



ESCAP/WMO
Typhoon Committee



FINAL REPORT ON
FLOOD RISK WATCH PROJECT
FOR LIFE-SAVING

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

 **WMO**

January 2026

TC/TD-No. 0025

FINAL REPORT ON FLOOD RISK WATCH PROJECT FOR LIFE-SAVING



Authors

Tomoya Kikuta (Ministry of Land, Infrastructure, Transport and Tourism, MLIT)
Yuji Amami (Ministry of Land, Infrastructure, Transport and Tourism, MLIT)
Kenichiro Tachi (Infrastructure Development Institute – Japan, IDI)
Yuichi Nakamura (Infrastructure Development Institute – Japan, IDI)
Ir. Surdiman Zahuri bin Sulaiman (Department of Irrigation and Drainage, DID)
Ir. Sazali bin Osman (Department of Irrigation and Drainage, DID)
Ir. Ts. Mohd Faizul Bin Mustapha (Department of Irrigation and Drainage, DID)
Nurul Husaif Bin Mohamed Ramely (Department of Irrigation and Drainage, DID)

NOTE

The designations employed in ESCAP/WMO Typhoon Committee (TC) publications and the presentation of material in this publication do not imply the expression of any opinion and whatsoever on the part of the Secretariat of TC, ESCAP or WMO concerning the legal status of any country, territory, city area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Opinions expressed in TC publications are those of the authors and do not necessarily reflect those of their agencies, their governments, TC, ESCAP, or WMO. The mention of specific companies or products does not imply that they are endorsed or recommended by TC, ESCAP or WMO in preference to others of a similar nature which are not mentioned or advertised.

TC/TD-No. 0025
©ESCAP/WMO TYPHOON COMMITTEE,2026
ISBN 978-99981-833-5-3

ESCAP/WMO Typhoon Committee Secretariat
Avenida 5 de Outubro, Coloane
Macao, China
Tel.:(+853) 8801053 1 Fax: (+853) 88010530
E-mail: info@typhooncommittee.org

Published in February2026

Digital printing, Macao, China in February, 2026

The right of publication in print, electronic and any other form and in any language is reserved by ESCAP/WMO Typhoon Committee. Short extracts from Typhoon Committee publications may be reproduced without authorization, provided that the complete source is clearly indicated. Editorial correspondence and requests to publish, reproduce or translate these publication in part or in whole should be addressed to the Secretary of ESCAP/WMO Typhoon Committee.

TABLE OF CONTENTS

Foreword	1
1. Introduction	2
1.1 Current status and challenges of water level observations in Typhoon Committee members.....	2
1.2 Overview of 3L Water Level Gauges.....	2
(1) Crisis management type water level gauges in Japan	2
(2) Overview of the 3L Water Level Gauge	4
1.3 Typhoon Committee Working Group on Hydrology AOP6 Project.....	4
(1) Typhoon Committee Working Group on Hydrology	4
(2) AOP6: Flood Risk Watch Project for Life-saving	4
2. Demonstration in Malaysia.....	6
2.1 Overview of Hydrological Observations in Malaysia	6
(1) Hydrological observation in rivers in Malaysia.....	6
(2) Malaysia's Flood Forecasting and Warning Program (PRAB)	6
1) Outline of PRAB	6
2) Background of Development	6
3) Development Goals.....	6
4) Flood and Inundation Forecasting Methodology and Disaster Prevention Information Release in PRAB	7
5) Information Items Provided by PRAB.....	7
2.2 Background of Activities in Malaysia	7
2.3 Selection of rivers and sites for test observation.....	9
(1) Situation of Klang River.....	9
(2) Langat River situation.....	12
(3) Pinang River Status.....	14
2.4 Selection of test observation sites	15
(1) Test observation site.....	15
(2) Overview of the Klang River basin and river	16
2.5 Location of the test equipment.....	16
3. Preparation for test observation (work in Japan)	18
3.1 Companies Participating in the Test and Observation	18
Work items and process of test and observation	18
(1) Cost sharing for test and observation	18
(2) Recruitment of participating companies.....	19

3.2 Localization of test and observation equipment (coordination with Malaysian specifications for equipment)	19
(1) Organize technical specifications for test observations.....	19
(2) Basic configuration of equipment.....	20
1) Water level gauge sensor	20
2) Communication unit (RTU).....	20
3) Communication lines	21
4) Data backup device	21
5) Power supply section.....	21
6) Enclosure.....	21
7) Water level observation and data storage and transmission	21
8) Observation period.....	21
9) Observation and data transmission intervals	21
10) Data storage	21
11) Observation items	21
12) Data transmission	22
4. Test observation	23
4.1 Installation of 3L water level gauge	23
(1) Transportation and on-site installation	23
(2) Adjustment of zero-point height	23
4.2 Test observation	24
(1) Demonstration experiment period	24
(2) Verification of the results of the demonstration experiment	24
5. Test observation results	25
5.1 Installation location.....	25
5.2 Evaluation Items for Test Observations.....	25
5.3 Evaluation of observation results.....	25
(1) Data Format.....	26
(2) Battery Voltage.....	26
(3) Observed Water Levels.....	26
(4) Data Transfer.....	27
6. Summary of test observations	28
6.1 Assessment of Water Level Suitability	28
(1) Data transfer	28
(2) Observed water level.....	28
(3) Battery voltage	28
(4) Data format	28

(5) Maintenance performance 28
(6) Overall evaluation 29
6.2 Development for introduction.....29
6.3 Conclusion.....29

References **30**

- APPENDIX-1 Observation Standards and Specifications for Crisis Management Type Water Level Gauges
- APPENDIX-2 Crisis Management Water Level Gauges Participating in the Test Observation (Pamphlet)
- APPENDIX-3 Presentation Materials at Typhoon Committee Working Group on Hydrology (WGH)

FOREWORD



In response to the escalating flood damage driven by climate change, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan developed a crisis-management water level gauge —

the 3L Water Level Gauge — featuring four key advantages:

- (1) long-term, maintenance-free operation;
- (2) a compact design enabling space-saving installation on bridges and similar structures;
- (3) lower initial investment costs; and
- (4) reduced ongoing maintenance and management expenses.

To promote capacity building in flood monitoring among ESCAP/WMO Typhoon Committee (TC) Members, MLIT proposed the Flood Risk Watch Project for Life-Saving as one of the Annual Operation Plans (AOPs) of TC Working Group on Hydrology (WGH). Officially launched at the TC 51st Session in 2019, the project concluded at the TC 56th Session in early 2024.

Throughout its implementation, the project was carried out in collaboration with the

Water Resources Management and Hydrology Division of the Department of Irrigation and Drainage (DID), Malaysia, which conducted a pilot study. Findings and results were subsequently shared with TC members.

This report provides an overview of the 3L Water Level Gauge, reviews the project's implementation in detail, and evaluates the gauge's performance under real-world conditions. It is intended to serve as a technical reference for the Typhoon Committee region and beyond.

I wish to express my deepest appreciation to all experts from Japan's MLIT and the Infrastructure Development Institute (IDI) for their invaluable contributions to this initiative. My sincere thanks are also extended to our colleagues at DID Malaysia for their dedicated support and cooperation throughout the project.

Dr. DUAN Yihong
ESCAP/WMO Typhoon Committee
Secretary
January 2026

1. Introduction

1.1 Current status and challenges of water level observations in Typhoon Committee members

In September 2021, the World Meteorological Organisation (WMO) and the United Nations Office for Disaster Reduction (UNDRR) announced that climate change and increasing extreme weather events have caused a surge in natural disasters over the past 50 years, disproportionately affecting developing countries.

According to the agency's "Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes", from 1970 to 2019, natural disasters accounted for 50% of all disasters, 45% of all reported deaths and 74% of all reported economic losses. However, it states that with early warning systems and improved disaster management, the number of fatalities will fall by about a third between 1970 and 2019, from 50,000 in the 1970s to less than 20,000 in the 2010s.

Water level observation systems are considered to be the backbone of this early warning system and disaster risk reduction and will be even more needed in the future to reduce and mitigate damage caused by water-related disasters.

In addition, effective flood control measures, including structural measures, are essential to mitigate damage caused by floods and to prevent the loss of assets accumulated through development. The planning and design of flood control measures require water level data accumulated by water level observation systems.

In Japan, the need for more detailed river water level monitoring has led to the installation of cheaper (less than USD 100) "3L Water Level Gauges", with more than 9,000 (as of May 2022) installed across the country. However, all Typhoon Committee Members have not established such water level stations, and river level data necessary for river and water resources management, including floods and droughts, are not sufficiently observed, collected and shared. One of the reasons for the lack of development of water level observatories is

the installment cost. The cost of water level gauges needs to be reduced so that they can be installed in more locations.

Even where water level gauges have been installed, many cases have been reported that they have not been adequately maintained and damaged hindering continuous observation. The major reason for this is considered to be maintenance costs, and effective measures to reduce the maintenance costs of water level observations are required.

On the other hand, in view of the intensification of water-related disasters in recent years, in addition to measuring and reliably collecting river level data at higher densities and frequencies, the data needs to be combined with forecast information and to be disseminated in an easy-to-understand and effective manner for use in evacuation of residents and in crisis management responses of governments and locals, in order to reduce damage caused by water-related disasters, including human lives.

Therefore, there is a need for water level observation equipment with low installation and maintenance costs, as well as proposals for observation systems. Furthermore, those river level observation systems need to be deployed in advanced river information systems that can provide the collected river information more clearly and effectively.

As one of the solutions to meet the needs in typhoon committee members, Japan has proposed the introduction of "3L Water Level Gauges" with the keywords "3L that is Low cost, Long Life and Localised".

1.2 Overview of 3L Water Level Gauges

(1) Crisis management type water level gauges in Japan

In Japan, while flood disasters occur frequently on small and medium-sized rivers, there are not enough water level monitoring stations compared to large rivers, which has

led to difficulties in crisis management based on the rising river levels of small and medium-sized rivers and responding to crisis management based on this information.

To address this challenge, the Ministry of Land, Infrastructure and Transport and Tourism (MLIT) has developed a low-cost water level gauge specialized for water level observation during floods in the framework of a public call for technology from companies under the Innovative River Management Project since 2016. By specializing in observations during floods, using mobile communication networks and utilizing generic components, the cost and size of the instrument has been significantly reduced. The aim is to promote the spread of water level gauges to rivers where no water level gauges were previously available and to rivers where higher-density water level monitoring is required, and to enhance the water level observation network.

The features of the crisis management type water level gauges are as follows.

The name "crisis management type water level gauge" is used to distinguish it from conventional water level gauges because of its special feature of monitoring water levels during floods.

(Features of crisis management type water level gauges).

- Long-term maintenance-free (more than 5 years of operation without power supply).
- Space saving (downsizing enables easy installation on bridges, etc.).
- Reduction of initial costs (The cost of the water level gauge itself is less than 1 million yen/unit due to the downsizing of the equipment, which was enabled as a result of observations limited to flood events, that led to smaller batteries and equipment with the help of technological development as well.
- Reduction of maintenance and management costs (reduction of data volume by specialising in water level observation during floods only, and reduction of communication costs in combination with IoT technology).
- The system has been installed in more than 9,000 locations nationwide (as of

May 2022), and further installations being promoted.

Crisis management type water level gauges are low-cost water level gauges specially designed for flood observation, which measure and transmit data at 10-minute intervals when the river level rises and exceeds a threshold water level. Under non-flood circumstances, only one inspection data transmission per day is required.

Crisis management-type water level gauges of national and local management have been installed at approximately 9,000 locations (as of May 2022), and further deployment is being promoted.

Crisis management-type water level gauges are broadly divided into water contact types and non-contact types, which are selected according to the conditions of the installation site. The basic configuration is the same for both types. Observation results from the crisis management type water level gauges and conventional water level gauges are published on the River Information Centre's 'River Level Information' website, which can be viewed by residents at any time via PC or smartphone. The website is operated by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), so prefectures and other local authorities do not need to build their own viewing systems, which is one of the reasons for cost-saving.

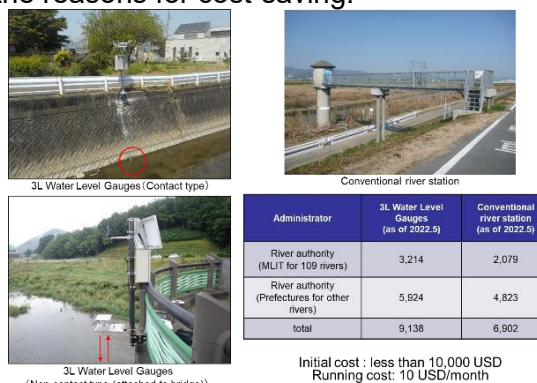


Figure 1-1 Images of Crisis management type water level gauges

The technical specifications of the crisis management type water level gauge are given in the Appendix at the end of this document.

(2) Overview of the 3L Water Level Gauge

The name "crisis management type water level gauge" in Japan is used to distinguish it from conventional water level gauges because of its special feature of monitoring water levels for crisis management during floods. However, when crisis management-type water level gauges are applied

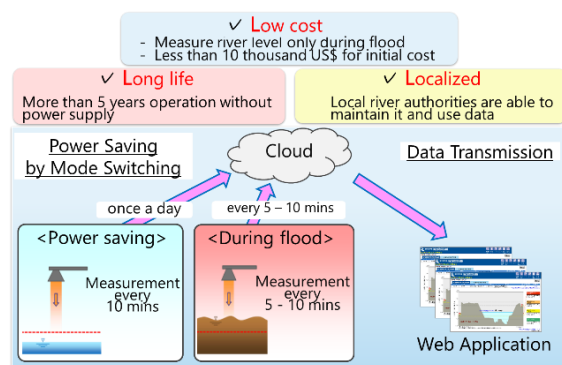


Figure 1-2 Overview of the 3L Water Level Gauge

1.3 Typhoon Committee Working Group on Hydrology AOP6 Project

(1) Typhoon Committee Working Group on Hydrology

The ESCAP/WMO Typhoon Committee (hereinafter referred to as 'TC: Typhoon Committee') is an intergovernmental organization for typhoon disaster mitigation established in 1968 for the purpose of cooperation among 14 members (as of March 2020) in East and South-East Asia.

In addition, the Working Group on Hydrology ('WGH') is one of the essential working groups of TC.

The Japanese Ministry of Land, Infrastructure and Transport (MLIT) has actively participated in the TC since its establishment.

The WGH members exchange information and discuss national and regional reports, AOPs (Annual Operation Plans) and other topics of discussion at the Hydrology Committee meetings.

(2) AOP6: Flood Risk Watch Project for Life-saving

overseas, their use is not necessarily limited to flood periods as in Japan. For this reason, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) introduces them as '3L Water Level Gauges' to make it easier for partners to understand their features in overseas applications. The 3L in 3L Water Level Gauge stands for Low Cost, Long Life and Localised.

From March 2019 to March 2023, as one of the individual activities of the Hydrology Committee (AOP6: Flood Risk Watch Project for Life-saving), a project was carried out to study the possibility of deploying 3L water level gauges to Typhoon Committee members. The long-term objective of the project is to promote the installation of water level stations in Typhoon Committee members and the more effective use of river information, including water levels.

As a first step towards this, the project aims to study the feasibility of 3L water Level Gauges application to other typhoon committee members by sharing the installation procedures and data utilization of the 3L Water Level Gauges with the typhoon committee members through demonstration (test observation) in a typhoon committee member outside Japan.

Test observations for applicability studies were conducted in cooperation with the Department of Irrigation and Drainage (DID), Ministry of Energy Transition and Water Transformation (PETRA), Malaysia, and after visiting three candidate sites, the observations in a river in Kuala Lumpur was chosen. Malaysia, like Japan, has a nationwide water level observation network and information system in place. The reasons for the selection of Kuala Lumpur were that it was easy to verify the test observation data and compare them with data of existing water level observation equipment. Moreover, Kuala Lumpur is undergoing significant urban development, and if flooding were to occur, the damage would be enormous and a more detailed understanding of river levels is required.

a) Objective

- To share the installation procedure and

data utilization of the 3L Water Level Gauge with Typhoon Committee members.

- Consideration of its installment to other typhoon committee members.

b) Implementation period

- March 2019 - March 2023

c) Area of implementation of the demonstration

- Specific river basins in Malaysia

In the project, the applicability of a Japanese companies' crisis management type water level gauges (3L Water Level Gauge), including modification and adjustment of the

equipment to Malaysian hydrological observation specifications, was confirmed by installing it on one river in Malaysia, and conducting test operations. Specifically, the 3L Water Level Gauges were installed at the same location as the existing water level gauge operated by the Malaysian DID, observations were carried out at the same time, and the observed values of them were compared to confirm the feasibility of introducing the 3L Water Level Gauges to Malaysia.

The next chapter details the demonstration in Malaysia.

2. Demonstration in Malaysia

2.1 Overview of Hydrological Observations in Malaysia

(1) Hydrological observation in rivers in Malaysia

DID through the Division of Water Resources Management and Hydrology (BSAH) as a whole is responsible for setting up and maintaining the hydrological stations throughout Malaysia, collecting, processing, archiving, and dissemination of the hydrological data such as rainfall, river stage (water level) and discharge (streamflow), evaporation, river suspended sediment, river water quality, and agro-hydrological data. The hydrological activities are carried out for three major purposes:

- i. Data collection and management;
- ii. Maintenance of a flood forecasting/warning service; and
- iii. Maintenance of a drought monitoring service.

To fulfill the activities in an orderly and standardised manner, a quality manual based on the MS ISO 9001:2015 was formed by the BSAH Division.

In the early days, the DID water level station consisted of stick gauges. The gauges must be read at least twice daily and recorded manually. Nowadays automatic or telemetry water level stations have been developed by DID. Automatic water level instrument mainly consists of sensors, data loggers or remote terminal units, communication modems, and power supply systems. By using this automatic equipment, water level data can be monitored in real time by DID and the public. This method is very useful for flood forecasting and monitoring.

Currently, DID is actively developing telemetry water level stations throughout the country. Based on information from the website <https://publicinfobanjir.water.gov.my>, there are 939 numbers of telemetry water

level stations that have been developed by DID. However, this number keeps increasing over time since hydrological station development projects are still ongoing.

(2) Malaysia's Flood Forecasting and Warning Program (PRAB)

1) Outline of PRAB

The National Flood Forecasting and Warning Program (PRAB) was initiated after the major floods that occurred in December 2014 that hit eight states namely Kelantan, Terengganu, Pahang, Perak, Perlis, Johor, Sabah and Sarawak. A total of 25 deaths were recorded, more than 500,000 people were evacuated, and the cost of losses exceeding RM 2.85 billion. This program is planned to be implemented comprehensively throughout the country where it involves the development of flood forecasting models for 40 main river basins.

2) Background of Development

The PRAB Program will be developed through 3 phases of implementation, namely Phase 1, Phase 2A, and Phase 2B. The implementation of PRAB is targeting 40 major river basins will have a highly accurate flood forecast model. PRAB Phase 1 Project has been implemented for three (3) major river basins namely Sg. Kelantan, Sg. Terengganu and Sg. Pahang. The PRAB Phase 2 Project will involve flood forecasting models in 38 river basins nationwide including Sabah and Sarawak. The PRAB project is expected to be completed by 2030.

3) Development Goals

PRAB aims to achieve the following four goals.

- i. To develop a system that can forecast monsoon flood 7 days earlier based on weather forecast data from the Malaysia

- ii. Meteorological Department (MET);
- ii. To increase the capacity of the existing system for warning and dissemination of monsoon flood from 6 hours to 2 days earlier for the benefit of related agencies and the population affected by the flood;
- iii. To increase the accuracy of flood forecasting by reducing the difference between forecast and observed data from 1 meter water level to less than 0.5 meter; and
- iv. To develop a system that's capable to forecast and disseminate flash flood warning to public from 1 to 3 hours earlier based on weather forecast data from Malaysia Meteorological Department (MET) focused on river overflow.

Figure 2-1 shows the overall structure of PRAB. The PRAB is composed of the following four components:

- i. Observation (rainfall and water level);
- ii. Data accumulation;
- iii. Forecasting (river level and inundation forecasting based on rainfall/water level data, tide levels, river topography, and land topography); and
- iv. Information Release.

