the separation levee, is built at approximately 3 meters lower than the separation levees, which enables flood water to flow into the basin (Figure 2). By temporarily storing the flood water in the basin, the basin protects surrounding and downstream communities from massive flooding. Subsequently, when the flood is over, the stored water is gradually discharged back into the Tsurumi River through the sewage gate. The real-time information on the status of retarding basin including water levels and flow rate in the river is monitored and published on the internet so that appropriate countermeasures can be taken in a timely manner.

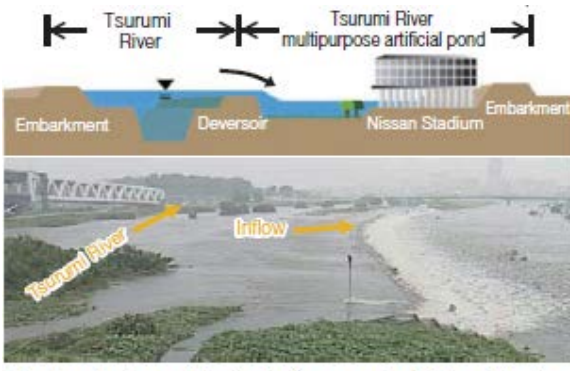

Figure 2: Structure of the retarding basin and inflow to the basin during flooding caused by Typhoon Phanfone

Source: Ministry of Land, Infrastructure, Transport and Tourism. Press release of 7 October, 2014.
http://www.ktr.mlit.go.jp/ktr_content/content/000111094.pdf

Recreation Facilities and Infrastructure in the Basin

Unique construction methods were utilized for the recreational facilities and infrastructure in the retarding basin. For example, both International Stadium Yokohama and the Yokohama Comprehensive Care Continuum were built using an elevated-floor construction method to prevent them from inundation even

if water flows into the retarding basin (Photo 2). In addition, main roads are built either on the top of an embankment or on an elevated roadway so that they can still be used even if water flows into the basin during floods.

Photo 2: Flooding around International Stadium Yokohama (left) and stored flooded water under the stadium (right)

Source: Ministry of Land, Infrastructure, Transport and Tourism. Press release of 7 October, 2014. http://www.ktr.mlit.go.jp/ktr_content/content/000111094.pdf

Project Impacts

This project provides flood protection functions while serving multiple other purposes. It is expected to produce the following impacts on the surrounding community.

Economic Impact:

International Stadium Yokohama, the largest sports stadium in Japan, has a capacity for 70,000 spectators. It hosted the final match in the FIFA World Cup (2002) and other major sports festivals. The stadium and other facilities in Shin-Yokohama Park produce economic benefits by attracting many people. In addition, the stadium has an annual income of JPY150 million from providing the naming rights of the stadium to Nissan Motor Company Ltd. (Thus, it is called now Nissan Stadium).

Social Impact:

The project has produced recreational and social benefits through the construction of sporting, park, and healthcare facilities. International Stadium Yokohama provides residents opportunities to view and play various sports such as track and field, soccer, and rugby. The park along the river provides visitors an opportunity to enjoy the natural environment. The athletic field and recreational area provides an active-lifestyle environment for local residents.

Environmental Impact:

The project is implemented in an environmentally and socially friendly way. The slope of the embankments was designed to be gentle, which enables wildlife to inhabit the area, and also allows local residents to walk around. Furthermore, because the basin was designed to be lower than the surrounding areas, it was necessary to excavate a large amount of soil (2.3 million m3) from the basin. The excavated soil was reused for the levees in the basin as well as a landfill project at Minami-honmoku in Yokohama. This basin plays an important role for education about nature and the environment. The ponds and wetlands serve as habitat for a variety of wildlife. Various wild birds can be observed throughout the year.

Disaster Preparedness Impact:

The project was put to the test in 2014, when

Japan had the second heaviest rainfall event on record due to Typhoon Phanfone. The flood control measures accommodated 1,540,000 m^3 (largest amount in history) of water and drastically reduced inundation damage compared to Typhoon Ida in 1958. Photo 3 shows how the retarding basin stored flooded water. The rainfall during Typhoon Phanfone in 2014 (322.9 mm) was very similar to the rainfall during Typhoon Ida in 1958 (342.6 mm).

However, the number of households that experienced inundation was only 6 in 2014 compared to more than 20,000 in 1958.

In addition, the Tsurumi River Administration Center increased public awareness that helped to mitigate flood damage. The center provides educational courses and host meetings for students and local residents about disaster preparedness (Photo 4).

