Outline of Lake Kasumigaura

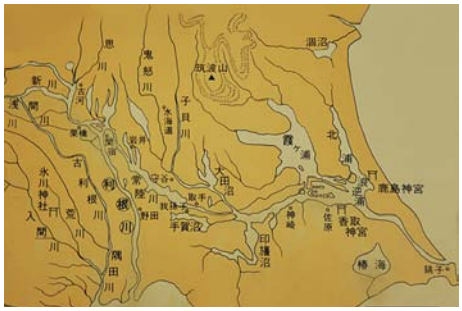
1 Profile

About 6000 years ago, during the oceanic transgression in the Jomon period, seawater penetrated into the alluvial valleys. This was the supposed beginning of Lake Kasumigaura. Subsequently, big rivers such as the Kinu and Kokai brought massive mud and sand, which accumulated at the neck of the inlet, gradually damming up the lake and resulting in desalination. It is said that the basic shape of the lake was formed 1500 ~2000 years ago. The surface area in those days was 2 or 3 times wider than at present, although the water was still brackish.

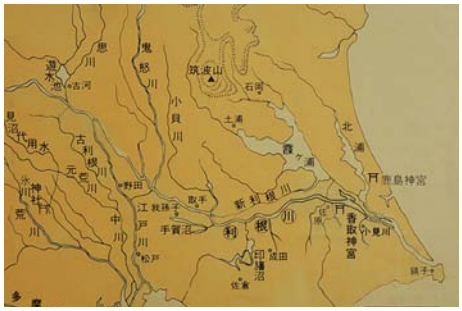
Lake Kasumigaura first appeared in the "Topography of Hitachinokuni", one of the formal records of Japan, edited in the Nara Era. Hitachinokuni was an old name for the Ibaraki Prefecture. In the description, the lake was called " Nagare-umi" or flowing sea.

In the Edo Era, the Eastward Diversion Project of the Tone River was completed to control the water and protect Edo City (now Tokyo) from water damage, resulting in the present morphology. There has been confusion regarding the description of "Kasumigaura". Here, "Lake Kasumigaura" is used as a general term for several water areas including Lake Nishiura (Kasumigaura), Lake Kitaura (Kitaura, Wanikawa), and the Hitachitone River (Kitatone River, Lake Sotonasakaura, Hitachi River).

Lake Kasumigaura, 1000 years ago



Lake Kasumigaura in the Edo Era



Present day Lake Kasumigaura

2 Geography

Lake Kasumigaura, located in the southeastern part of Ibaraki Prefecture, consists of three bodies of water, i.e., Lake Kasumigaura (Lake Nishiura), Lake Kitaura, and the Hitachi-tone River. Its surface area is about 220 ㎢ , the second largest in Japan after Lake Biwa. A total of 56 rivers, including the Sakura, inflow into the lake.

Lake Kasumigaura is an extremely shallow lake (coastal lake formed by enclosure of a lagoon) due to its formerly being an inland sea. It is close to sea level, with 4-m mean water depth and 10-m maximum water depth. The watershed is spread across 24 municipalities, including a part of Chiba Prefecture and Tochigi Prefecture. It is 2157 ㎢ in size, covering one-third of Ibaraki Prefecture, where approximate 0.96 million people live.

Numerical aspects of lakes including Lake Kasumigaura

classification	item	unit	Lake Kasumigaura	Lake Biwa	Lake Suwa	Lake Hinuma	Ushiku Swamp
lake	cause	—	coastal lake	fault lake	fault lake	coastal lake	accumulation of mud and sand at river mouth
	maximum water depth	m	7	103.58	7.2	6.5	3
	mean water depth	m	4	41.2	4.7	2.1	1
	lake area	km^2	220.0	670.25	13.3	9.35	6.52
	lakeshore line	km	approximate252	235.2	15.9	22	20
	lake capacity	billion m^3	approximate0.85	approximate27.5	approximate0.06	0.02	0.0065
	mean retention time	day	approximate200	approximate2,000	39	50	17
	above sea level	m	T.P.+0.26 ～ 0.46	84.371	759	0	6
watershed	watershed area	km^2	2,157	3,174	531.2	439	151
	municipalities in watershed	municipalities	24	20	6	6	4
	municipalities in lakeside	municipalities	13	10	3	3	4
	population in watershed	million people	approximate0.96	approximate1.33	approximate0.18	approximate0.16	approximate0.13

