

Measures to make Horikawa River Limpid

Implementation by Nagoya City

Sep.5th 2015

**Nagoya City Greenification & Public Works Bureau
River Dep. River Plannning Div.**

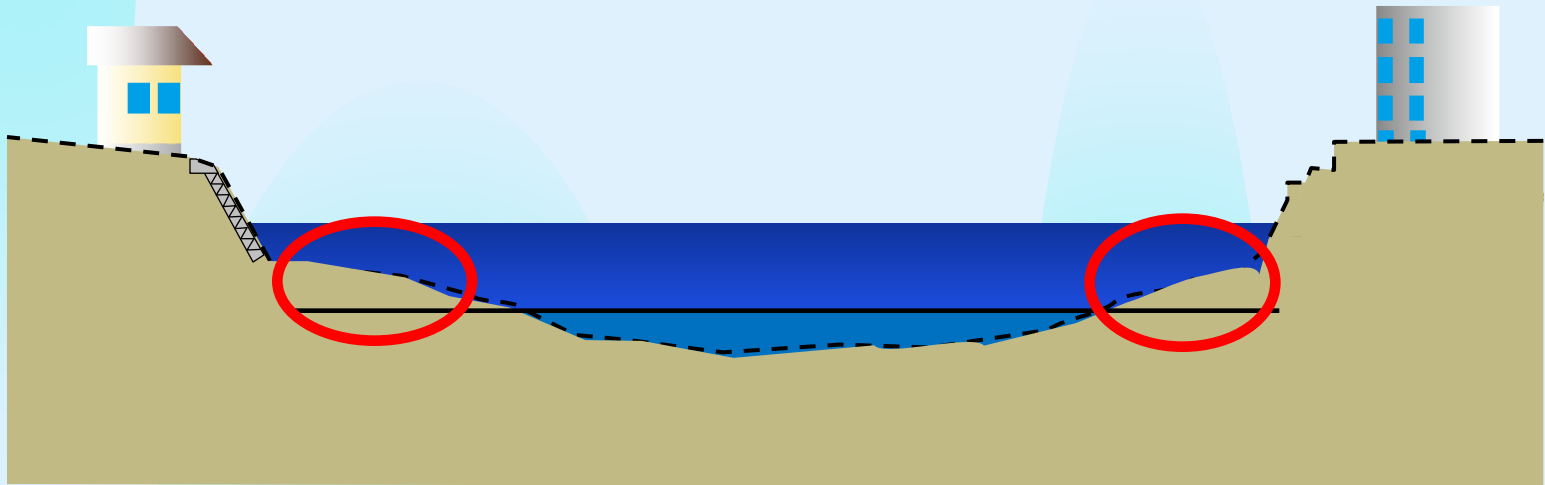
Outline of Clarification Experiments by Covering Sand

Sludge appearing from riverbed on the ebb tide.



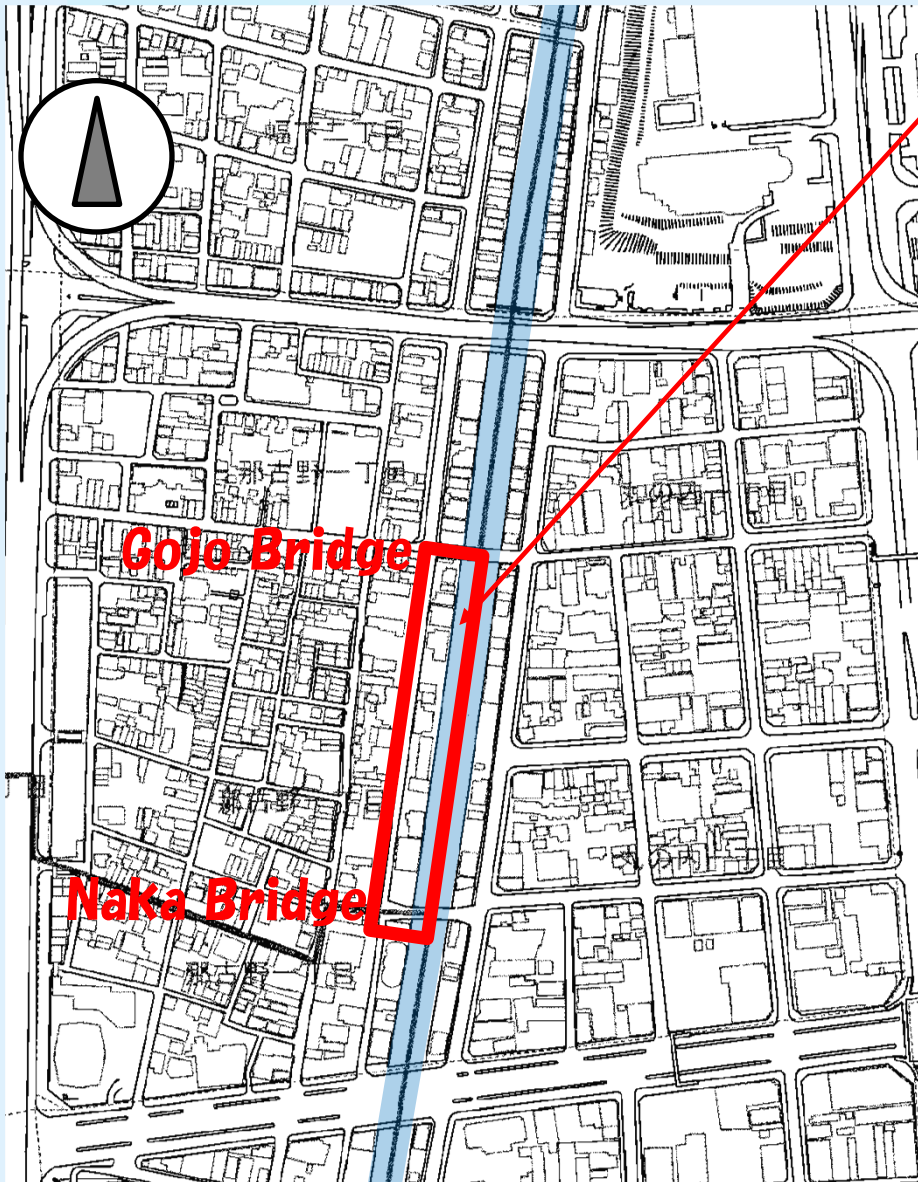
Outline of Clarification Experiments

We, City of Nagoya, implemented several clarification experiments that focused on Sludge that appeared on ebb tide.

