

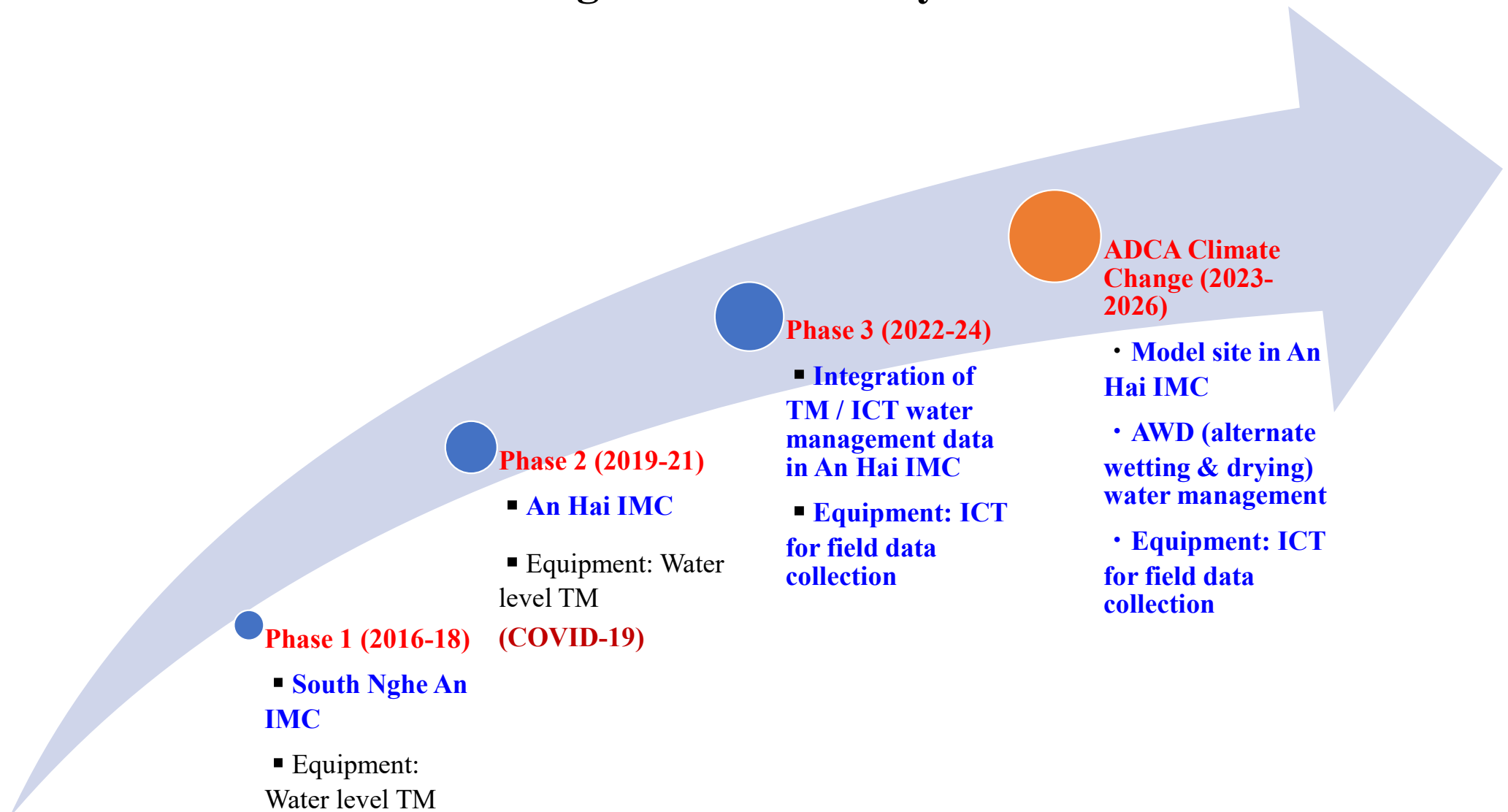
**Phase 3 Study of Efficient Water Management System Based on the
Advanced Telemetry Technology in Vietnam (ADCA3)**

The Output of the Study

11 December, 2024

Agricultural Development Consultants Association (ADCA)

Image of ADCA study



ADCA2

Kimson Gate

Kim Son Gate



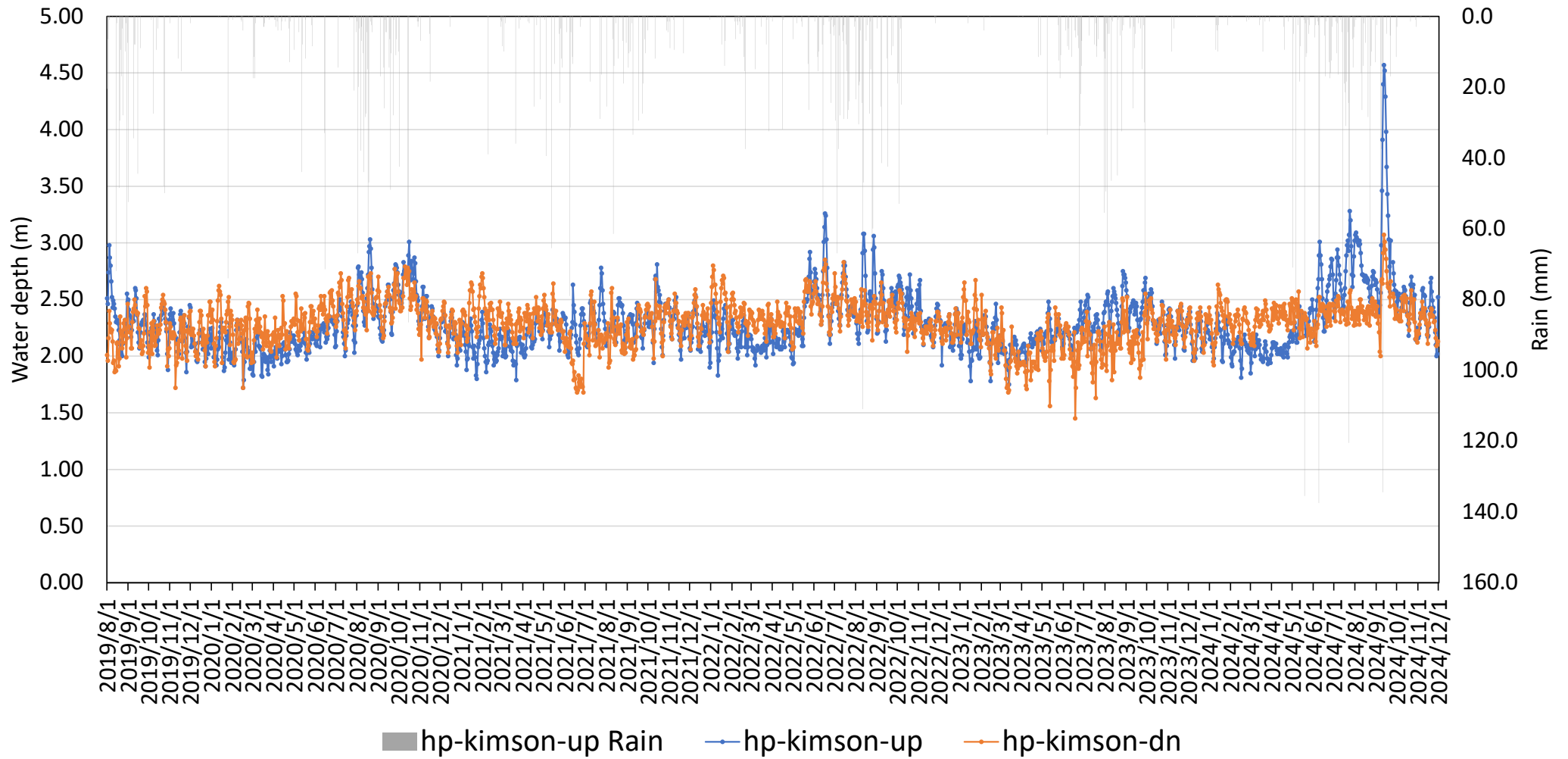
Equipment

- Water level gauge 2: at up-stream and down stream of gate
- Rainfall gauge 1: at up-stream of gate

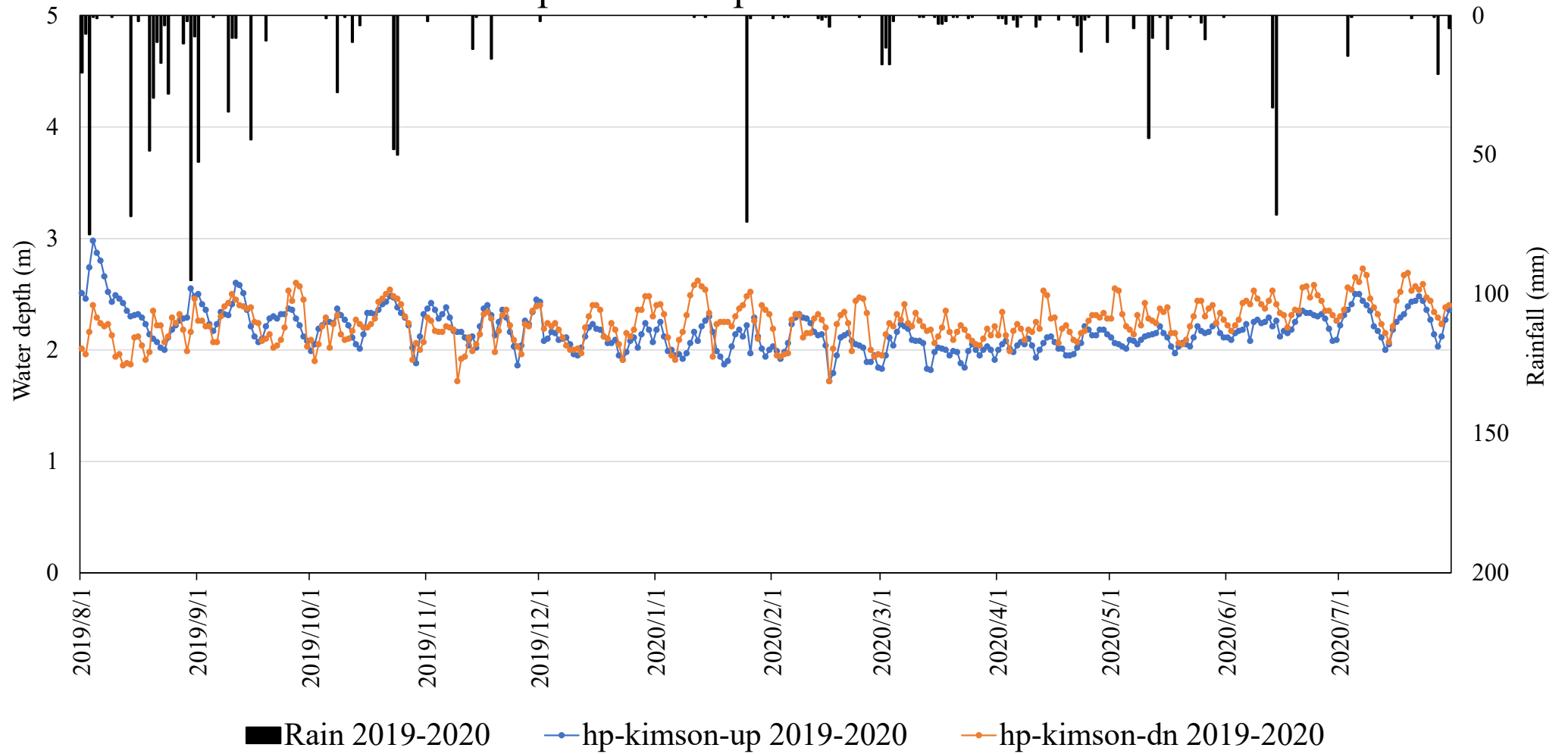
Installation

- Preparation: July 26-30
- Installation: July 31

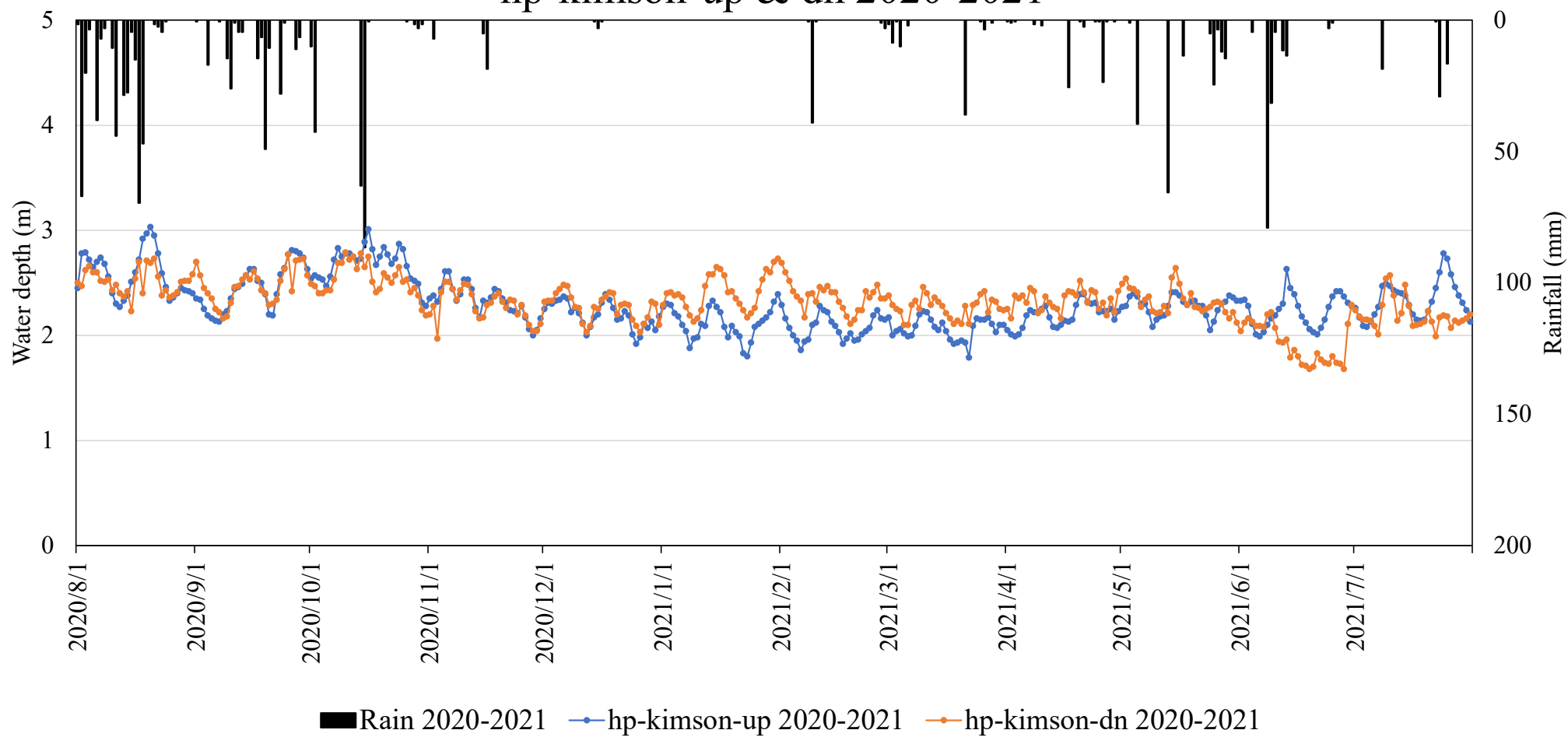
TM Data of Kim Son Gate from 1 Aug 2019 – 30 Nov 2024