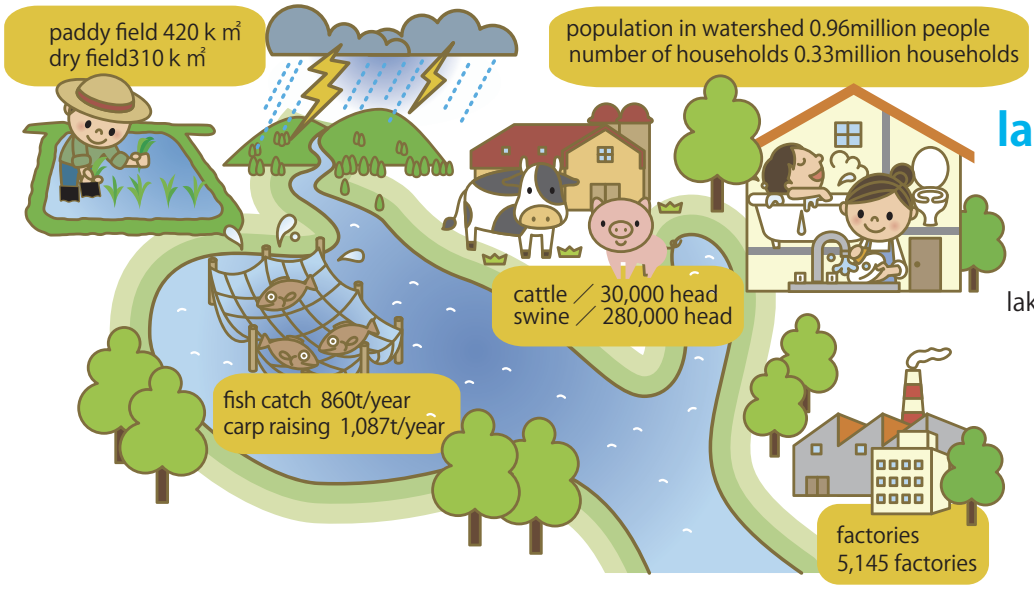
(Note) Values are based on information from the prefecture websites (Ibaraki, Shiga, Nagano, etc.)

3 Land use

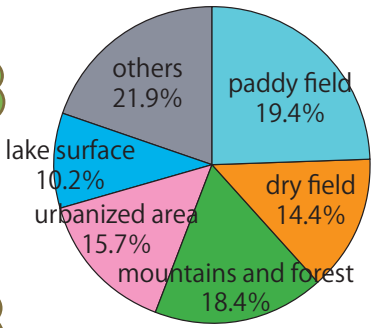
The watershed of Lake Kasumigaura is used primarily as farmland, forest, and urban districts, in that order. In recent years, the trend has been for urbanized areas to increase and farmland to decrease. The watershed is blessed with fertile plains, a comfortable climate, and abundant water resources. Agriculture, livestock. and fishery industries are flourishing.

In particular, Ibaraki Prefecture has been and continues to be a favorable place for the fishing industry. In 2015, the inland-fishery catch was the 4th highest in Japan. The livestock industry is also thriving, with hog breeding in the region the 6th highest in the nation (2015). In addition, various industrial factories have recently branched out to this district, which is located on the outskirts of the Tokyo Metropolitan Area, resulting in an incremental increase in industrial shipments.