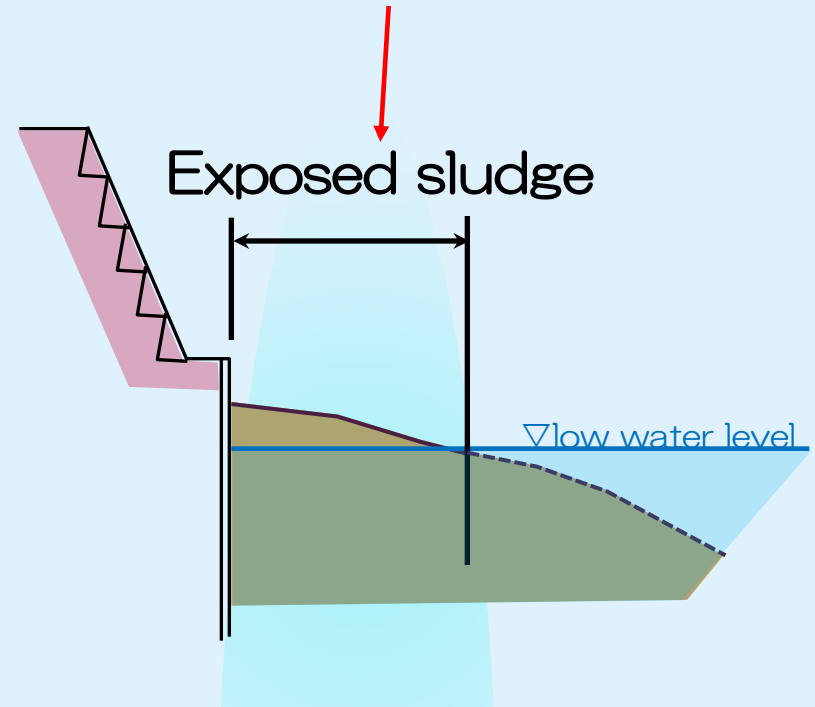


Outline of Clarification Experiments

Location



- about 300m long
(600m on both sides)
- 3m wide on each side



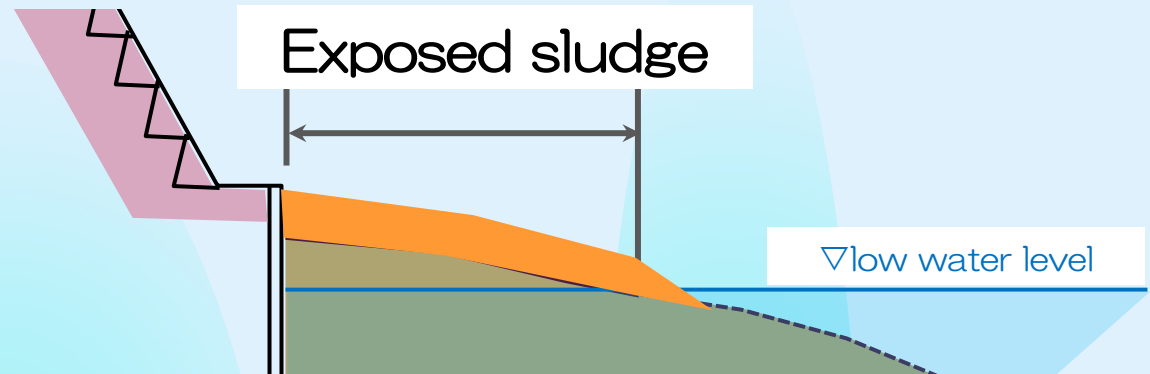
- 5 kinds of trial pattern
in this section

Outline of Clarification Experiments

■ Experiment

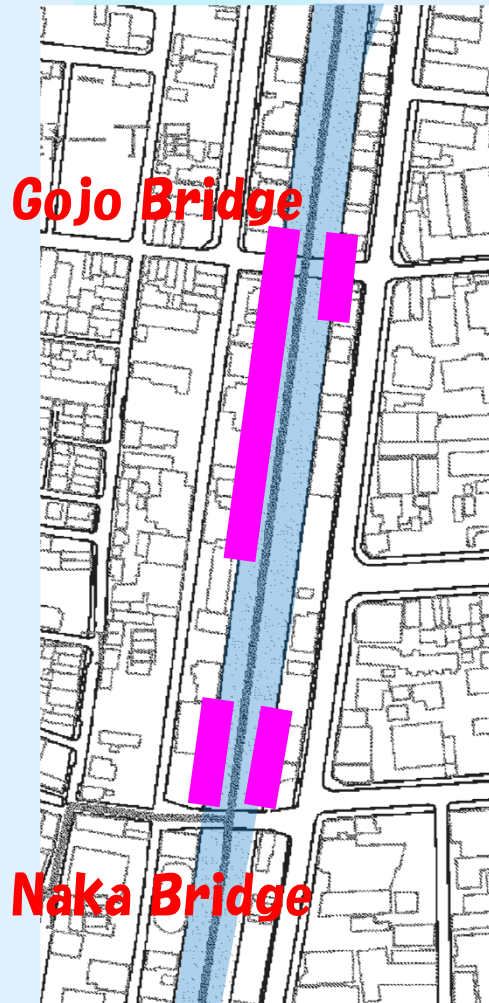
① covering sand

cover the sludge with 30cm thick sand bed



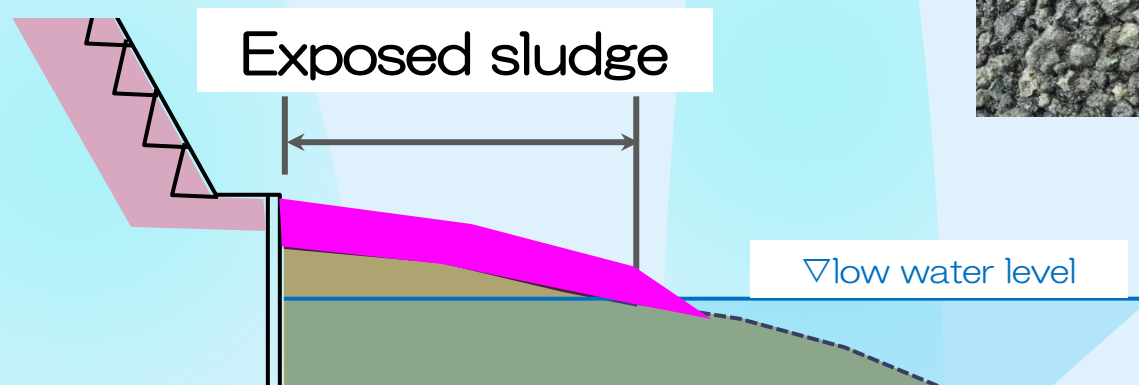
Outline of Clarification Experiments

■ Experiment



② cover with clarification materials

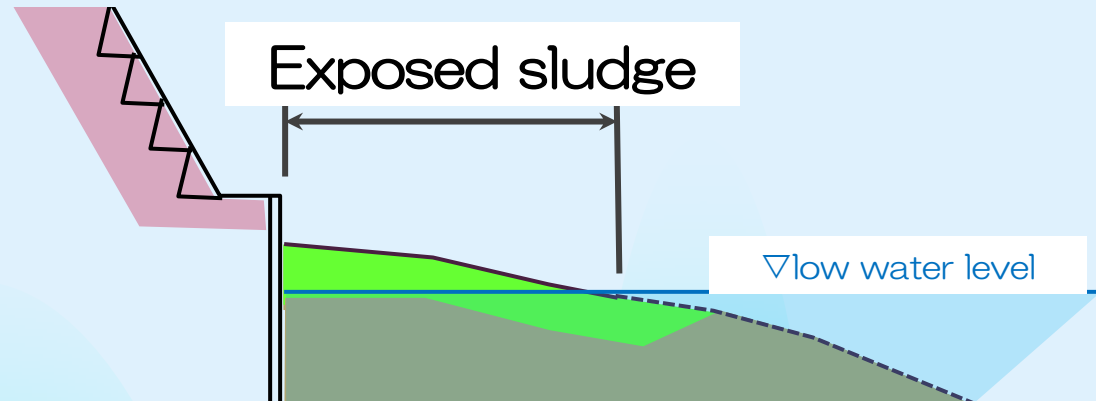
cover the sludge with 30cm thick clarification materials made from ash (by-product of coal thermal power station) and absorbing for its porousness



Outline of Clarification Experiments

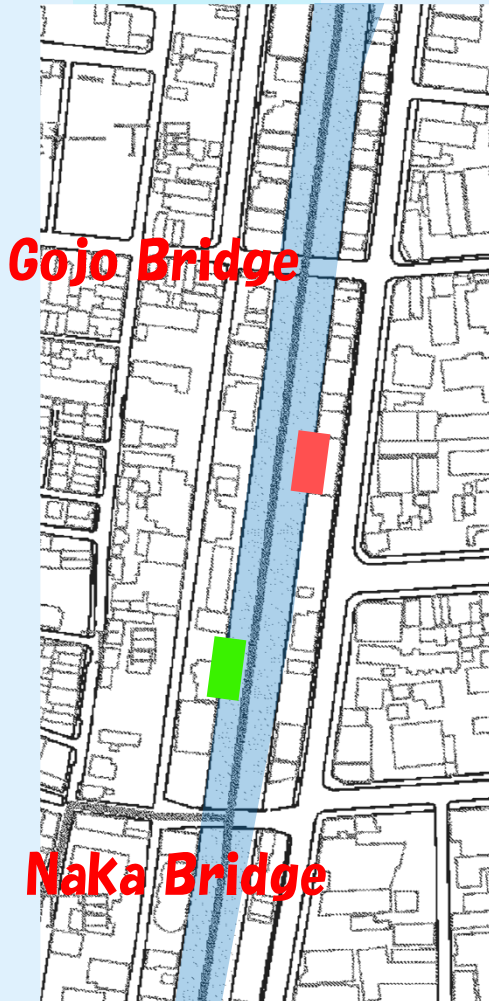
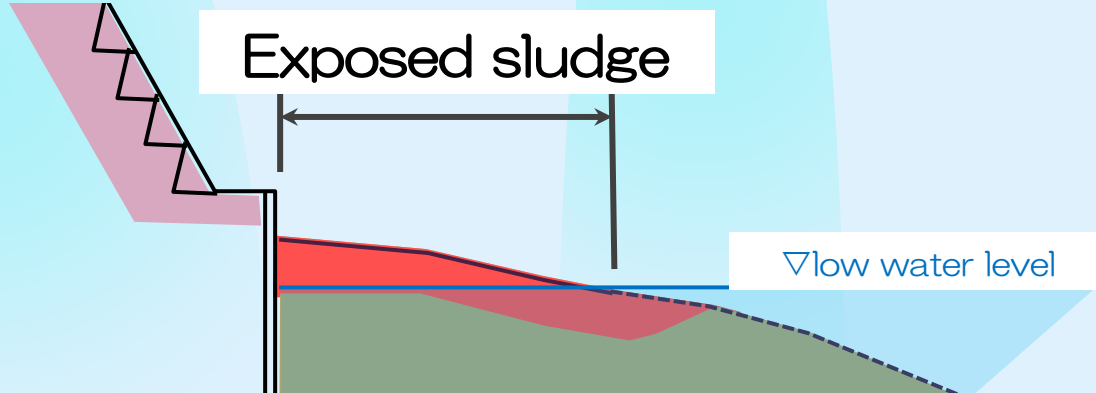
■ Experiment ③ covering sand after removing sludge