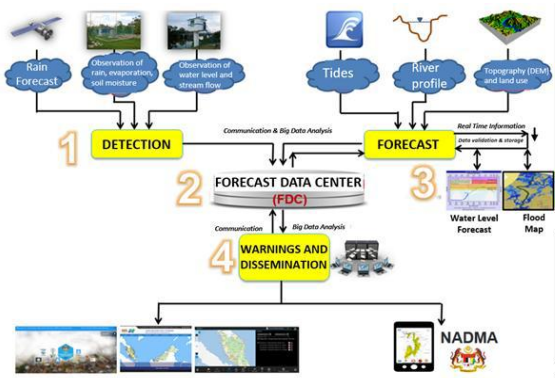


Figure 2-1 PRAB overall structure

4) Flood and Inundation Forecasting Methodology and Disaster Prevention Information Release in PRAB

PRAB aims to issue out flood warning to the public as early as two (2) days ahead based

on the meteorological data from the Malaysia Meteorological Department (MET). In issuing flood warning to the public, data from various source is required as an input to the flood forecasting model. One of the crucial data is water level in river which is obtain from telemetric water level station throughout Malaysia. More water level gauge observations are needed to improve the accuracy of flood forecasting and to issue early warnings.

5) Information Items Provided by PRAB

A website has been developed in the PRAB program which is called as Public Infobanjir. The website provides hydrological observation data as well as images of flood conditions via cameras and flood forecasts.

Figure 2-2 shows the installation status of rain gauges, water level gauges, and web cameras station.



Figure 2-2 Rainfall Observations, Water Level Gauges and Cameras (Near Kuala Lumpur)

(∇ : rainfall station, ○ : water level gauge, ■ : camera)

<https://publicinfobanjir.water.gov.my/?lang=en>

2.2 Background of Activities in Malaysia

The installation of 3L water level gauges in Malaysia was conducted since 2018 with the Department of Irrigation and Drainage (DID), Ministry of Energy Transition and Water Transformation (PETRA) Malaysia as a counterpart. The history of activities to date is summarized in Table 2-1..

Table 2-1 Background of Activities

FY	Period	Contents
2018	October	2019 8th Typhoon Committee Working Group on Hydrology (Tokyo) Explanation of the project to members at the Typhoon Committee Working Group on Hydrology Explanation of the 3L water level gauge to DID officials during a seminar in Malaysia
2019	January	Visit to Malaysia DID (Kuala Lumpur) Visit to Malaysia DID's water level observation facilities and exchange of opinions
	October	2019 8th Meeting of the Typhoon Committee Working Group on Hydrology (Seoul) Project description to the members of the Hydrological Committee of the Typhoon Committee
		Visit to Malaysia (Kuala Lumpur) Held seminars on Hima Dam inspection and flood risk monitoring Explanation of the project to Malaysian DID officials
	December	Field survey of potential 3L water level gauge installation in Malaysia (Kuala Lumpur, Penang) Meeting DID water level observation and hydrological data application staff and field survey →Approval for trial construction of a 3L water level gauge
2020	January	Visit to Japan by Malaysian DID officials, site visit to 3L water level gauge, MLIT meeting Visit the crisis management type water level gauges of Yamato River and Tsurumi River Explanation of Japanese policy by MLIT staff
	Year-round	Coordination of 3L water level gauge technical specifications, test observation locations, customs clearance procedures, etc.
2021	August	Public solicitation of companies participating in the test observation of 3L water level gauges →Confirmation of participation request for test observation (4 companies applied)
	September	Online briefing for companies participating in the test observation →Final confirmation of observation participation (4 companies decided)
	November	Online information exchange meeting for companies participating in the test observation
2022	January ~February	Application for test observation to Malaysia DID (Letter sent) →Official approval for test observation of 3L water level gauge
	March	Online meeting by DID Malaysia, Ministry of Land, Infrastructure, Transport and Tourism, and companies participating in the test observation
	April ~August	Installation of 3L water level gauge (Malaysia)
	August	Installation of water level gauges at all participating companies completed and observation started
	October	Start of test observation
2023	March	Test observation completed
	April	Removal of 3L water level gauge (planned)
	September	Adjustment of AOP6 test observation results
	October	Report the results to the Typhoon Committee

2024	February	Coordination of final report with Malaysia
------	----------	--

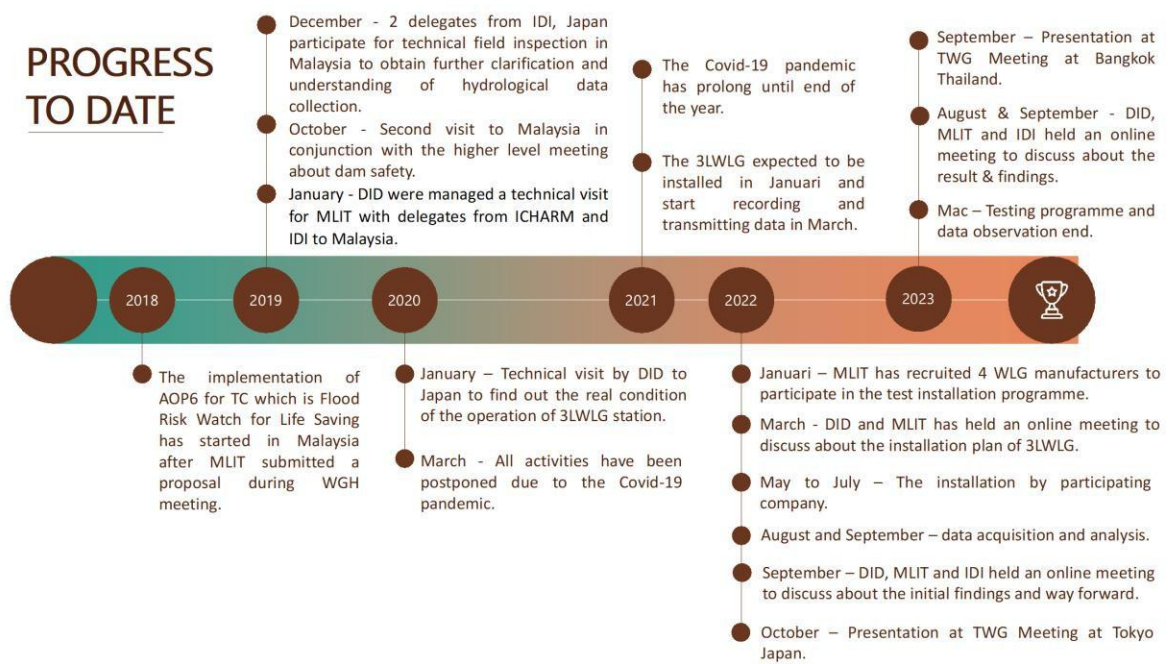


Figure 2-3 Background of activities (DID organizing documents)

2.3 Selection of rivers and sites for test observation

The Malaysian DID side proposed the three basins shown in Figure 2-2 as the target basins for the test observation of the 3L water level gauge. During the field visit in December 2019, we visited the water level stations in these three basins and examined candidate sites for the implementation of the test observation sites.

- Klang River
- Langat River
- Pinang River



Figure 2-2 Map of candidate locations of model watersheds

(1) Situation of Klang River

- The Klang River is an urban river that flows through the urban area from Kuala Lumpur City in the upper basin to Klang City in the lower reaches.
- DID presented two water level gauge

test sites: the Klang Gate Dam upstream and the Sultan Sulaiman Bridge water level station in the center of Kuala Lumpur.

- Non-contact water level gauges were installed at both the Klang Gate Dam and Sultan Sulaiman Bridge, one on the dam body at the Klang Gate Dam and one on the water pipe bridge at the Sultan Sulaiman Bridge.
- The Sultan Sulaiman Bridge was also equipped with a radio wave velocimeter for real-time flow observation. The station has been monitoring the water level for more than 40 years and is one of the most important stations on the Klang River.
- The station used to be observed by a propeller-driven anemometer using a cableway. It is still used for the verification of radio wave anemometers.



Figure 2-5 Klang Gate Dam and existing water level gauge (non-contact type)



Figure 2-6 Sultan Sulaiman Bridge Water Level and Rainfall Observatory and Existing Water Level Gauge and Radio Velocity Gauge (non-contact type)

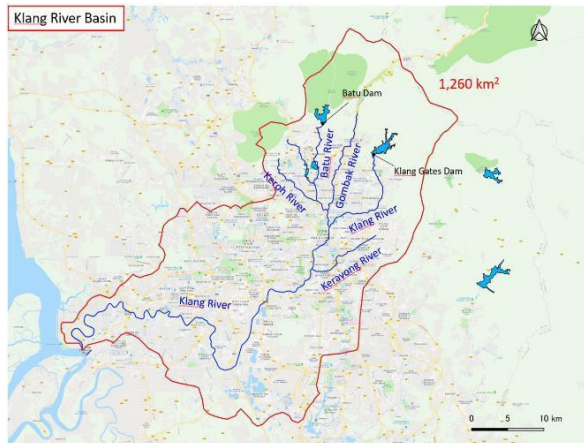


Figure 2-3 Location map of Klang River basin and observed water level gauge



Figure 2-4 Klang Gate Dam and existing water level gauge (non-contact type)



Figure 2-7 Sultan Sulaiman Bridge Water Level and Rainfall Observatory and Existing Water Level Gauge and Radio Velocity Gauge (non-contact type)



Figure 2-8 Sultan Sulaiman Bridge
Observation section and building



Figure 2-9 Sultan Sulaiman Bridge
Observation section and building

(2) Langat River situation

- The Langat River, like the Klang River, is urbanized in its upper basin and is frequently flooded.
- In this survey, we visited two sites: Kg. Sg. Kantan, which is a branch of the Langat River and flows through a residential area, and Sg. Langat Batu 12, which is along the main river of the Langat River and near the flooded area.
- The two water level gauges we visited were both non-contact.
- The Batu 12 site on the upstream side of the Langat River was flooded twice in October 2019, when a siren warning was issued. In the upper Langat River basin, the floodplain is topographically restricted to the riverbanks, and the inundation area seems to be limited to a part of the riverbanks where the ground elevation is low.
- The siren equipment was a mechanical type using floats and was not linked to the PRAB system, but operated independently depending on the water level in the ground. The range of the alarm is about 1 km from the siren point, according to the hearing.
- At Batu 12, a web camera was installed in addition to a water level gauge and siren. The web camera costs 3000 RM (about 78,000 yen) for the camera itself and 20,000 RM (about 52,000 yen) for the whole camera.



Figure 2-10 Langat River Basin Map

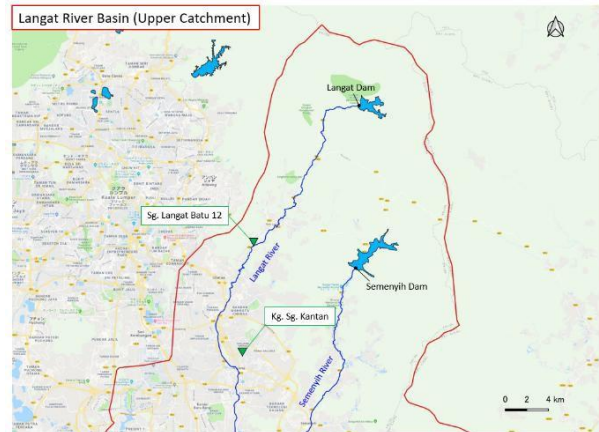


Figure 2-11 Langat River Upper Basin and Inspection Water Level Gauge Location Map



Figure 2-12 Kg. Sg. Kantan Water Level and Rainfall Observatory and Observation Section



Figure 2-13 Kg. Sg. Kantan Water Level and Rainfall Observatory and Observation Section



Figure 2-14 Sg. Langat Batu 12 Water Level and Rainfall Observatory and Water Level Gauge Sensor Section (Non-contact)



Figure 2-15 Sg. Langat Batu 12 Water Level and Rainfall Observatory and Water Level

Gauge Sensor Section (Non-contact)



Figure 2-16 Web camera and siren device



Figure 2-17 Web camera and siren device

(3) Pinang River Status

- The Pinang River basin is used by urban areas from the mouth to the upstream basin, similar to an urban river in Japan.
- In recent years, flooding damage in the Pinang River has mainly occurred in the downstream area, which is affected by tidal fluctuations, while the upstream area appears to be free of flooding damage due to the effects of the reservoirs described below.
- At the most downstream point, Sg. Pinang di Jalan P.Ramlee, two water level gauges (non-contact type), one new and the other old, were being tested.
- The instruments were similar at Sg. Pinang di Jalan P.Ramlee and one upstream at Sungai Air Itam @ Jalan Scotland. The RTU device to be employed on Penang Island has a data logger function and has different specifications from the two rivers in the mainland part. It will be necessary to evaluate both types during the test observation.
- The Lolong Batu Lanchang site, where no water level gauge has been installed, is currently equipped with a rain gauge only, but it appears that overflow flooding also occurs from this site, and is considered a candidate site for installation of a new water level gauge.



Figure 2-18 Pinang River Basin and Observation Water Level Gauge Location Map



Figure 2-19 Sg. Pinang di Jalan P.Ramlee Water Level and Rainfall Observatory and Observation Section



Figure 2-20 Sg. Pinang di Jalan P.Ramlee Water Level and Rainfall Observatory and Observation Section



Figure 2-21 Water level gauge, siren, rain gauge and solar panel



Figure 2-22(2) Water level gauge, siren, rain gauge and solar panel



Figure 2-23(1) Kolam Sg. Dondang Water Level and Rainfall Observatory and Retarding Basin



Figure 2-24(2) Kolam Sg. Dondang Water Level and Rainfall Observatory and Retarding Basin

2.4 Selection of test observation sites

(1) Test observation site

Of the three candidate basins, the Klang River basin was selected for the test

observation. The Klang River is an urban river that flows through the capital city of Kuala Lumpur and is a river that has been severely flooded. Although water level gauges have already been installed in other rivers, a more detailed understanding of river water levels was desired, which was the reason for the selection. In the early stages of implementation, the test observation site was selected at the Klang River Sulaiman Bridge site (Sg. Kelang di Jam. Sulaiman), located in downtown Kuala Lumpur, in consultation with Malaysian Department of Irrigation and Drainage.

Table 2-2 Test and Observation Site

District	River	Station name
Kuala Lumpur	Klang River	Sg. Kelang di Jam. Sulaiman



Fig. 2-18 Klang River Basin Location Map

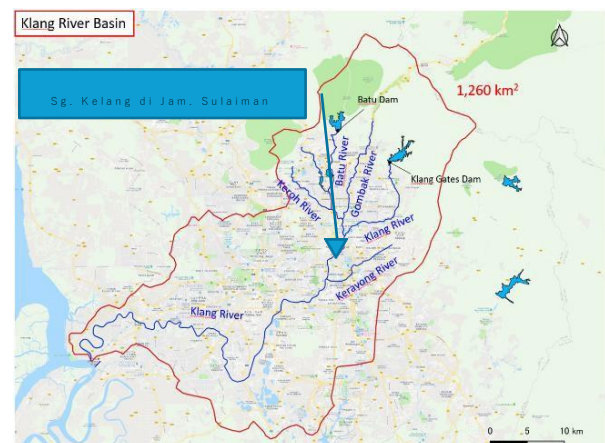


Figure 2-19 Location map of the Klang River basin and test observation sites



Figure 2-20 Sg. Kelang di Jam. Sulaiman Water Level Observatory Exterior

However, due to space limitation and installation constrain, the installation location of the 3LWLG was decided to be changed to the Sentul Hydrology Station, Kuala Lumpur. Only one location was selected in order to make fairly comparison on data analysis and equipment performance between all the 3LWLG installed. Besides that, it can facilitate the monitoring work by the DID personnel. The proposed installation location is as shown in the Figure 2-21 below.



Figure 2-21: Propose Location for 3L WLG Installation

(2) Overview of the Klang River basin and river

The Klang river basin has a catchment area of 1,285.00 square kilometer, and 253 numbers of tributaries. The catchment area involves Kuala Lumpur and 6 districts in the state of Selangor which is Klang, Kuala Langat, Sepang, Petaling, Hulu Langat, and Gombak. There are 2 dams in the Klang river basin which are Batu Dam, and Klang Gates Dam which provide water supply to the

people of Klang Valley and for flood mitigation purposes.

The Klang River is a river which flows through Kuala Lumpur and Selangor and eventually flows into the Straits of Malacca. It is approximately 120 km in length, and has 11 tributaries which are includes Sg. Gombak, Sg. Batu, Sg. Kerayong, Sg. Damansara, Sg. Keruh, Sg. Kuyoh, Sg. Penchala and Sg. Ampang.

2.5 Location of the test equipment

The Sentul Hydrology Station, Kuala Lumpur is selected as the test observation because there is a steel bridge owned by DID that has plenty of space for installation of 5 numbers of 3LWLG. Besides that, DID has a number of water level gauge installed on that bridge, which can be used as a reference for 3LWLG comparison.

Before the delivery of 3LWLG to Malaysia was carried out by the participating companies, several matters were be informed and decided as follows:

- i. All the 3LWLG shall be installed on the existing 30-meter-long steel bridge at the Sentul Hydrology Station, Kuala Lumpur. The Picture and sketches of the steel bridge as shown in Figure 2-22 have been sent to all the participating companies through MLIT, for their reference;
- ii. The 3LWLG installation point on the bridge has been set as shown in Figure 2-23;
- iii. The participating companies were informed about the existence of one (1) water level gauge unit owned by DID at the steel bridge, which will be used for data comparison with 3LWLG from Japan. In addition, the installation of 3LWLG must be done at a distance of at least 6m from the river bank due to the existence of exposed sedimentation during low water level at a distance of 4m from the river bank. Please refer to

- Figure 2-24; and
- iv. The participating companies are allowed to install the 3LWLG on the existing safety railing on that steel bridge, but they must be responsible for the damage and failure that will occur. In addition, the participating companies also need to make repairs to the original condition of the safety railing after the testing program is completed. The picture of the safety railing is as shown in Figure 2-25.

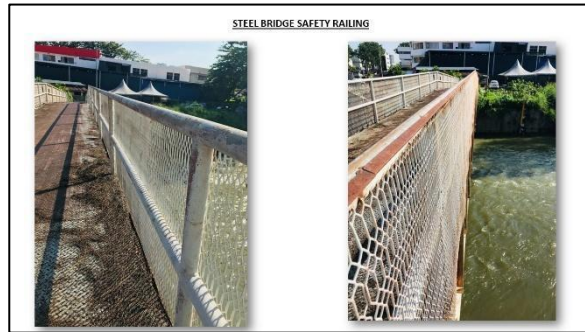


Figure 2-25: Steel Bridge Safety Railing

The installation work has been carried out in stages by each of the participating companies. The first installation works were carried out by the Midori Engineering Laboratory on the 11th of May 2022, followed by MEISEI ELECTRIC Co.,Ltd. on the 23rd of May 2022. Then, the YACHIYO Engineering Co., Ltd. / OSASI Technos Inc. completed their WLG installation works on the 27th of June 2022. And finally, on the 26th of June 2022, eTRUST Co.,Ltd. have installed their WLG on site. The picture of all WLG installed on the steel bridge at the Sentul Hydrology Station is as shown in the

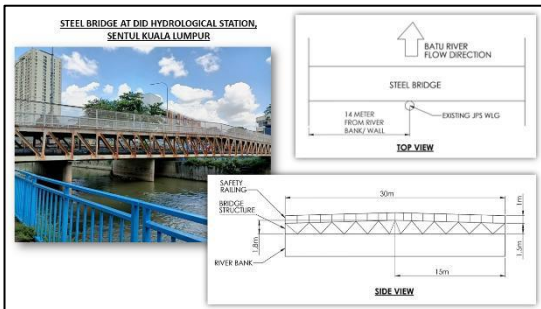


Figure 2-22: Steel Bridge at Sentul Hydrological Station, Kuala Lumpur

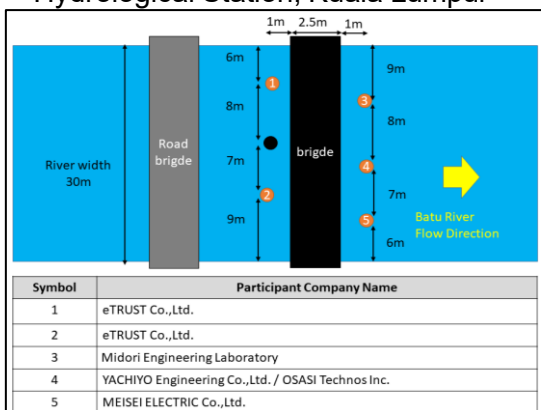


Figure 2-23: Arrangement of Sensor Placement on the Bridge

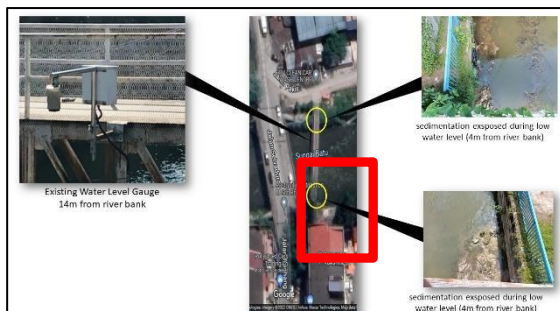


Figure 2-24: Installation Location



Figure 2-26. The summary of the installation date of WLG is shown in the Table 2-3 below.