Main industries in watershed

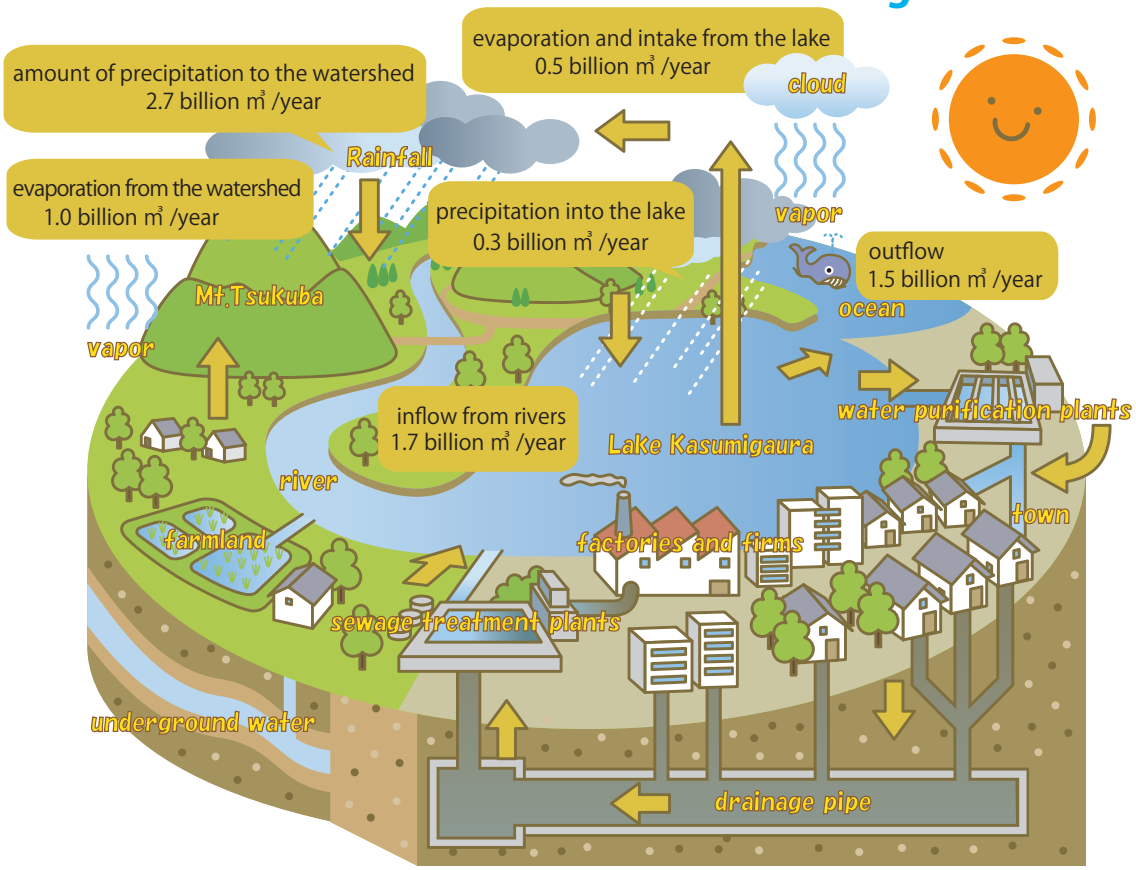


land use in watershed



*Figures for 2015

inflow and outflow of Lake Kasumigaura



4 Living creature

（1）Aquatic plants

Aquatic plants consist of emerging plants (Common reed, Narrow-leaved cattail, Indian rice), floating-leaf plants (Water chestnut, Water fringe), submerged plants (Curled pondweed, Common hornweed) and drifting plants (Frogbit), as shown below.

It is said that aquatic plants not only offer spawning sites for fish, but also absorb nitrogen (N) and phosphorus (P), resulting in improved water quality. However, the number of these aquatic plants is decreasing due to environmental changes in the lake. In the past, 96 kinds of aquatic plants were recorded in and around Lake Kasumigaura, and there were 63 types of aquatic plants identified in 1979. That number is decreasing year by year. At present, very few submerged plants can be observed in the lake.