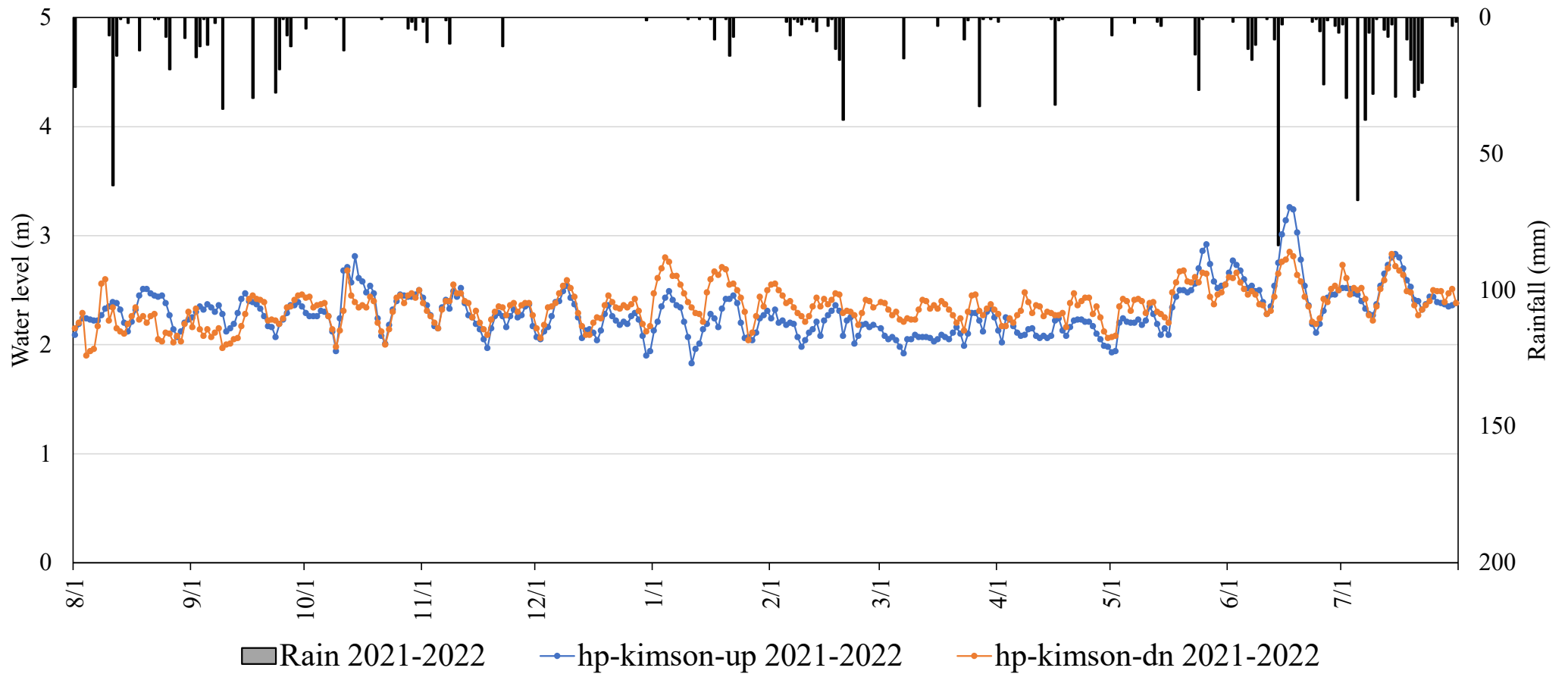
hp-kimson-up & dn 2019-2020



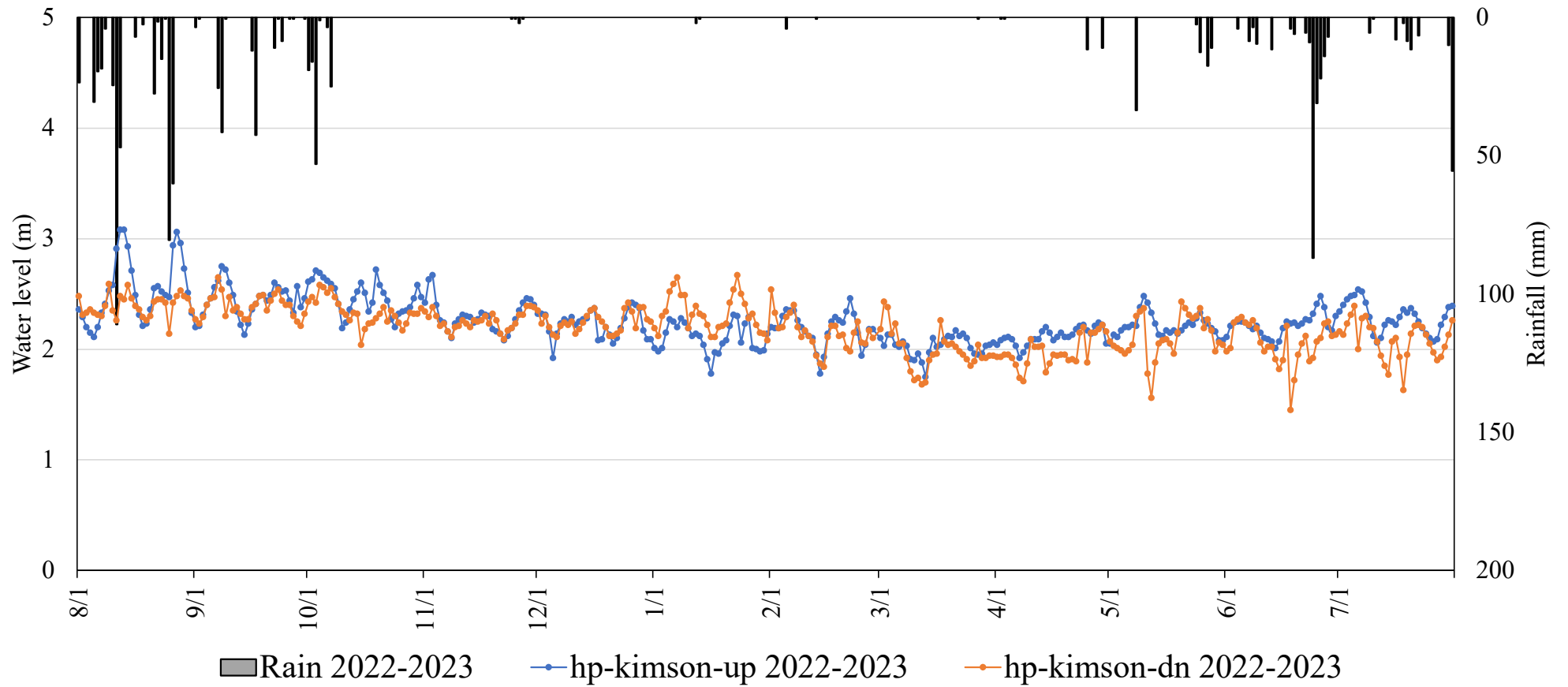
hp-kimson-up & dn 2020-2021



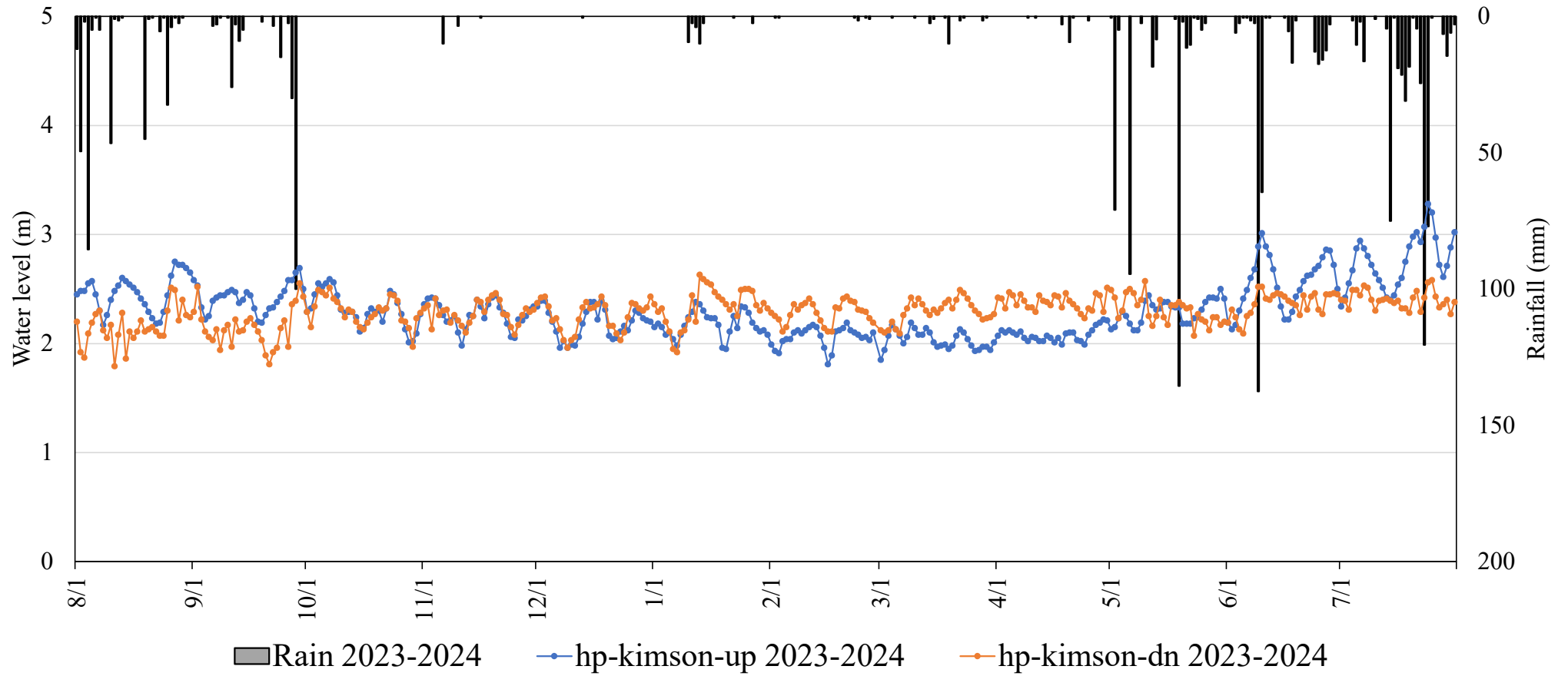
hp-kimson-up & dn 2021-2022



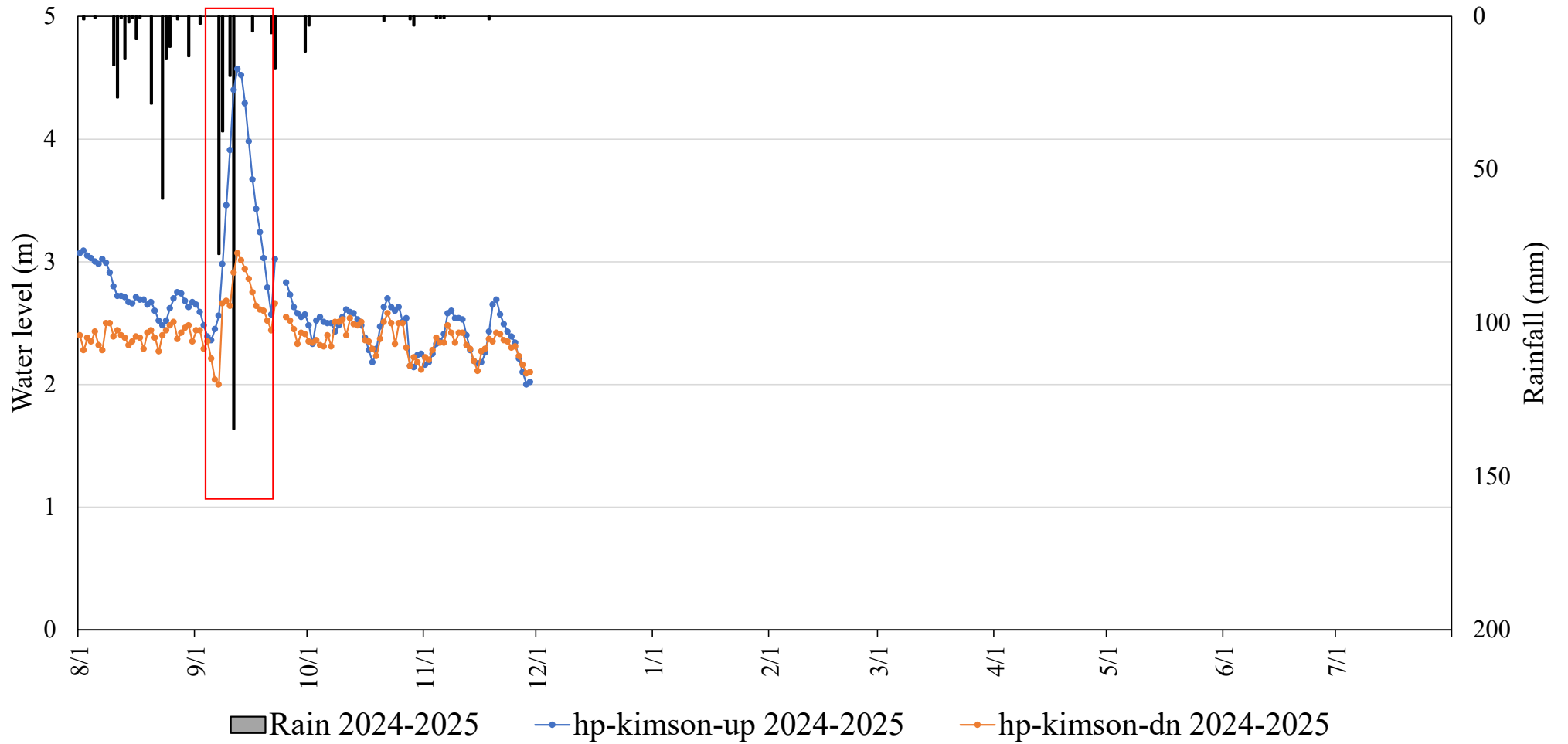
hp-kimson-up & dn 2022-2023



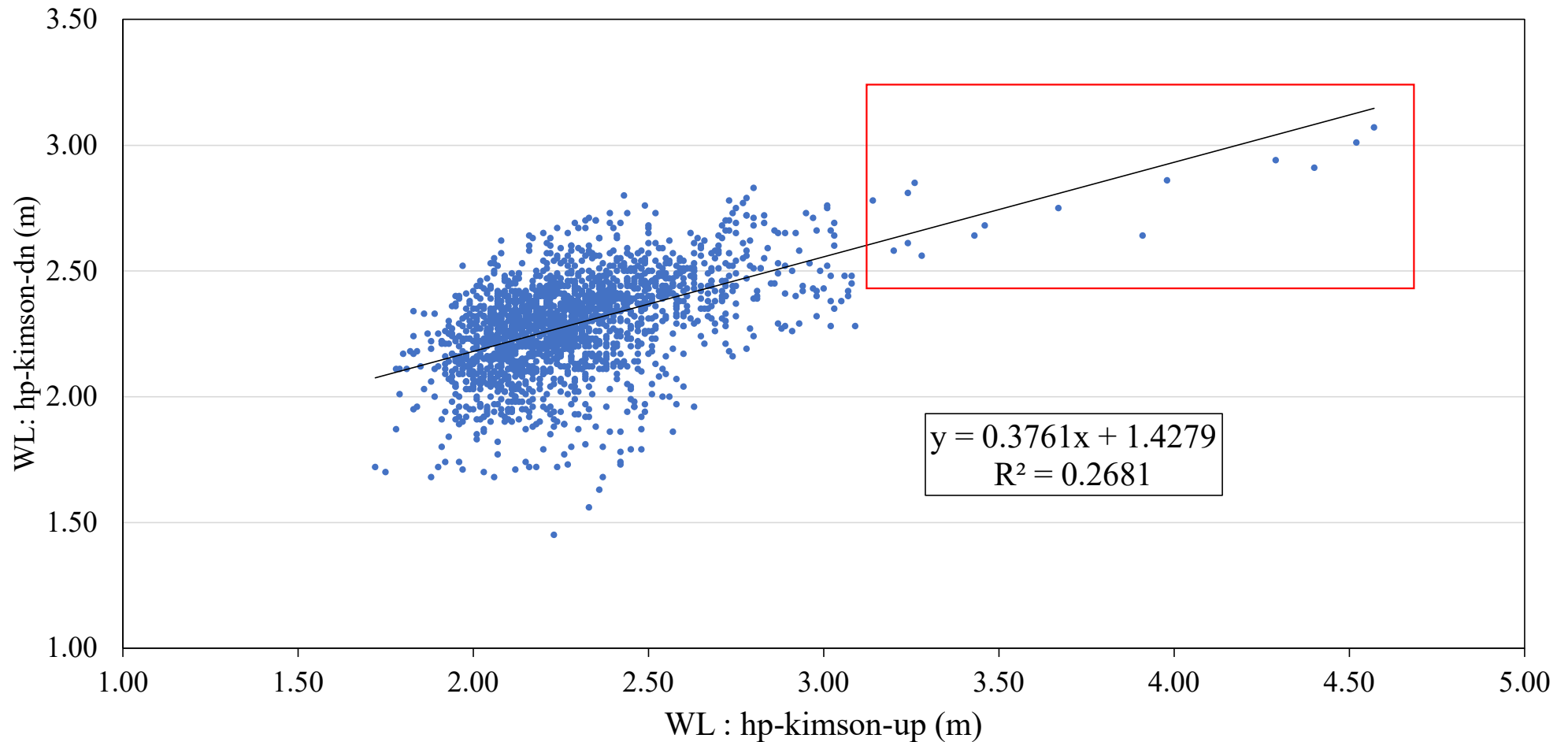
hp-kimson-up & dn 2023-2024



hp-kimson-up & dn 2024-2025

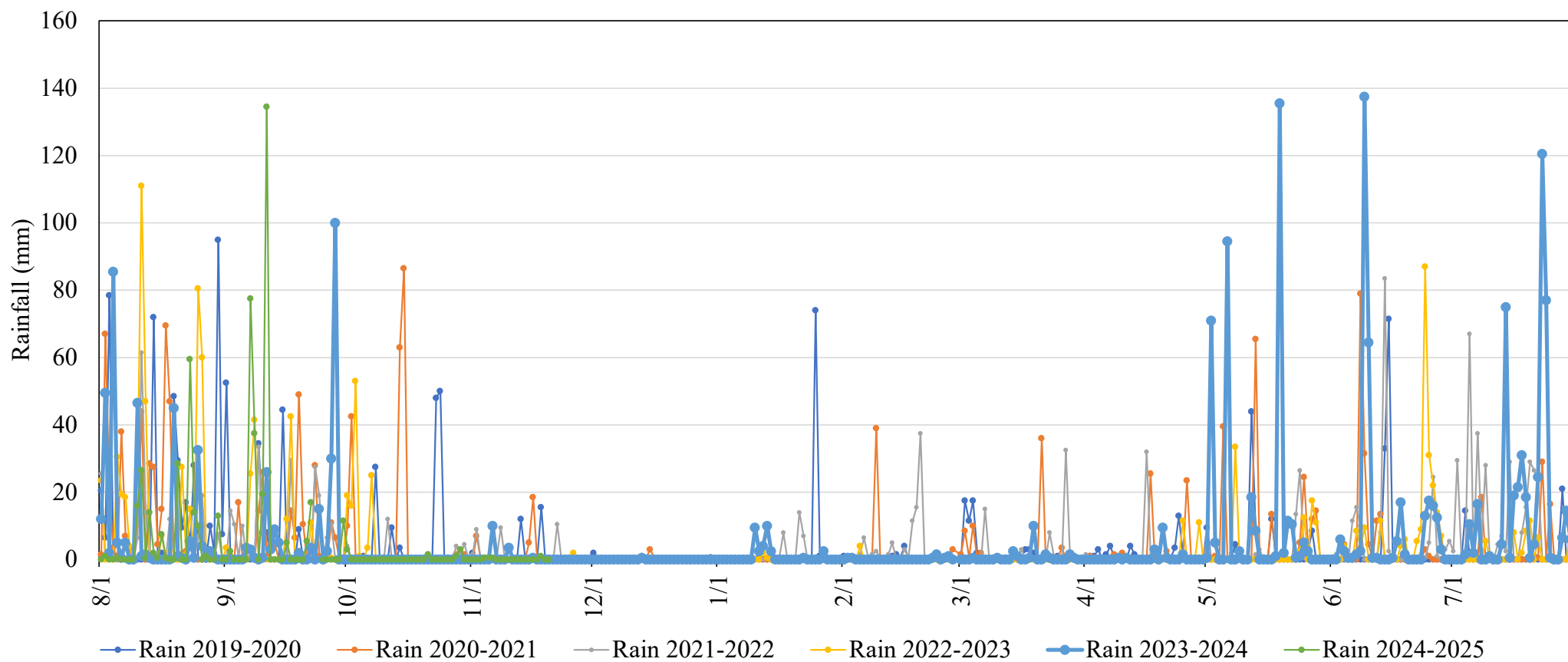


WL relation 2019-2024

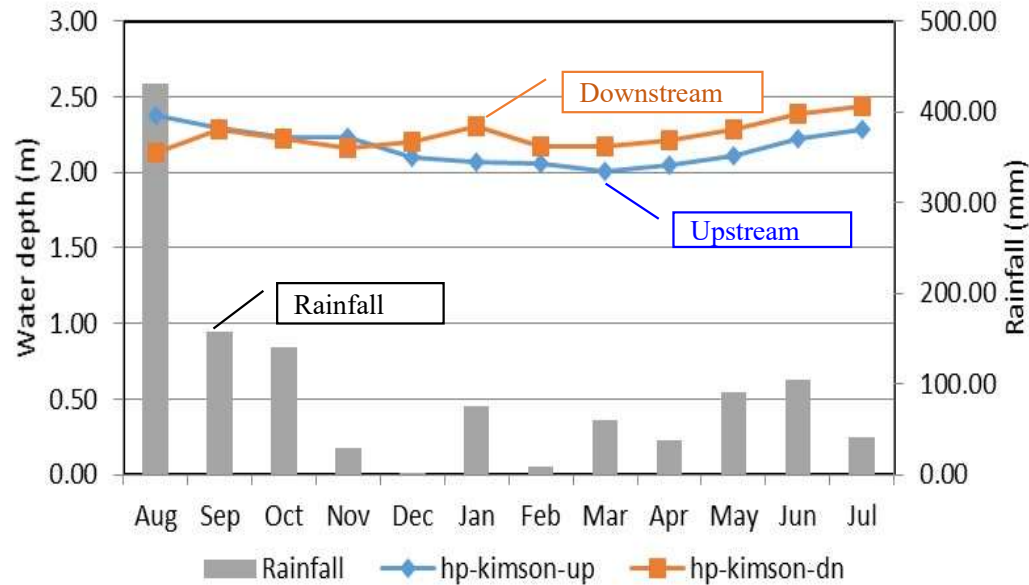


When the water level is high, the upstream and downstream of the gates move in tandem, indicating that the gates are properly controlling the water level of the river when the water level rises.

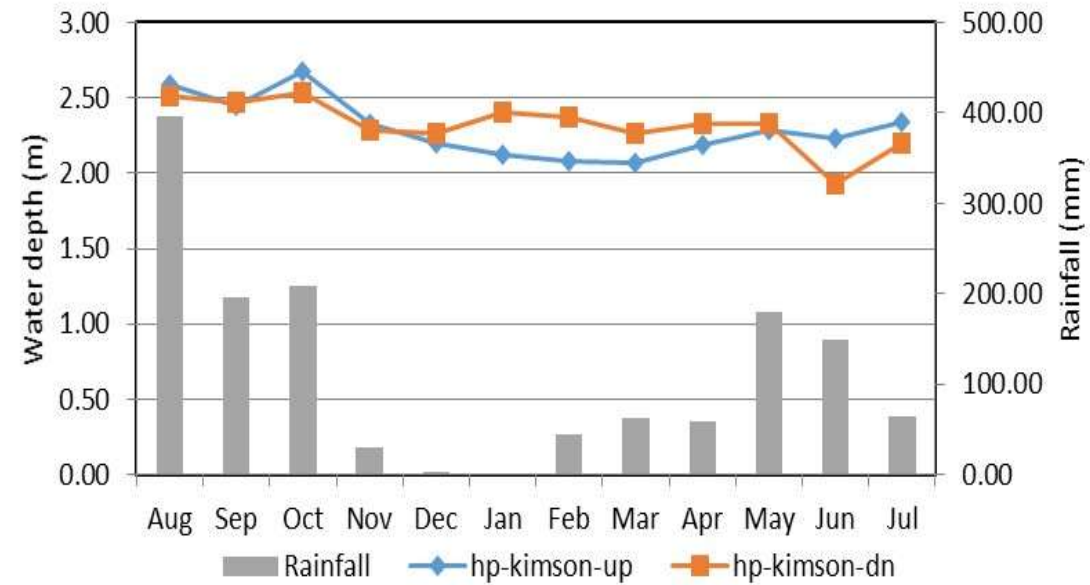
Rain: Kimson gate



Monthly average TM data at Kim Son Gate (2019 - 2021)

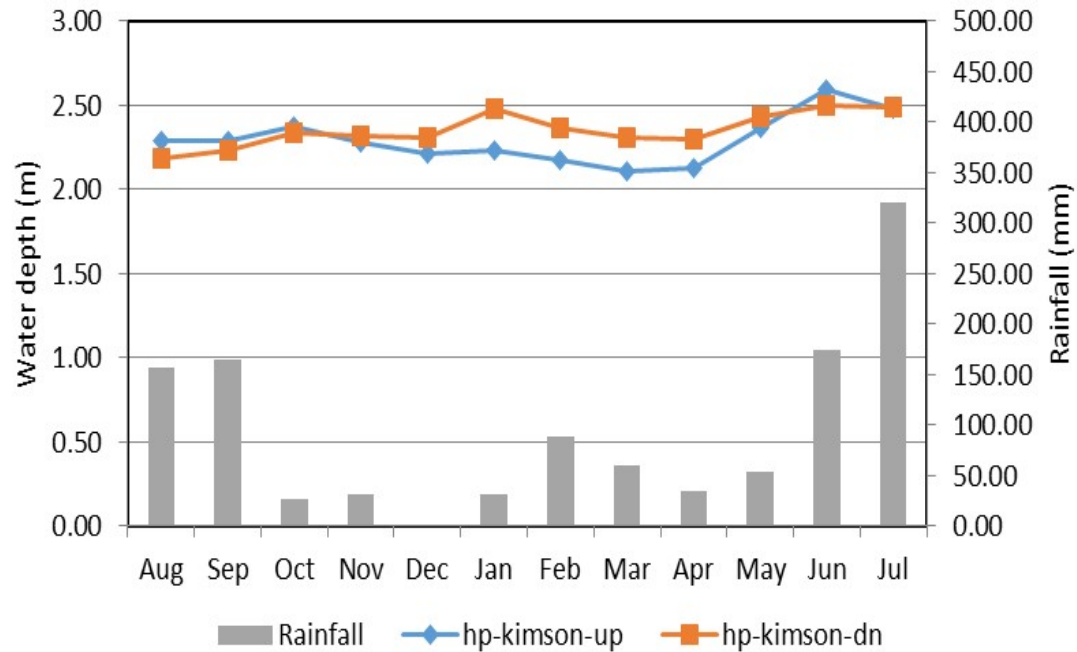


August 1, 2019 to July 31, 2020

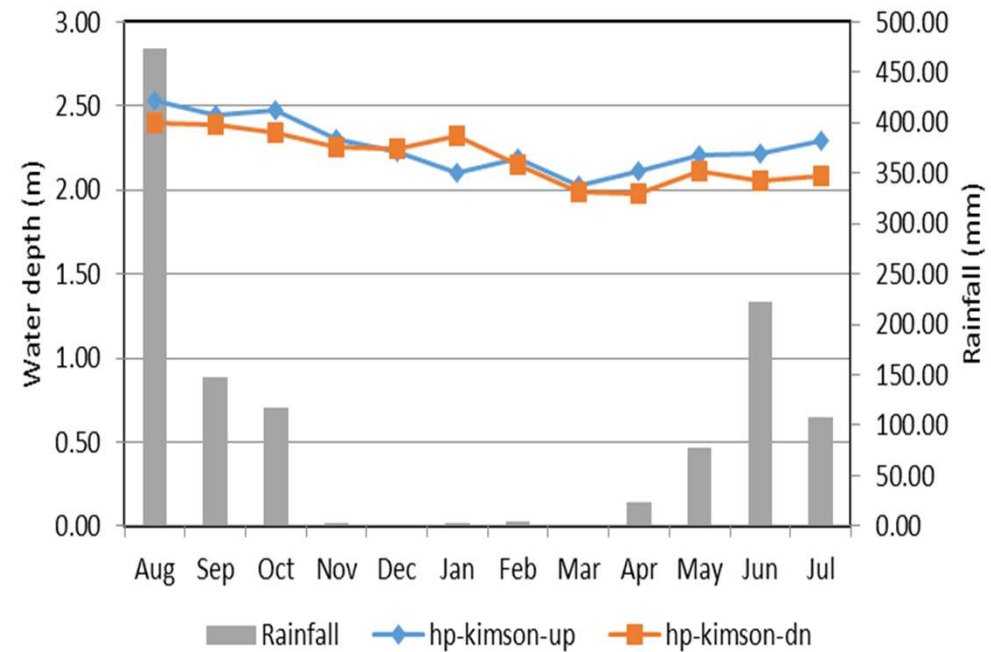


August 1, 2020 to July 31, 2021

Monthly average TM data at Kim Son Gate (2021 - 2023)

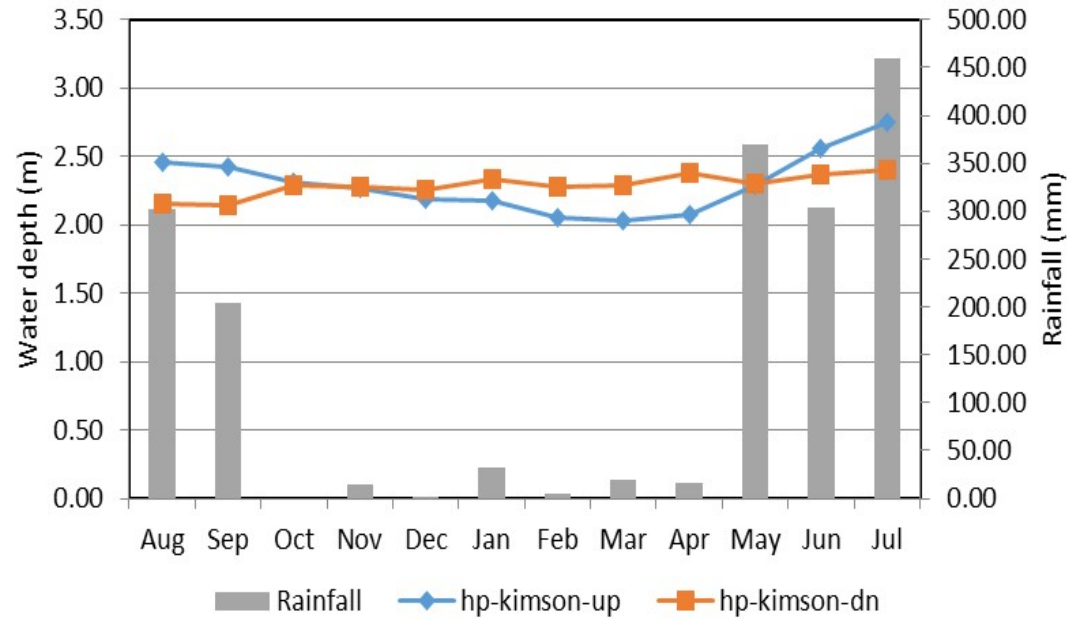


August 1, 2021 to July 31, 2022

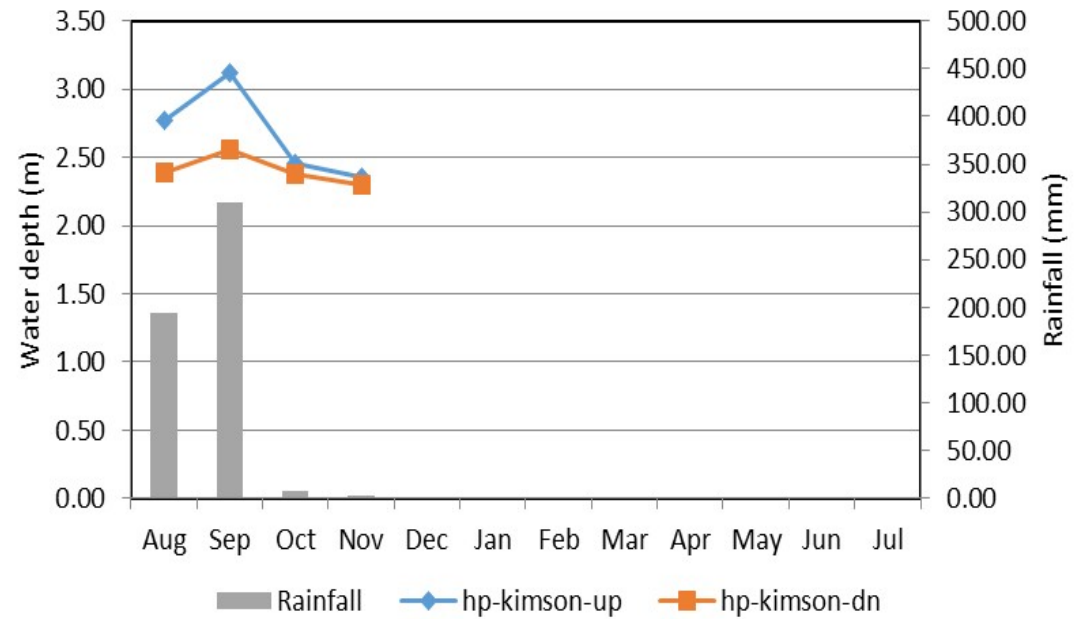


August 1, 2022 to July 31, 2023

Monthly average TM data at Kim Son Gate (2023 - 2025)



August 1, 2023 to July 31, 2024



August 1, 2024 to July 31, 2025

Summary of TM data at Kim Son Gate (2019 - 2024)

Item		Upstream WD (m)	Downstream WD (m)	Rainfall
Average / Total	2019-2020	2.17	2.25	1,182.0 mm/year
	2020-2021	2.29	2.32	1,393.5 mm/year
	2021-2022	2.29	2.35	1,144.0 mm/year
	2022-2023	2.26	2.19	1,180.0 mm/year