remove 30cm thick sludge and cover with 30cm thick sand bed



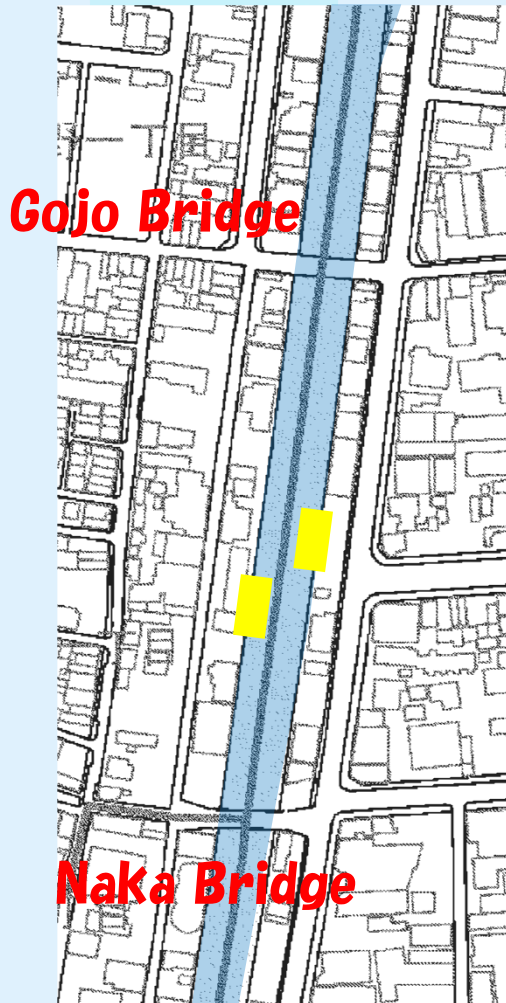
④ cover with clarification materials

remove 30cm thick sludge and cover with 30cm thick clarification materials



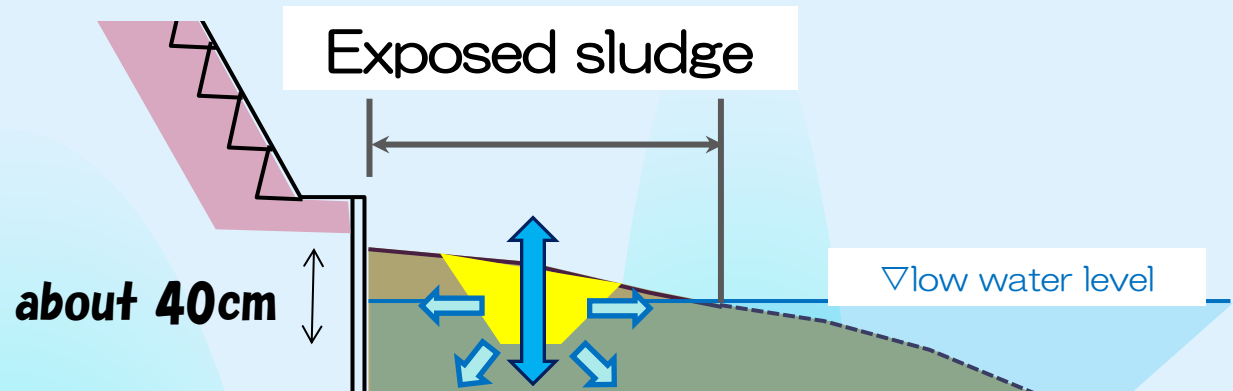
Outline of Clarification Experiments

■ Experiment



⑤ settle infiltrators

settle corn-shaped infiltrators made with solid clinker ash every 1m through sludge



[mechanism of infiltrator]

- make stream inside the facilities by ebb and flow
- supply oxygen into the bottom

⇒ improve the bottom layer

Construction of the experiment site

from Jan.16 to Jan.23



**Machines set on a float
constructed the experiment site.**

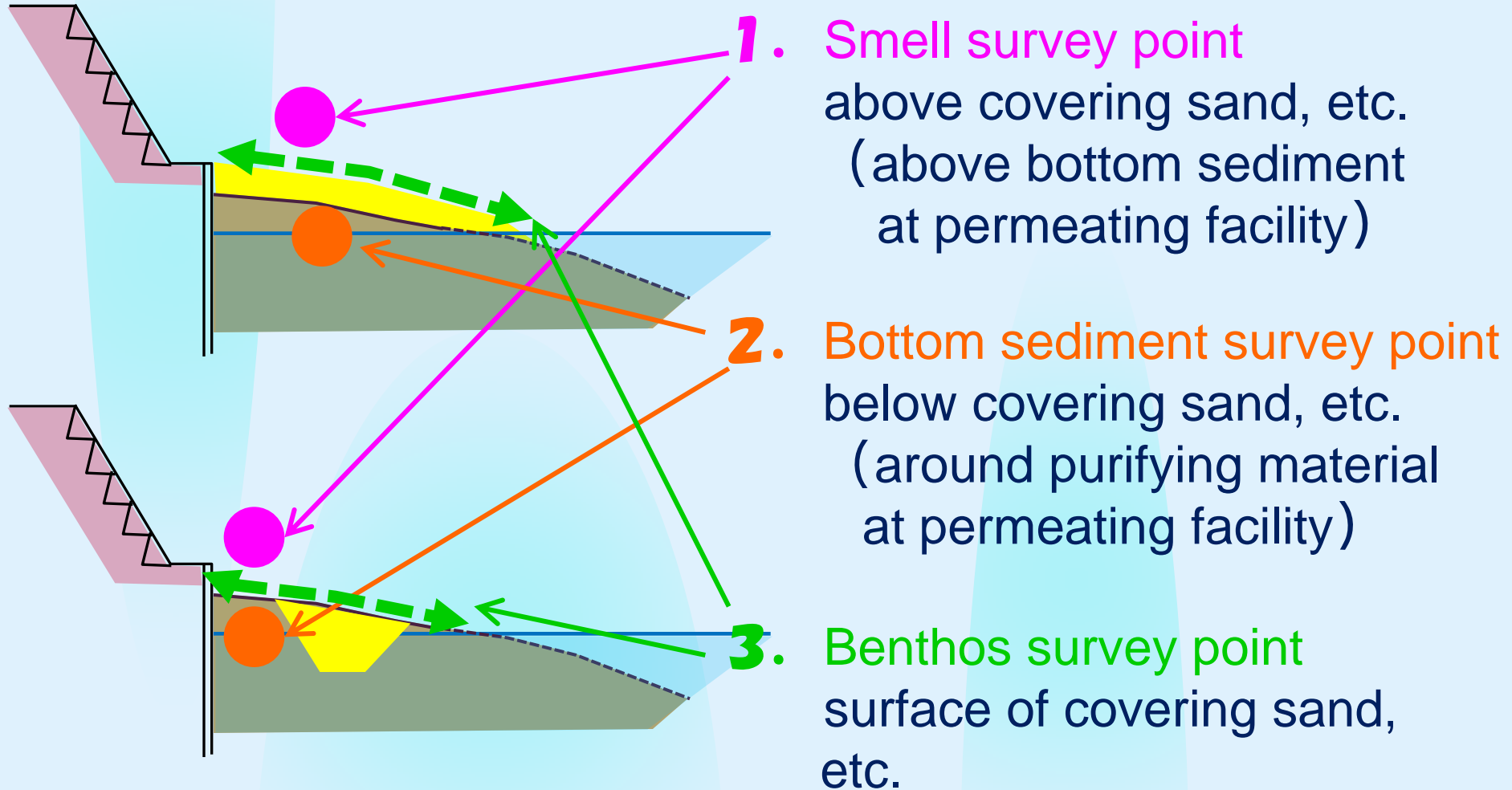


The situation of Clarification Experiments in Gojo Bridge area.



the view of Gojo Bridge from riverside.