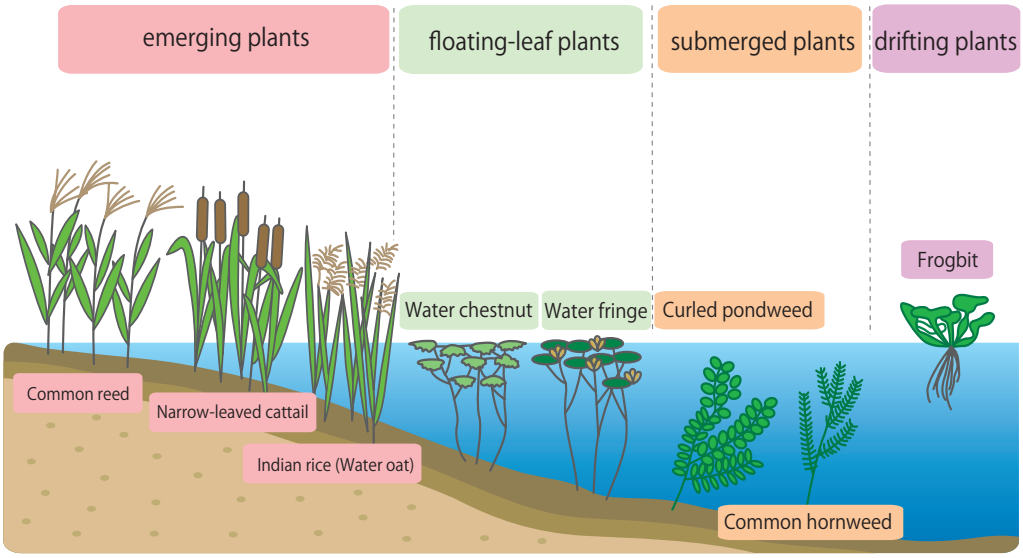


Illustration of aquatic plants

Common reed(emerging plants)

Water chestnut(floating-leaf plants)

Frogbit(drifting plants)

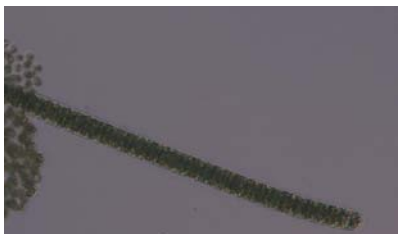
（2）Planktons

There are two categories of plankton, which are organisms that float in the water: phytoplankton and zooplankton.

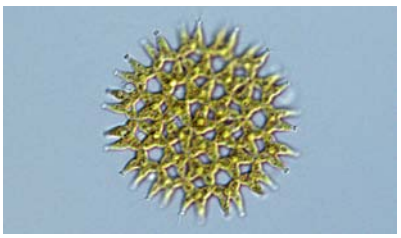
In Lake Kasumigaura, more than 200 kinds of phytoplankton and 100 kinds of zooplankton were recorded.Phytoplanktons, which absorb carbon dioxide (CO_2), N, and P in water, proliferate through photosynthesis.

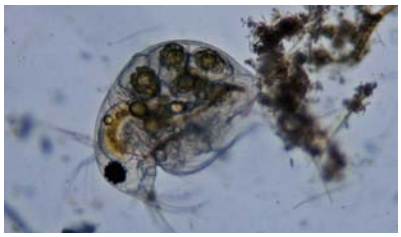
Small-sized phytoplankton, called primary producers, support the various animals that live in the lake by grazing mainly on zooplankton.

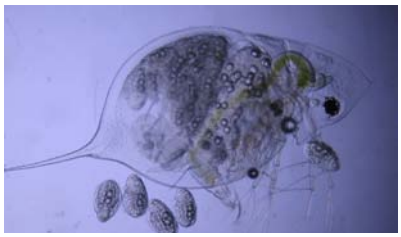
In recent years, the flora of phytoplankton has been changing. Until 2010, Planktothrix (filamentous blue-green algae) proliferated throughout the year. Since 2011, however, outbreaks of Microcystis (Aoko in Japanese: blue-green algae) have occurred in the water like scattered green powder, because blooms of Microcystis possessing gas vacuoles cover the water surface. Typical zooplankton in the lake include Cladocera (water fleas), Copepoda, Rotifer, Protozoa and Neomysis. As representing species, Bosmina and Diaphanosoma of Cladocera, Brachionus and Keratella of Rotifer, Vorticella and Tintinnidium of Protozoa, Neomysis of Opposum shrimp could each be cited. In addition, Daphnia, one of the larger sized Cladocera, were often seen in the lake water in 2011 and 2012. Such zooplankton proliferate by eating phytoplankton, and are predated by small fish.