	2023-2024	2.30	2.29	1,722.5 mm/year
Maximum	2019-2020	2.98	2.73	95.0 mm/day
	2020-2021	3.03	2.79	86.5 mm/day
	2021-2022	3.26	2.85	83.5 mm/day
	2022-2023	3.08	2.67	111.0 mm/day
	2023-2024	3.28	2.63	137.5 mm/day
Minimum	2019-2020	1.72	1.72	-
	2020-2021	1.79	1.97	-
	2021-2022	1.83	1.90	-
	2022-2023	1.75	2.19	-
	2023-2024	1.81	1.79	-
Number of days when the water depth of downstream exceeded that of upstream	2019-2020	267 days (73% per year)		
	2020-2021	223 days (61% per year)		
	2021-2022	256 days (70% per year)		
	2022-2023	126 days (35% per year)		
	2023-2024	202 days (55% per year)		

ADCA3
New Tinh Thuy Gate
Nhu Kieu Gate

1. Outline of Phase 3 study (almost same as Phase 2)

(1) Background and purpose

- In order to enhance the productivity of existing land and food security, a high priority should be placed on irrigation modernization and improved water resources management.
- Recently, with the rapid expansion of mobile phone networks in the country, the CDMA and GPRS (GSM) mobile internet and SMS facilities are available even in remote area.
- ADCA, assigned by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, intends to verify a precise and low-cost telemetry system which uses the mobile internet for the improvement of water management.
- With the agreement and support of VAWR, ADCA will decide a model site where the recommendable system will be verified.
- If the verification activity is successful, the possibility to disseminate the system in irrigation areas by Japanese ODA will be examined.