Monitoring Survey



Monitoring Survey Result (bottom sediment and smell)

Survey was conducted
during low tide in spring tide

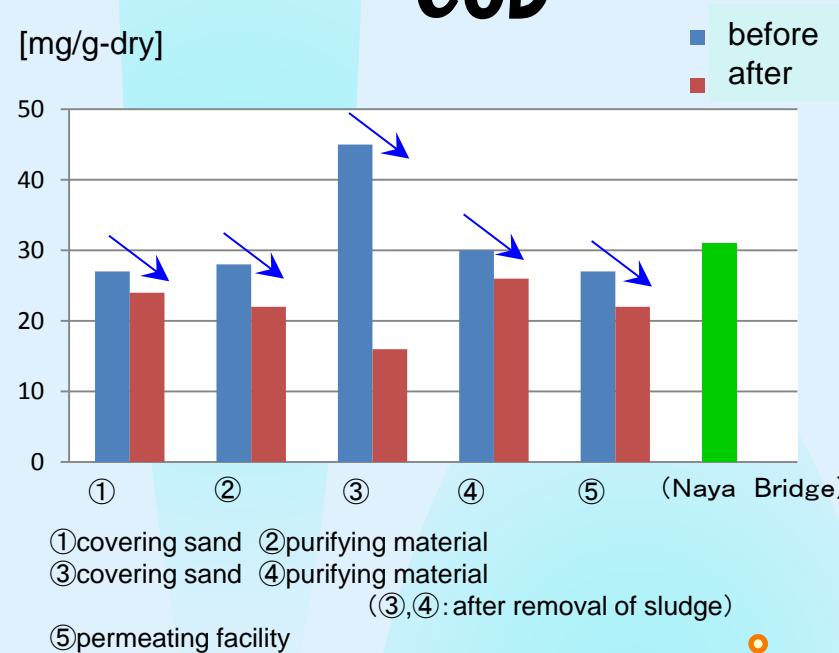
- pre-survey (before construction)
Aug. 25, 26 2014
- post-survey (after construction)
Jul. 31 2015

| | point | ①covering sand | | ②purifying material 【coal ash】 | | ③covering sand (after removal of sludge) | | ④purifying material 【coal ash】 (after removal of sludge) | | ⑤permeating facility 【coal ash】 | |
|--------------------|------------------------|--------------------------------------|----------|-----------------------------------|-------------------------|--|----------|--|-------------------------|------------------------------------|----------|
| | date | before | after | before | after | before | after | before | after | before | after |
| | temp.(℃) | 28.4 | 34.7 | 30.2 | 33.2 | 28.2 | 34.4 | 30.2 | 34.3 | 30.2 | 33.4 |
| | water temp.(℃) | 25.7 | 26.8 | 25.7 | 26.8 | 26.0 | 26.6 | 26.3 | 26.8 | 25.7 | 26.8 |
| | mud temp.(℃) | 26.3 | 24.6 | 26.3 | 27.0 | 26.0 | 26.4 | 25.8 | 24.3 | 26.5 | 25.4 |
| | color | black-gray | black | black-gray | black | black | black | black-gray | black | black-gray | black |
| | soil | silt mixed with sand and stone | clay | silt mixed with sand | silt mixed with clay | silt mixed with sand | clay | silt mixed with sand | silt mixed with clay | silt mixed with clay | clay |
| | smell | weak H2S | weak H2S | H2S | weak oil | strong H2S | weak oil | H2S | weak H2S | H2S | weak oil |
| bottom sediment | pH | 7.9 | 6.6 | 7.8 | 6.7 | 7.8 | 6.4 | 7.5 | 6.5 | 7.6 | 6.5 |
| | COD (mg/g-dry) | 27 | 24 | 28 | 22 | 45 | 16 | 30 | 26 | 27 | 22 |
| | T-N(mg/g-dry) | 1.6 | 1.8 | 2.7 | 1.6 | 4.2 | 2.1 | 2.7 | 2.5 | 2.3 | 1.6 |
| | T-P(mg/g-dry) | 1.9 | 1.9 | 2.1 | 1.1 | 4.1 | 1.3 | 3.2 | 1.7 | 1.6 | 1.4 |
| | T-C(%) | 2.4 | 3.0 | 6.8 | 3.4 | 9.5 | 3.1 | 5.1 | 5.2 | 6.2 | 3.9 |
| | free sulfar (mg/g-dry) | 0.36 | 0.25 | 0.71 | 0.44 | 1.1 | 0.34 | 0.24 | 0.90 | 1.1 | 0.35 |
| | sulfar (mg/g-dry) | 8.9 | 14 | 4.8 | 12 | 9.2 | 3.7 | 8.5 | 11 | 9.7 | 6.5 |
| | ORP(mV) | -200 | -87 | -240 | 12 | -210 | 40 | -290 | -46 | -240 | 3 |
| | ignition loss(%) | 6.0 | 6.3 | 13.5 | 6.7 | 13.5 | 7.4 | 9.4 | 12.2 | 14.2 | 8.3 |
| | loose on drying(%) | 32.4 | 42.1 | 51.1 | 32.7 | 46.9 | 40.0 | 43.7 | 47.3 | 48.8 | 38.6 |
| | H2S(mg/kg-dry) | <0.1 | <0.1 | 230 | <0.1 | 370 | <0.1 | 0.1 | <0.1 | 32 | <0.1 |
| smell | H2S (ppm) | <0.0005 | 0.0006 | 0.0013 | 0.0034 | 0.0018 | 0.010 | <0.0005 | 0.14 | <0.0005 | 0.0025 |

Monitoring Survey Result (bottom sediment)

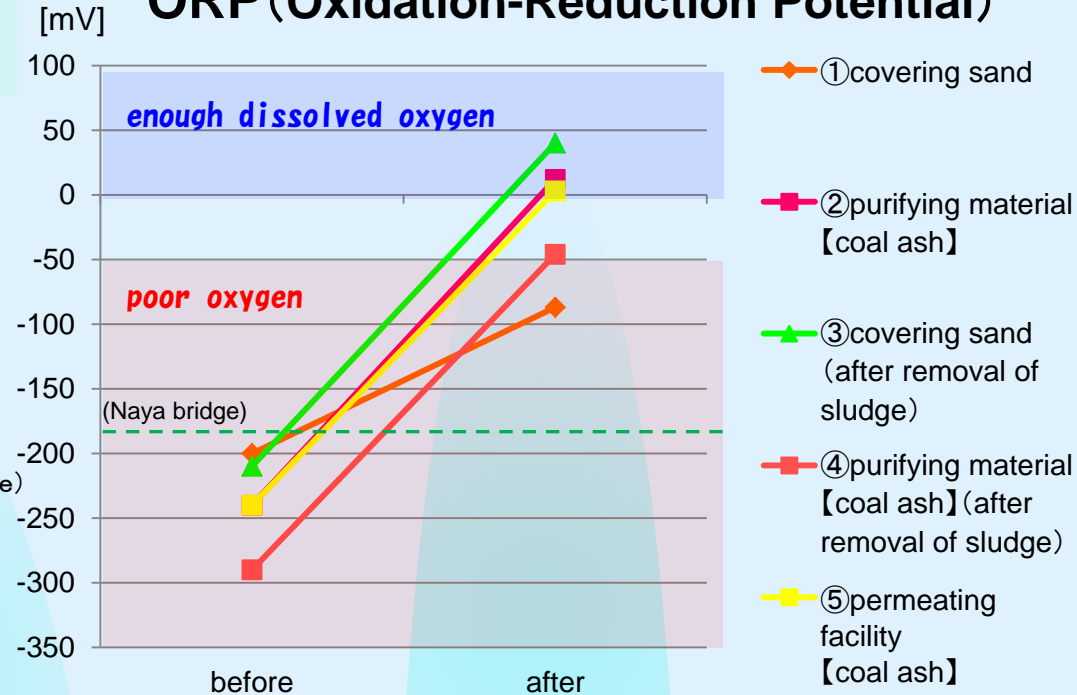
- pre-survey (before construction)
Aug. 25,26 2014
- post-survey (after construction)
Jul. 31 2015

COD



→ improved
→ not improved

ORP (Oxidation-Reduction Potential)



COD improved in all sections

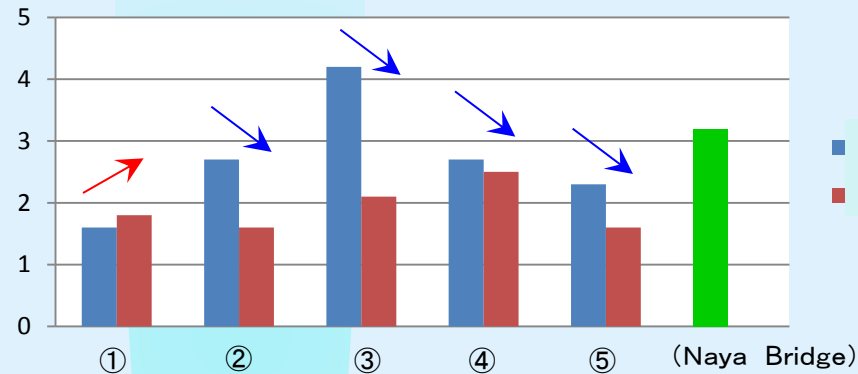
Monitoring Survey Result (bottom sediment)

- pre-survey (before construction)
Aug. 25,26 2014
- post-survey (after construction)
Jul. 31 2015

organic matter and nutritious salt decreased.