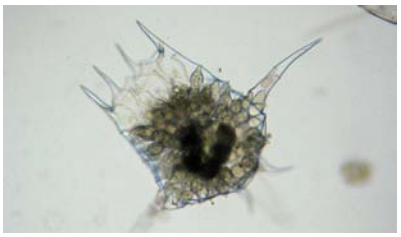

Planktothrix


Microcystis


Pediastrum


Bosmina


Daphnia


Brachionus

（3）Fish

In Lake Kasumigaura, over 100 kinds of fish have been recorded to date due to the close relationship with the sea environment, because the lake was formerly a coastal lagoon.

However, the number of species has been changing in response to environmental alteration. Since the Hitachi River tide gate was constructed, seawater fish, brackish water fish, and eels have decreased. At present, 50~60 kinds of fish live in the lake. Common species are Pond smelt, Ice fish, Gobies, Carp, and Crucian carp. Sweet fish also inhabit the waters. Furthermore, exotic species, such as Channel catfish, Largemouth bass, Silver bighead, Grass carp, Chinese rose bitterling, and Blue gill are seen.

＜ Indigenous fish ＞


Eel


Pond smelt


Ice fish


Trident goby


Stone moroko


Silver crucian carp

＜ Nonnative fish ＞


Channel catfish


Largemouth bass


Silver bighead


Grass carp


Chinese rose bitterling


Blue gill

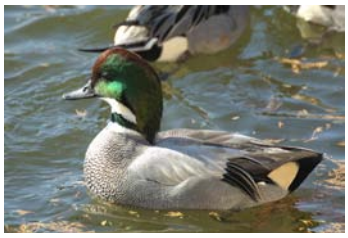
（4）Birds

About 80 kinds of wild birds can be seen in the vicinity of Lake Kasumigaura. Bird watchers observe various kinds of birds seasonally. Examples include residential birds such as the Little grebe and Gray heron, migratory birds that breed in summer such as the Chinese little bittern and Great reed warbler, wintering birds such as the Falcated teal and Black-headed gull, and migratory birds visiting in spring and autumn such as snipes and plovers. Particularly in winter, water birds, including many ducks, migrate to the lake. Pintail, Whistling swan, and Great crested grebe can frequently be seen. The number of ducks visiting the lake fluctuates significantly every year. According to the survey conducted (Jan 2018) by the Ibaraki Branch of the Wild Bird Society of Japan, about 79,000 individuals of 19 species were recorded. Of these, the Falcated teal represents 1% of the total number of this species in the world. As a result, Lake Kasumigaura was selected as a hidden Ramsar Site candidate by the Japanese Ministry of the Environment.

Moreover, the Inami reclamation land in Inashiki City is the only wintering site of the Greater bean goose (a natural monument of Japan) in the Kanto Plain. In recent years, over 100 individuals of the flock have visited. Lake Kasumigaura is thus a very important habitat for water birds in Japan.