(2) Budget

Commissioned by the Ministry of Agriculture, Forestry and Fisheries, Japan

(3) Study schedule

Total 3 years from FY 2022 to FY 2024

JFY	Activities	Remarks
2022	• Selecting a model site • Signing of ‘Minutes of Discussion’	• Decision of a model site • Signing of MOD
2023	• Installation of new equipment • Monitoring of data • Study on ICD data integration system	• Monitoring and study
2024	• Verification of the study • Preparing a report on the verified ICD data integration system	• Evaluation of the system

JFY: Japanese fiscal year

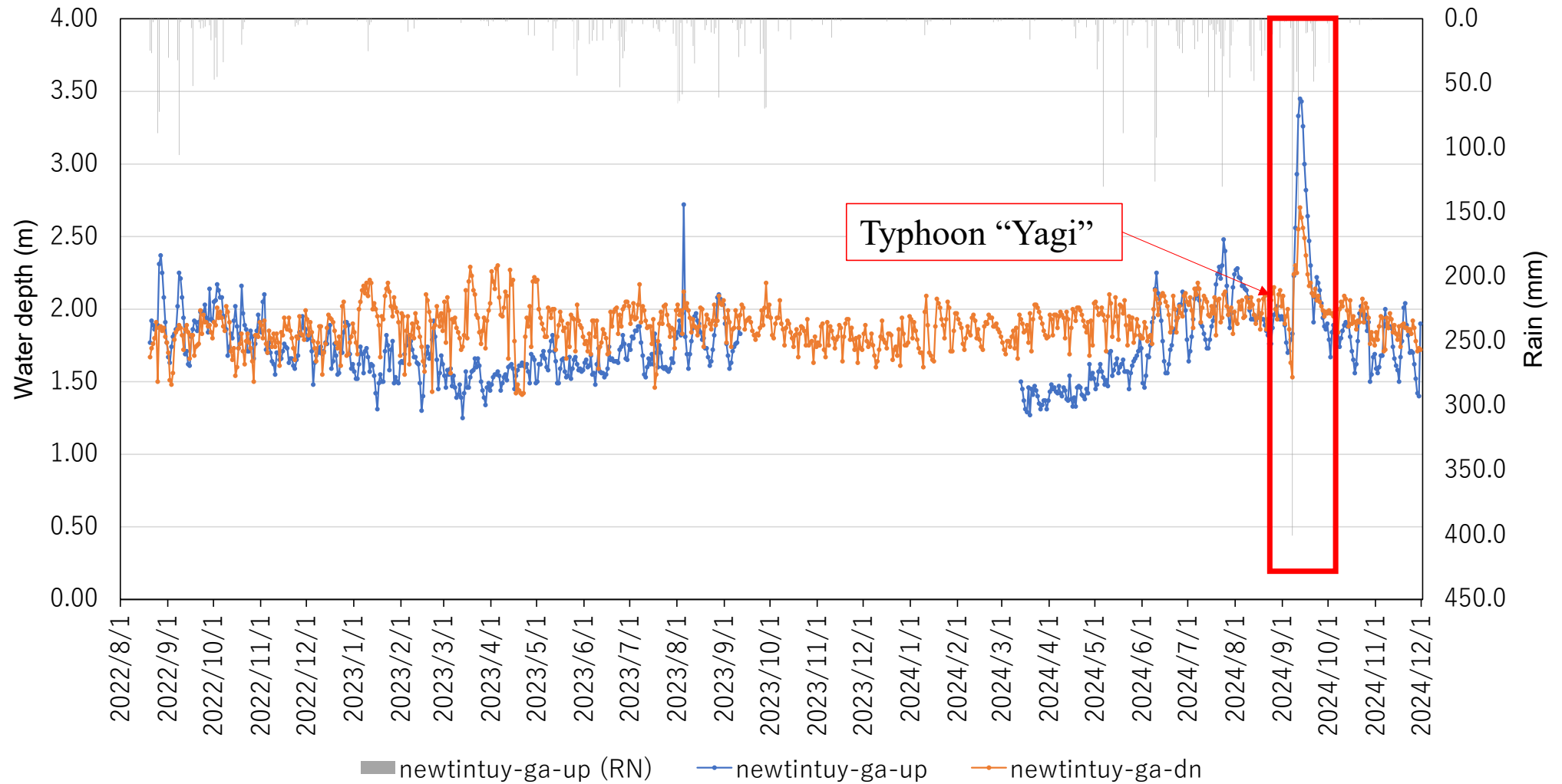
(4) Equipment

- Effective use of existing TMs
- New ICT field equipment

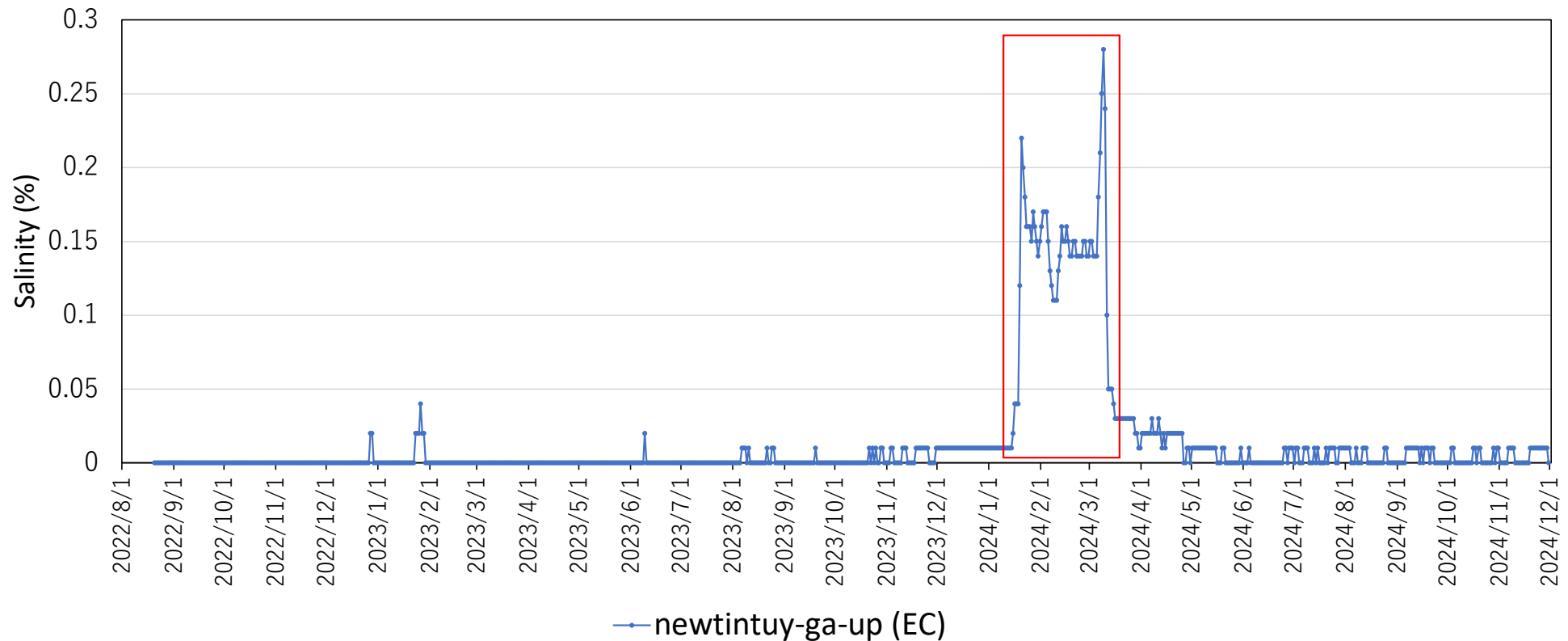
New Tinh Thuy Gate



TM water depth data of New Tinh Thuy Gate from 1 Aug 2022 – 30 Nov 2024

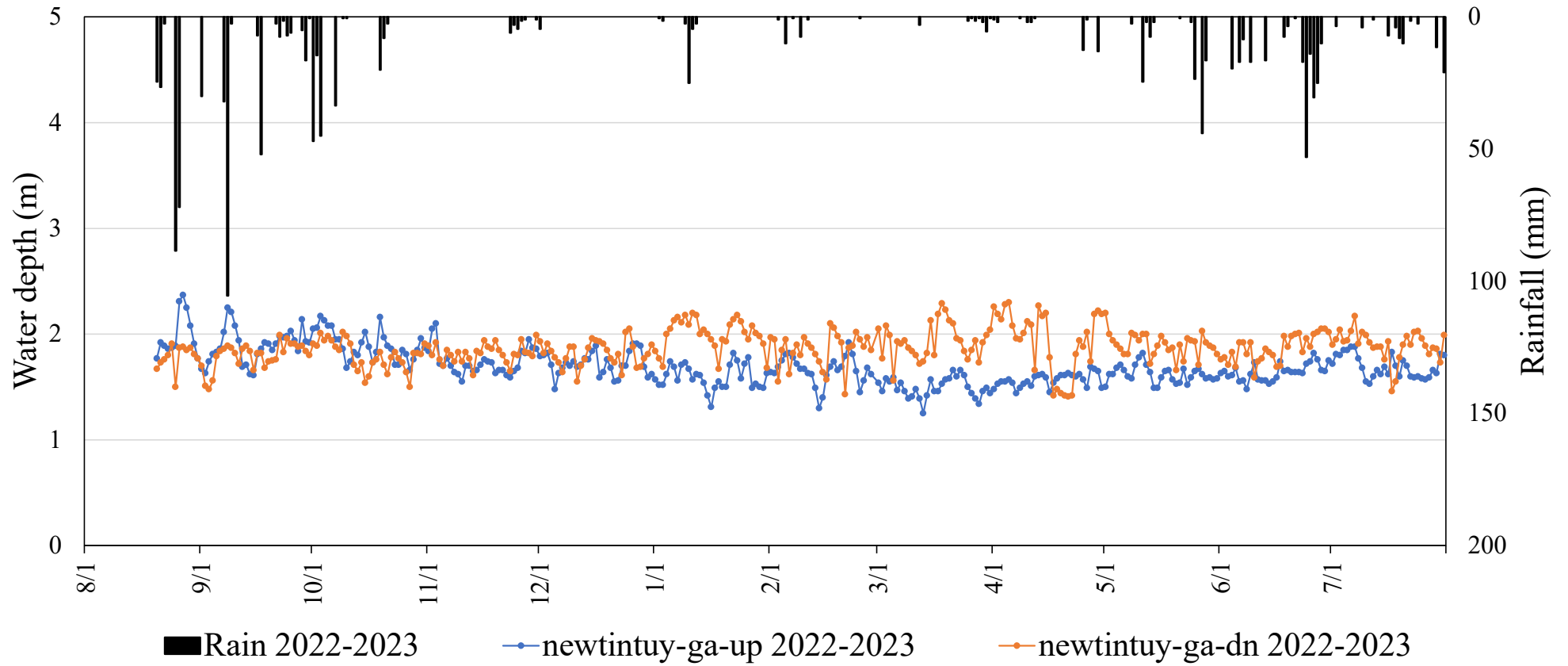


TM EC data of New Tinh Thuy Gate from 1 Aug 2022 – 30 Nov 2024

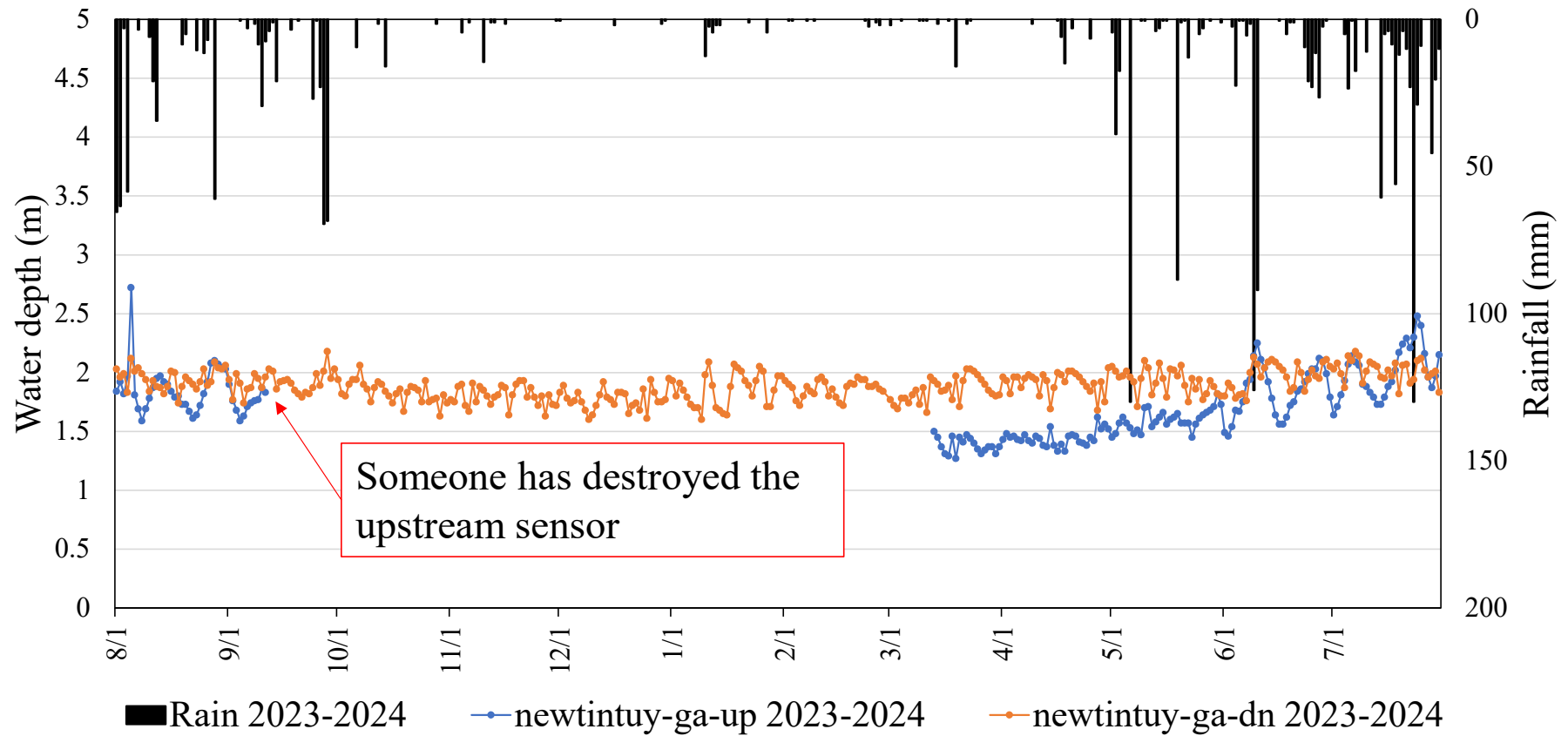


If an **abnormal EC** value occurs, it is assumed that some substance has gathered around the sensor or that the sensor is abnormal. The reason why the value returns to normal after an abnormality occurs cannot be identified. If an abnormality occurs, it is recommended to measure the water quality with a different water quality sensor and inspect the sensor itself.