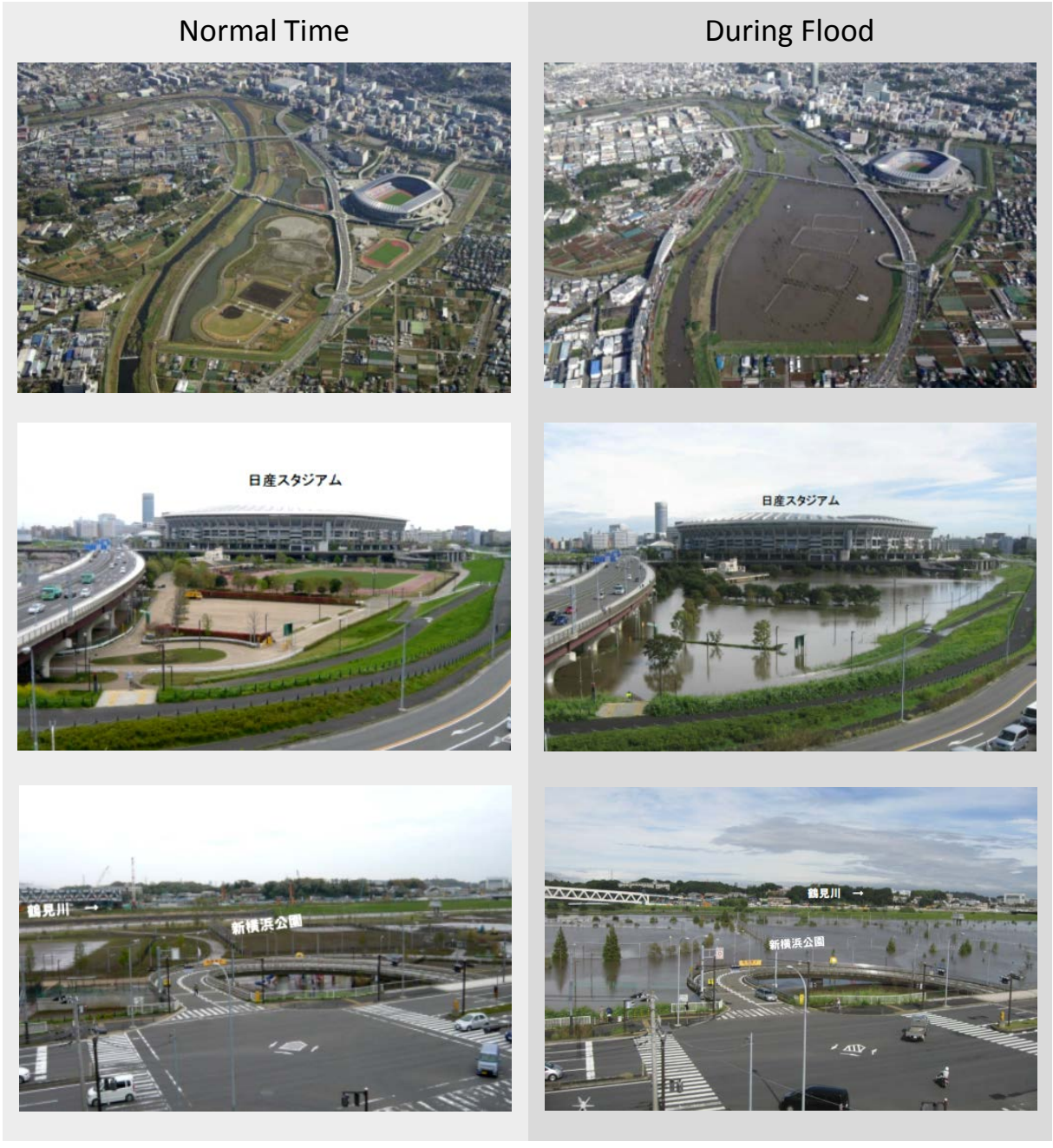

Photo 3: Comparison between normal time and during flooding

Source: Ministry of Land, Infrastructure, Transport and Tourism. Press release of 7 October, 2014. http://www.ktr.mlit.go.jp/ktr_content/content/000111094.pdf

Photo 4: Disaster prevention education in the Tsurumi River Administration Center

Source: Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism. Introduction on adaptation measures in Tsurumi river. http://www.mlit.go.jp/river/basic_info/english/pdf/conf_02-7.pdf

Lessons Learned

Multipurpose Retarding Basin:

Because of rapid urbanization, land is a critical resource for cities. For this reason, securing a large area of land only for flood risk management might be a luxury for cities. Therefore, a multipurpose retarding basin, such as Tsurumi river multipurpose retarding basin, is a good practice. It can provide recreation and entertainment spaces in sports facilities and parks during normal times, while it will serve as a large-scale infrastructure to mitigate flood damage.

Significance of Green Infrastructure:

Multipurpose retarding basin was constructed in order to address increased peak of runoff and discharge. The peak of runoff and discharge drastically increased because of the decreased amount of land that can infiltrate and store rainfall temporarily due to urbanization. In this sense, when urban cities are rapidly growing in developing nations, there also needs to be green infrastructure that can enable urban land cover to infiltrate rainfall into the ground.

[1] Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism. Introduction on adaptation measures in Tsurumi river. http://www.mlit.go.jp/river/basic_info/english/pdf/conf_02-7.pdf

[2] Keihin Work Office, Kanto Regional Development Bureau, Ministry of Land, Infrastructure, and Transport. Protecting People from Flooding. http://www.japanriver.or.jp/EnglishDocument/DB/file/004%20Kanto%2023/02.htm

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