Gray heron

Great reed warbler

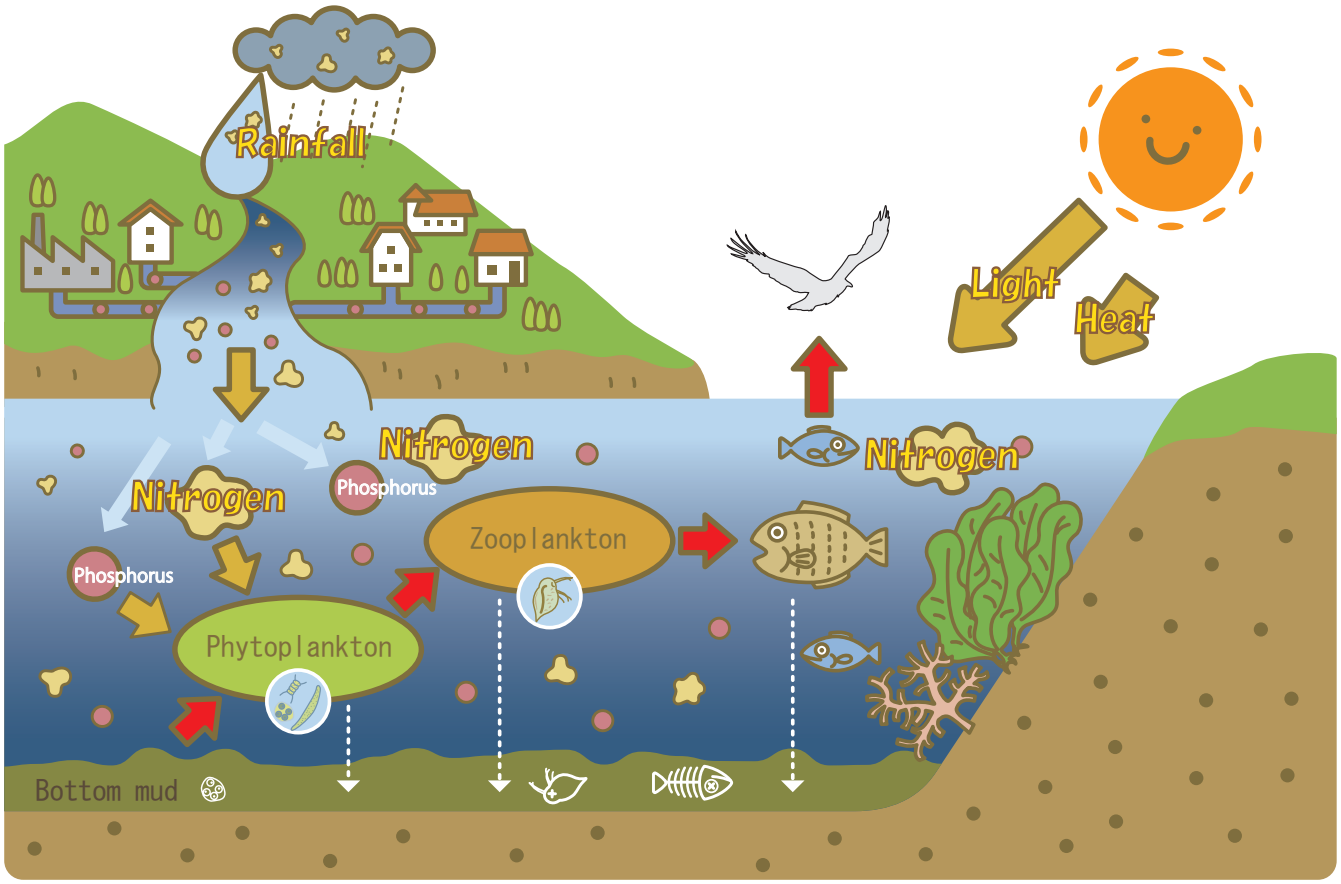


Falcated teal

Greater bean goose

（5）Material cycle in Lake Kasumigaura

Nutrient salts from various sources (i.e., households, factories and firms, forests, farmland, etc.) in the watershed of 24 municipalities (22 in Ibaraki Prefecture) are inflowing into Lake Kasumigaura. These nutrients are utilized by phytoplankton and aquatic plants, and then eaten by zooplankton, insects and fish, and further eaten by birds, resulting in water purification.



5 Water Resource Development and Use

（1） Water Resource Development

A. The Lake Kasumigaura Comprehensive Development Project

The coastal area, including farmland around Lake Kasumigaura, has often suffered from flooding and intrusion of seawater. Meanwhile, with the forecasting of incremental water demand, in March in 1968 the Kasumigaura development project was implemented to both control and use the lake water efficiently.