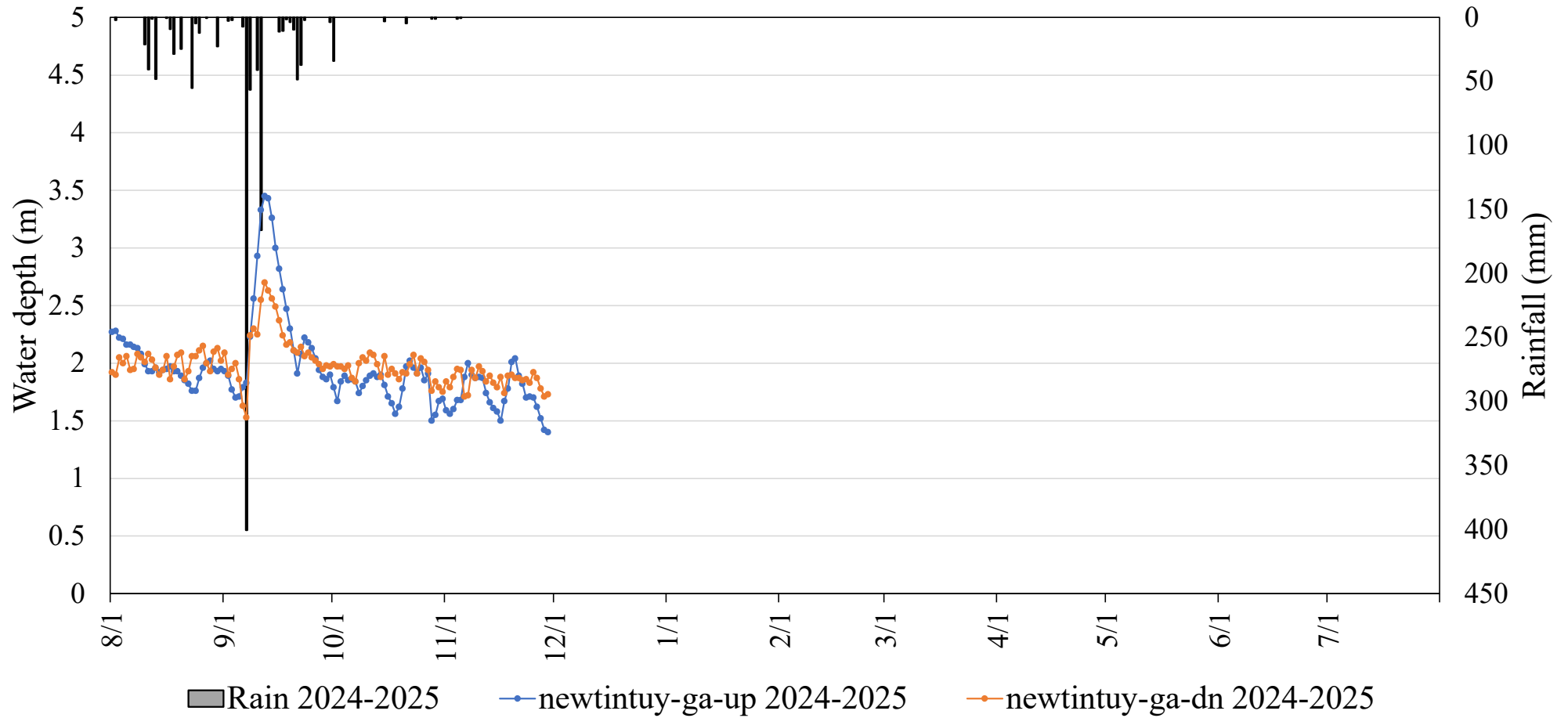
newtintuy-ga-up & dn 2022-2023



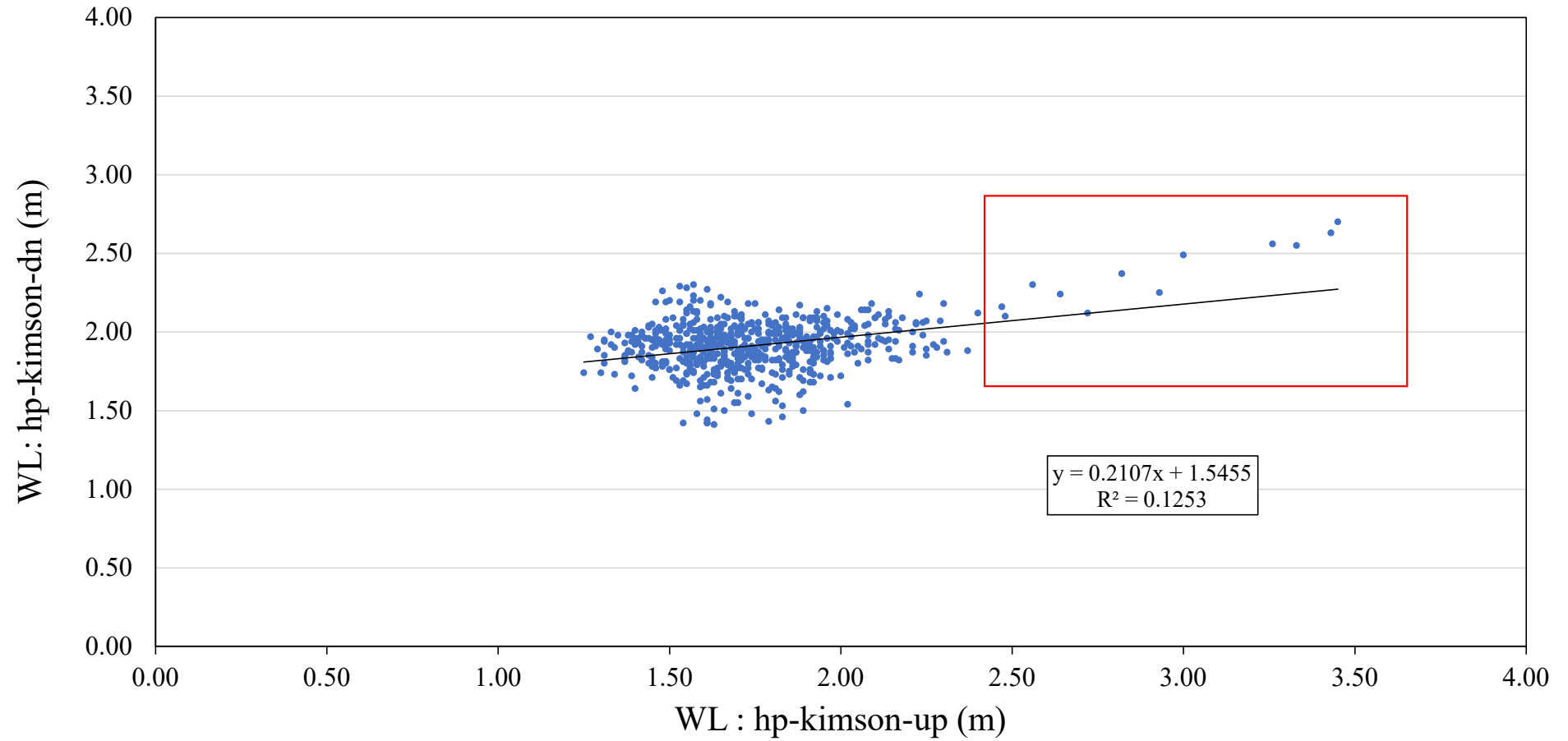
newtintuy-ga-up & dn 2023-2024



newtintuy-ga-up & dn 2024-2025



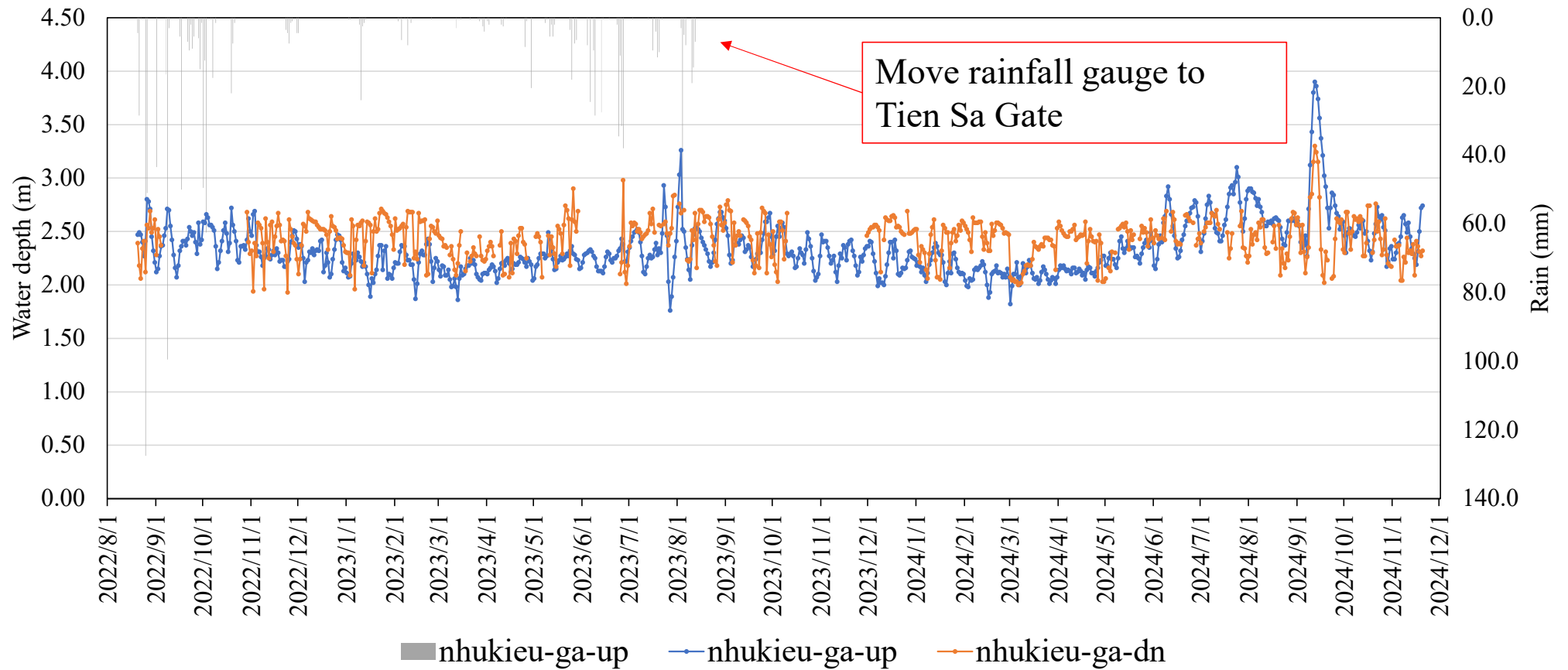
WL relation 2022-2024



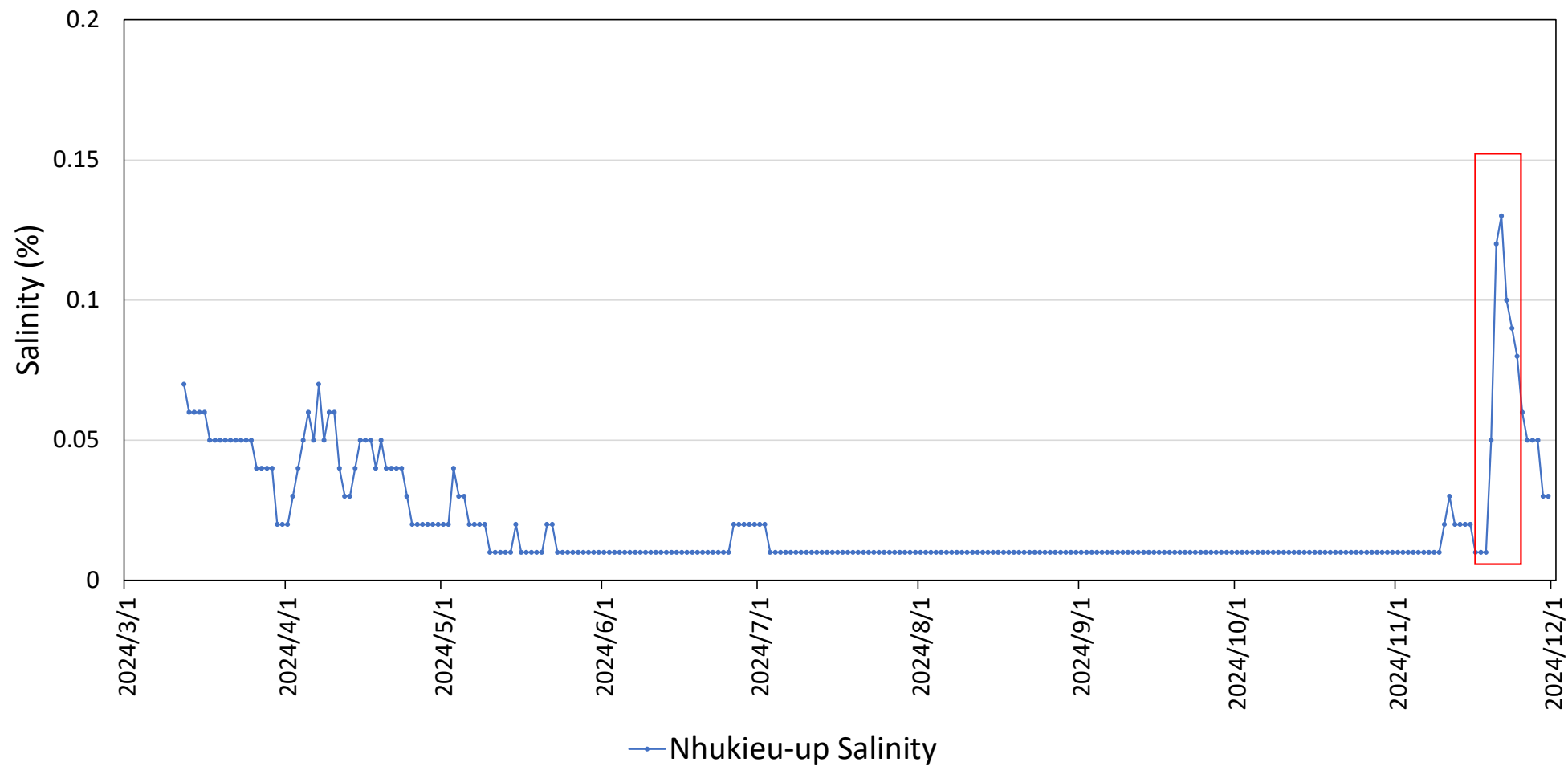
Nhu Kieu Gate



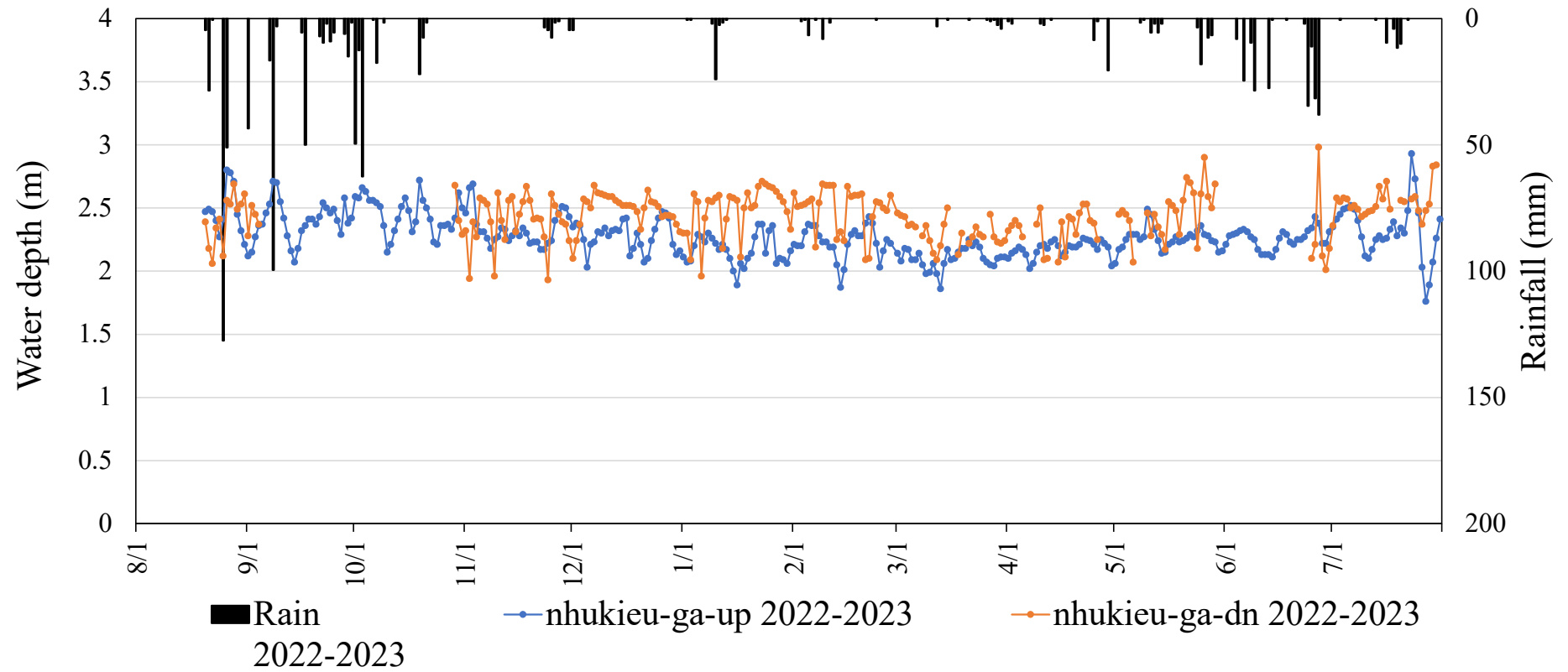
TM water depth data of Nhu Kieu Gate from 1 Aug 2022 – 30 Nov 2024