Table 2-3: Installation Date

No.	Participating Company	Installation Date
1	Midori Engineering Laboratory	11/5/2022
2	MEISEI ELECTRIC Co.,Ltd.	23/5/2022
3	YACHIYO Engineering Co.,Ltd. / OSASI Technos Inc.	27/6/2022
4	eTRUST Co.,Ltd.	26/7/2022

(2) Recruitment of participating companies

The 3L water level gauge is an observation device that serves as the backbone of the river water level monitoring and early warning system. Therefore, it is expected that it will be widely disseminated through the Typhoon Committee Working Group of Hydrology. The 3L water level gauge began with the Japanese concept of the crisis-management type water level gauge. To disseminate this concept, it is important to participate in the test observation.

The public application period was 26 days, from August 2, 2021, to August 27, 2021, during which a total of nine companies confirmed or inquired about the project, and received applications for participation from the four companies and JVs listed in the table below.

Table 3-2 Testing and construction publicly solicited companies/JVs

NO.	Company Name
1	eTRUST Co.,Ltd.
2	Midori Engineering Laboratory
3	YACHIYO Engineering Co.,Ltd. / OSASI Technos Inc.
4	MEISEI ELECTRIC Co.,Ltd.

3.2 Localization of test and observation equipment (coordination with Malaysian specifications for equipment)

(1) Organize technical specifications for test observations

The differences in the technical specifications between the domestic Crisis-management-type water level gauge and Malaysian 3L water-level gauges are

use the knowledge of companies and water level gauge manufacturers that already have experience with the implementation of such gauges in Japan. Therefore, we decided to invite companies interested in overseas activities to participate in the project. To this end, the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) publicly solicited participating companies regarding this test observation on its website, and all companies that applied were eligible to

summarized in Table 3-3.

Comparing the existing water level gauges in Malaysia with the 3L water level gauges in Japan, although their equipment configuration and parts are generally equal, it is not possible to conduct water level observations in Malaysia using the 3L water level gauges with Japanese specifications due to differences in observation conditions and communication environment. Therefore, the test observation required partial modification of the 3L water level gauge to meet the Malaysian required specifications.

The following four items are the summary of the modifications required for the 3L water level gauge. The sensor part of the water level gauge was limited to a non-contact type based on the requirements of the Malaysian side.

- Support for year-round observations (observation periods, intervals, and associated power supply modifications)
Backup support in case of communication breakdown (logger function added)
- Modification of communication unit (RTU) (Modification of communication program to support Malaysian telecommunication lines and to communicate with Malaysian data center)
- Steel enclosure (anti-theft measure)

Table 3-3 Summary of differences in water level gauge observation specifications

Entry	Japanese specification	Malaysian Specifications
Water Level Gauge Type	Contact type / Non-contact type / Image type	Non-contact type
Water level observation period	Flood season only	Year-round observation (Observation outside of flooding season)
Water level observation interval	2 minutes / 5 minutes / 10 minutes interval	5 minutes interval
Water level transmission interval	2 minutes / 5 minutes / 10 minutes interval	15-minute intervals
Water Level Observation Accuracy	Depends on each company (1 mm to 1 cm)	1cm
Power Specifications	Depends on each company	Storage batteries/solar panels
No-sunshine guarantee period	Depends on each company	14 days (2 weeks)
cellular telephone network	4G(LTE Cat.1)	2G(GSM)/4G(LTE)
communication protocol	MLIT's own TCP	FTP
Water level gauge housing	(made of) plastic	made from iron

(2) Basic configuration of equipment

The 3L water level gauge shall be a partially modified version of the Japanese domestic crisis-management-type water level gauge to Malaysian domestic specifications.

The companies participating in the test observation provided the 3L water level gauge itself as well as components related to its installation.

The 3L water level gauge body refers to the part shown in yellow in Figure 3-1. Specifically, it consists of a sensor unit (water level gauge), RTU unit, power supply unit (battery and solar panel), and housing.

The components involved in installation are shown in blue in Figure 3-1, and include the foundation, mounting components, and jigs.

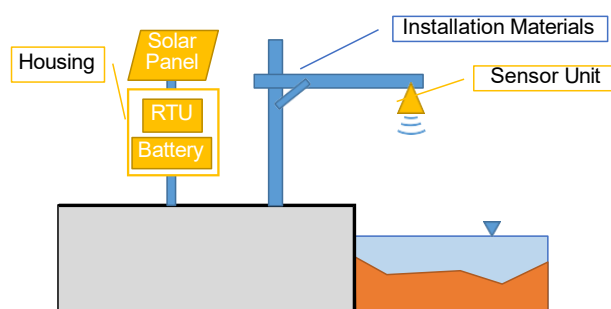


Figure 3-1 3LWLG equipment configuration image

1) Water level gauge sensor

Water level gauge sensors shall be limited to non-contact (radio frequency or ultrasonic) types.

2) Communication unit (RTU)

The communication unit (RTU: Remote Terminal Unit), which controls the entire water level gauge, stores data, and transmits observation data, was set to observe water levels every 5 minutes and transmit data to the DID server every 15 minutes (three sets of water level data at 5-minute intervals were sent).

3) Communication lines

As with existing water level meters in Malaysia, private cellular phone lines will be used. The telephone network to be used will be 2G (GSM) or 4G (LTE), which is in service throughout Malaysia.

4) Data backup device

A data logger function is maintained in the RTU as a backup means in case of communication breakdown. The data storage period shall be one year from the observation. Backup data will be stored on SD cards or other general-purpose storage media that can be manually retrieved by DID staff for viewing and transmission on a PC.

5) Power supply section

The power supply section shall be self-generated by batteries and solar panels. The battery capacity and solar panel size will be designed to be appropriate considering the Malaysian requirement specification "continuous operation under no sunlight for 2 weeks" and the amount of communication.

6) Enclosure

The enclosure that houses the communication unit (RTU) and battery shall be made of steel, based on a theft case in Malaysia. The size of the enclosure shall be set based on the size of the communication unit and battery to be stored.

7) Water level observation and data storage and transmission

Water level observations shall be conducted in accordance with the observation items and intervals specified by Malaysia DID.

8) Observation period

The water level observation period should be year-round (constant observation), not only during floods.

9) Observation and data transmission intervals

Water level observations shall be made at 5-minute intervals, data storage in RTUs shall also be made at 5-minute intervals, and data transmission to the data center shall be made at 15-minute intervals.

10) Data storage

Observation data is stored in a logger in the

RTU in a predetermined format at 5-minute intervals and transmitted to the data center at 15-minute intervals. In addition, the storage capacity is set so that the saved data can be stored in the logger for a minimum of one year from the point of storage.

Observation data were in text format every 5 minutes and given file names according to the following naming conventions.

11) Observation items

Only items related to water level observations were observed based on the Malaysian DID's PRAB system common data format. (Observations were made for 17 of the 87 DID observation items)

Table 3-4 Observation items (only water level observation items among DID observation items are set)

NO	parameter	Observation interval	transmission interval	Setting with 3L water level gauge
1	start character	5mins	15mins	\$
2	Station Number (PRAB)	5mins	15mins	DID assigned
4	RTU ID number	12hrs	12hrs	Each company sets its own limit of 25 characters
5	Data acquisition year, month, date, time, second	5mins	15mins	Data acquisition year, month, date, time, second
6	Alarm Related Parameters	5mins	15mins	Value of DID designation (A2)
7	Battery voltage	5mins	15mins	Current battery voltage value
8	Signal strength of communication devices	5mins	15mins	RTU signal strength
10	Initial battery voltage	5mins	15mins	Initial battery voltage value
11	Solar panel voltage	5mins	15mins	Generated voltage value of solar panel
16	Alert threshold of water level gauge	12hrs	12hrs	DID will be given at a later date if needed
17	Warning threshold of water level gauge	12hrs	12hrs	DID will be given at a later date if needed
18	Danger threshold of water level gauge	12hrs	12hrs	DID will be given at a later date if needed
36	Water level gauge 1ID	12hrs	12hrs	Each company sets its own limit of 25 characters
37	Water level 1	5mins	15mins	Water level observation value
85	Observation point latitude	5mins	12hrs	Water level observed value point latitude
86	Observation point longitude	5mins	12hrs	Longitude of water level observation point
87	final character	-	15mins	*

12) Data transmission
 Observation data is transmitted to the data center at 15-minute intervals.
 The connection protocol to the data center shall be FTP, and the observation data file

shall be sent to the data center after the observation. (every 15 minutes)
 The address, connection ID, and password for the connection to the data center were specified by the DID.

4. Test observation

4.1 Installation of 3L water level gauge

(1) Transportation and on-site installation
The 3L water level gauges were transported by the companies participating in the test observation.

The on-site installation of the 3L water level gauge was done by the test observation participants themselves.

(2) Adjustment of zero-point height

The water level gauge measures the distance from the sensor surface of the water level gauge to the river surface. The measured distance is added to the zero height of the water level gauge to obtain the observed water level. In the test observation, this zero-point height was not sufficiently set due to a lack of prior coordination. Therefore, we decided to add the corrected value to the 3L water level gauge and compare the water level with the DID water level gauge until the zero-point height of the water level gauge was corrected.

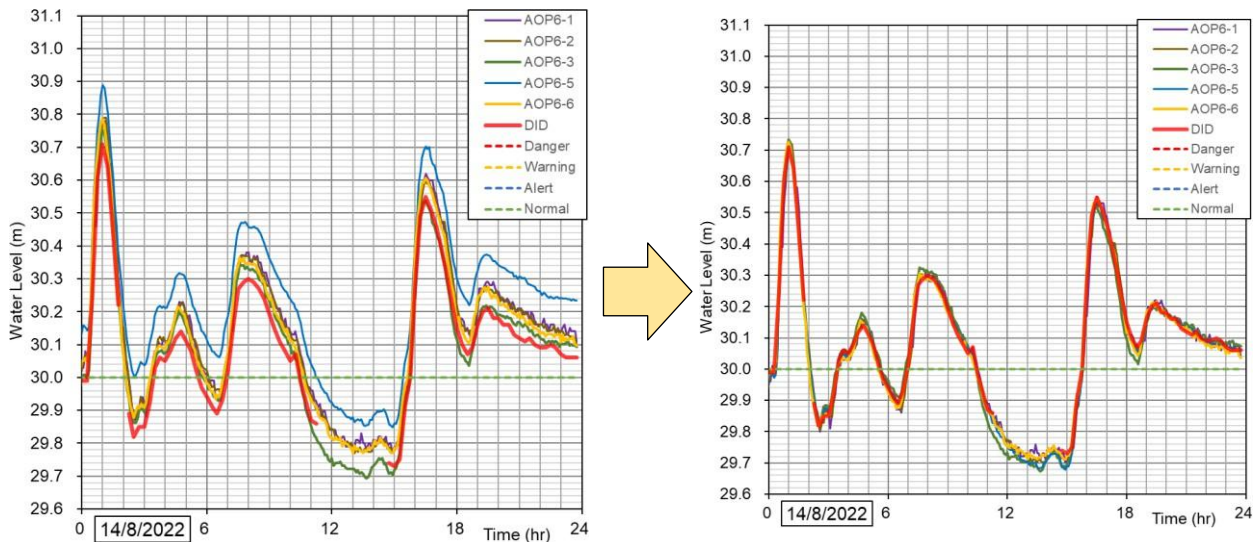


Figure 4-1 Adjustment of zero-point height

Specifically, corrections were made as shown in the table below. The correction of the zero-point height of the water level gauge at AOP60003 was the slowest, with the

correction completed on January 15, 2023. This allows a direct comparison of DID water level gauge observations with all water level gauge observations

Table 0-1 Method of comparison with DID's WLG

WLG	Company	Comparison Method (1)		Comparison Method (2)		Notes
		Period (Malaysian time)	Comparison Method	Period (Malaysian time)	Comparison Method	
AOP60001	eTRUST Co.,Ltd.	14.10.2022- 6.12.2022 14:50	Observations corrected and compared Observed value -0.141m	6.12.2022 14:55-	Comparison of DID WLG observations with 3LWLG observations	
AOP60002		14.10.2022- 6.12.2022 14:50	Observations corrected and compared Observed value -0.154m	6.12.2022 14:55-	Comparison of DID WLG observations with 3LWLG observations	
AOP60003	Midori Engineering Laboratory Co., Ltd.	14.10.2022- 15.1.2023 11:45	Observations corrected and compared Modified calculation formula	1.15.2023 22:20-	Comparison of DID WLG observations with 3LWLG observations	calculation formula: $y=a \cdot x+b$ $a=-0.00473$ $b=40.31434$
AOP60005	YACHIYO Engineering /OSASI Technos Inc.	14.10.2022- 28.12.2022 13:00	Observations corrected and compared Observed value -0.090m	28.12.2022 13:05~	Comparison of DID WLG observations with 3LWLG observations	
AOP60006	MEISEI ELECTRIC Co.,Ltd.	14.10.2022- 1.12.2022 15:45	Observations corrected and compared Observed value -0.151m	—	—	
		1.12.2022 15:50- 11.1.2023 16:30	Observations corrected and compared Observed value -0.098m	11.1.2023 16:45-	Comparison of DID WLG observations with 3LWLG observations	

4.2 Test observation

(1) Demonstration experiment period

The demonstration period for the test observations was at least six months from the start of the observations.

The six-month period was established based on the minimum required period in operation during the transfer of water level gauges within Malaysia.

(2) Verification of the results of the demonstration experiment

Through test observations, we demonstrated that the Japanese 3L water level gauge meets the requirements of the Malaysian water level gauge.

For the verification work, IDI received observation data from each company and existing Malaysian water level gauge observation data from the Malaysian DID,

and conducted data comparison and coordination work including confirmation with the Malaysian DID.

The evaluation perspectives to be demonstrated in the test observations are as follows.

(Observation Performance Evaluation)

- Comparison of 3L water level gauge and existing Malaysian water level gauge observations and water level mark readings

(Maintenance Performance Evaluation)

- Assessment of crisis communication status (data transfer status)
- Assessment of equipment failure frequency (confirm no-failure period, non-stop observation period, and evaluate battery condition (Battery Volt))

5. Test observation results

5.1 Installation location

Details of the installation locations are shown in the figure below, with the 3L water level gauge installed around DID's WLG.

WLG No.	Station No.	Code Station	Station Name	Company Name
1	1	AOP6001	Sungai Sentul AOP6-1	eTRUST Co.,Ltd.
2	2	AOP6002	Sungai Sentul AOP6-2	eTRUST Co.,Ltd.
3	3	AOP6003	Sungai Sentul AOP6-3	Midori Engineering Lab.
5	5	AOP6005	Sungai Sentul AOP6-5	YACHIYO Engineering /OSASI Technos Inc.
6	6	AOP6006	Sungai Sentul AOP6-6	MEISEI ELECTRIC Co.,Ltd.

Table 5-1 Installed water level gauge

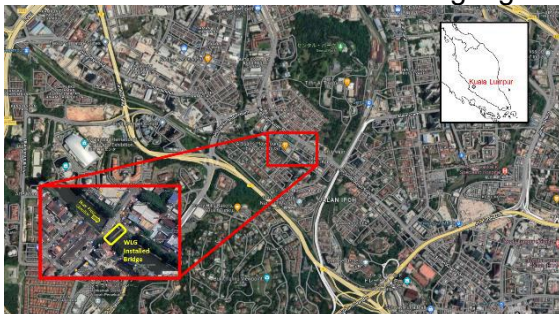


Figure 5-1 Installation location (1)

Station ID (Station Name)	Water Level (Station Water)	Station Code	Station Name (Cross Section)	District (Dist)	Main Basin	Sub Basin	Last Update	Water Level (m) (Average)	Last Update Time	Rise (m) (1st Rise)	Rise Date (1st Rise)	Flow (m³/s)	Normal	Alarm	Warning	Danger
No Data	AOP6001	AOP6001	SUNGAI SENTUL AOP6-1	Kuala Lumpur	Sungai Klang (WLG)	Sg.Klang K. Lumpur	07/10/2022 18:25	25.04	07/10/2022 18:15	25.64	25.04	30.00	32.00	32.30	33.00	
No Data	AOP6002	AOP6002	SUNGAI SENTUL AOP6-2	Kuala Lumpur	Sungai Klang (WLG)	Sg.Klang K. Lumpur	07/10/2022 18:25	25.86	07/10/2022 18:15	26.83	25.86	30.00	32.00	32.30	33.00	
No Data	AOP6003	ACT6003	SUNGAI SENTUL AOP6-3	Kuala Lumpur	Sungai Klang (WLG)	Sg.Klang K. Lumpur	07/10/2022 18:25	26.80	07/10/2022 18:15	26.83	26.80	30.00	32.00	32.30	33.00	
No Data	AOP6005	AOP6005	SUNGAI SENTUL AOP6-5	Kuala Lumpur	Sungai Klang (WLG)	Sg.Klang K. Lumpur	07/10/2022 18:25	25.59	07/10/2022 18:15	25.59	25.59	30.00	32.00	32.30	33.00	
No Data	AOP6006	ACT6006	SUNGAI SENTUL AOP6-6	Kuala Lumpur	Sungai Klang (WLG)	Sg.Klang K. Lumpur	07/10/2022 18:25	26.95	07/10/2022 18:15	26.85	26.95	30.00	32.00	32.30	33.00	

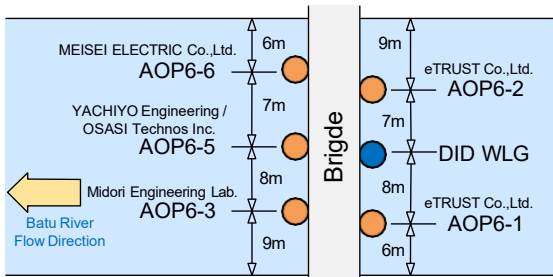


Figure 5-2 Installation location (2)



Figure 5-3 Installation location (3)

In the test observation, data was sent to DID's FTP server, and water levels were displayed on DID's website.

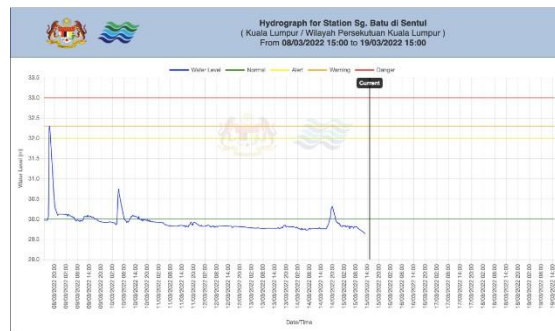


Figure 5-4 Example of water level display of a comparative water level gauge (Sg. Batu di Sentul)

5.2 Evaluation Items for Test Observations

The four evaluation items for the test observations were 1) Data Format, 2) Battery Voltage, 3) Observed Water Levels, and 4) Data Transfer. The evaluation period was 6 months from October 2022 to March 2023.

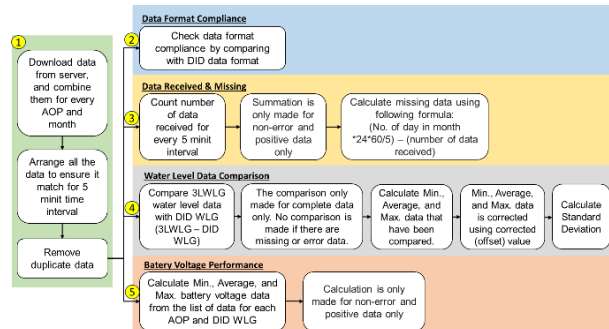


Figure 5-5 Evaluation items for test observation (DID organizing documents)

5.3 Evaluation of observation results

(1) Data Format

The status of DID's conformance to the PRAB system common data format (only items related to water level observations) was checked.