T-N (total nitrogen)

[mg/g-dry]

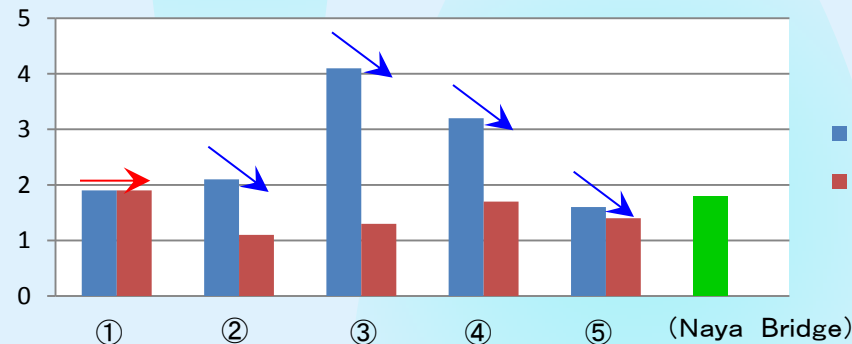


①covering sand ②purifying material
③covering sand ④purifying material (③,④: after removal of sludge)
⑤permeating facility

→ improved
→ not improved

T-P (total phosphorus)

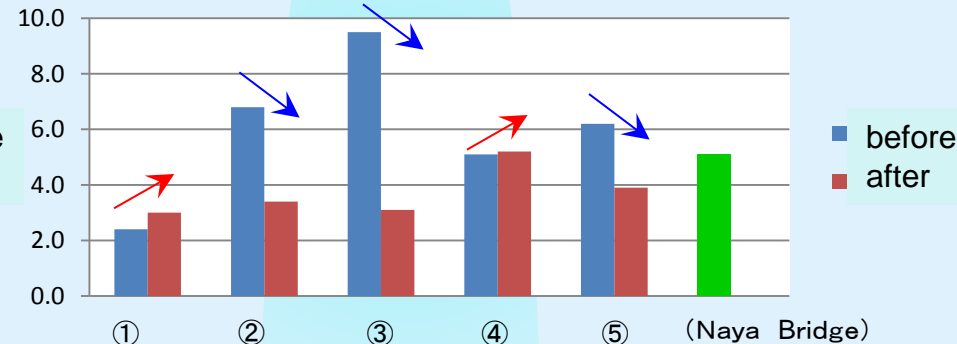
[mg/g-dry]



①covering sand ②purifying material
③covering sand ④purifying material (③,④: after removal of sludge)
⑤permeating facility

T-C (total carbon)

[%]



①covering sand ②purifying material
③covering sand ④purifying material (③,④: after removal of sludge)
⑤permeating facility

Monitoring Survey (Benthos survey results)

Investigated at low tide of spring tide

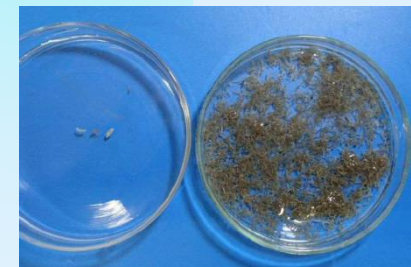
Pre-survey Date August 25, 2014

Post-survey Date July 31, 2015

*numbers of sample per 0.025m³

| 門名 | 綱名 | 目名 | 科名 | 種和名 | Pre-survey | | Post-survey | |
|------------------------------|------|----------|---------|------------|------------|-------------------|---|-------------------------|
| | | | | | | Covered with sand | ②浄化材料に使用された【石灰灰】 Covered with purification material | Infiltration facilities |
| 環形動物門 | ゴカイ綱 | サシバゴカイ目 | ゴカイ科 | カワゴカイ属 | | | | |
| | | スピオ目 | スピオ科 | Polydora 属 | | | | |
| | ミミズ綱 | イトミミズ目 | ミズミズ科 | エラミミズ | | | | |
| | | | | ウチワミミズ属 | | | | |
| | | | | ユリミミズ属 | | | 40 | 1 |
| | | | | ミズミズ科 | | | | |
| | | | | トガリミズミズ属 | 11 | | | |
| | | | | イトミミズ亜科 | 55 | 4 | 1,850 | 44 |
| | ヒル綱 | 吻蛭目 | グロシフォニ科 | ハバヒロビル属 | | | 1 | |
| | | | | ヌマビル | | | | |
| 節足動物門 | 軟甲綱 | ワラジムシ目 | ミズムシ科 | ミズムシ | | | | |
| | | ハエ目（双翅目） | ユスリカ科 | セボリユスリカ属 | | | | |
| Total kind number | | | | | 2 | 1 | 3 | 2 |
| Total individual body number | | | | | 66 | 4 | 1,891 | 45 |

Many organisms are discovered at places where purification materials had been installed



Monitoring Survey (Other view points)

1. Durability of covering materials against river flow

Purification material and sand are covering in stable now.

Continuous observation would be needed until over flood season.



2. Deposition of sludge on riverbank

Higher angle of cover materials for river stream decreases deposition of sludge.

Higher angle (15%)



Lower angle (5%)



More sludge deposited

Few sludge deposited



Monitoring Survey (Summary)

We could see some hopeful changes: COD, ORP and Benthos for example. But some other viewpoints like smells couldn't improve or got worse trend. So we should hold obvious review at this point.

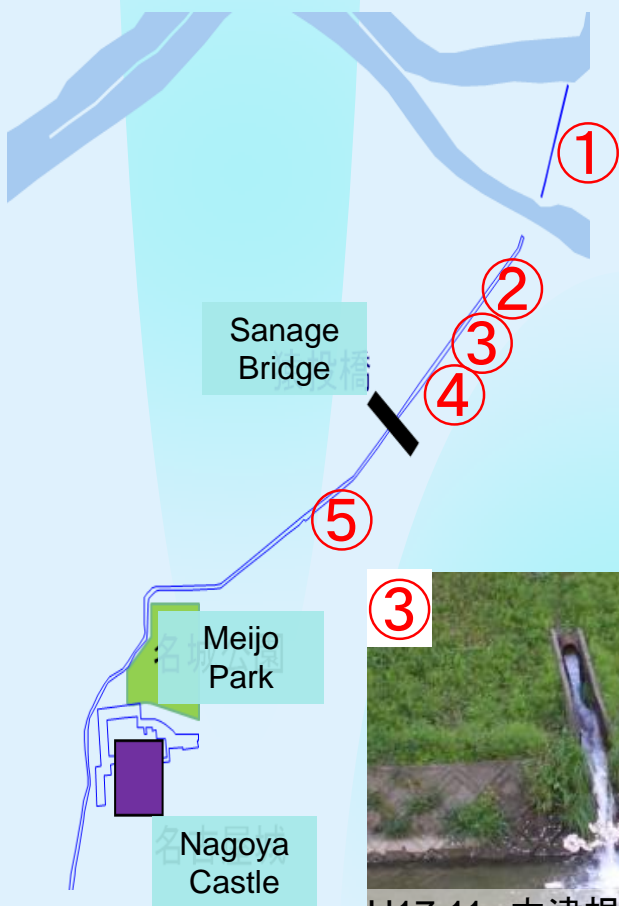


This survey is just a half year report, and continuous monitoring in the long term eyes will be needed

Reservation of Water Source

◆ Use of Shallow Ground Water Upstream area of Horikawa River

Report of other
measures



■Reservation of Additional Water Source(FY2014)

◆Upstream of Shiga Bridge

0.01 m³/s of water will be added (March 2015)