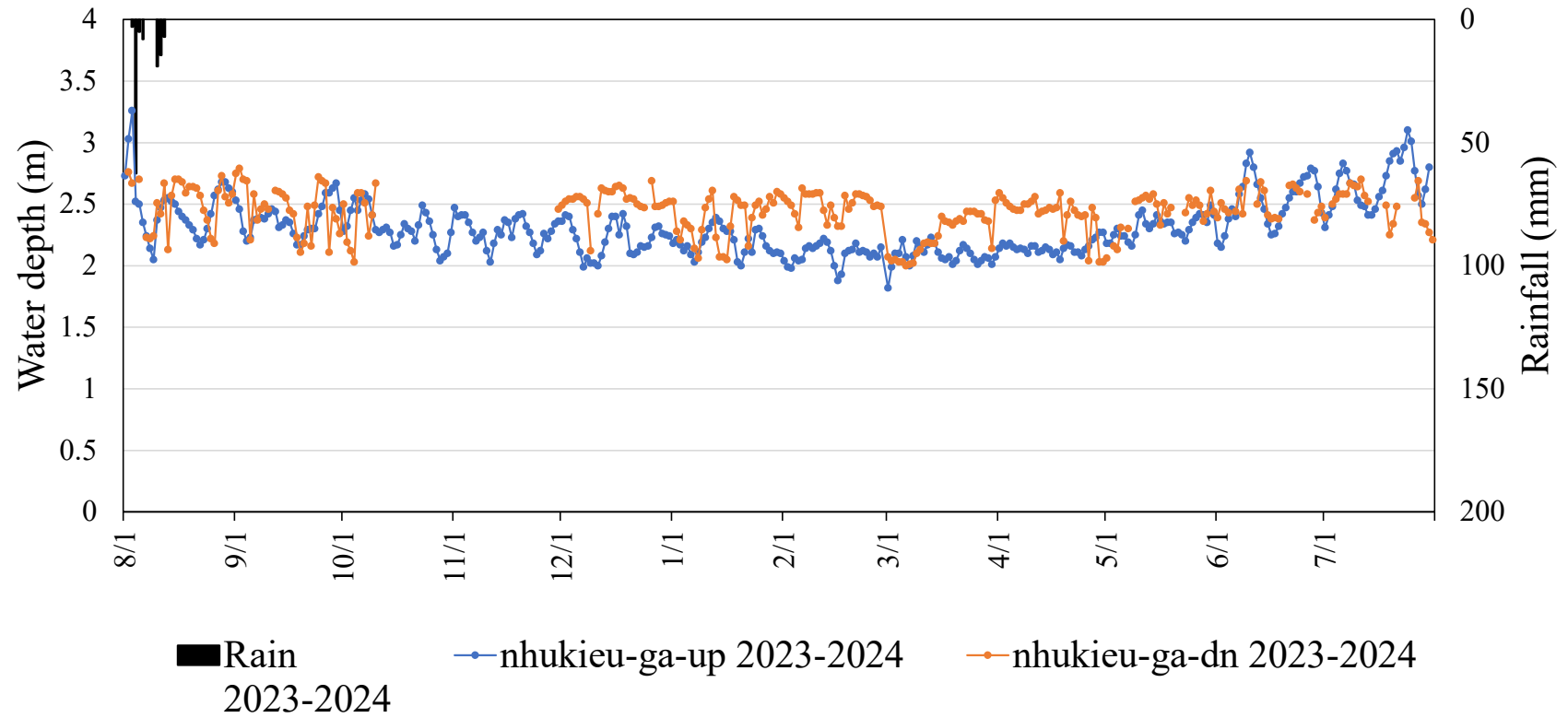
TM EC data of Nhu Kieu Gate from 1 Mar 2024 – 30 Nov 2024



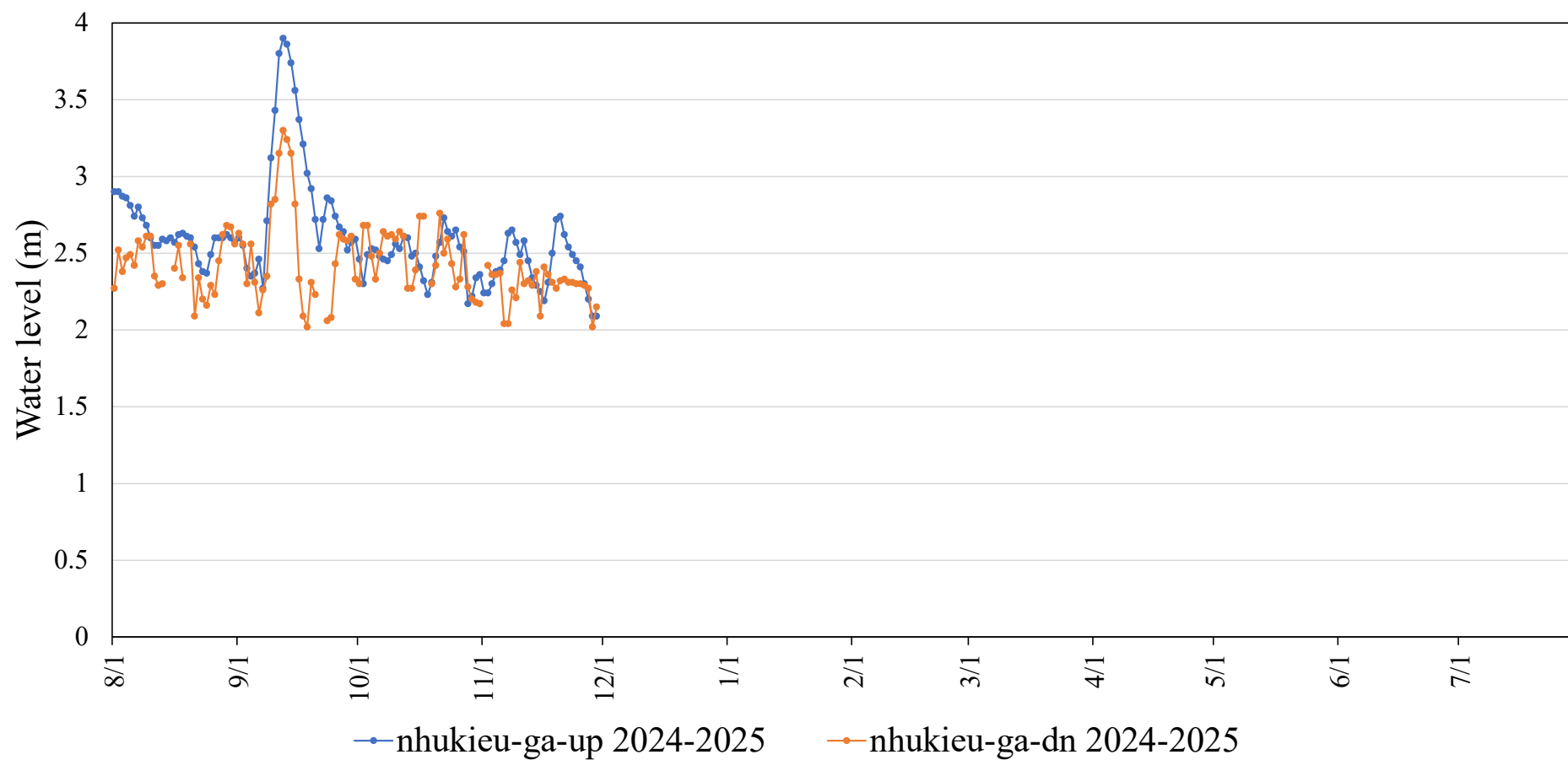
nhukieu-ga-up & dn 2022-2023



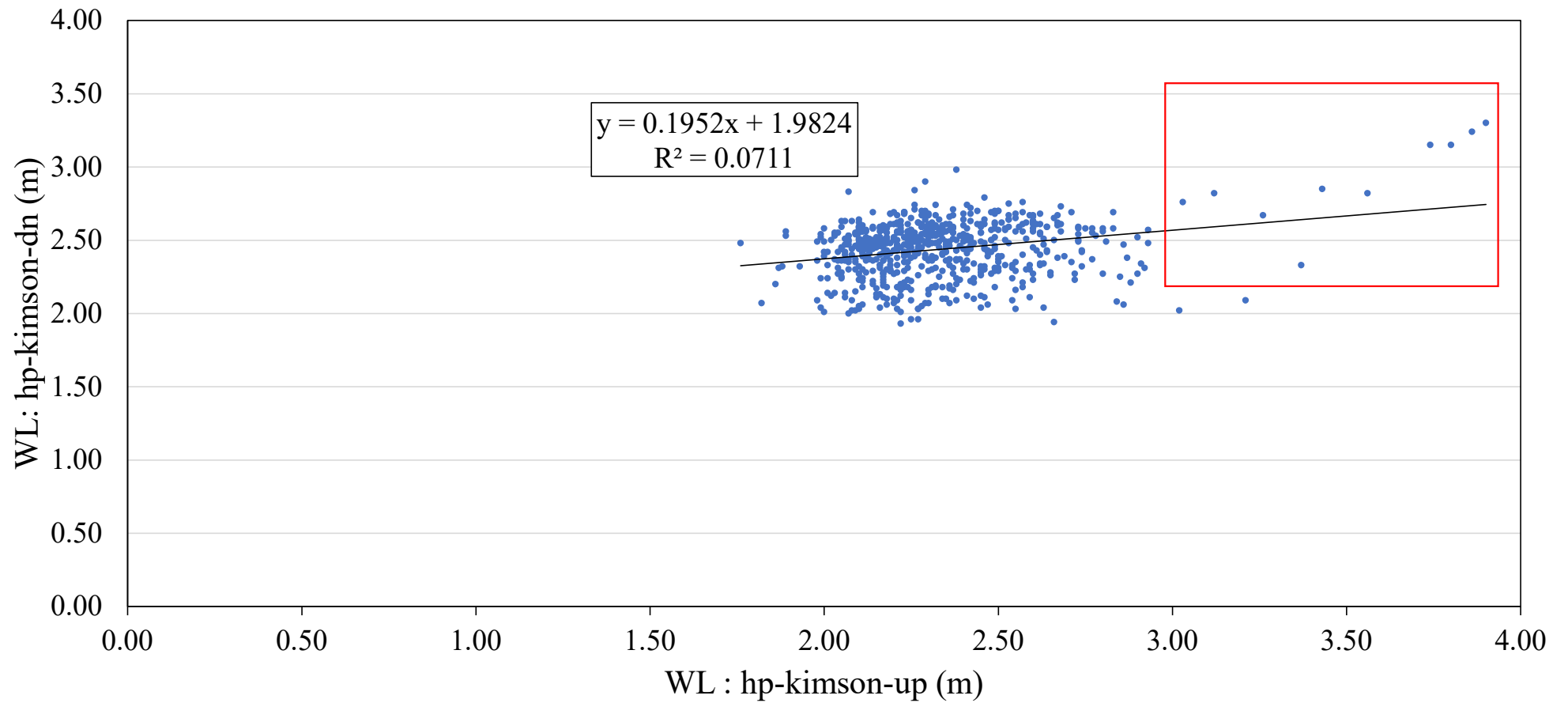
nhukieu-ga-up & dn 2023-2024



nhukieu-ga-up & dn 2024-2025



WL relation 2022-2024



ADCA3

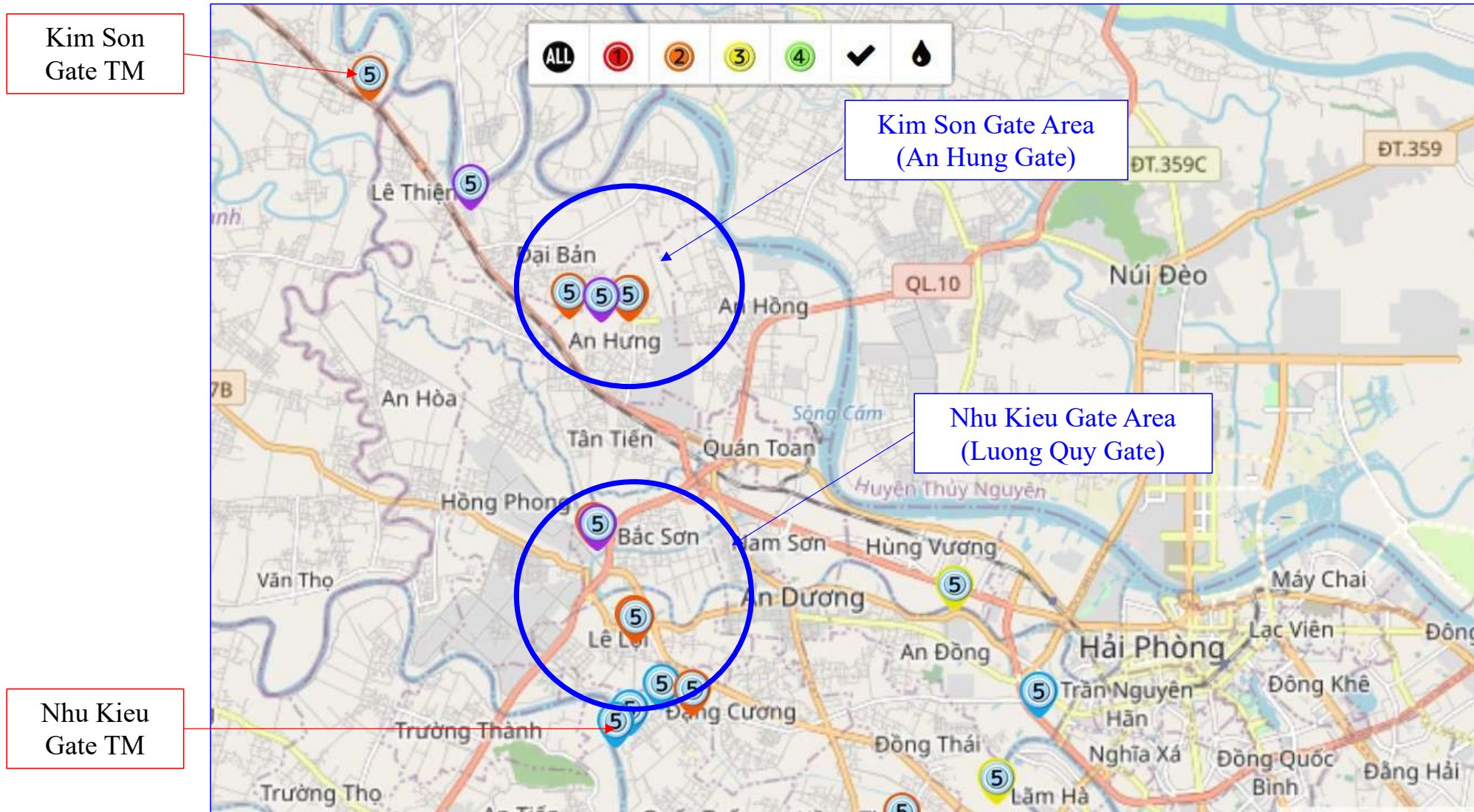
FARMO (LPWA)

&

JAIF2

**(Efficiency enhancement of regional irrigation
water management in gravity irrigation system)**

Location of FARMO equipment



Location of FARMO equipment (detail)

An Hưng Gate (COM)

An Hưng UP (WL)

An Hưng Down (WL)

Đình Nam Pumping Station
(WL)

Lương Quy Gate (COM)

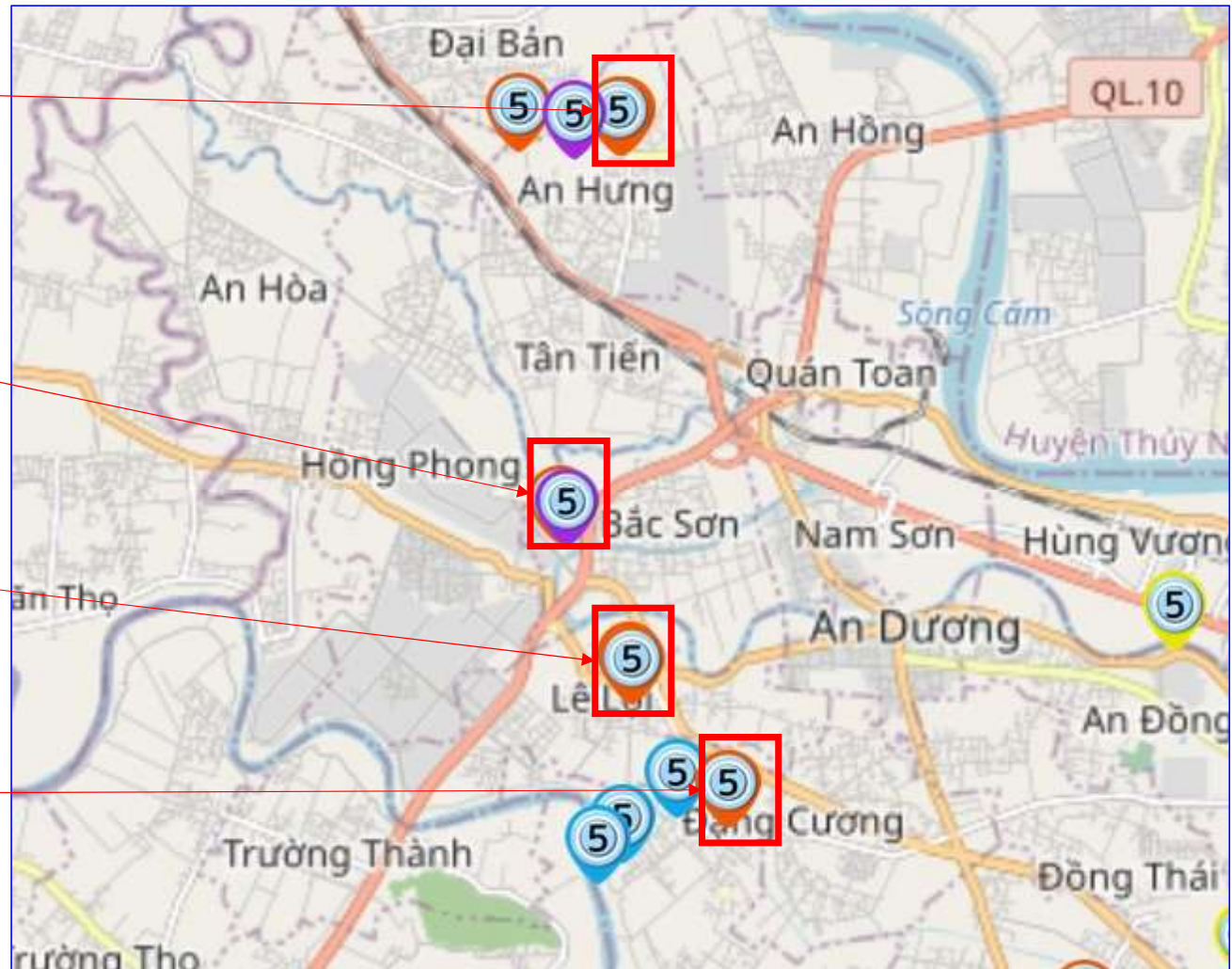
Lương Quy UP (WL)