There were a few items for which data different from the regulations were recorded, but these were omitted because this was a test operation, or because the 3L water level gauge supplier misidentified and recorded different data. Adaptation to the format stipulated in Malaysia is easily possible, and it can be concluded that there are no problems regarding the data format.

Table 5-2 Data Format

NO	Unit Parameter	ARTIST Co. Ltd	Masih Engineering Laboratory Co.	VADCO Engineering Co. Ltd / SPM Engineering	MBE/EL/ET/EC/CO. LTD
1	Station ID	5	5	5	5
2	Station Name	ACP60001	ACP60001	ACP60001	ACP60001
3	Station Type	Water Level	Water Level	Water Level	Water Level
4	Station Location	1000000000	1000000000	1000000000	1000000000
5	Station Elevation (m)	0	0	0	0
6	Station Elevation (ft)	0	0	0	0
7	Station Elevation (m)	0	0	0	0
8	Station Elevation (ft)	0	0	0	0
9	Station Elevation (m)	0	0	0	0
10	Station Elevation (ft)	0	0	0	0
11	Station Elevation (m)	0	0	0	0
12	Station Elevation (ft)	0	0	0	0
13	Station Elevation (m)	0	0	0	0
14	Station Elevation (ft)	0	0	0	0
15	Station Elevation (m)	0	0	0	0
16	Station Elevation (ft)	0	0	0	0
17	Station Elevation (m)	0	0	0	0
18	Station Elevation (ft)	0	0	0	0
19	Station Elevation (m)	0	0	0	0
20	Station Elevation (ft)	0	0	0	0
21	Station Elevation (m)	0	0	0	0
22	Station Elevation (ft)	0	0	0	0
23	Station Elevation (m)	0	0	0	0
24	Station Elevation (ft)	0	0	0	0
25	Station Elevation (m)	0	0	0	0
26	Station Elevation (ft)	0	0	0	0
27	Station Elevation (m)	0	0	0	0
28	Station Elevation (ft)	0	0	0	0
29	Station Elevation (m)	0	0	0	0
30	Station Elevation (ft)	0	0	0	0
31	Station Elevation (m)	0	0	0	0
32	Station Elevation (ft)	0	0	0	0
33	Station Elevation (m)	0	0	0	0
34	Station Elevation (ft)	0	0	0	0
35	Station Elevation (m)	0	0	0	0
36	Station Elevation (ft)	0	0	0	0
37	Station Elevation (m)	0	0	0	0
38	Station Elevation (ft)	0	0	0	0
39	Station Elevation (m)	0	0	0	0
40	Station Elevation (ft)	0	0	0	0
41	Station Elevation (m)	0	0	0	0
42	Station Elevation (ft)	0	0	0	0
43	Station Elevation (m)	0	0	0	0
44	Station Elevation (ft)	0	0	0	0
45	Station Elevation (m)	0	0	0	0
46	Station Elevation (ft)	0	0	0	0
47	Station Elevation (m)	0	0	0	0
48	Station Elevation (ft)	0	0	0	0
49	Station Elevation (m)	0	0	0	0
50	Station Elevation (ft)	0	0	0	0
51	Station Elevation (m)	0	0	0	0
52	Station Elevation (ft)	0	0	0	0
53	Station Elevation (m)	0	0	0	0
54	Station Elevation (ft)	0	0	0	0
55	Station Elevation (m)	0	0	0	0
56	Station Elevation (ft)	0	0	0	0
57	Station Elevation (m)	0	0	0	0
58	Station Elevation (ft)	0	0	0	0
59	Station Elevation (m)	0	0	0	0
60	Station Elevation (ft)	0	0	0	0
61	Station Elevation (m)	0	0	0	0
62	Station Elevation (ft)	0	0	0	0
63	Station Elevation (m)	0	0	0	0
64	Station Elevation (ft)	0	0	0	0
65	Station Elevation (m)	0	0	0	0
66	Station Elevation (ft)	0	0	0	0
67	Station Elevation (m)	0	0	0	0
68	Station Elevation (ft)	0	0	0	0
69	Station Elevation (m)	0	0	0	0
70	Station Elevation (ft)	0	0	0	0
71	Station Elevation (m)	0	0	0	0
72	Station Elevation (ft)	0	0	0	0
73	Station Elevation (m)	0	0	0	0
74	Station Elevation (ft)	0	0	0	0
75	Station Elevation (m)	0	0	0	0
76	Station Elevation (ft)	0	0	0	0
77	Station Elevation (m)	0	0	0	0
78	Station Elevation (ft)	0	0	0	0
79	Station Elevation (m)	0	0	0	0
80	Station Elevation (ft)	0	0	0	0
81	Station Elevation (m)	0	0	0	0
82	Station Elevation (ft)	0	0	0	0
83	Station Elevation (m)	0	0	0	0
84	Station Elevation (ft)	0	0	0	0
85	Station Elevation (m)	0	0	0	0
86	Station Elevation (ft)	0	0	0	0
87	Station Elevation (m)	0	0	0	0
88	Station Elevation (ft)	0	0	0	0
89	Station Elevation (m)	0	0	0	0
90	Station Elevation (ft)	0	0	0	0
91	Station Elevation (m)	0	0	0	0
92	Station Elevation (ft)	0	0	0	0
93	Station Elevation (m)	0	0	0	0
94	Station Elevation (ft)	0	0	0	0
95	Station Elevation (m)	0	0	0	0
96	Station Elevation (ft)	0	0	0	0
97	Station Elevation (m)	0	0	0	0
98	Station Elevation (ft)	0	0	0	0
99	Station Elevation (m)	0	0	0	0
100	Station Elevation (ft)	0	0	0	0

(2) Battery Voltage

It was verified that 12V, the voltage required for the operation of general observation equipment, is always available.

The low voltage of AOP60001 in February and March 2023 was due to a disconnection between the solar generator and the battery (shutdown due to power supply interruption).

Except for that, the minimum voltage of all 3L water level gauge hydrometer batteries are at least 12 V, and it can be concluded that the 3L hydrometer batteries have adequate performance.

Table 5-3 Battery Voltage

Month	# O/P60001			# O/P60002			# O/P60003			# O/P60005			# O/P60006			ID	VOLT
	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.		
Oct 2022	12.70	13.02	14.20	12.90	13.29	14.40	12.90	13.25	14.50	12.60	12.96	13.90	12.90	13.48	14.70	12.64	13.31
Nov 2022	12.60	12.99	14.10	12.90	13.28	14.30	13.00	13.26	14.40	12.60	12.98	13.90	12.90	13.44	14.70	12.62	13.28
Dec 2022	12.60	12.96	14.10	12.90	13.27	14.30	13.00	13.26	14.40	12.60	12.98	13.90	12.90	13.42	14.70	12.59	13.26
Jan 2023	12.50	12.96	14.20	12.90	13.27	14.40	12.90	13.25	14.50	12.60	12.99	14.00	12.90	13.44	14.70	12.59	13.27
Feb 2023	11.80	12.74	14.10	12.90	13.25	14.40	12.90	13.23	14.40	12.60	12.96	14.00	12.90	13.41	14.70	12.55	13.25
Mar 2023	11.80	12.31	14.00	12.90	13.25	14.40	12.90	13.23	14.40	12.60	12.93	13.90	12.90	13.46	14.70	12.53	13.30
Ave.	12.33	12.83	14.12	12.90	13.27	14.37	12.93	13.25	14.43	12.60	12.97	13.83	12.90	13.44	14.70	12.59	13.28

(DID organizing documents)

Battery Voltage was checked on a daily and monthly basis, but no abnormalities in voltage could be identified, except for some water level meters.

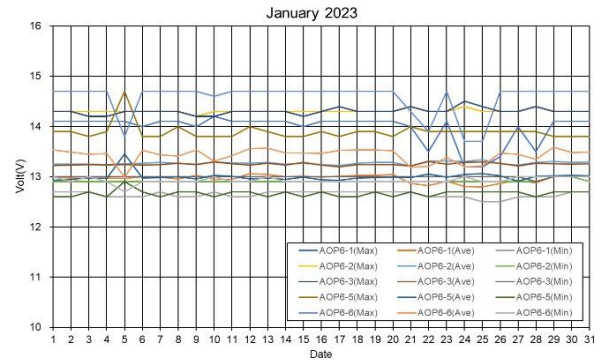


Figure 5-6 Monthly voltage check (average)

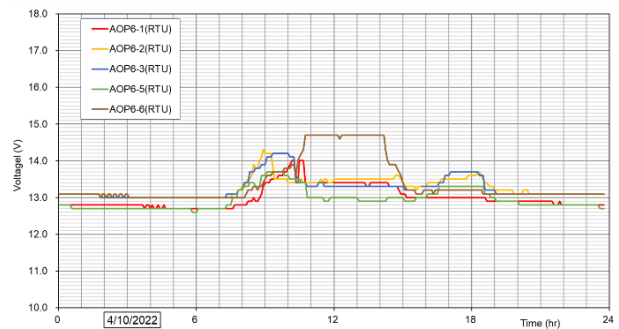


Figure 5-7 Voltage check on a daily basis (charged during the day by solar cells)

(3) Observed Water Levels

The accuracy of the 3L water level gauge was verified by comparison with a water level gauge in operation at DID.

The average observed water level difference between all 3L water level gauges and DID water level gauges is about 1 cm, and no specific large errors occur. Therefore, it can be concluded that the observed water level of the 3L water level gauge is sufficiently accurate compared to the DID water level gauge.

Table 5-4 Observed Water Levels

Mtr.	Mtr.						Max.	Ave.	σ	
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.				
AOP60001	Min.	-3.90	-13.00	-13.90	-1.10	-3.10	-19.00	40.10	0.18	
	Max.	30.10	34.10	23.10	35.10	40.10	34.10			
	Ave.	-0.01	0.12	0.83	-0.93	0.11	-1.20			
	σ	0.02	0.03	0.02	0.02	0.03	0.03			
	σ	0.02	0.03	0.02	0.02	0.03	0.03			
AOP60002	Min.	-7.40	-21.50	-6.70	1.00	2.60	1.00	-21.50	87.90	-0.16
	Max.	25.60	28.40	27.80	45.30	87.90	42.90			
	Ave.	6.13	-9.12	0.95	-3.43	0.34	0.10			
	σ	0.02	0.03	0.02	0.02	0.02	0.02			
	σ	0.02	0.03	0.02	0.02	0.02	0.02			
AOP60003	Min.	-7.89	-15.40	-6.50	2.70	3.70	4.70	-15.40	13.40	-1.19
	Max.	13.03	12.88	13.20	12.91	13.40	12.90			
	Ave.	1.47	0.98	2.00	0.99	1.06	0.64			
	σ	0.03	0.04	0.03	0.04	0.03	0.04			
	σ	0.03	0.04	0.03	0.04	0.03	0.04			
AOP60005	Min.	-7.40	-12.60	-6.60	1.90	2.10	1.60	-12.60	24.10	-0.19
	Max.	9.00	11.40	11.70	9.00	24.10	14.10			
	Ave.	0.04	-0.15	0.70	0.13	0.32	0.08			
	σ	0.02	0.02	0.02	0.02	0.02	0.02			
	σ	0.02	0.02	0.02	0.02	0.02	0.02			
AOP60006	Min.	-9.50	-20.90	-11.30	0.00	0.80	-0.20	-20.90	10.30	0.22
	Max.	7.60	7.30	8.20	8.80	9.60	10.30			
	Ave.	-0.01	-0.23	0.55	-0.82	-0.24	-0.38			
	σ	0.02	0.03	0.02	0.02	0.02	0.02			
	σ	0.02	0.03	0.02	0.02	0.02	0.02			

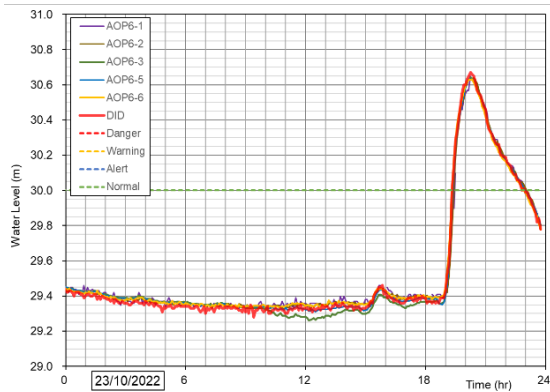


Figure 5-8 Observed Water Levels

(4) Data Transfer

The threshold for data transfer for DID is 95%. Test observations showed that AOP60001 and AOP60002 had transfer rates below thresholds of 84% and 94%, respectively; AOP60003, AOP60005, and AOP60006 had transfer rates above thresholds.

A particularly low transfer rate for AOP60001 was caused by a period of inactivity of the water level gauge (approximately 15 days) due to a disconnection between the solar generator and the battery; even excluding this period, the transfer rate did not exceed 95%.

Table 5-5 Data transfer status

Month	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived
Oct. 2022	251	97%	924	89%	17	100%	3	100%	0	100%	448	95%
Nov. 2022	777	91%	654	92%	250	97%	177	98%	32	100%	0	100%
Dec. 2022	351	98%	519	94%	291	96%	90	99%	20	100%	6	100%
Jan. 2023	312	96%	354	96%	497	94%	48	99%	35	100%	6	100%
Feb. 2023	635	92%	298	97%	351	96%	6	100%	3	100%	0	100%
Mar. 2023	5908	29%	339	96%	579	93%	222	97%	6	100%	12	100%
TOTAL	8234	84%	3048	94%	1985	96%	546	99%	96	100%	472	99%

6. Summary of test observations

To explore the feasibility of introducing a Japanese 3L water level gauge (non-contact type)* to Malaysia, we confirmed the fulfillment of general requirements for water level observation in Malaysia through test operation for more than 6 months (based on DID's internal regulations).

6.1 Assessment of Water Level Suitability

(Consistent with Malaysian water level requirements)

(1) Data transfer

The threshold for DID is generally 95%.

In contrast, AOP60001 and AOP60002 had transfer rates below the threshold of 84% and 94%, respectively, for the entire observation period; AOP60003, AOP60005, and AOP60006 had transfer rates above the threshold.

A particularly low transfer rate for AOP60001 was caused by a period of inactivity of the water level gauge (approximately 15 days) due to a disconnection between the solar generator and the battery; even excluding this period, the transfer rate did not exceed 95%.

AOP60006 has a data transfer rate close to 100%. This is because AOP60006 incorporates a system that retransmits data to the server at a later time, even if the time could not be transferred due to a data server outage or other reasons.

AOP60003 and AOP60003 have an internal storage device inside the water level gauge. In the internal data, generally, 100% of the data is stored. This suggests that the low transfer status may be due to radio wave conditions and server conditions.

For AOP60001 and AOP60002, the DID threshold is below 95%. These water level gauges do not have built-in storage devices. In the future, we believe that adding a storage device to the water level gauges and the data retransmission system described above will ensure that the threshold value of

95% or higher can be achieved.

(2) Observed water level

The accuracy of the 3L water level gauges was verified by comparison with a water level gauge in operation at DID.

The average difference in observed water levels between all 3L water level gauges and DID's water level gauges is about 1 cm, and no specific large errors have occurred. Therefore, it can be concluded that the observed water levels of the 3L water level gauges are sufficiently accurate compared to those of the DID water level gauges.

(3) Battery voltage

It was verified that 12 V, the voltage required for the operation of general observation equipment, is always available.

The low voltage of AOP60001 in February and March 2023 was due to a disconnection between the photovoltaic generator and the battery (shutdown due to power supply interruption).

Except for that, the minimum voltage of all 3L water level gauge batteries are at least 12 V. It can be concluded that the 3L water level gauge batteries have adequate performance.

(4) Data format

The status of DID's conformance to the PRAB system common data format (only items related to water level observations) was checked.

There were a few items for which data different from the regulations were recorded, but these were omitted because this was a test operation, or because the 3L water level gauge supplier misidentified and recorded different data. Adaptation to the format stipulated in Malaysia is easily possible, and it can be concluded that there are no problems regarding the data format.

(5) Maintenance performance

During the test observation period, some problems with AOP60001 and other equipment occurred, but no major problems with equipment maintenance, such as

situations requiring repair of water level gauges, occurred.

In addition, all observations were powered by batteries and solar panels for on-site power generation, but no action was required except for a problem that occurred with a disconnection between the solar generator and the batteries. Therefore, it can be said that the performance was satisfactory from the standpoint of maintenance-free operation of the equipment.

(6) Overall evaluation

Taken together, the above-mentioned items can be concluded that the general requirements for water level gauges in Malaysia are satisfied for AOP60003, AOP60005, and AOP60006 based on the current test operation. For AOP60001 and AOP60002, the observed water level, battery voltage, and data format were satisfied, but the data transfer rate did not meet the threshold value of 95%.

No major maintenance problems were encountered with the equipment, and continuous observation was possible with in-house power generation. Therefore, it can be said that the 3L water level gauge meets satisfactory performance from the standpoint of maintenance-free operation of the equipment.

As a result, it can be evaluated that the 3L water level gauge performed satisfactorily in terms of Long Life (long-term maintenance-free) and Localize (adaptability to Malaysian observation specifications).

In addition, the introduction of the system into water level observation in Malaysia will require performance certification through the Test and Commissioning process, which will be established separately for each project in Malaysia.

6.2 Development for introduction

Through the demonstration tests, it can be said that the Japanese 3L water level gauge has generally met the performance requirements for introduction into Malaysia. Full-scale introduction to Malaysia will be possible in the future after performance certification through the Test and Commissioning process to be set up individually. Full-scale operation is expected to provide further validation that will contribute to the deployment of 3L water level gauges in the members of the Typhoon Committee.

6.3 Conclusion

Through the demonstration in Malaysia, it was shown that the 3L water level gauge could be applied to water level observations in the members of the Typhoon Committee. In the future, it is expected that the introduction and demonstration of the equipment, including other members of the Typhoon Committee, will lead to the enhancement of the river water level observation system among the Typhoon Committee members and the mitigation of flood damage, including loss of human lives, through the effective use of river information.

References

List of Reference Materials

(1) Observation Standards and Specifications for Crisis Management Type Water Level Gauges

Observation Standards and Specifications for Crisis Management Type Water Level Gauges (1/2)

Item	Items to be determined	Standards and Specifications
1. Standards to be followed	Standards to be followed	Ministry of Land, Infrastructure, Transport and Tourism's river standards
2. Operational system	(1) Target organization	River administrators
	(2) Targeted field	River floods
	(3) Targets for measurement	River water level
	(4) Observation data	Water level data
	(5) Disclosure	In principle, the data will be made available to the general public (open data).
3. Instruments and equipment	(1) Equipment to be provided	
	Water level mark	Water level markers shall be installed as necessary at the discretion of the river administrator.
	Duplication of water level gauges	Duplication of main and secondary water level gauges shall be implemented as necessary at the discretion of the river administrator.
	(2) Water level gauge reading unit	
	Minimum reading unit	The minimum reading unit shall be 1 cm. In the case of an image processing type water level gauge, the resolution calculated from the coverage area and the number of pixels captured shall be clearly indicated.
	(3) Observation equipment	
	Method of determining the water level	The water level is determined by averaging the observed water level for 20 seconds or more at sampling intervals of 1 second or less. The water level shall be determined by averaging the observed water level for at least 20 seconds at sampling intervals of 1 second or less, removing any instantaneous abnormal values. Instead of removing anomalous values, the water level may be determined by averaging the data obtained by removing the two largest and two smallest data. Example: If measurements are made for 20 seconds at 1-second intervals, 16 data are averaged.
	Inactive (Inactive mode)	
	Normal water level monitoring (monitoring mode)	The water level is monitored every 10 minutes or less until it reaches the observation start water level (monitoring mode). When the water level is below the observation start water level, data transmission is not required (except for the dead/alive monitoring).
	Observation start water level, observation stop water level	When the water level exceeds the observation start level, water level observation is performed (observation mode). When the water level falls below the observation stop water level, observation is stopped (monitoring mode). For rivers where water levels remain high for a long period of time due to late-stage dam releases, etc., appropriate settings should be made while also considering the power supply capacity.
	Water level monitoring during flooding (observation mode)	When the water level exceeds the observation start level, observation and transmission of measured data shall be performed at intervals of 10 minutes for large rivers, 5 minutes for small and medium-sized rivers, and 2 minutes for rivers with rapidly rising water levels as a standard. The observation time interval shall be determined by the river administrator based on the river's outflow characteristics.
	Dead/Inactive monitoring (except for cold weather specifications)	Transmit measurement data at least once a day for deadly monitoring.
	Communication device	The data shall be transmitted separately to an external database via a closed network connection in accordance with the communication specifications specified in the special specifications at the time of procurement. The data transmission function is to resend the data in case of undelivered data during transmission.
Logger function	Logger functions shall be secured as necessary at the discretion of the river administrator.	
Clock function	Periodic time correction by radio clock, GPS, NTP (Network Time Protocol), etc.	