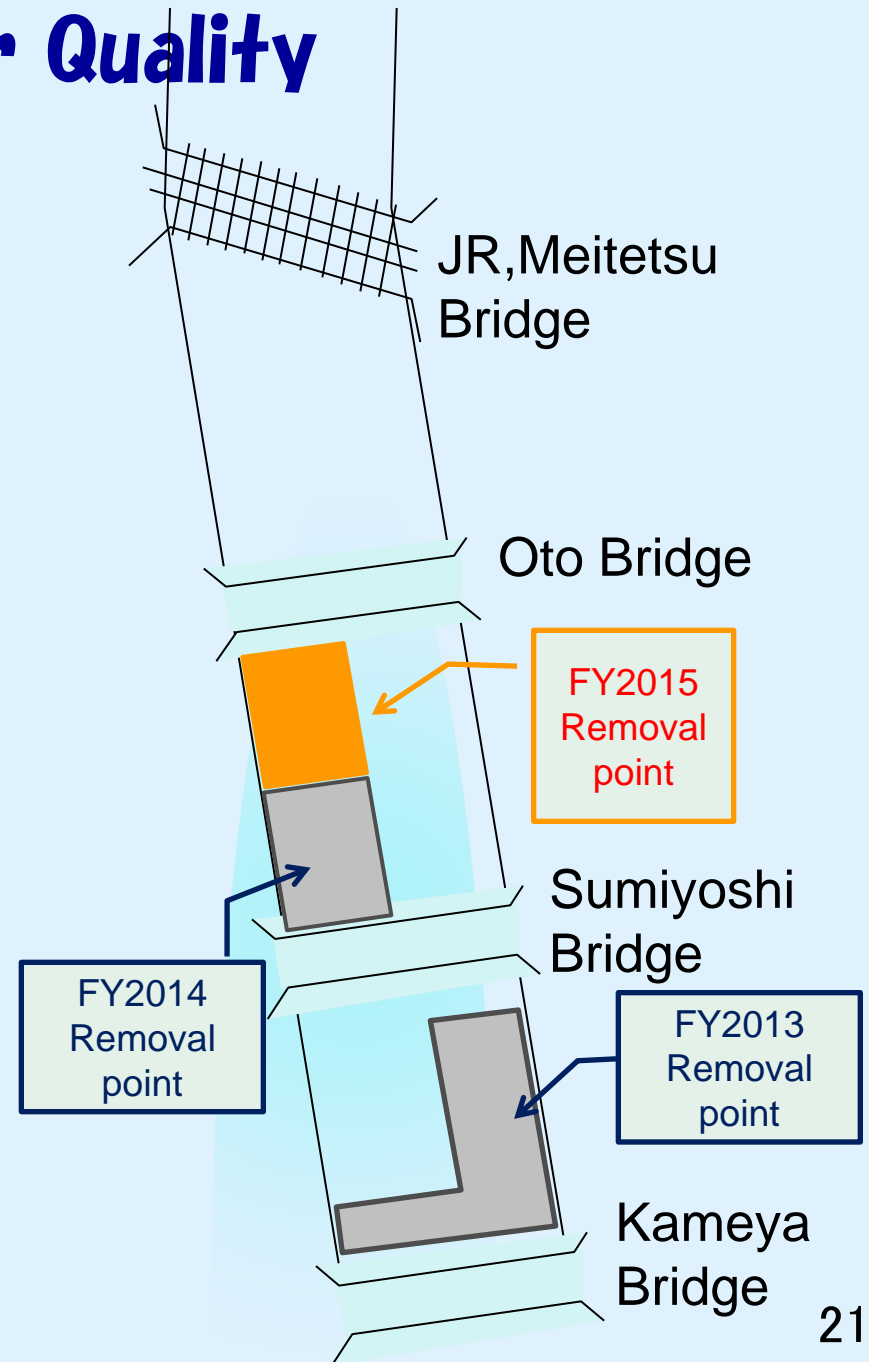
■Reservation of Additional Water Source(FY2015)

- ◆Upstream of Nakaido Bridge
0.01 m³/s of water will be added (March 2016)



Improvement of Water Quality

◆ Removal of Sludge

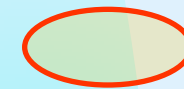


Improvement of Water Quality

◆ Making shallows and abyss

Setting wooden piles and ripraps generates variable stream on the river for enforcing river's self-purification function with growth of plants.

Since FY 2014



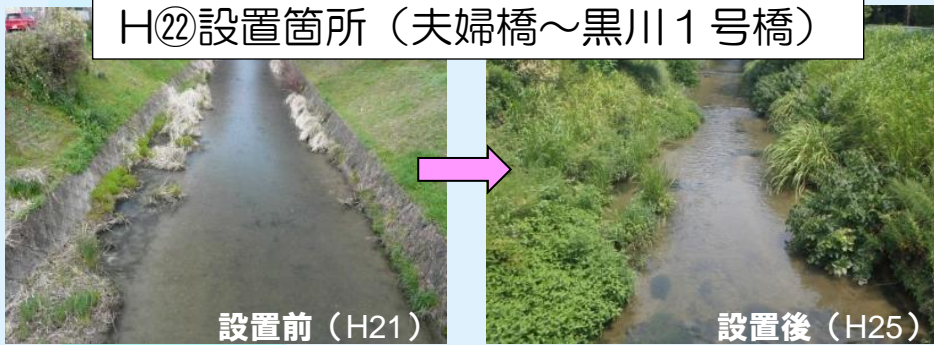
fish spawning and
plant seed ashore



Change of stream

Improvement of Water Quality

H②設置箇所（夫婦橋～黒川1号橋）



設置前 (H21)

設置後 (H25)

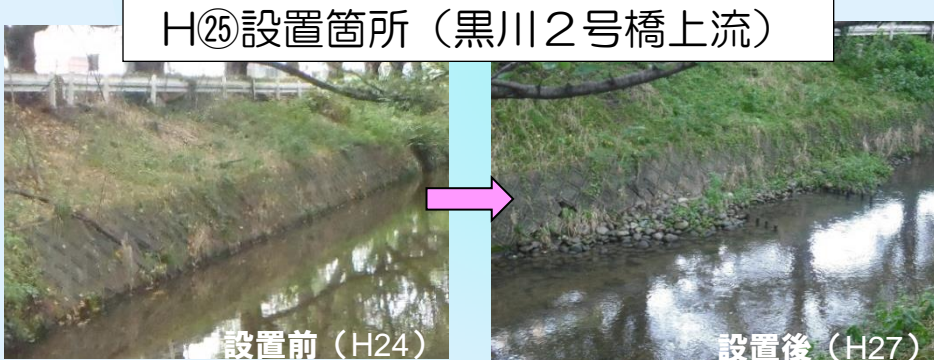
H④設置箇所（黒川2号橋下流）



設置前 (H23)

設置後 (H25)

H⑤設置箇所（黒川2号橋上流）



設置前 (H24)

設置後 (H27)

◆Improvement

Variety and amount of fish increased

Benthos increased

Plants growth is promoted

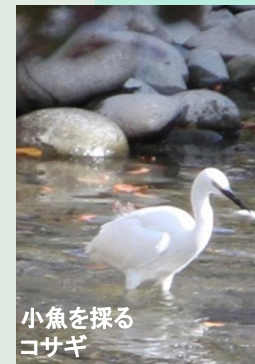
Wild living shown at upstream of Horikawa River



設置した玉石に
群がるオイカワ



モクスガニ



小魚を探る
コサギ



淵に集まる
マガモ

■ Pollutants removal/inflow reduction

◆ Control of combined sewer overflow (Rainwater storage facilities)

Construct rainwater storage facilities to reduce pollution load for Horikawa River in rainy weather by storing high polluted first flush rainwater temporarily.