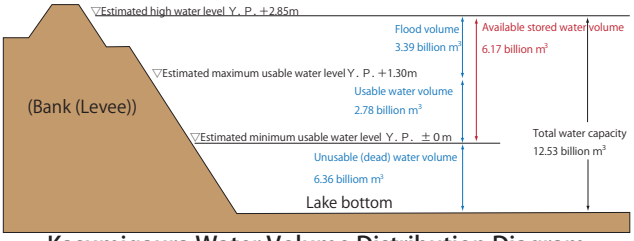
This project called for the construction of banks with a height of Y.P. + 3 m (Y.P.:Yedogawa Peil, the standard water level of the Yedogawa River system, including Lake Kasumigaura and the Tone River) which protects residents from floods while producing in a new water volume of approximately 43㎥ / s.

In addition, because this project promises to bring about significant changes in the fundamental conditions around the lake, a preparation project involving regional water infrastructure is being implemented to conserve lake water quality and improve the welfare and stability of those who live in the area.

These two projects form what is called the Lake Kasumigaura Comprehensive Development Plan.

Users of Kasumigaura Development Project Water （unit：m^3/S）

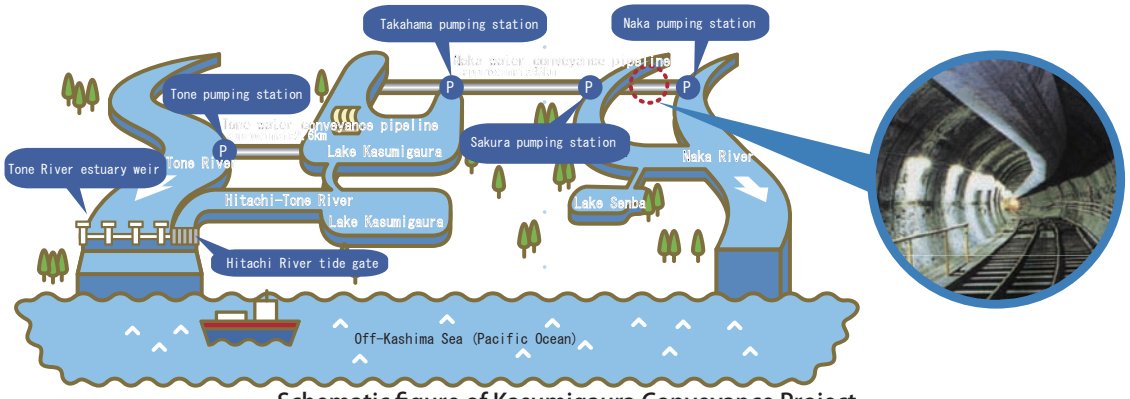
Use category	Ibaraki Prefecture	Chiba Prefecture	Tokyo	Total
Drinking water	4.38	1.91	1.50	7.79
Industrial water	14.72	0.85	—	15.57
Agricultural water	18.13	1.43	—	19.56
Total	37.23	4.19	1.50	42.92



Kasumigaura Water Volume Distribution Diagram

B. The Kasumigaura Water Conveyance Project

This project to connect the lower Naka River and lower Tone River to Lake Kasumigaura by pipeline will convey water in both directions. Together with improving water quality in the lake, this project will secure a water volume of 9.0㎥ /s for new water uses.



Schematic figure of Kasumigaura Conveyance Project

Water Conveyance System Users （unit：m^3/S）

Use category	Ibaraki Prefecture	Chiba Prefecture	Tokyo	Saitama Prefecture	Total
Drinking water	3.626	1.086	1.400	0.940	7.052
Industrial water	1.574	0.400	—	—	1.974
Total	5.200	1.486	1.400	0.940	9.026

（2） Water Use

The water from Lake Kasumigaura is utilized for irrigation, drinking, industrial purposes, etc.

Permitted water right situation （unit：m^3/S）

Use category	Number	Maximum water intake amount (Supply)	
Agricultural water	138	approximate	76.67
Drinking water	5	approximate	4.13
Industrial water	3	approximate	12.30
Water for miscellaneous use	40	approximate	0.67
Total	186	approximate	93.77