Observation Standards and Specifications for Crisis Management Type Water Level Gauges (2/2)

Item	Items to be determined	Standards and Specifications
3. Instruments and equipment	(4) Power supply, etc. Power supply	Using a solar battery or a chemical battery in principle. It is standard to secure the power supply capacity that enables continuous observation for five years as shown in the table below. When using a solar battery, it should be in monitoring mode during normal times throughout the year, and should have a capacity of at least 150 observations in observation mode after 9 days of no sunshine. If a chemical battery is used, it should be in monitoring mode during normal times, and should have a capacity of at least 150 observations four times a year in observation mode (no need to replace batteries for 5 years). ■ Estimated number of observations (table)
		Determine in the special specifications according to the situation of the installation location.
	(5) Common to (2) to (4) Durability, moisture resistance, and lightning resistance	The durability and moisture resistance shall be secured under the environmental conditions at the installation location specified in the special specifications at the time of procurement. Dustproof and waterproof performance of outdoor boxes, etc. shall be IP55 (Japanese standard) or higher. Ensure resistance to induced lightning (especially for water level gauges wired in river channels).
	Product Performance Certification (Test Results)	Product performance certification shall be based on the outgoing quality assurance for the accuracy specified in the special specifications at the time of procurement, against the type specifications of the equipment prepared by the equipment manufacturer.
4. Technical standards	(1) Setting of base height	Set the base height as the inundation start height (bank height, river bank shoulder, etc.) at the point where the water level gauge is installed or in the vicinity. The water depth or water level up to the base height is indicated. In principle, the elevation of the base elevation should be determined; a simple method using GNSS, etc. or known elevations of bridges, etc. may be used to determine the elevation. If the base elevation (flood inundation start elevation) changes due to river maintenance, etc., the base elevation of the water level gauge shall be changed.
	(2) Inspection method	The installation status of equipment shall be checked through periodic inspections at least once a year, such as before the start of the flooding season.
5. Data organization and management	Concept of Data Storage	Observed water level data measured at or above the starting water level and registered in an external database will be stored for a certain period of time.
	Data verification	In principle, post-verification of water levels measured by risk management type water level gauges shall not be conducted. When data is used for flood analysis, etc., detection of abnormal values in observed values should be conducted as necessary.
6. Data format	Data to be transmitted by the water level gauge	The information to be transmitted to an external database in the form of data to be transmitted as specified in the special specifications at the time of procurement. Crisis management type water level gauges shall create a water level gauge ledger at the time of installation.
7. Cold weather specifications (added to 3.)	Installation Method	Installation method May be removed during the winter months. The structure shall be easily removable.
	Measurable temperature	Normal monitoring and water level observation during flooding is possible at temperatures of -5°C or higher. Can be automatically turned off at temperatures below -5°C.
	Dead/Inactive monitoring	Transmit measurement data for life and death monitoring at least once a day during periods other than winter when the power is turned off.
	Freeze resistance (common in 3.(2) to (4))	Ensure freeze resistance so that the sensor will not be damaged even if it freezes.
	Cold, snow, and salt resistance (common to 3.(2)-(4))	Ensure cold resistance according to the conditions of the installation location. Ensuring snow resistance so that it will not be damaged by accumulated snow. Alternatively, take measures to prevent damage due to snow accumulation. When installing on a bridge that uses an antifreeze agent, take measures to prevent deterioration and corrosion due to the antifreeze agent.

(2) Crisis Management Water Level Gauges Participating in the Test Observation (Pamphlet)

• Midori Engineering Laboratory Co., Ltd.

WEB monitoring system SESAME-WEB

Measured data can be checked in real time. Flexible data analysis is available.

Water level is rising. Normal

You can get the detailed situation of your monitoring point.

株式会社 みのり工学研究所
Midori Engineering Laboratory

[Main office] 〒060-0805 Hokkaido Sapporo-shi Chuo-ku North 5 West 6-chome 1-23 Dotted Building 2th Floor
TEL: 011-555-5000 / FAX: 011-555-3000

[Tokyo office] 〒350-0003 Saitama Prefecture Tokorozawa City South Naikatami 4-26-14
TEL: 090-2870-3107

[URL] <http://www.midori-eng.com>
[e-mail] info@midori-eng.co.jp

As for content of description, we may change without prior notice for quality improvement, so please be beforehand.
2019.10 (the 3rd edition)



SESAME series Crisis management type water level gauge

This water gauge was developed as a crisis management type water gauge for small- and medium-sized rivers and mainly installed at areas with high risks of floods.

Low cost, high performance

- ▶ Using reliable data logging and transmitting device
- ▶ Connected to pressure/microwave/ultrasonic type water level gauge
- ▶ Rain gauge and warning lamp can be set together

Long Life

- ▶ Maintenance free (Continuous use record for 10 years)
- ▶ Driven by solar cell and rechargeable battery

Camera (option)

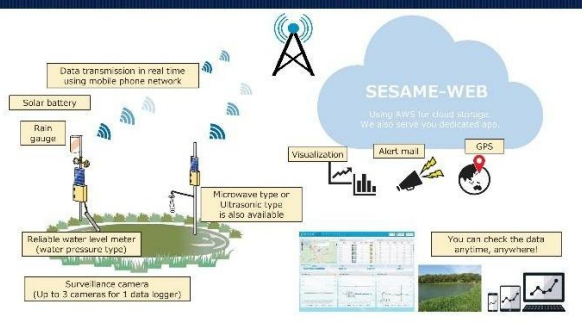
- ▶ Catch the situation with the images and water level data

Data Visualization by WEB system

- ▶ Flexible data analysis
- ▶ Data is available in .csv format
- ▶ Using a cloud service, water level information service can be browsed by anyone from a smartphone, etc.

Midori Engineering Laboratory Co., Ltd.

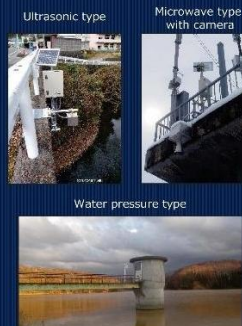
About SESAME system



Water gauge specifications

Type	Water pressure type	Microwave type	Ultrasonic type
Common data			
Temperature	-20~50℃		
Endurance	For about 5 years continuous operable.		
Communication	3G・4G(LTE)		
Water level measurement part			
Range	from 0-5m to 0-20m	from 0-10m to 0-20m	from 0-3m to 0-10m
Minimum unit	3.125mm (When 0-10m)		
Accuracy	±0.1%FS	±10mm (beyond 0.5m)	±0.25%FS
Cable length	Can be specified		
IP code	IP68	IP65	IP67
Temperature	-40℃~+80℃ (-5~+50℃)	-20℃~+70℃	-40℃~+80℃
Measurement control part			
Data logging unit	4~20mA Input : 1 (for water level), 0~2V Input : 1 Temperature : 2 (Measurement by electric resistance is available) Pulse input : 1 (for rainfall meter) Pulse output : 2 (for emergency lamp, etc.) Storage : memory card and internal memory		
Power source part			
Power supply	Lead deep cycle battery (commercial battery is available)		
Battery capacity	12V12Ah	12V22Ah	12V12Ah
Solar panel	20W		
Without charge	Up to 9 days available		
Box part			
Material	Polycarbonate + ABS resin		
Contents	Control unit, data logging unit, communication module		
Size	W500×D500×H200 mm		
IP code	IP65		
Weight			
Measure unit	0.15kg without cable	4.2kg without cable	1.0 kg without cable
計測制御部	2.0kg (Substrate, case, wire)		
Secondary battery	3.4kg	6.8kg	3.4kg
Solar panel	2.5kg		
Box	8.8kg		
Total weight without cable	17.1Kg	24.5kg	17.9Kg

Example of water level gauges



Camera specifications

System specifications	
Name	SESAME-CAMERA USB model
Communication	3G・4G(LTE)
Temperature	-20~40℃
Power supply	Solar battery 20W / Deep cycle battery (XLR2V-12Ah) (Optional) (Commercial power supply is available)
Battery capacity	[Solar battery] About 3 days without recharge (about 800 times)
Weight	7.04kg(Camera 530g,Solar battery,metal fittings)
Cable length	Infrared light 1.5m
Option	Up to 3 cameras are available
Camera specifications	
Sensor type	CMOS
Interface	USB2.0/USB Video Class
Shooting interval	Changeable
Effective pixels	Up to 200 megapixels
Resolutions	3280x1920 / 6480x4860 / 8096x6080 / 1280x720 / 1920x1080
Shooting range	Horizontal angle of view more than or equal to 90° at fixed camera. (no circling)
Min illuminance	≦ 0.05lx (Default equipment)
External infrared light	Range : 30m / Irradiation angle : 60°
Endurance	For about 5 years continuous operable.
Camera size	φ98mm x height 7mm

WATER LEVEL MONITORING

Low operation cost, Long life, Localized

【SENSORS】

RADIO WAVE · ULTRA SONIC

PRESSURE



The sensor is selectable from 3 types depending on observation point

【Features】

RADIO WAVE · ULTRA SONIC

- ◆ Sensor can be installed on a bridge. Suitable for new installation
- ◆ Regular Maintenance free
- ◆ No mechanical moving part. Friction loss fixing is less due to aging deterioration

PRESSURE

- ◆ Accurate water level observation. Suitable for upgrade of existing pressure sensor
- ◆ No affection by wind or waves

**Water level information is centralized to cloud server.
The information can be viewed on demand.
The water level gauges support
High dense-Earliest-Accurate Information acquisition**

OVERVIEW

MEISEI manufactures natural disaster monitoring equipment
We are the first manufacturer in Japan to develop the quartz water level gauge

Situation in Japan

- Quartz water level gauge: We have more than 30 years of experience and have delivery record more than 3,000 systems for dams, rivers, floodgates, etc.
- Radio wave water level sensor: We have delivered about 60 radio wave water level sensors to Japan Meteorological Agency, and we have many delivery record to local governments and other companies.

About 3L...

Since 2015, We have been providing weather information by POTEKA; all in one weather station and the cloud server. The weather information is available every one minute through Internet, and the data is display in Real-time.
 850 stations are approximately operating units in Japan and overseas as of Feb 2021 . The water level data is acquired via POTEKA station and the network.
 So stable observation is realized.



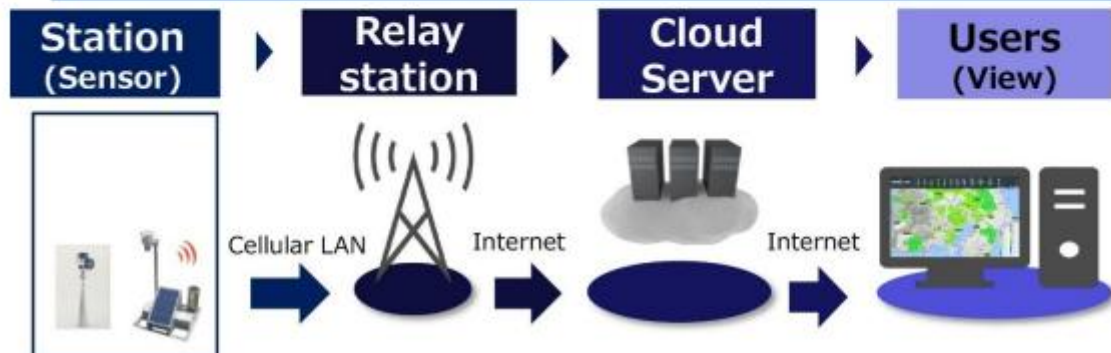
POTEKA



- **Low operation cost :**
 Less Communication cost reduction by less measurement interval of river level in normal time.(+3L sensor for MLIT only)
 Data acquisition from POTEKA cloud server. No designated operating software required.
- **Long line,** Less regular maintenance
- **Local** river authorities are able to measure and monitor water level on their own.

* MLIT Ministry of land Infrastructure transport and tourism

Flow

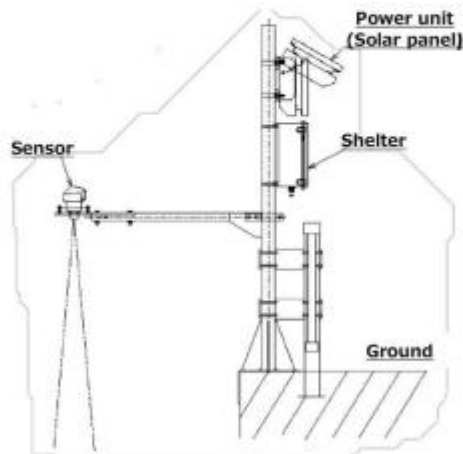


SPECIFICATIONS

Items	Specifications	Remarks
Common		
Temperature	- 20 °C~ 50 °C	
Lightning protection	Available	
Dust/Water proof	IP55 equivalent	
Service life	5 years	
Equipment		
Sensor type	Radio wave, Ultra sonic, Pressure	
Measurement range	0 m~ 10 m	
Reading unit	1 cm	Minimum
Accuracy	Within ± 0.3 %F.S	
Observation type	Self standing	
Observation mode	Monitoring/Observation automatic switch	*3L sensor for MLIT only
Observation item	Measurement time, Water level, Battery voltage	
Communication	LTE (4G)	
Data store device	SD card	Optional
Time calibration	NITZ	
Battery capacity	18 Ah	Lead storage
Solar panel	20 W	
No sunlight operation period	9 days	
Materials	Polycarbonate etc.	
Size	approximately W330 × H410 × D200	Shelter
Weight	Radio wave : Approximately 27 kg Ultra sonic : Approximately 24 kg Pressure : Approximately 25 kg	

INSTALLATION EXAMPLES

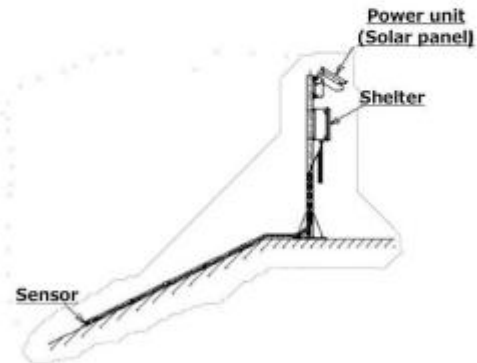
RADIO WAVE · ULTRA SONIC



- ◆ Sensor : Radio wave type
- ◆ Location : Bridge



PRESSURE



⚠ Cautions

- For safe and correct usage, please read the "Operation Manual" prior to the use of the products.
- The specifications and appearances might be changed without prior notice, which please understand.
- The specifications shown in the catalog are of our standard products. We are pleased to customize it to meet customer's requirements. For the details, please contact us.
- Please understand in advance that our company cannot assume the responsibility of any claims made by the third party about any monetary damages or any loss of profits arising out from the use of our products.
- The color of the product photography on catalog might be different from that of actual product because of printing.

MEISEI ELECTRIC CO., LTD.
1-1, Toyosu 3-chome, Koto-ku, Tokyo 135-8115, Japan
Tel: +81-3-6204-8254 Fax: +81-3-6204-8888
<https://www.meisei.co.jp/english/>

MSPA-088 M2407 The specifications this catalog are current as of July 2024.

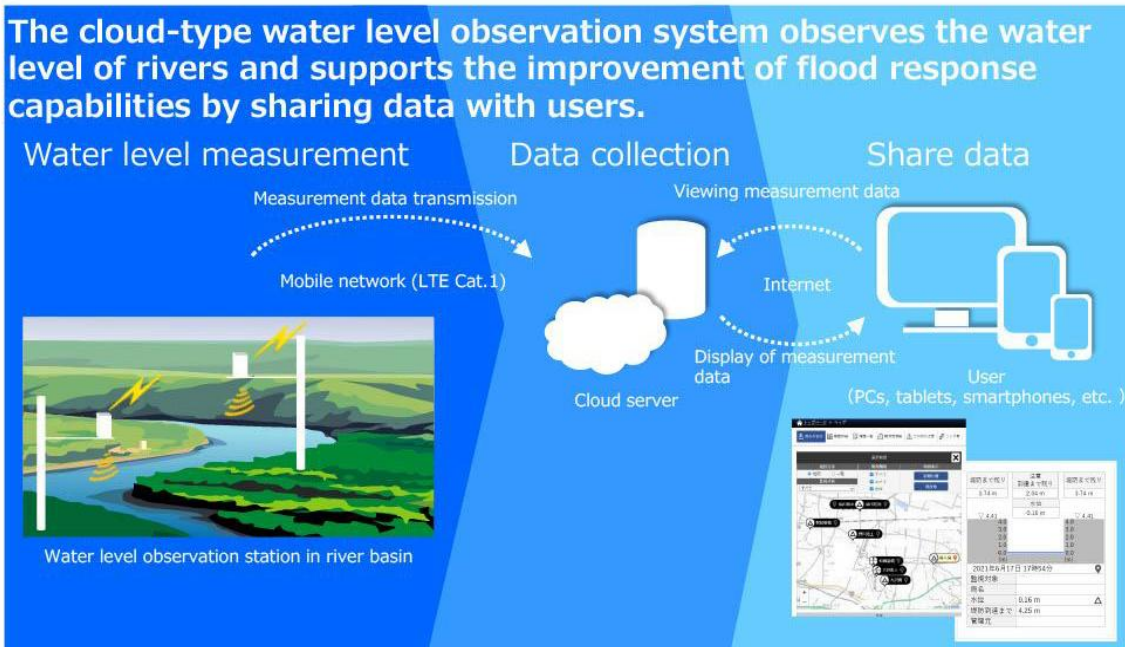


Cloud type water level observation system using Radio wave type water level gauge

eTRUST Co., Ltd.



About cloud type water level observation system



Features of the water level gauge

It is a radio wave type water level gauge that complies with the "observation standards and specifications of crisis management type water level gauges".
Using a 24GHz microwave radar, it is possible to measure in the range of 0.5m to 30m.



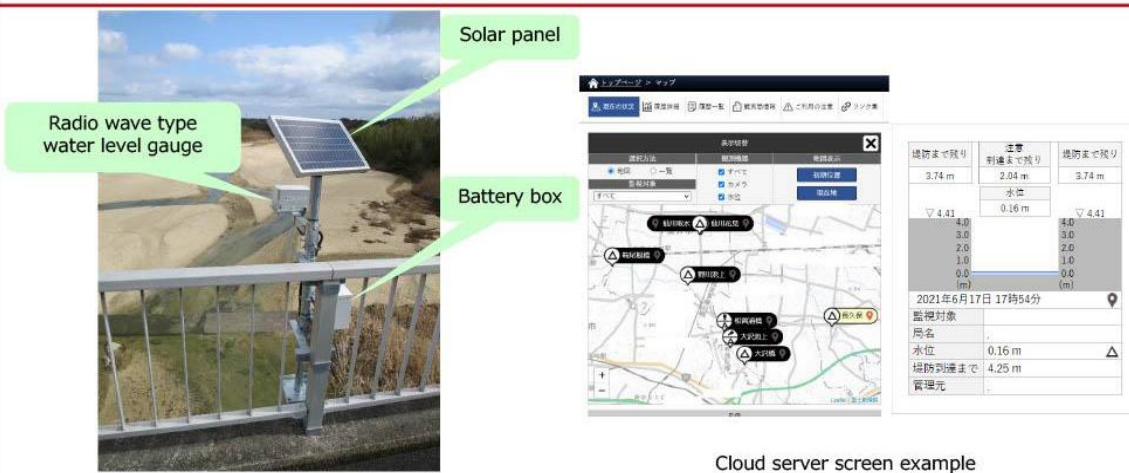
About crisis management type water level gauge

A water level gauge developed by an innovative river management project that specializes in water level observation during floods.

It is a water level gauge that aims to promote the spread of water level gauges in small and medium-sized rivers where there was no water level gauge so far, and to enhance the water level observation network by using a low-cost water level gauge.