Ozone stormwater
reservoir



Started operation in 2006
(12,000m³)

Horikawa Ugan Rain-
water Reservoir for
pollution control



Started operation in 2010
(13,000m³)

Horikawa Sagan Rain-
water Reservoir for
pollution control



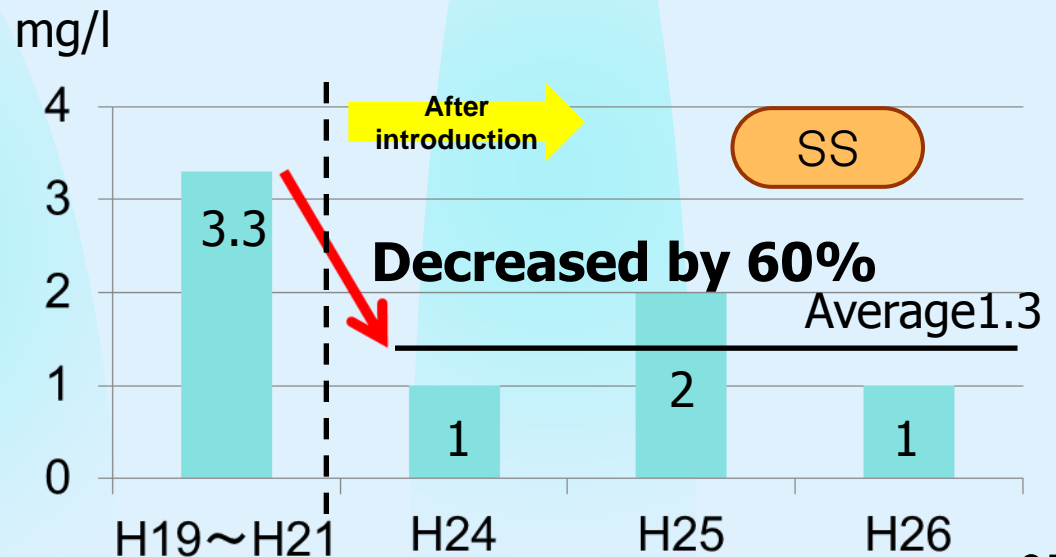
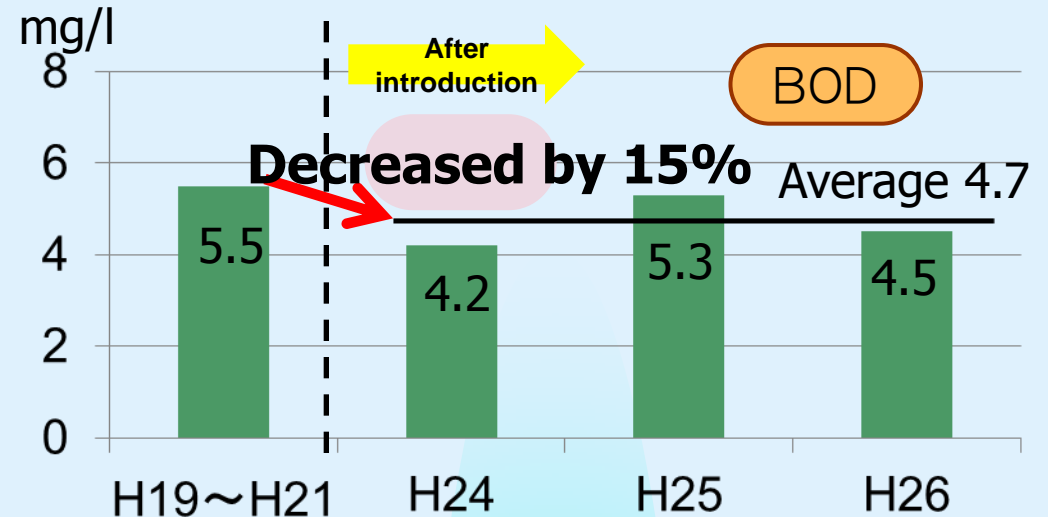
Under construction
(14,000m³)

■ Pollutants removal/inflow reduction

◆ Advanced water treatment at Meijo Water Treatment Center (Started operation in May, 2010)

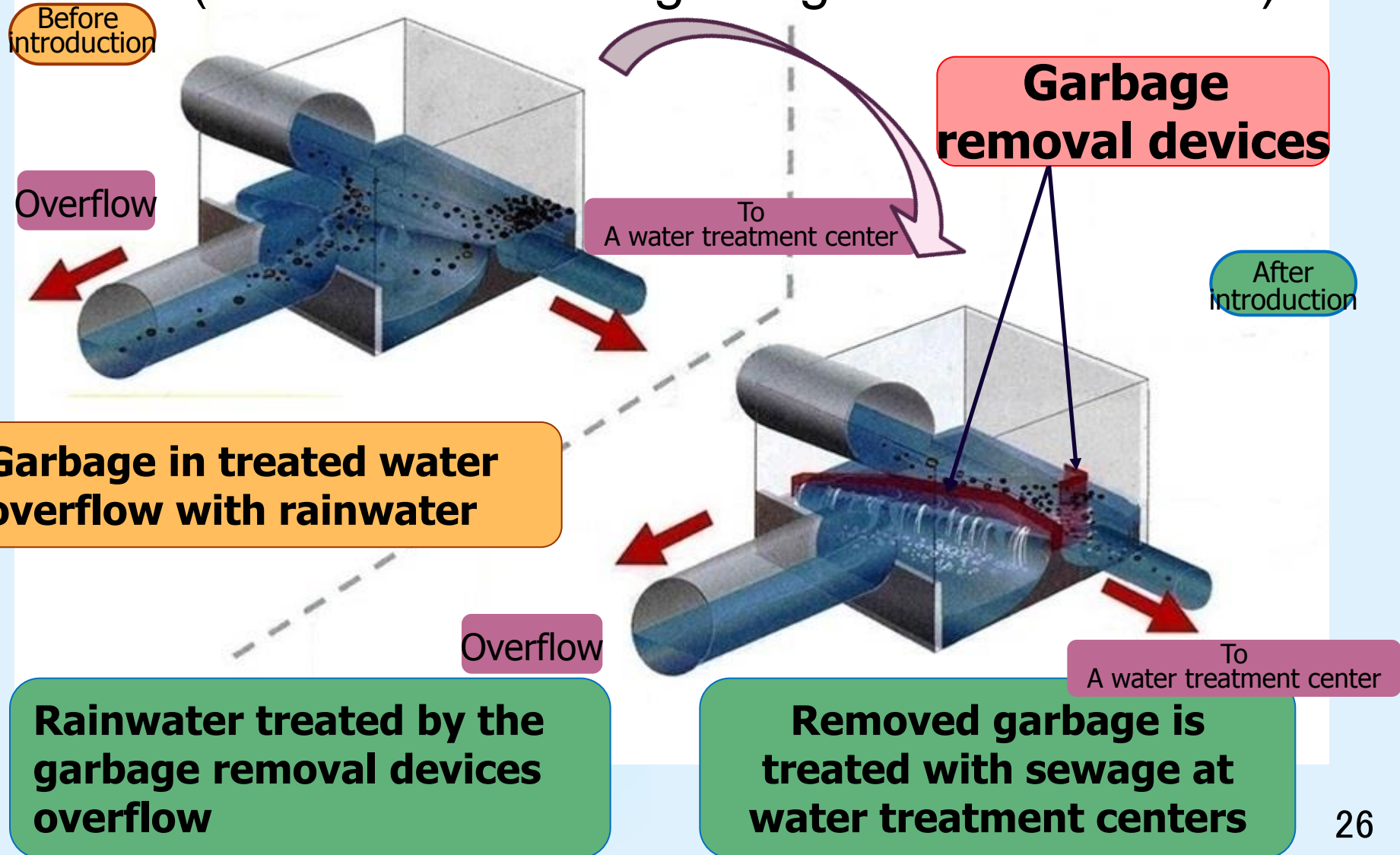


Filter out more minute Suspended Solids(SS) in treated water by filtration devices