Lương Quy Down (WL)

Đồng Quang Gate
Đồng Quang Down (WL)

COM: Communication device

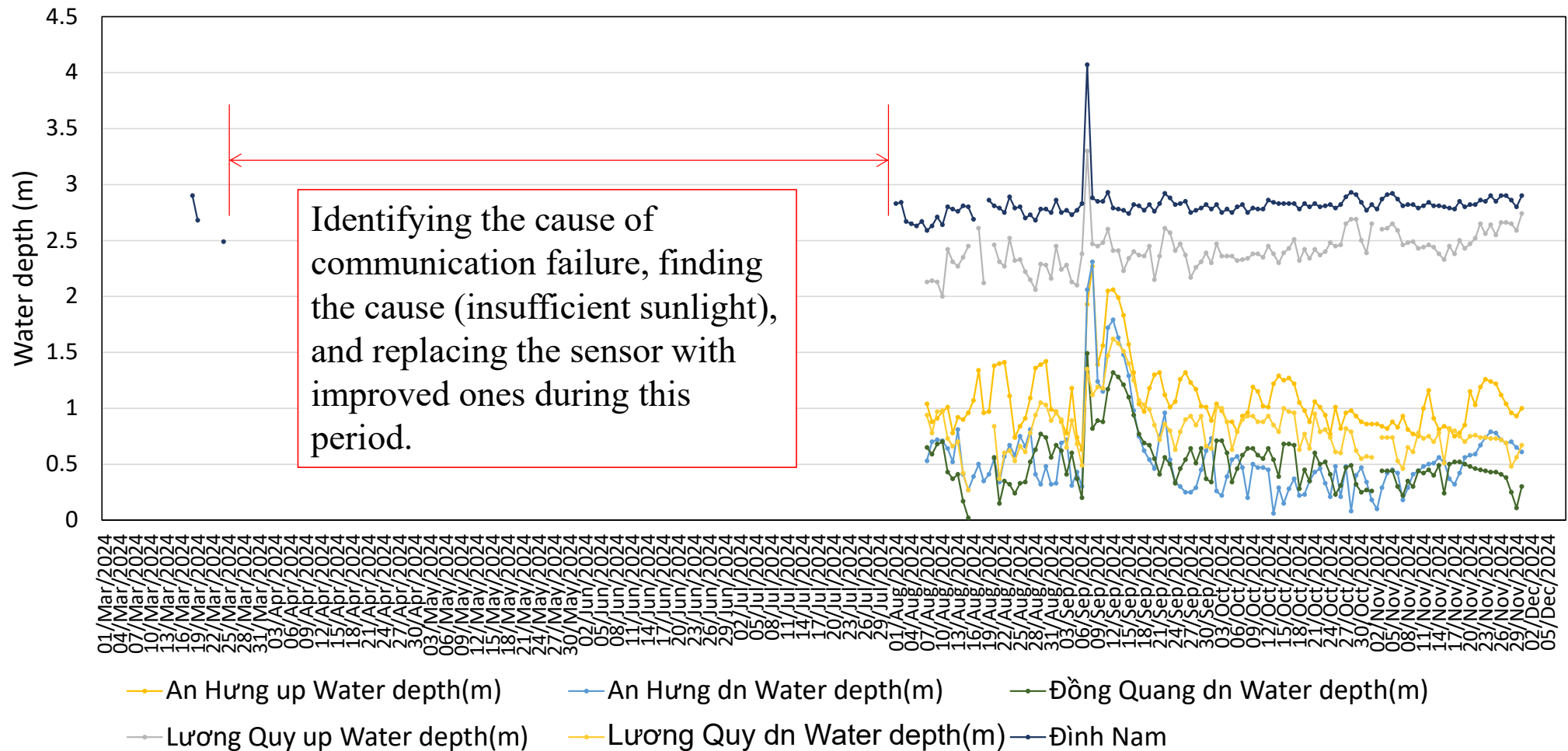
WL: Water level sensor



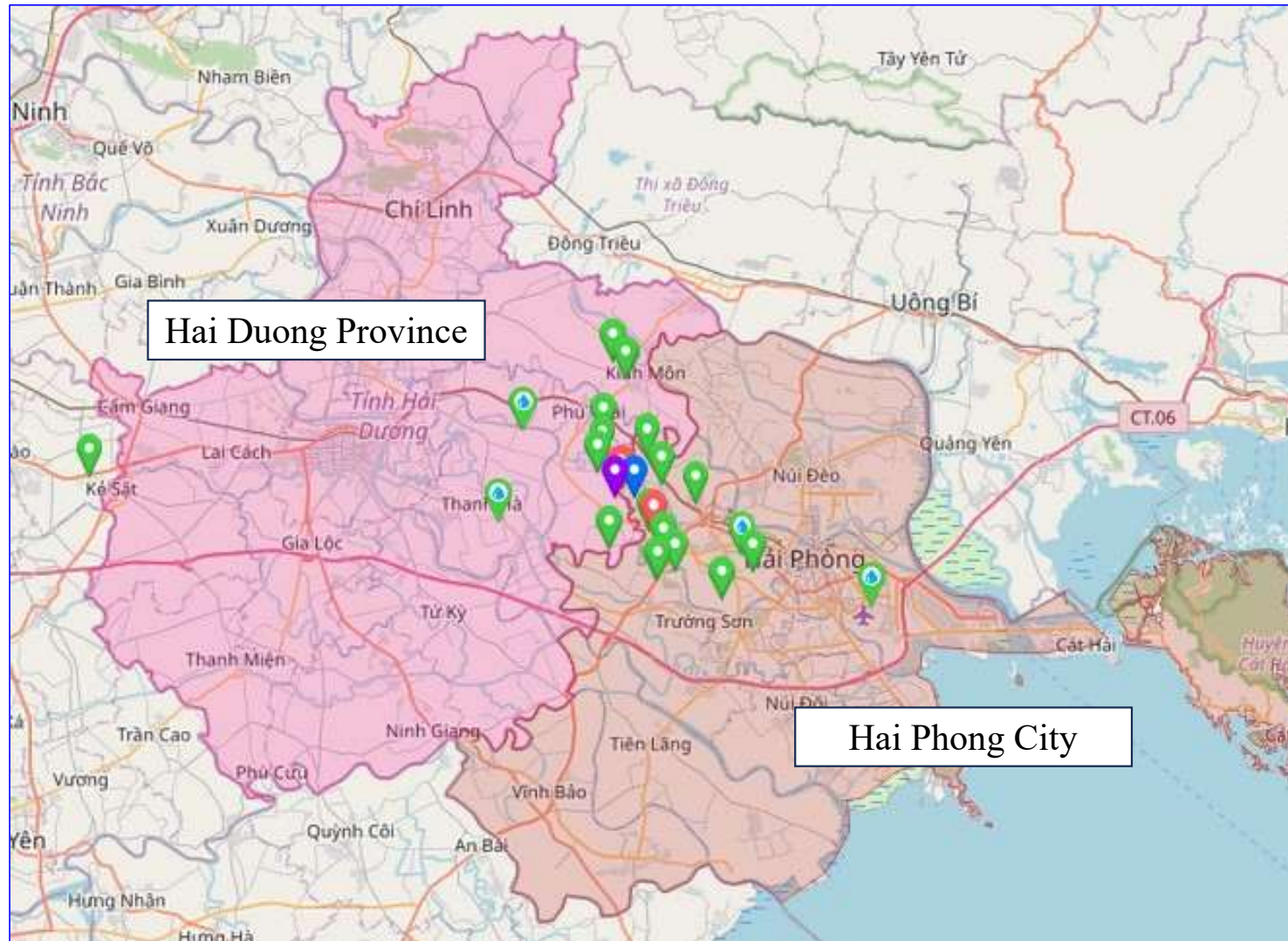
Lương Quy Gate



TM data of FARMO equipment from 1 Mar 2024 – 30 Nov 2024



JAIF2 TM Locations in Hai Phong City and Hai Duong Province



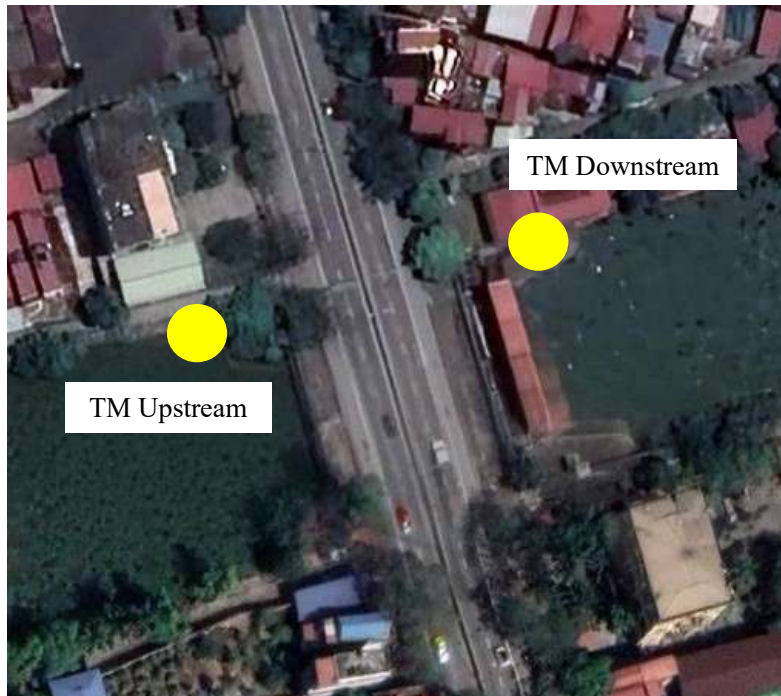
Cai Tat Gate Upstream (WL) / Downstream (Rain & WL): Installed in March 2024



Upstream



Downstream



Training of TM installation from An Hai IMC engineers to Hai Duong IMC engineers.

Use of telemetry equipment from South Nghe An IMC



Control box : 8 (7 for WLS + Rain gauge, 1 for WLS + EC + Rain gauge)

Water level sensor : 6 (Cable L=15m to 30m)

EC sensor : 1

Rain gauge : 5

TM equipment in An Kim Hai irrigation system

Province	No	Name of structure	GPS Latitude (N)	GPS Longitude (E)	Sensor 1 Water level (no)	Sensor 2 Water level 2 (no)	Sensor 3 Rainfall (no)	Sensor 4 Salinity (no)	Sensor 5 CCTV (no)	Control box (no)	Cable length (m)	Hand hole (no)	Remarks
Hai Phong (ADCA2)	1	Kim Son gate	20.945275	106.545097	1	1	1			1	30,50	2	
	2	New Tinh Thuy gate	20.863778	106.549975	1	1	1	1		1	40,40	2	Salty
	3	Nhu Kieu gate	20.841581	106.585961	1	1		1		1	40,40	1	Salty
Hai Phong (JAIF)	1	Cai Tat gate	20.859939	106.65065	1	1	1			2	30,50	2	Salty
	2	Tien Sa gate	20.827794	106.635717	1	1	1			1	30,40	1	Salty
	3	Bai Mam gate	20.930017	106.578725	1	1		1		1	30,40	1	Salty
	4	Song Mai gate	20.89546	106.61544	1	1				2	30,40	2	Salty
	5	An Dong gate	20.850317	106.653017	1	1				1	30,40	1	Salty
	6	Tan Hung Hong gate	20.877187	106.579641	1	1				1	30,40	1	Salty
	7	T3 Regulator	20.918361	106.539606	1	1				1	30,40	1	
	8	Cau Ho bridge	20.899305	106.568589	1	1			1	1	30	1	Salty
	9	Phi Truong A gate	20.822747	106.750031	1		1			2	30,40	2	Salty
	10	Cu gate	20.927969	106.544548	1	1				1	30,40	1	Salty
Hai Duong (JAIF)	11	Quang Dat gate	20.948847	106.482792	1	1	1			2	30,40	2	
	12	An Luu gate	20.9971	106.5527	1	1	1			1	30,40	1	
	13	An Trung gate	21.007457	106.621768	1	1				1	30,40	1	
	14	Song Huong gate	20.8834	106.4646	1	1	1			2	30,40	2	
	15	Cau Sop PS gate	20.915067	106.151124	1	1	1			1	30,20	1	
	16	Tien Kieu PS gate	20.965157	106.279403	1		1			1	30	1	
Total	19				19	17	10	3	1	24		26	

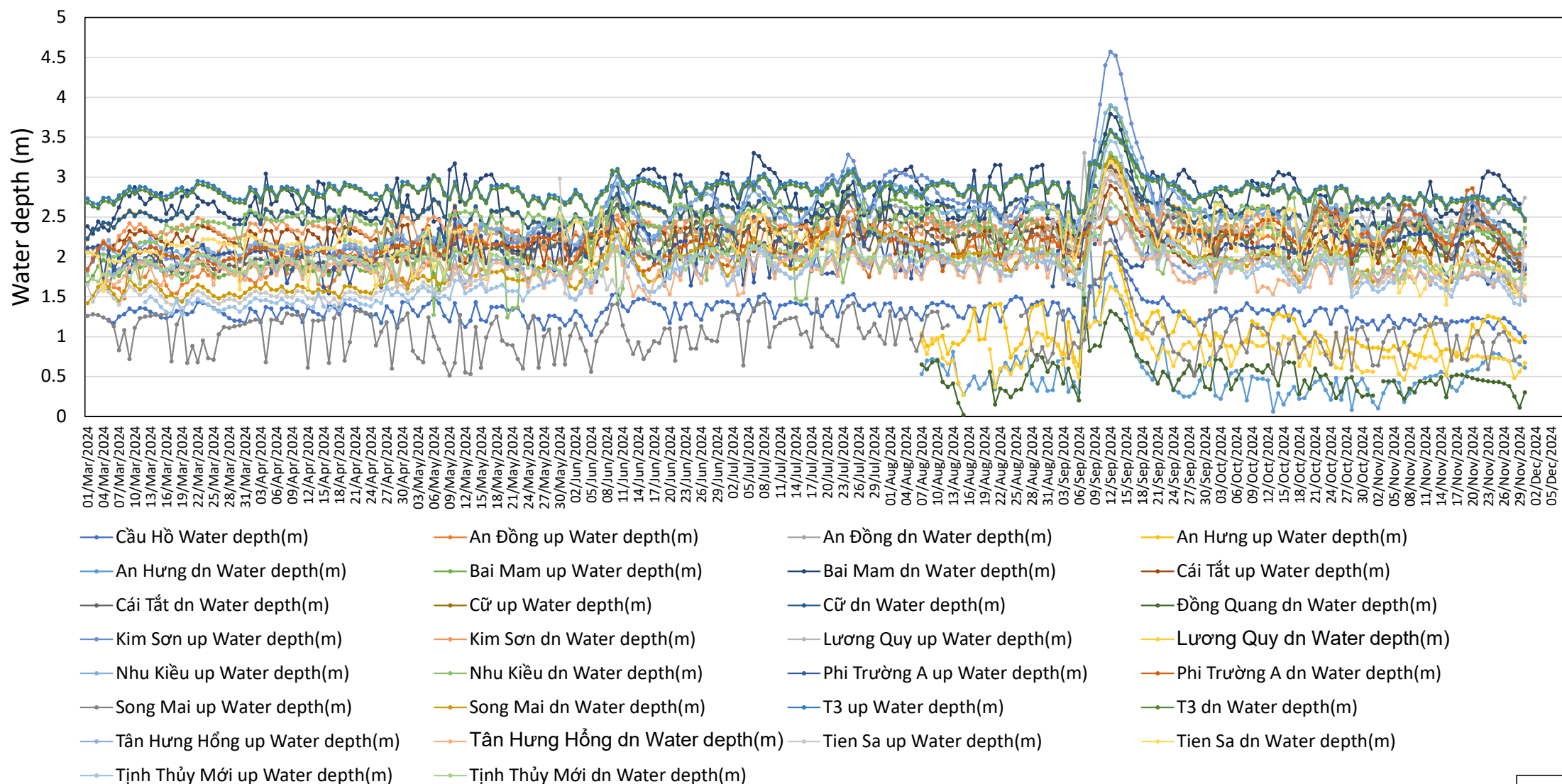
IP address change of communication devices from **South Nghe An IMC**