3

Features of river monitoring system / cloud server



Radio wave type water level gauge

Solar panel

Battery box

Water level gauge installation example

Cloud server screen example

■ Main features as a river monitoring system

- Leverage IoT and cloud
- Autonomous power supply (solar panel and battery)
- Use LTE Cat.1
- No wire connection required
- Easy to install
- Achieves maintenance-free for over 5 years

■ Main features of our cloud server (eT-Cloud)

- Map display (mapping)
- List display
- Water level display
- Can be stored in the database
- Alarm notification is possible
- Cooperation with other systems

4

Cloud server user interface and feature overview

Not only the water level gauge but also the river monitoring camera can be displayed.

It is possible to display the location of the water level gauge (water level observation station) on the map. It is possible to easily check where the water level is rising in the river, and it is possible to grasp areas with a high risk of flooding within a certain range, not at each point.

Visualize water level information as a river cross section along with numerical values. It is possible to quickly judge the danger of flooding.

You can immediately check whether the water level is rising or falling along with the measurement status of the water level information.

5

Specification details

【Specification】

Water level observation system	
network	LTE Cat.1
Water level gauge	range of measurement : 0.5m~30m Measurement accuracy : ±3cm (±5cm for 0.5m to 1m and 20m to 30m) Radar method: 24GHz microwave radar Advanced FMCW
Power supply	Solar panel: 13W Battery: 13Ah Power consumption: Average 2W or less (when observing water level)
Operating environment	Waterproof and dustproof : IP55 Operating temperature : -10℃~+50℃ No sunshine operation: up to 9 days
River monitoring web service	
Service form	Cloud type application service
Monitoring function	Monitoring point mapping, water level observation, video monitoring, database Sending alarm mail, linking with other systems
Monitoring items	Latest water level data at monitoring points, past time series graph Latest image of monitoring point, past time series image (* When a surveillance camera is installed)
Data storage	6 months (for basic contract)
Security	Access right management by user ID / password



6

Installation example of water level gauge



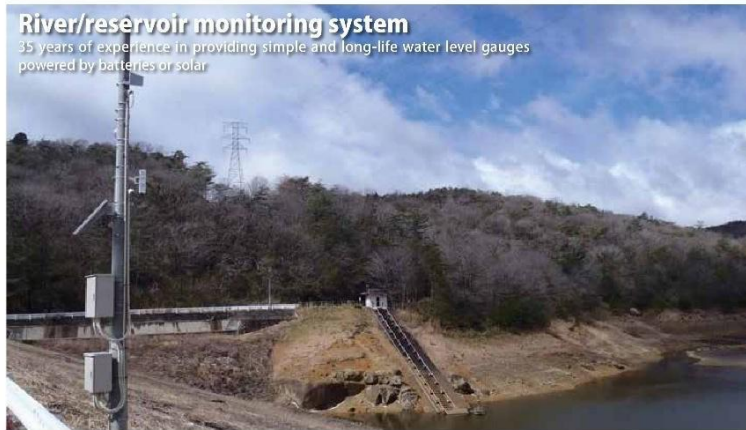
Toriyama River, Kanagawa Prefecture



Wada River, Yamagata Prefecture



Isuzu River Faction River , Mie Prefecture



We are professional at building monitoring systems in mountainous areas where it is difficult to secure commercial power supplies and communication infrastructure. We provide monitoring systems throughout Japan by making full use of lightweight and compact measurement devices and outdoor data transmission technology.

Achievements of water level gauge introduction: from the beginning, we participated in the innovative river management project of the Ministry of Land, Infrastructure, Transport and Tourism, which is a Japanese government agency, produced level gauges for water crisis management, and introduced them to 1,300 small and medium-sized rivers all over Japan.



Crisis management type water level gauge introduction site (in Aichi prefecture)



Reservoir monitoring system introduction site (in Kochi prefecture)



River monitoring system introduction site (in Saitama prefecture)

A remote monitoring system that enables browsing on the Internet, by sending observation data of water level and rainfall and image taken by a surveillance camera to a server.

When the water level or rainfall exceeds a certain value, it also enables to send an alarm mail to the specified address. Each device is lightweight and compact, so it is easy to install, and the thorough power-saving design allows long time operation with solar or batteries.

In addition, we have multiple combinations of measuring, communication, and alarming devices, which makes it possible to propose a system that matches the communication environment and higher-level system at the desired observation point.



Reservoir monitoring system introduction site overseas



Landslide monitoring system introduction site overseas

Sales overseas

In addition to water level gauges and rain gauges, we also provide measuring devices for slope disaster prevention. We have experienced exporting to more than 37 countries including Asia and Central and South America.

We have introduced a reservoir remote monitoring system. We also have introduced remote landslide monitoring systems for reducing human damage caused by serious landslide disasters in mountainous areas. Our system is customizable; we carry out everything from design and development of products and systems to manufacturing at our own factory.

We can propose systems that take into account the conditions different from country to country.

OSASI Technos, Inc.

65-3 Hongu-cho, Kochi-City, Kochi, Japan 780-0945
 mail:osasi@osasi.co.jp
 https://www.osasi.co.jp/en/
 TEL:+81-88-850-0535 FAX:+81-88-850-0530



20

Guidbook for selected production Kochi 2021 senchi edition 21

Advanced Disaster Prevention

- River water level monitoring
- Road flooding countermeasures
- Reservoir water level monitoring
- Tsunami and high tide countermeasures
- Facility disaster prevention

Natural disasters cannot be totally prevented. But damages may be mitigated through disaster risk reduction efforts!

No problem at places without a power source. Our emergency disaster monitoring system may be configured right away at the site of disaster.

Intensification of typhoons and more frequent occurrence of torrential rainfall in recent years not only induce large-scale landslide disasters but also cause various problems in maintenance and management of water-related facilities. Prediction of sudden and local torrential rainfalls is extremely difficult, and they have not been properly addressed by today's social systems. Sufficient workers cannot be assigned to wide range of maintenance and management tasks for slopes, road flooding, river embankments, reservoir water level, irrigation channels, etc. As a result, countermeasures could be delayed. The emergency disaster monitoring system commercialized by Osasi Technos may be configured and operated promptly at the site of disaster. This is made possible by the simple networking system utilizing compact measuring instruments. If the technology was used with an on-site information system to be operated over a long period, in addition to being utilized for temporary measures at a time of emergency, a high-performance disaster information system may be configured at a low cost.

Damage minimization by clarifying the risk level and sharing the information!

Using a monitoring system for water level management of reservoirs and irrigation channels, for example, will help not only in saving energy but also in clarifying the risk levels on a real-time basis. The system may be utilized for structures and factors for which the risk level needs to be assessed and measures need to be implemented while clarifying the situations, such as slopes, river embankments, river water level, reservoir water level, irrigation channels, and road flooding.

Promptly detecting flooding and shutting off the traffic

Flood monitoring (for underpasses)

Underpasses are among the places along roads that are difficult to manage. An underpass is a structure built at an intersection between a road and a railway or another road that leads one of them underground, so as to prevent their intersection on the same plane. Many underpasses have been built in urban areas where traffic is heavy.

At a time of torrential rainfall, road flooding takes place suddenly in underpasses due to rapid inflow of rain water from the surrounding areas. Being a topographical structure of a form that retains water, an underpass could witness sudden rise in the flooding water level that in many cases leaves automobiles in the flooding water.

Since it is almost impossible to deal with sudden changes in road conditions at many locations with a limited number of personnel, a system with a water level detection sensor and a notification apparatus, which promptly detects flooding and shuts off the traffic, has proven to be effective.

Tsunami and high tide countermeasures

Tide level information provision system

Osasi Technos proposes an information system through which tide level data necessary for port and harbor management are obtained and the situations of tide level observation are made open to the public using graphs and images, for urging the residents in lowlands and along the coast to evacuate promptly when a flood is anticipated due to tsunami and high tide and thus minimizing damages.

Flood damage

Increase in the occurrences of local torrential rainfalls and gigantic typhoons, which stems from global warming, has aggravated disaster risks each year. Especially on small and medium rivers with relatively small river basin areas, the flow volume increases rapidly even at the time of relatively short torrential rainfall. Since prediction of sudden changes in the water level is difficult, it is not always easy to notify the residents of the risk without delay.

Thus, attempts are being made to enhance the accuracy of flood prediction by installing a large number of simple water level gauges along a river, thereby raising the density of water level measurements of the river.

For preventing reservoir collapse

Reservoir water level prediction system to be used at times of torrential rainfall

Reservoirs have collapsed in an increasing number of cases due to frequent torrential rainfalls. Collapsing of a reservoir could bring about tremendous damages in downstream regions.

In view of the situation, Osasi Technos has, in collaboration with the National Agriculture and Food Research Organization, developed a reservoir water level prediction system capable of judging whether a dam body could collapse at times of torrential rainfall, and how much the water level needs to be lowered in order to ensure safety. The system predicts collapse of a reservoir at a time of torrential rainfall beforehand or on a real-time basis and calculates the necessary prior water discharging volume and the amount of reservoir water level lowering, for preventing the reservoir collapse.

Lineup of water level gauge products

Water level gauges of Otsu Technos are compact and lightweight and may be installed readily, enabling measurement to start at any location.
 The most distinguished feature is that the water level gauges, of thoroughly energy-saving designs, may be used for measurement over a long period using commercially available batteries.
 Drawing on the technologies and know-how accumulated in the 30 years since the launch of our first water level gauge, the water level gauges have continued recording the data reliably even in the most demanding outdoor environment.



010

Water level sensors

DS-1

Measurements in units of cm (Made of SUS)
 Precision: $\pm 0.1\%$
 *Measurement range: 10 to 100 m



DS-7

Measurements in units of mm (Made of SUS)
 Precision: $\pm 0.13\%$
 *Measurement range: 0 to 750 mm



MS-2L

Measurements in units of cm (Made of SUS)
 Precision: $\pm 0.25\%$
 *Measurement range: 10 to 50 m



PDCR-1830

Made of titanium
 Small-diameter
 (Sensor diameter: $\phi 17.5$)
 Precision: $\pm 0.1\%$



その他

Output: 4 to 20 mA
 Small-diameter
 (Sensor diameter: $\phi 10$)
 Fit for use in cold areas, and more



Water level data loggers

WLG-01N

With liquid crystal screen for displaying graphs
 Supports networking
 With alarm function
 Supports SD cards



ITC-01

With built-in web server function
 Internet-connected water level gauge



WP-1

Waterproof-type
 No storage box needed



*Under development

NetMAIL-WR

With liquid crystal graph display
 With built-in packet communication function
 Single channel for water level measurement / single channel for rainfall measurement
 Supports networking



*Under development

SFLG-01

With liquid crystal graph display
 With built-in Sigfox communication function
 Single channel for water level measurement / single channel for rainfall measurement



NetLG-001N

Supports networking
 With alarm function



NetAW-01L-S

Ad-hoc wireless-type
 Supports networking



WRM series risk management-type water level gauges



Monitoring of small and medium-sized rivers, whose flood risks have heightened due to more frequent occurrences of torrential rainfall, may be realized in a short delivery time at low cost.



011

(3) Presentation Materials at Typhoon Committee Working Group on Hydrology (WGH)

2019

Flood Risk Watch Project for Life-saving

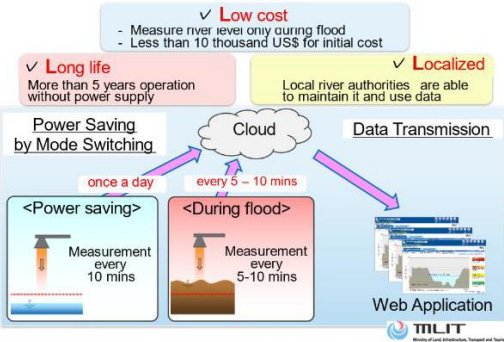
Most-advanced hydro-infomatic project

- Cut cost to install into as many flood-prone areas as possible
- Provide real-time information for emergency operation
- Develop flood prediction system in small/medium-scale rivers

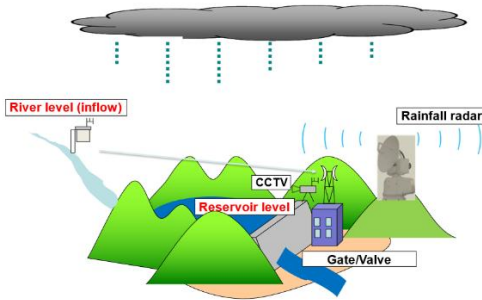
Japan's case



LLL water level gauges



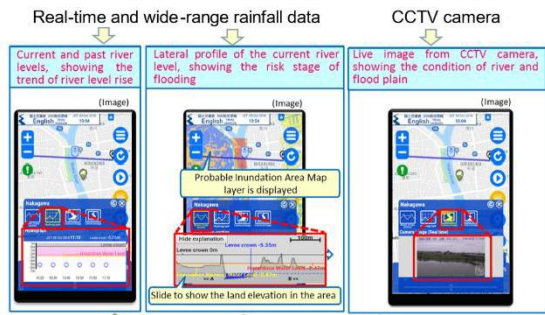
For dam/reservoir operation



Rebuilding Flood-conscious Societies

- In recent years, due to the record-breaking amount of and extensive area of rainfalls, Japan has experienced levee breaches of river levees, long-lasting inundations and unexperienced land slides. There were a number of disaster victims, escalated by delay in evacuation.
- Because modern river improvement succeeded in reducing flood events in last 100 years, the society had dreamed that "Any flood can be prevented by river facilities". However, recent severe flood damages remind us that "Large-scale floods can exceed river facilities' capacity". Climate change is now exacerbating flood magnitude and frequency. A whole society should prepare for future possible flood disasters.
- In this situation, the MLIT published a new policy vision of "Rebuilding Flood-conscious Societies". While structural measures take long period of time, the MLIT put the highest priority in human lives and launched a new project for fail-proof evacuation for "No failure in evacuation".

Real-time data required for user-oriented project



Expansion of observation network by LLL gauges

Administrator	Rain gauge station	Water gauge station
River authority (MLIT for 109 rivers)	2,407	2,336
River authority (Prefectures for other rivers)	5,246	4,599
Japan Meteorological Agency	1,303	-
total	8,856	6,935

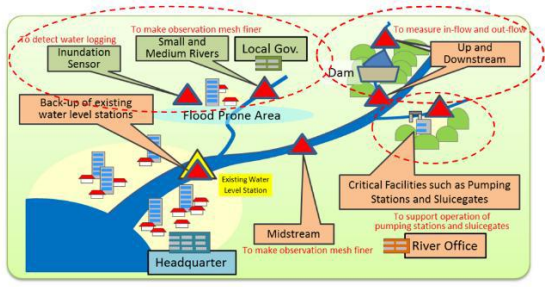
Number of observation and automatic data transfer units (as of Mar 2016)



For flood forecasting in a river basin



For total river information network



Concept of Flood Risk Watch Project for Life-saving

That is the Flood Risk Watch Project for Life-saving with newly developed LLL water level gauges. The MLIT wish to promote the project in Japan and Asia-Pacific region with TC members.

- Decision making of facility managers, flood forecasters, emergency commanders, local authorities (Mayors) and "each person to take action".
 - Real-time and on-site through "Local data for Local people", and for share data for all.
 - Promote DRR by dual engines of "Central-driven and Local-motivated".
 - Change social/personal attitude "from Waiting to Watching".
- All TC partners are able to and required to realize "Early warning and Self warning".

Flood Risk Watch Project for Life-saving
FLORIST Project

2019 Technical visit

Technical Visit Program Report

Flood Risk Watch Project for Life-Saving
21 January – 26 January 2019
Kuala Lumpur, Malaysia

○○○○ 2019

International Affairs Office, River Planning Division,
Water and Disaster Management Bureau
Ministry of Land, Infrastructure, Transport and Tourism
(MLIT), Japan

Overview

	Program
Day1, 21 January	•Arrival of Delegation from Japan
Day2, 22 January	•Presentation from DID and MLIT, Discussion on AOP6 Project •Site Visit: PRABN Control Center and Smart Control Center.
Day3, 23 January	•Site Visit : Hydrological Station at Langat River Basin
Day4, 24 January	•Site Visit : Klang Gate Dam at Selangor
Day5, 25 January	•Visit : DID State Flood Operation Room •Site Visit : Hydrological Station at Penang River Basin •Discussion and Closing at DID Penang
Day6, 26 January	•Travel to Tokyo from Penang

Main participants

	Name	Position	Organization
Japan	1 Hirotsada Matsuki	Director	MLIT
	2 Satoshi Omatsu	Senior Deputy Director	MLIT
	3 Tetsuya Ikeda	Chief Researcher	ICHARM
	4 Takaaki Kusakabe	Director	IDI
	5 Yukihiro Yamashita	Senior Counsellor	IDI
DID	1 Ir.Nasir	Director General	DID
	2 Ir.Salwo Raming	Deputy Director	DID SMART
	3 Md Khairi Seleamat	Director	DID
	4 Azman Said	Deputy Director	DID
	5 Ir.Rajaselvam Govindarju	Chief Engineer	DID



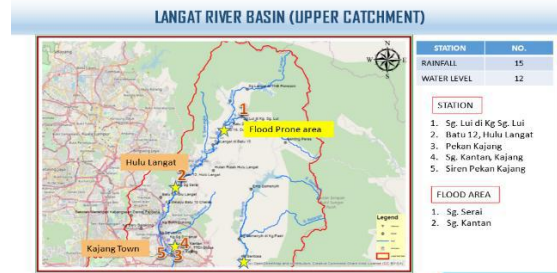
Group Photo at DID Ampang



Group Photo at DID SMART



Site Visit : Hydrological Station at Langat River Basin



Site Visit : Hydrological Station at Langat River Basin



Site Visit : Klang Gate Dam at Selangor



Site Visit : Hydrological Station at Penang River Basin

Presentation from Japan

- (1) Flood Management for Wide-area and Long-lasting Rainfall
Dr.Hirofuda Matsuki,MLIT
- (2) Flood Risk Watch Project for Life -saving
Mr.Satoshi Omatsu,MLIT
- (3) Introduction of Typhoon Committee (TC)
and the expected input from ICHARM
Dr.Tetsuya Ikeda ,ICARM

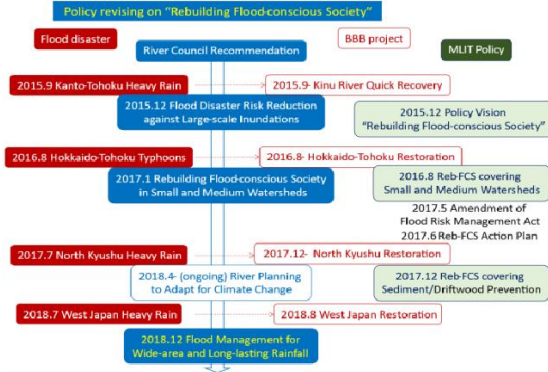
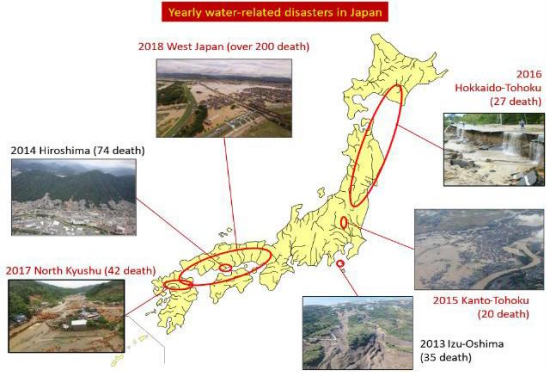
Flood Management for Wide-area and Long-lasting Rainfall

Recommendations
December 2018

River Council
for Social Infrastructure Development

Climate change adaptive approach to flood risk management

In 2018 July Heavy Rain, long-lasting rainfall brought huge human damage and socio-economic losses. Japan have to remember that "inevitable large-scale flood will exceed river facility's capacity" and started a new policy vision of "Rebuilding Flood-conscious Societies" to prepare for the next flood together with all social entities after 2015 September Kanto-Tohoku Heavy Rain. Then, structural and non-structural measures have limited function so that those have to work collaboratively and exert synergistic effects of disaster prevention and mitigation.