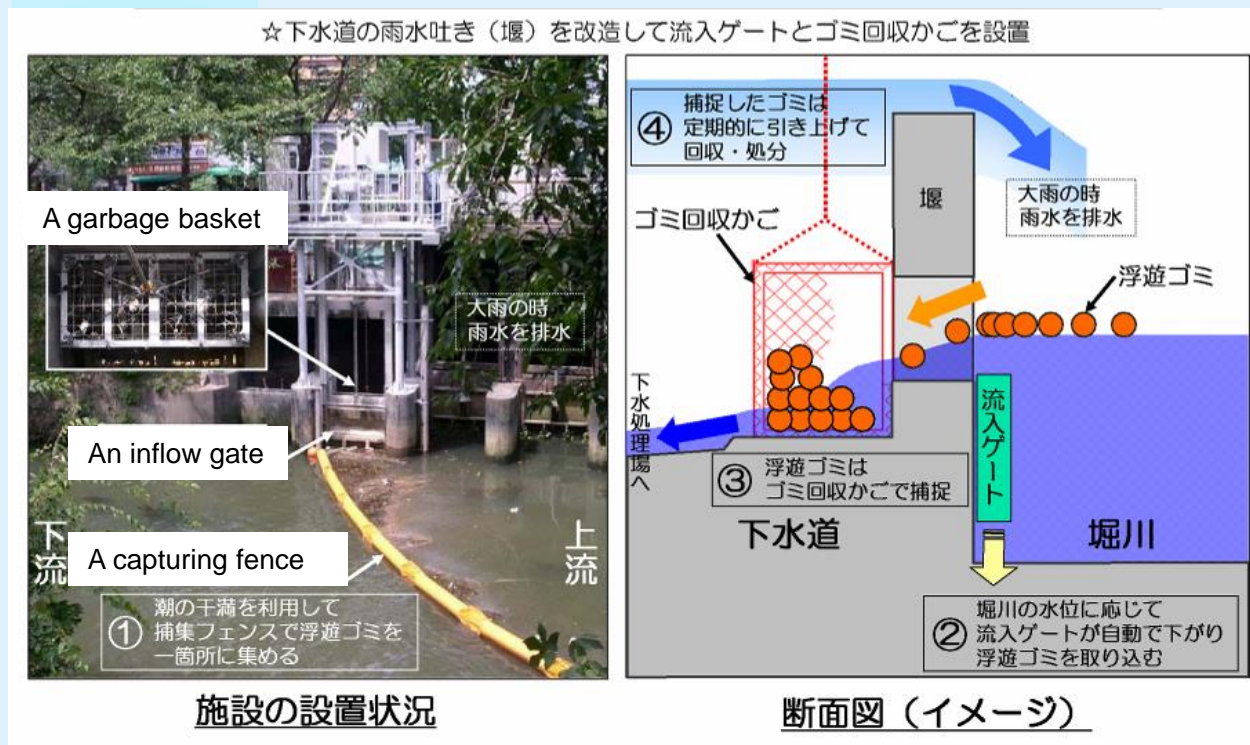
■ **Pollutants removal/inflow reduction**

◆ Improvement of the combined sewer system (Installation of the garbage removal device)



■Pollutants removal/inflow reduction

◆A Garbage Catcher(Near Johoku Bridge) Introduced in 2006

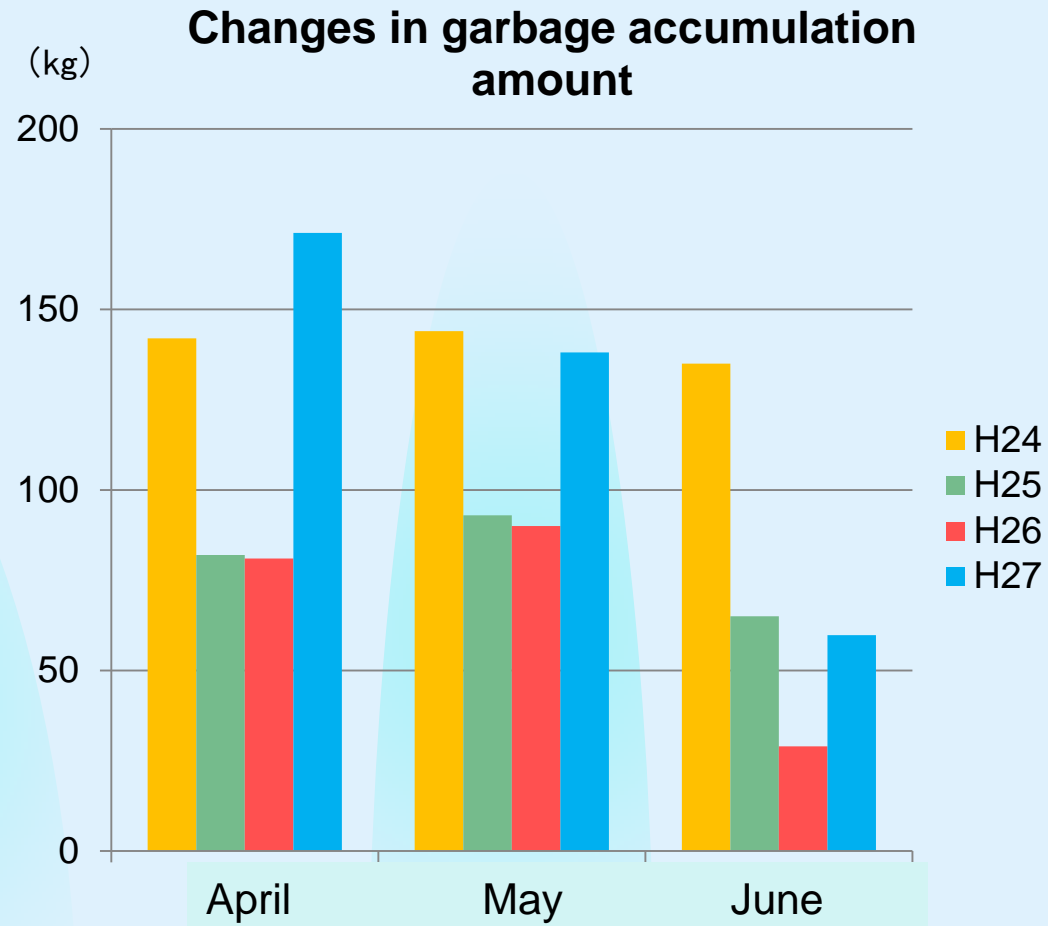


| | |
|---------------------------------|----------|
| The accumulation result in 2012 | 1.1 tons |
| in 2013 | 0.8 tons |
| in 2014 | 0.7 tons |

■ Pollutants removal/inflow reduction

◆ Changes in garbage accumulation amount by the Garbage Catcher

After the repair
(Carried out in March, 2015)



Secure the river source

◆ Reclaimed wastewater supply

Use of reclaimed wastewater treated by the membrane filtration process at Moriyama Water Treatment Center



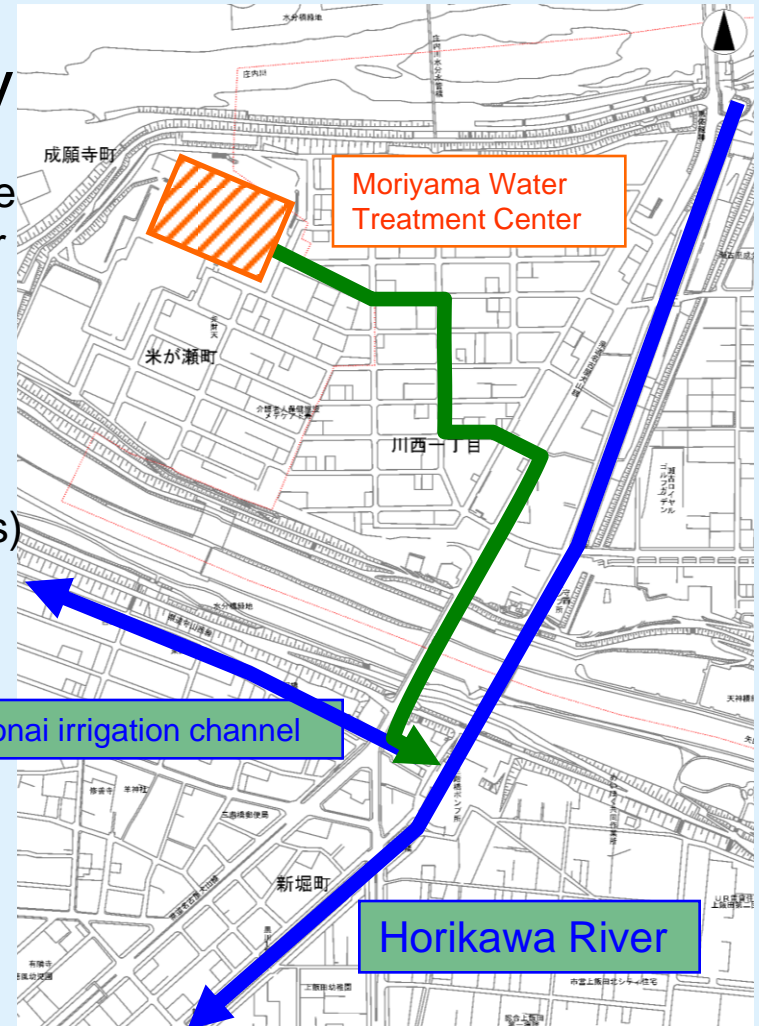
Flat membrane units
in aerobic tanks
(400 sheets × 12 units)

The membrane case
of an upper stage
(200 cartridges inside)

The membrane case
of a lower stage
(200 cartridges inside)



Flat membrane units



※Water conveyance period is generally irrigation seasons (from April to October)
(except the period for Shonai irrigation channel (from November to March))

Others

[Construction of Gojo Bridge River Park]

The river park is under construction on the edge of Gojo Bridge (right bank of its upstream)

The park with historical explanation boards and roofed mud walls suggestive of Minoji Roads

The completion image



The construction status



***Thank you for
your kind attention.***