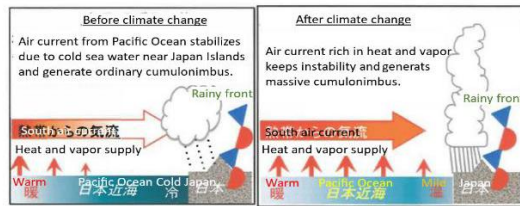
Recommendation on Flood Management for Wide-area and Long-lasting Rainfall
December 2018
River Council for Social Infrastructure Development

Contents

1. Introduction
2. Problems revealed by the 2018 July Heavy Rain
 - (1) Background of the rainfall
 - (2) Outline of the damage
 - (3) Features of the flood
 - (4) Problems to be solved
3. Basic concept of countermeasures
4. Solutions to be implemented promptly
 - (1) Saving life in external forces exceeding structural capacity
 - (2) Minimizing socio-economic damage and immediate recovering/rebuilding
 - (3) Adapting to due to climate change
 - (4) Promoting technical research and development
5. Message to societies

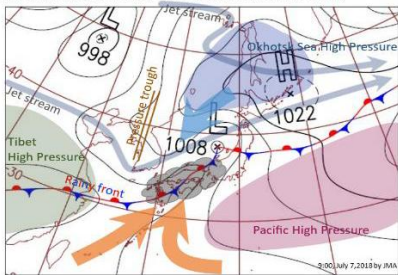
Climate change impact

Climate change and ocean warming have potential to make the south air current generate more and higher cumulonimbus and heavier rainfall.



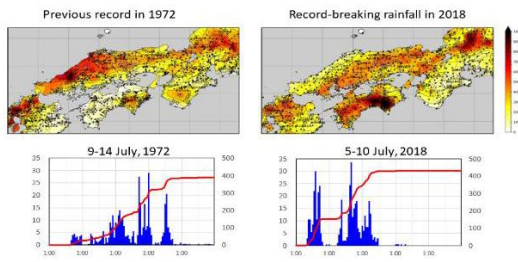
Meteorological analysis on 2018 Heavy Rain

Two major air currents gather into a lingering rainy front to bring wide-area and long-lasting rainfall in West Japan. The Japan Meteorology Agency firstly announced the specific impact of climate change as "contribution of water vapor increased by climate change". The Agency analyzed the amount of water vapor was the largest since 1958.



Hydrological observation

The Japan Metrology Agency analyzed the amount of water vapor in 2018 July West Japan Heavy Rain was 1.4 times larger than the historical record in 1972. In upper Takahashi Watershed, the 5-day rainfall marked the new record.



Disaster mechanism
 Typhoon, rainy front or squalls are triggers of water-related disasters. Climate change impact assessment and localized researches are needed to find peculiar generating mechanisms and effective solutions of the whole societies.

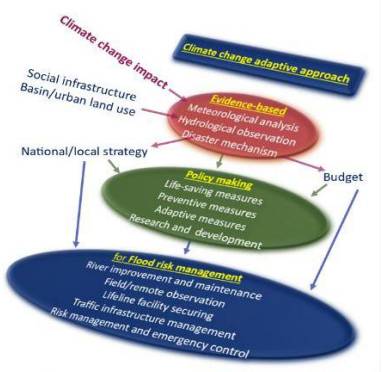


Solution (1) "Life-saving measures against external forces exceeding facility's capacity"

- Disaster information delivery from ordinary time to flood event
 - Real-time flood information and risk area information
 - Visualized information to understand risks
 - Time-series disaster operation plan for evacuation
 - Integrated disaster information and risk level indicator
 - Information delivery in cooperation with the mass media
 - Capacity disclosure of disaster management facilities.
- Risk information without a blind spot
 - Probable inundation zoning with water level gauges
 - Probable inundation map at dam downstream
 - Sediment disaster warning zoning
 - Hazard map revised using maximum flood simulation
 - Water-related hazard map portal site
- Real-time information to encourage evacuation
 - Time-series risk assessment and flood forecasting
 - Flood forecasting with real-time water level
 - Public explanation of flood forecasting and water level by river authorities
 - Dam information delivery for evacuation
 - Debris flow information to supplement warning
 - Water resilient information equipment against mega-scale flood
- Self-motivated disaster response
 - Mutual help enhancement
 - Custom-made evacuation plan and information map
 - Support tools for evacuation planning
 - Human resources development for local disaster management capacity
 - Disaster education
 - Evacuation drill with public participation
- Facilities to reduce flood risks
 - Resilient levee to stand longer against breach
 - Evacuation routes and shelters with higher security
- Life-saving shelters for stranded people
 - Life-saving shelters as an emergency measure
- Risk management to save lives in complex disasters
 - Confidence improvement
 - Sediment management to prevent overflow
 - Channel capacity maintenance
 - Cooperative scheme against complex disasters
- Countermeasures against flood exceeding facility's capacity
 - Dam upgrading for flood control
 - Flood control capacity development
 - Masonry sabo weirs reinforcement

Message to society

Japan has been improving proactively resilient and reliable land management to cope with frequent heavy rain disasters, however recently, vulnerability to water-related disasters are increasing due to external force aggravated by changing climate, social transformation including aging, and other factors. Japan is expected to mobilize all social resources and cutting-edge science and technology to develop a leading system for disaster prevention and mitigation.



Policy making

Basic concept should stress importance of structural measures by concerning authorities and multilayered measures to prepare for complex disasters by all social entities using the local Flood Management Committee. In practice, following four basic concepts are important to accelerate "Rebuilding Flood-conscious Societies".

- Concept 1: Life-saving measures against external forces exceeding facility's capacity
- Concept 2: Preventive measures to minimize socioeconomic losses and launch quick recovery and reconstruction
- Concept 3: Adaptive measures to frequent and wide-area heavy rain exacerbated by climate change
- Concept 4: Research and Development

Solution (2) "Preventive measures to minimize socio-economic losses and launch quick recovery and reconstruction"

- Measures to minimize socio-economic losses
 - Resilient function of critical infrastructures
 - Resilient function of the urban center
- Measures to launch quick recovery and reconstruction
 - New scheme to advance drainage facilities
 - Waterproofing of drainage facilities
 - Reinforcement of the emergency control center
 - Preparation for quick recovery and reconstruction

Solution (3) "Adaptive measures to frequent and wide-area heavy rain exacerbated by climate change"

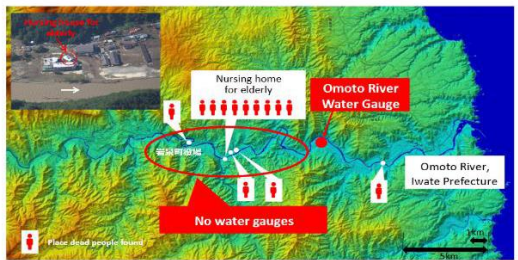
- Adaptation to climate change
 - Systematic upgrade of security level
 - Strategic observation and advanced maintenance
- Preparation for wide-area and long-lasting heavy rain
 - Legalization and activation of the TEC-FORCE
 - Rapid disaster information collection
 - Time-series emergency operation plan involving various agencies
- Renovation of resident's way of living
 - On-street disaster risk disclosure
 - Social disaster risk internalization

Solution (4) "Research and Development"

- Advanced disaster risk assessment
 - Clarification of changing risks due to climate change
 - Outbreak mechanism analysis on various water-related disasters
 - Development of unified risk assessment method for various disasters
 - Socio-economic losses assessment due to heavy rain
- Risk-based disaster prevention and mitigation
 - Step-by-step approach to climate change impact
 - Improvement in flood forecasting accuracy by water level gauges
 - Advanced dam operation using rainfall forecasting
- Risk information management to support evacuation
 - Advanced sediment disaster warning
 - Risk information delivery for evacuation

Human damage in small and medium scale watershed

21 people dead around Omoto River with no water gauge in August 2016.



National plan for increasing 3L water gauge

	Present	3L water gauges	Total
MLIT 863 watersheds	1,934 ※1	2,957	4,891
prefectures 20,930 water sheds	5,221 ※2	5,755	10,976
	7,155	8,712	15,867

Doubling

※1 川の防災情報(2018.3.31)提供数
 ※2 国土交通省調査(2017.11)
 ※ 河川数は2018.4.30現在

THE WORLD BANK GROUP Action Plan on Climate Change Adaptation and Resilience

- The Action Plan will increase the World Bank's level of ambition and commitment to adaptation and resilience. It has three core objectives:
- Boost adaptation financing**
 The WBG will ramp up \$1 direct adaptation climate finance to reach \$50 billion over FY21-25. This financing level—an average of \$10 billion a year—is more than double what was achieved during FY15-18. The WBG will also pilot new approaches to scale up private finance for adaptation and resilience.
 - Drive a mainstreamed, whole-of-government programmatic approach**
 The WBG intends to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically managing and incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation.
 - Develop a new rating system to create incentives for, and improve the tracking of, global progress on adaptation and resilience**
 A new rating system will be developed to promote public and private sector investments in adaptation. It will be designed to create incentives for donors and countries to engage in more and better adaptation, more effectively report on what the WBG and clients are doing, and serve to establish a global standard for financial markets and public procurement. The new system will be piloted over FY19-20 with an anticipated roll-out to projects in relevant sectors by FY21.

Objective 1: Boost adaptation financing (\$50 billion over 2015-25)

Objective 2: Drive a mainstreamed, whole-of-government programmatic approach (involving finance and planning sectors)

Objective 3: Developing a new rating system (to improve soft/hard infrastructure encouraging private investment)

Flood Risk Watch Project for Life-saving

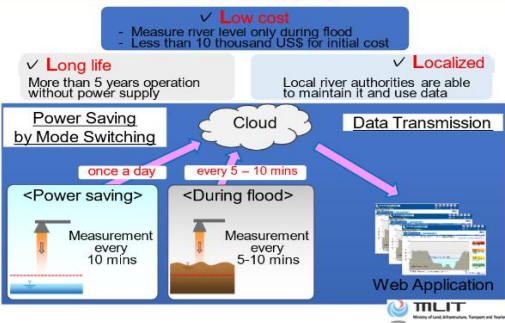
Most-advanced hydro-infomatic project

- Cut cost to install into as many flood-prone areas as possible
- Provide real-time information for emergency operation
- Develop flood prediction system in small/medium-scale rivers

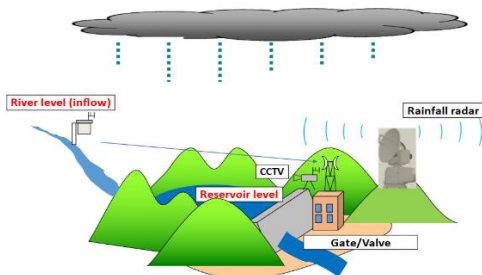
Japan's case



LLL water level gauges



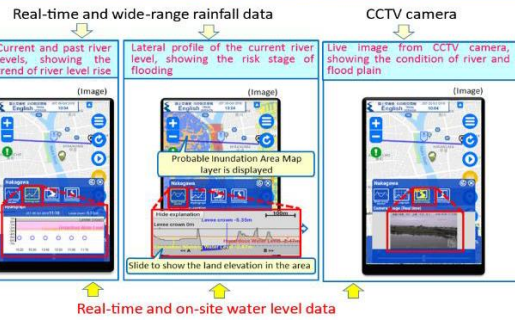
For dam/reservoir operation



Rebuilding Flood-conscious Societies

- In recent years, due to the record-breaking amount of and extensive area of rainfalls, Japan has experienced levee breaches of river levees, long-lasting inundations and unexperienced landslides. There were a number of disaster victims, escalated by delay in evacuation.
- Because modern river improvement succeeded in reducing flood events in last 100 years, the society had dreamed that
 - "Any flood can be prevented by river facilities"
- However, recent severe flood damages remind us that
 - "Large-scale floods can exceed river facilities' capacity"
- Climate change is now exacerbating flood magnitude and frequency. A whole society should prepare for future possible flood disasters.
- In this situation, the MLIT published a new policy vision of
 - "Rebuilding Flood-conscious Societies"
- While structural measures take long period of time, the MLIT put the highest priority in human lives and launched a new project for fail-proof evacuation for
 - "No failure in evacuation"

Real-time data required for user-oriented project



Expansion of observation network by LLL gauges

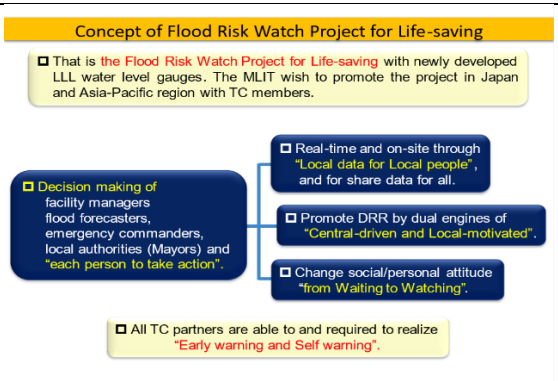
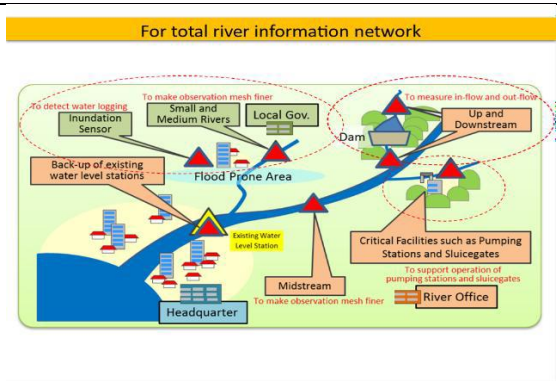
Administrator	Rain gauge station	Water gauge station
River authority (MLIT for 109 rivers)	2,407	2,336
River authority (Prefectures for other rivers)	5,246	4,559
Japan Meteorological Agency	1,303	—
total	8,856	6,935

Number of observation and automatic data transfer units (as of Mar. 2016)

The table is accompanied by images of 'Conventional river station' and 'LLL water level gauge' (Contact type and Non-contact type attached to bridge).

For flood forecasting in a river basin





2020

Annual Operation Plan 6 Flood Risk Watch for Life Saving

Content

- Outline
- Activities in 2019-2020
- Next Actions in 2020-2021
- Conclusion

Ministry of Land, Infrastructure, Transport and Tourism
Kitagawa
October 22, 2020

Outline

AOP 6: Flood Risk Watch for Life Saving

- Background
 - MLIT Japan has been promoting an innovative initiatives using 3L water level gauges (WLG) to decrease flood damages.
 - ※ 3L means Low Cost, Long Life and Localism
 - Low cost : Less than 10,000 US\$ for initial cost
 - Long Life : More than 5 years operation without power supply
 - Localized : Can be modified to fit local situation
- Objectives
 - to share installation procedure and data utilization of 3L WLG
 - to study on application to TC members
- Period
 - 3 years, Mar 2019 - Feb 2022
- Study Areas
 - Selected river basins in Malaysia

Outline

3L WLG features in Japan

- MLIT Japan asked for developing 3L WLG to support flood management in small and medium rivers from 2016 to 2017
- The cost is reduced by the downsizing of the device, and the technological development of the battery and communication device
- The communication cost is reduced by reducing data transfer frequency
- Now increasing 3L WLGs in Japan
- Anybody can assess Japanese 3L WLGs' information on website below

Power Saving by Mode Switching
Data Transfer Frequency once a day
Cloud
Data Transmission
Web Application

<Power saving> Measurement every 10 mins
<During flood> Measurement every 5-10 mins

Data Transfer Frequency and Communication

Two times
About 5,000 unit (2017) vs 11,000 units (2020)

* Limited to sections managed by prefectures, etc.
Changes 3L WLG Number in 2017 and 2020

Road Map

Outline

	2019	2020	2021	2022
with partner country	- 3L technical seminar in Malaysia - Field survey and meetings in Malaysia	- Site visiting and meetings in Japan - Preparatory commutation on site study - Finalize the specification and site requirements for installation	- Install 3L water level gauges (WLGs) in selected river basin - Collect and evaluate 3L WLGs data - Produce study report	
for WGH members	- AOP 6 presentation in the 8th WGH Meeting and the 14th IWS	- AOP 6 presentation in the 9th WGH Online Meeting	- Progress report during the 10th WGH meeting - AOP 6 presentation in the 16th IWS	
report			- Make final report	- Issue final report

LEGEND
Black : Finished
Red : Planning

Activities in 2019-2020

- Malaysia and Japan held a seminar and visited each other to understand current usage status of water level gauges
 - Oct 2019 : a collaborative meeting in Malaysia
 - Dec 2019 : Japan side(IDI-Japan) visited Malaysia
 - Jan 2020 : Malaysia side(DID) visited Japan

Collaborative Meeting between Malaysia and Japan in October 2019

Site Visit in Malaysia on Malaysian WLG (Klang River@Kuala Lumpur)

Site Visit in Japan on 3L WLG (Yamato River@Nara Pref.)

Activities in 2019-2020

Field Inspection in Malaysia in December 2019

- Inspect WLG equipments and installation status of 3 river basins.
- Basic agreement to conduct testing at WLG Station at Sulaiman Bridge in Klang River.
- Confirm the difference between Japan's 3L WLG and Malaysian WLG.
- Improvements needed for localization based on Malaysia's configurations.

Malaysian WLG (Sulaiman Bridge)

Visited Site Map

Activities in 2019-2020

Improvements in localization of 3L WLG to Malaysia's demands

	Japan	Malaysia	Improvement Points
WL Sensor	Various Type	Non-Contact Only	Choose Non-Contact Type
Observation Period	Flood Event Only Every 10 mins.	Throughout Year Every 15 mins.	Revise the Control Program
Battery Capacity (w/o Sunlight)	24 Hours (1 Day)	2 weeks (14 Days)	Enlarge Battery and Solar Panel
Cellular Network	Narrow-Band LTE(4G)	GSM (2G)	Replace Modem
Transmission Rule	Japanese Style	Malaysian Style	Revise the Control Program

RTU Unit
→Replace Modem
→Revise Control Program



Battery
→Enlarge

Next Actions in 2020-2021

Malaysia and Japan resumed preparatory activities for test installation in Malaysia during early 2021.

- Set Conditions for Test Installation
- Recruit Participating Company for Test Installation, and Develop 3L WLG with Malaysian Specifications
- Install 3L WLG
- Start Test Observation on data consistency (for more than 6 months)

Activities in 2019-2020

- Malaysia and Japan agreed to conduct test installation in FY2020 towards actual introduction



Meeting at MLIT, Japan (21 JAN 2020)

Conclusion

1. Japan has been implementing three-year AOP6 since 2019 for the purpose of promoting 3L WLG and embedded systems in TC member countries
2. The following activities have been already conducted:
 - Oct 2019; a collaborative meeting in Malaysia
 - Dec 2019; on-site investigation in Malaysia to decide testing site and specifications
 - Jan 2020; on-site visit in Japan by DID
3. Now been engaged in coordination with Japanese manufacturers for developing Malaysian spec 3L WLG and discussion with Malaysia side for test installation.
4. Planning to start test observation early next year.
5. Investigation can be conducted for collecting information if any other TC member countries have interests in 3L WLG.

2021

Annual Operation Plan 6 Flood Risk Watch for Life Saving

Content

1. Outline
2. Activities in 2019-2020
3. Activities in 2020-2021
4. Next Actions in 2021-2022
5. Conclusion

River Planning Division, Water and Disaster Management Bureau
Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan

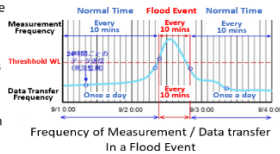
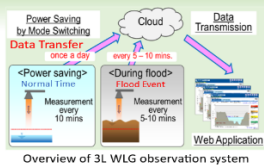
Yuko SUDA

October 22, 2021

Outline

3L WLG features in Japan

- MLIT Japan commissioned the development of 3L WLGs to support flood management of small and medium-sized rivers from 2016 to 2017
- 3L WLGs are characterized by low cost of equipment and communication
 - Equipment :Downsizing and technological development of battery and communication device
 - Communication :Limiting observations in flood events
- As of the end of 2020, 11,000 3L WLGs have been installed and operated
- MLIT Japan publishes the observation status by 3L WLGs on following English website (<https://www.river.go.jp/e/>)



Outline

AOP 6: Flood Risk Watch for Life Saving

➢ Background

MLIT Japan has been promoting an innovative initiatives using 3L Water Level Gauge (WLG) to decrease flood damages.

- ※ 3L means Low Cost, Long Life and Localized
- Low cost : Less than 10,000 US\$ for initial cost
- Long Life : More than 5 years operation without power supply
- Localized : Can be modified to fit local situation

➢ Objectives

- To share installation procedure and data utilization of 3L WLGs
- To study on application to TC members

➢ Period

3 years, Mar 2019 - Feb 2022

➢ Study Areas

Selected river basins in Malaysia



Outline

Road Map (Initial Plan)

LEGEND
Black :Finished
Red :Planning

	2019	2020	2021	2022
with partner country	- 3L technical seminar in Malaysia - Field survey and meetings in Malaysia	- Site visiting and meetings in Japan - Preparatory commutation on site study - Finalize the specification and site requirements for installation	- Install 3L water level gauges (WLGs) in selected river basin - Collect and evaluate 3L WLGs data - Produce study report	
for WGH members	- AOP 6 presentation in the 8 th WGH Meeting and the 14 th IWS	- AOP 6 presentation in the 9 th WGH Online Meeting	- Progress report during the 10 th WGH meeting - AOP 6 presentation in the 16 th IWS	
report			- Make final report	- Issue final report

Outline

Road Map (Ongoing)

➢ Initial AOP6 plan is delayed by 1 year due to the influence of Covid -19 pandemic

	2019	2020	2021	2022
with partner country	- 3L technical seminar in Malaysia - Field survey and meetings in Malaysia	- Site visiting and meetings in Japan - Preparatory communication on site study	- Finalize the specification and site requirements for installation	- Install 3L water level gauges (WLGs) in selected river basin in Malaysia - Observation and Evaluation of 3L WLGs data - Produce study report
for WGH members	- AOP 6 presentation in the 8 th WGH Meeting and the 14 th IWS	- AOP 6 presentation in the 9 th WGH Online Meeting	- AOP 6 presentation in the 10 th WGH Meeting and the 16 th IWS	LEGEND Black :Finished Red :Planning
report			- Make progress report	

Activities in 2020-2021

➢ The worldwide pandemic of Covid-19 from early 2020 forced the suspension of 3L WLGs test installation plans in Malaysia.

➢ Japan and Malaysia were discussing detailed conditions for test installation plans in preparation for resuming overseas travel after the Covid-19 infection had subsided.

➢ At the same time, MLIT Japan recruited WLG manufacturers to participate in the 3L WLGs test installation plan, and four companies decided to participate in the test installation.

Next Actions in 2021-2022

➢ Malaysia and Japan will proceed with concrete activities toward the start of 3L WLGs observation in early 2022.

➢ The following is a draft schedule when not affected by Covid-19.

- **Until the end of 2021** WLG manufacturers participating in test construction develop 3L WLG to meet Malaysian specifications
- **January 2022:** WLG manufacturers bring 3L WLG to Malaysia and install it on the test site
- **After February 2022:** Start test observation (6 months or more), check the accuracy of observation data and operability of equipment

Activities in 2019-2020

- Malaysia and Japan held seminars and visited each other to understand current usage status of water level gauges
 - Oct 2019 : a collaborative meeting in Malaysia
 - Dec 2019 : Japan side(IDI-Japan) visited Malaysia
 - Jan 2020 : Malaysia side(DID) visited Japan
- Malaysia and Japan agreed to conduct 3L WLGs test installation in FY2020 towards actual introduction




Collaborative Meeting between Malaysia and Japan in October 2019 Meeting at MLIT, Japan (21 JAN, 2020)

Activities in 2020-2021

Improvements in localization of 3L WLGs to Malaysia's demands

	Japan	Malaysia	Improvement Points
WL Sensor	Contact/Non-Contact	Non-Contact Only	Choose Non-Contact Type
Observation Period	Flood Event Only Every 10 mins.	Throughout Year Every 15 mins.	Revise the Control Program
Battery Capacity (w/o Sunlight)	24 Hours (1 Day)	2 weeks (14 Days)	Enlarge Battery and Solar Panel
Cellular Network	Narrow-Band LTE(4G)	LTE(4G)/GSM (2G)	Replace Modem
Transmission Rule	Japanese Style	Malaysian Style	Revise the Control Program

RTU Unit
 →Replace Modem
 →Revise Control Program

Solar Panel
 →Enlarge


WL Sensor
 →No Change



3L WLG in Japan (Non-Contact Type)

Conclusion

1. Japan has been implementing three-year AOP6 since 2019 for the purpose of promoting 3L WLG and embedded systems in TC member countries
2. The following activities have been already conducted:
 - Oct 2019: a collaborative meeting in Malaysia
 - Dec 2019: on-site investigation in Malaysia to decide testing site and specifications
 - Jan 2020: on-site visit in Japan by DID-Malaysia
 - Dec 2020: Confirmation of Malaysian 3L WLG specifications, adjustment of test installation conditions
 - September 2021: Select WLG manufacturers to participate in test
3. WLG manufacturers are planning to proceed with development and on-site installation work for test observations in early 2022.
4. Japan and Malaysia can provide information about 3L WLGs if TC member countries are interested in.



Annual Operation Plan 6 Flood Risk Watch for Life Saving

October 18, 2022

Ministry of Land, Infrastructure, Transport and Tourism, Japan

Yuko SUDA

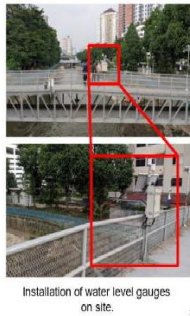
Table of Contents

1. Outline
2. Progress to Date
3. What we will do in the future
 - (1) Re-configuration of all the WLGs
 - (2) Monitoring and analysis of the observed data
 - (3) Battery performance and power consumption of the 3LWLGs
4. Extension of the observation period

1. Outline

AOP 6: Flood Risk Watch for Life Saving

- Background
 - MLIT Japan has been promoting an innovative initiatives using 3L Water Level Gauge (WLG) to decrease flood damages.
 - ※ 3L means Low Cost, Long Life and Localized
 - Low cost : Less than 7,000 US\$ for initial cost
 - Long Life : More than 5 years operation without power supply
 - Localized : Can be modified to fit local situation
- Objectives
 - To share installation procedure and data utilization of 3L WLGs
 - To study on application to TC members
- Period
 - Mar 2019 - Dec 2022
- Study Areas
 - Selected river basins in Malaysia



Installation of water level gauges on site.

1. Outline

Activities from 2019 to October 2021

year	Activities
2019 - 2020	Seminars on WLG in Japan and Malaysia. Agreement to carry out test installations in Malaysia.
2020 - 2021	Suspension of planned installation of WLG due to Covid-19. Recruiting companies, which participate in WLG test observations
2021 -	Working on modification of water level gauges to meet Malaysian specifications for 3LWLG with Japanese specifications (year-round observation, larger battery size, mobile phone communication network support).

Planned actions as of October 2021

year	Planned activities
2021	Completion of work on modification of water level gauges in December 2021
2022	Installation of water level gauges in January 2022 Start of test observations in February 2022 (for 6 months) Removal of the water level gauge in December 2022

Red: actions that required a change in timing in 2022

Location map of WLG installations (Kuala Lumpur)



3. What we will do in the future

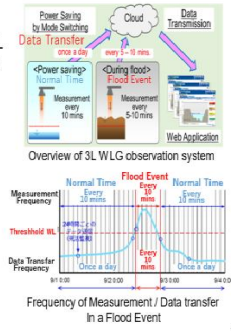
The following are to be done in the future.

Item	Contents
(1) Re-configuration of the WLGs elevation	<ul style="list-style-type: none"> Differences in the elevation settings of the water level gauges of the participating companies resulted in errors in the observed values. DID has adjusted the Stick Gauge and WLG. Based on DID's WLG observations, WLG elevations of the participating companies will be re -configured
(2) Monitoring and analysis of the observed data	<ul style="list-style-type: none"> The status of data reception from the WLGs is currently being checked. Reception of WLGs of participating enterprises in September was at least 98%. The data reception status during the observation period will continue to be monitored and analysed. We will check the accuracy by type of sensor. We will monitor and analyse the battery performance and power consumption of the 3LWLG.
(3) Monitoring battery performance and power consumption	

1. Outline

3L WLG features in Japan

- MLIT Japan commissioned the development of 3L WLGs to support flood management of small and medium-sized rivers from 2016 to 2017.
- 3L WLGs are characterized by low cost of equipment and communication.
 - Equipment : Downsizing and technological development of battery and communication device.
 - Communication : Limiting observations in flood events.
- As of the end of 2021, 13,600 3L WLGs have been installed and operated.
- MLIT Japan publishes the observation status by 3L WLGs on following English website. (<https://www.river.go.jp/e/>)



2. Progress to Date

(1) Status of installation and observation of water level gauges

- Four participating companies installed five water level gauges (WLGs) on site between mid-May and early July 2022
- By 29 July, all WLGs have started observations in DID format

Company Name	Company A	Company B	Company C	Company D
Number of units installed	2 units	1 unit	1 unit	1 unit
Date of installation	Early July	12 May	5 July	23 May
Method of setting elevation	Measured from Stick Gauge at Sentul Station	Measured from Stick Gauge at Sentul Station	Measured from GPS surveying	Measured from Stick Gauge at Sentul Station
Start of observation	20 July Start of observations 26 July Start of observations in DID format	12 May Start of observations in DID format	6 July Start of observations 29 July Start of observations in DID format	23 May Start of observations 30 June Start of observations in DID format

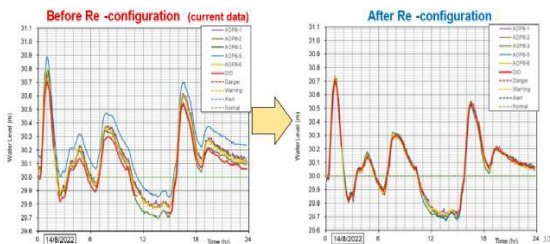
(2) Location of WLGs

WLG No.	Station No.	Code Station	Station Name	Company Name
1	0001	AOP60001	Sungai Sentul AOP6-1	Company A
2	0002	AOP60002	Sungai Sentul AOP6-2	Company A
3	0003	AOP60003	Sungai Sentul AOP6-3	Company B
5	0005	AOP60005	Sungai Sentul AOP6-5	Company C
6	0006	AOP60006	Sungai Sentul AOP6-6	Company D



(1) Re-configuration of the WLGs elevation

- DID is currently re -configuring Stick Gauge and WLG.
- Participating companies will re -configure their WLGs before the wet season in Kuala Lumpur starts (by the end of October 2022).
- After the DID's WLGs have been re -configured, participating companies will re -configure their WLGs using the DID's WLG re -configuration data.



(2) Monitoring and analysis of the observed data

- AOP6-1 is out of observation due to a power supply -related problem.
- The table below shows the total missing data from 1 September to 30 September. It excludes the period from 19 to 22 September, when communication conditions were bad.
- The percentage of data received is at least about 98%.
- DID and MLIT will continue monitoring and analysis of the observed data of WLGs, in terms of reception, format, and accuracy.

3LWLG	Participant Company	Total number of data (5 minutes data)	Total data missing (5 minutes data)	Percentage of data received
AOP60001	Company A	7488	-	-
AOP60002	Company A	7488	152	98.0%
AOP60003	Company B	7488	48	99.4%
AOP60005	Company C	7488	6	99.9%
AOP60006	Company D	7488	9	99.9%

4. Extension of the observation period

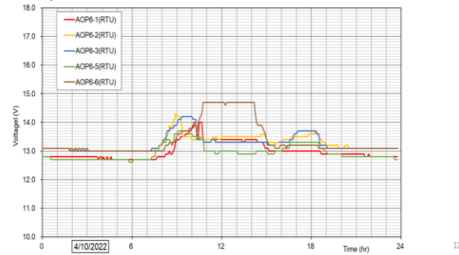
- The test observations require a certain lengthy observation period, as it is necessary to continuously transfer data and assess battery degradation.
- The wet season in Kuala Lumpur is from November to March. It is important to observe the wet season when river water levels rise.
- This plan envisages observations until December 2022, but we will apply for an extension of the observation period to March 2023 and the removal of the water level gauge in April 2023.

Draft roadmap

	2019	2020	2021	2022	2023
With partner country	- 3L technical seminar in Malaysia	- Site visiting and meetings in Japan	- Finalize the specification and site requirements for installation	- Install 3L water level gauges (WLGs) in selected river basin in Malaysia	- Observation and Evaluation of 3L WLGs data
For WGH members	- Field survey and meetings in Malaysia	- Preparatory communication on site study	- ACP 6 presentation in the 10th WGH Meeting and the 16th IWS	- Produce study report	- ACP 6 presentation in the 11th WGH Meeting and the 17th IWS
Report	- ACP 6 presentation in the 8th WGH Meeting and the 14th IWS	- ACP 6 presentation in the 9th WGH Online Meeting	- Make progress report	- Make progress report	- Make final report - Issue final report

(3) Monitoring battery performance and power consumption

- DID and MLIT will monitor and analyse battery performance and power consumption of the 3LWLGs.
- As of October, the power supply from the solar panels is sufficient in the dry season.
- We will monitor and analyse the battery performance and power consumption of the 3LWLG. (If the battery does not return to the specified voltage after charging, the battery deteriorates.)



2023



**Annual Operation Plan 6
Flood Risk Watch for Life Saving**

September 21, 2023

Ministry of Land, Infrastructure, Transport and Tourism, Japan

Yuji AMAMI

Outline

Background

MLIT Japan has been promoting an innovative initiatives using 3L Water Level Gauge (WLG) to decrease flood damages. 3L means Low Cost, Long Life and Localized

- Low cost : Less than 7,000 US\$ for initial cost
- Long Life : More than 5 years operation without power supply
- Localized : Can be modified to fit local situation

Objectives

- To share installation procedure and data utilization of 3L WLGs
- To study on application to TC members

Period

- Mar 2019 - Dec 2023

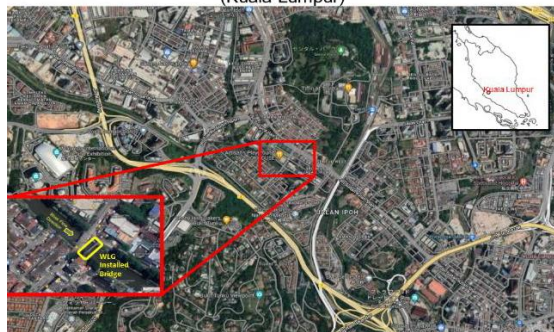
Study Areas

- Selected river basins in Malaysia



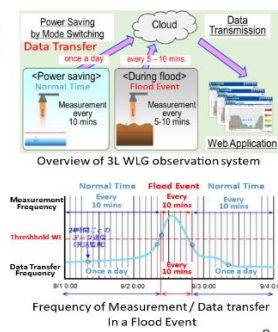
Installation of water level gauges on site.

Location map of WLG installations (Kuala Lumpur)



3L WLG features in Japan

- MLIT Japan commissioned the development of 3L WLGs to support flood management of small and medium-sized rivers from 2016 to 2017
- 3L WLGs are characterized by low cost of equipment and communication
 - Equipment : Downsizing and technological development of battery and communication device
 - Communication : Limiting observations in flood prod
- As of the end of 2020, 11,000 3L WLGs have been installed and operated
- MLIT Japan publishes the observation status by 3L WLGs on following English website (<https://www.river.go.jp/e/>)



Location of WLGs

WLG No.	Station No.	Code Station	Station Name	Company Name
1	0001	AOP60001	Sungai Sentul AOP6-1	eTRUST Co., Ltd.
2	0002	AOP60002	Sungai Sentul AOP6-2	eTRUST Co., Ltd.
3	0003	AOP60003	Sungai Sentul AOP6-3	Midori Engineering Lab.
5	0005	AOP60005	Sungai Sentul AOP6-5	YACHIYO Engineering / OSASI Technos Inc.
6	0006	AOP60006	Sungai Sentul AOP6-6	MEISEI ELECTRIC Co., Ltd.



Evaluation Items, Period

- Evaluation items
 - 1) Data Format
 - 2) Data Transfer
 - 3) Observed Water Levels
 - 4) Battery Voltage
- Evaluation Period
 - Six months
 - From October 2022 to March 2023

Data Format

The status of conformity with the DID's PRAB system common data format (only items related to water level observations) was confirmed. There were a few items where data was recorded differently from the regulations, but these were either omitted because this was a trial operation, or different data were recorded due to misunderstanding by the 3L WLG supplier. Adaptation to the forms prescribed in Malaysia is easily possible thus it can be concluded that there are no problems with the data forms.

COMPLIANCE OF DATA FORMAT

Item	Compliance	Remarks
1. No data for internal battery voltage, and solar output voltage.	Yes	
2. The data sent for alert code 'A2', even the water level is below alert threshold (normal). The correct data is no.	No	Alert code 'A2' is not used.
3. The data sent for internal battery voltage, and solar output voltage is battery voltage, which is wrong.	No	Internal battery voltage and solar output voltage are not recorded.
4. No data for Officer Handphone Number and Station Name.	Yes	
5. Data of communication signal strength sent for 15th minute only, which is no data for 5th and 10th minute.	No	Communication signal strength is recorded for 15th minute only.

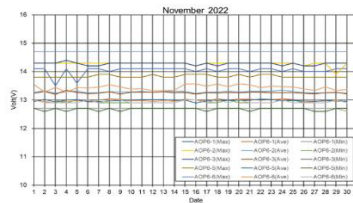
List of Non-Compliance of Data Format:

- No data for internal battery voltage, and solar output voltage.
- The data sent for alert code 'A2', even the water level is below alert threshold (normal). The correct data is no.
- The data sent for internal battery voltage, and solar output voltage is battery voltage, which is wrong.
- No data for Officer Handphone Number and Station Name.
- Data of communication signal strength sent for 15th minute only, which is no data for 5th and 10th minute.

DID arrangement results

Battery Voltage

It was verified if necessary 12 V for the operation of general observation equipment was always secured. The low voltage of AOP 60001 in February and March 2023 was due to a disconnection between the solar generator and the battery (shut down due to a loss of power supply). Excluding that period, the minimum voltages of all 3L WLG batteries were above 12 V, it can be concluded that the 3L WLG batteries have adequate performance.



Data Transfer

The minimum threshold data transfer of DID is 95%. Test observations showed that AOP60001 and AOP60002 had transfer rates below the threshold of 84% and 94% respectively. AOP60003, AOP60005 and AOP60006 had transfer rates above the threshold. AOP60001's particularly low transfer rate was caused by a period of inactivity of the water level gauge (approximately 15 days) due to a disconnection between the solar generator and the battery; even excluding this period, the transfer rate did not exceed 95%.

DATA RECEIVED & MISSING ANALYSIS AT DID SERVER FROM OCTOBER 2022 TO MAC 2023

Month	AOP60001		AOP60002		AOP60003		AOP60005		AOP60006		DID WL	
	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived	No. of Miss-ing Data	% Re-ceived
Oct 2022	251	97%	324	89%	17	100%	3	100%	0	100%	448	96%
Nov 2022	777	91%	654	92%	250	97%	177	98%	32	100%	0	100%
Dec 2022	351	98%	519	94%	291	96%	90	99%	20	100%	6	100%
Jan 2023	312	96%	354	96%	497	94%	48	99%	35	100%	6	100%
Feb 2023	635	92%	258	97%	351	96%	6	100%	3	100%	0	100%
Mar 2023	5908	29%	339	96%	579	93%	222	97%	6	100%	12	100%
TOTAL	12234	84%	3548	94%	1085	99%	548	99%	58	100%	472	96%

Highlighted with yellow, shows the percentage of data that have less than 95%.

DID arrangement results

Overall Evaluation

Overall, based on the above, it can be concluded that AOP60003, AOP60005, and AOP60006 satisfied the general requirements for water level gauges in Malaysia through this test operation.

For AOP60001 and AOP60002, the data transfer rate was below the threshold. Further verification is needed for them.

It should be noted that to introduce 3L WLG into Malaysian water level monitoring, the performance must be certified through a Test and Commissioning process individually set for each project.

The results of this test observation of 3L WLGs will be documented for submission to TC.

Thank you for listening

Digital Printing in Macao, China. Feb. 2026

@ ESCAP/WMO Typhoon Committee, 2026

ISBN 978-99981-833-5-3

Secretariat of ESCAP/WMO Typhoon Committee

Avenida 5 de Outubro, Coloane

Macao, China

Tel.: (+853) 88010531

Fax: (+853) 88010530

E-mail: info@typhooncommittee.org



ESCAP/WMO TC/TD-No. 0025