Province	No	Name of structure	GPS Latitude (N)	GPS Longitude (E)	Sensor 1 Water level (no)	Sensor 2 Water level 2 (no)	Sensor 3 Rainfall (no)	Control box (no)	Cable length (m)	Hand hole (no)	Remarks
Hai Phong (4)	1	Cai Tat gate	20.859939	106.65065	1	1	1	2	30,50	2	Up
	4	Song Mai gate	20.89546	106.61544	1	1		2	30,40	2	Up
	5	An Dong gate	20.850317	106.653017	1	1		1	30,40	1	Gate
	9	Phi Truong A gate	20.822747	106.750031	1	1	1	2	30,40	2	Up
Hai Duong (2)	11	Quang Dat gate	20.948847	106.482792	1	1	1	2	30,40	2	Dn
	14	Song Huong gate	20.8834	106.4646	1	1	1	2	30,40	2	Dn

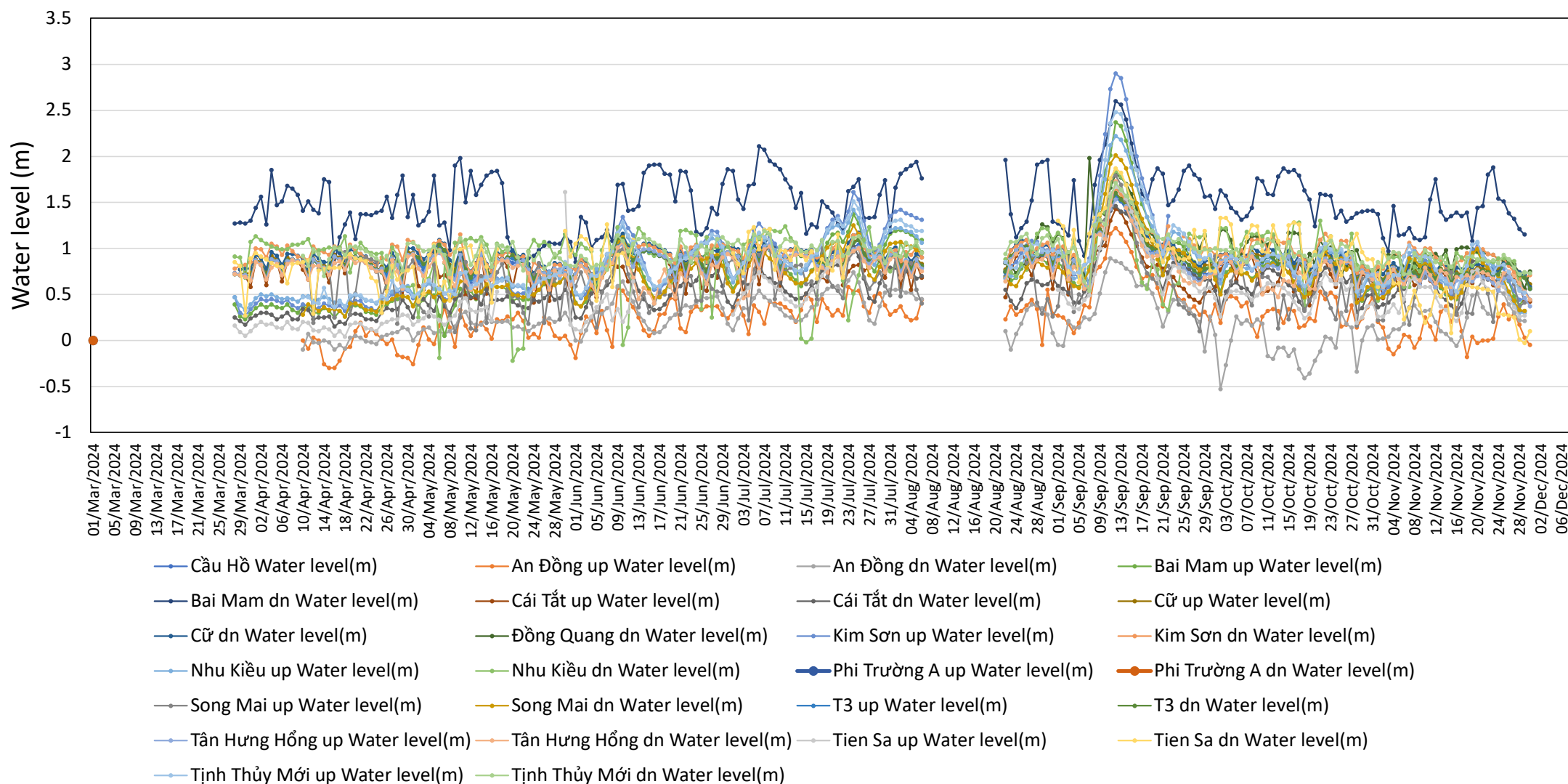
FARMO Equipment

No	Communication Device	Name of Sensor	GPS Latitude (N)	GPS Longitude (E)	Sensor 1 Water level (no)	Sensor 2 Weather (no)	Control box (no)	Battery Box (no)	Remarks
1	Luong Quy Gate	Luong Quy Up			1		1	1	Gate
		Luong Qui Dn			1				Canal
		Dong Quang Dn			1				Gate
		Dinh Nam PS			1				PS
2	An Hung Gate	An Hung Up			1		1	1	Gate
		An Hung Dn			1				PS
3	An Hoa PC	An Hoa PC				1	1	1	Canal
		An Hoa PS Up			1				PS
		An Hoa PS Dn			1				Canal
	Total				8	1	3	3	

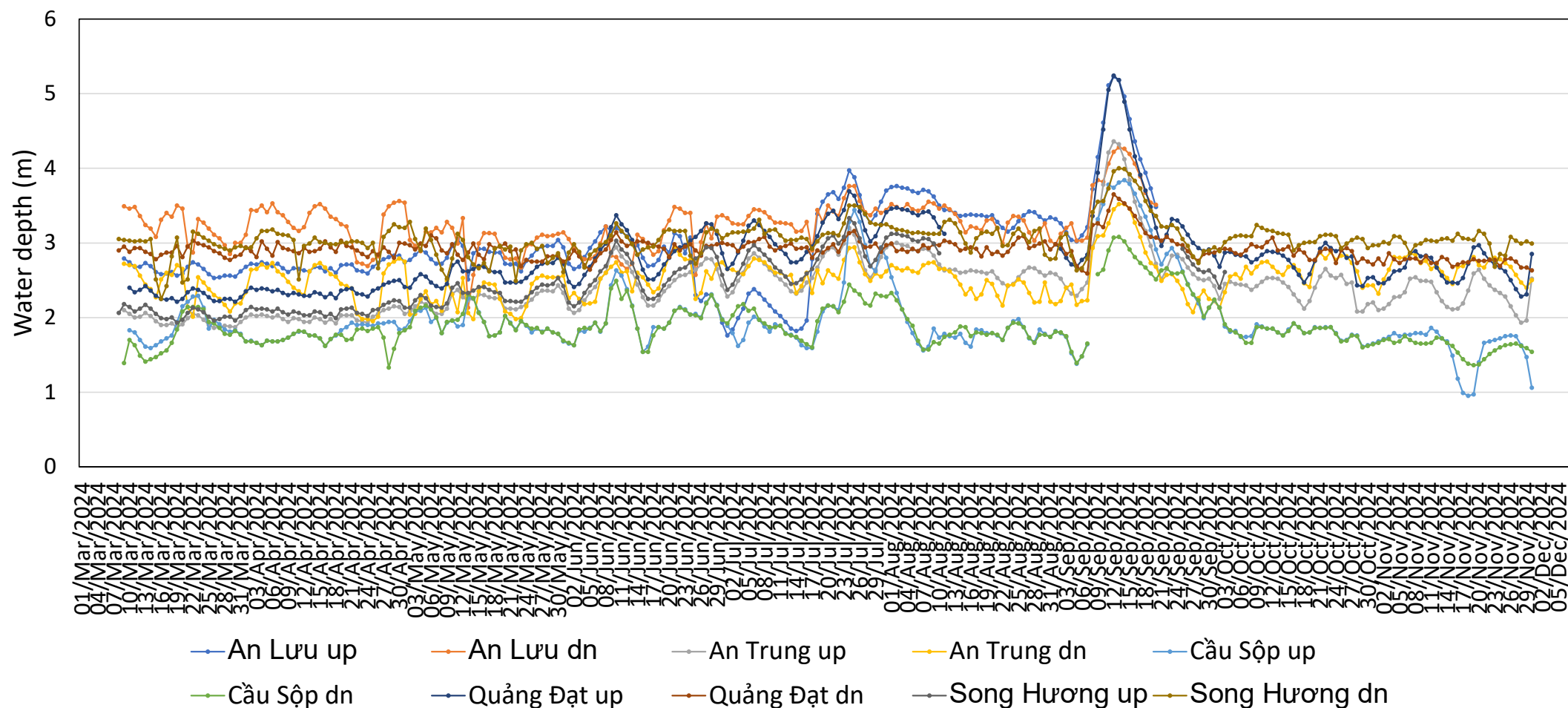
Water depth trend in An Hai IMC from 1 March to 30 November, 2024



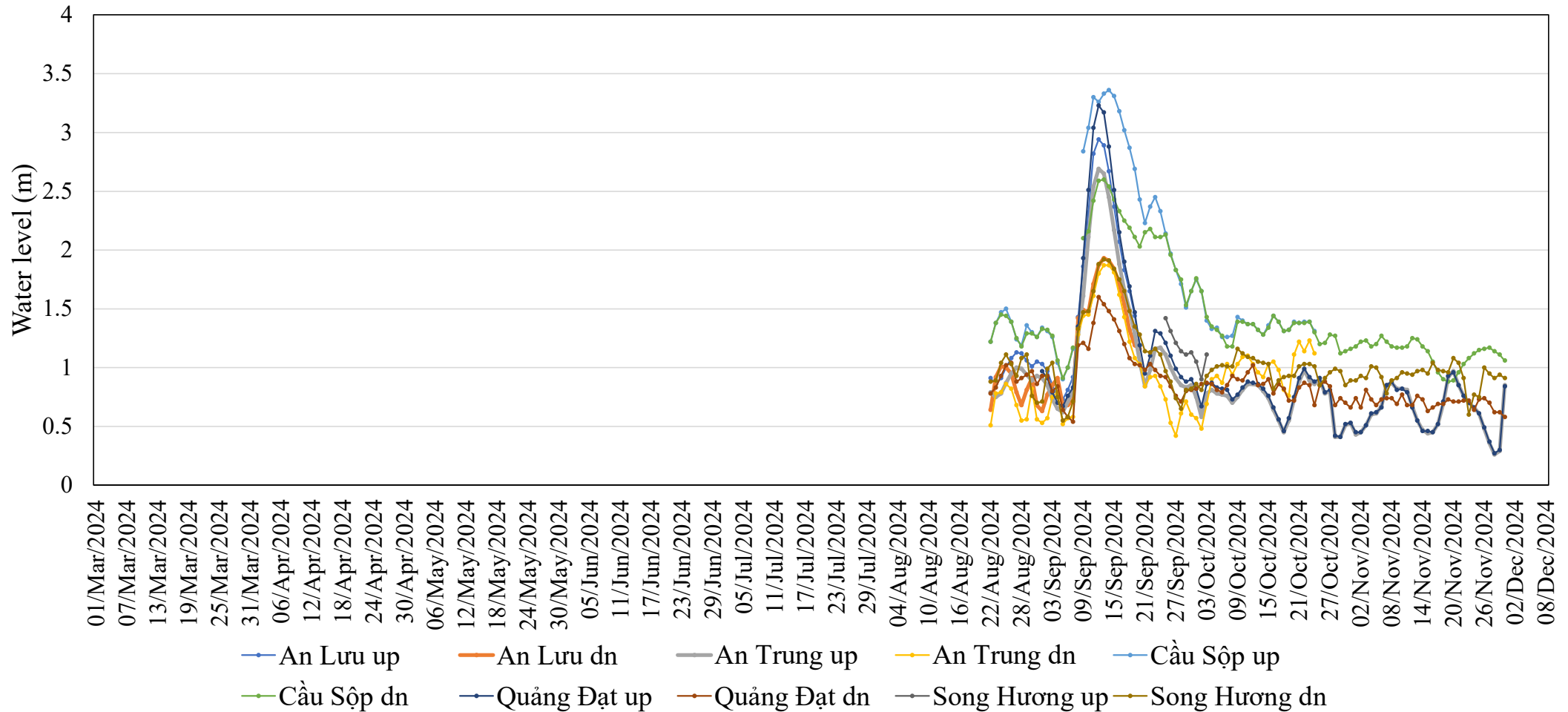
Water level trend in An Hai IMC from 1 March to 30 November, 2024



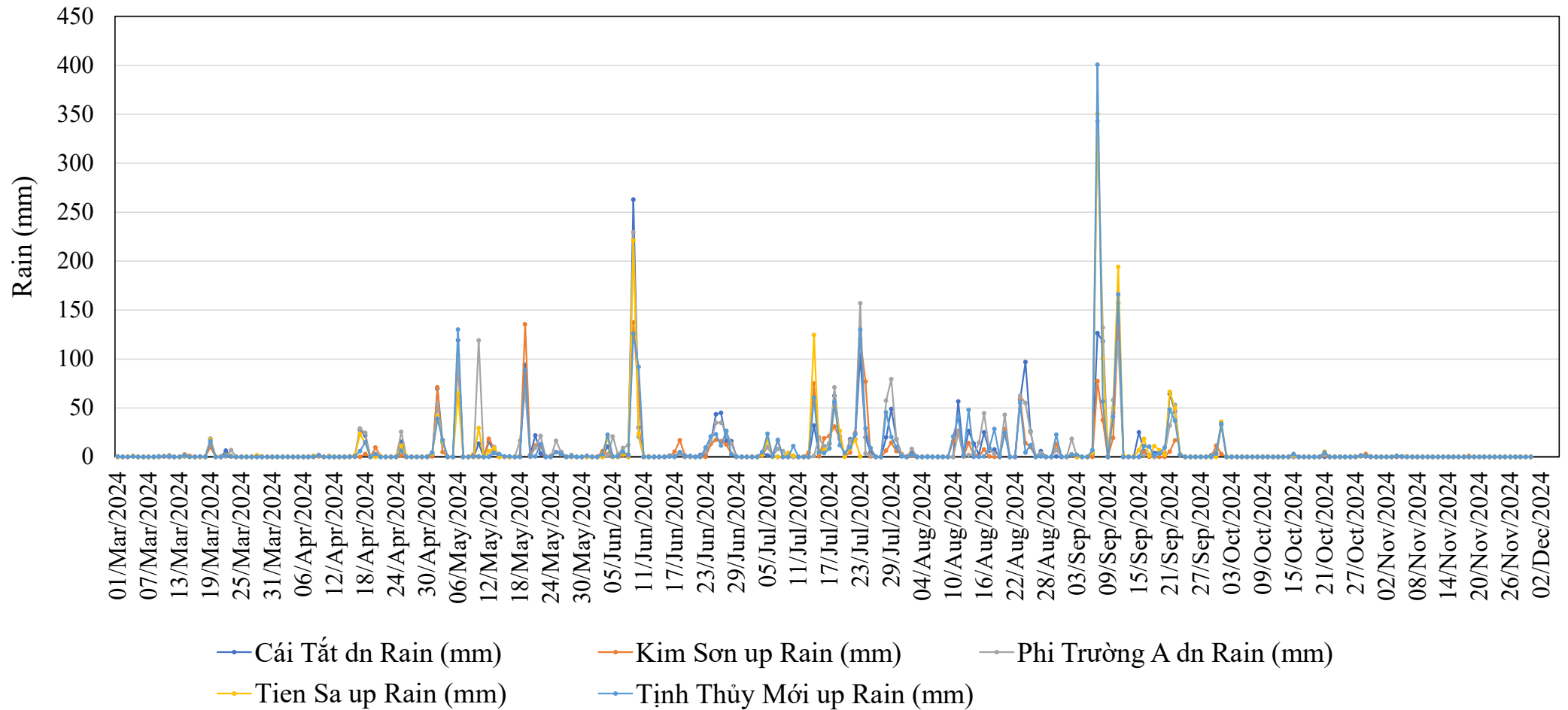
Water depth trend in Hai Duong IMC from 1 March to 30 November, 2024



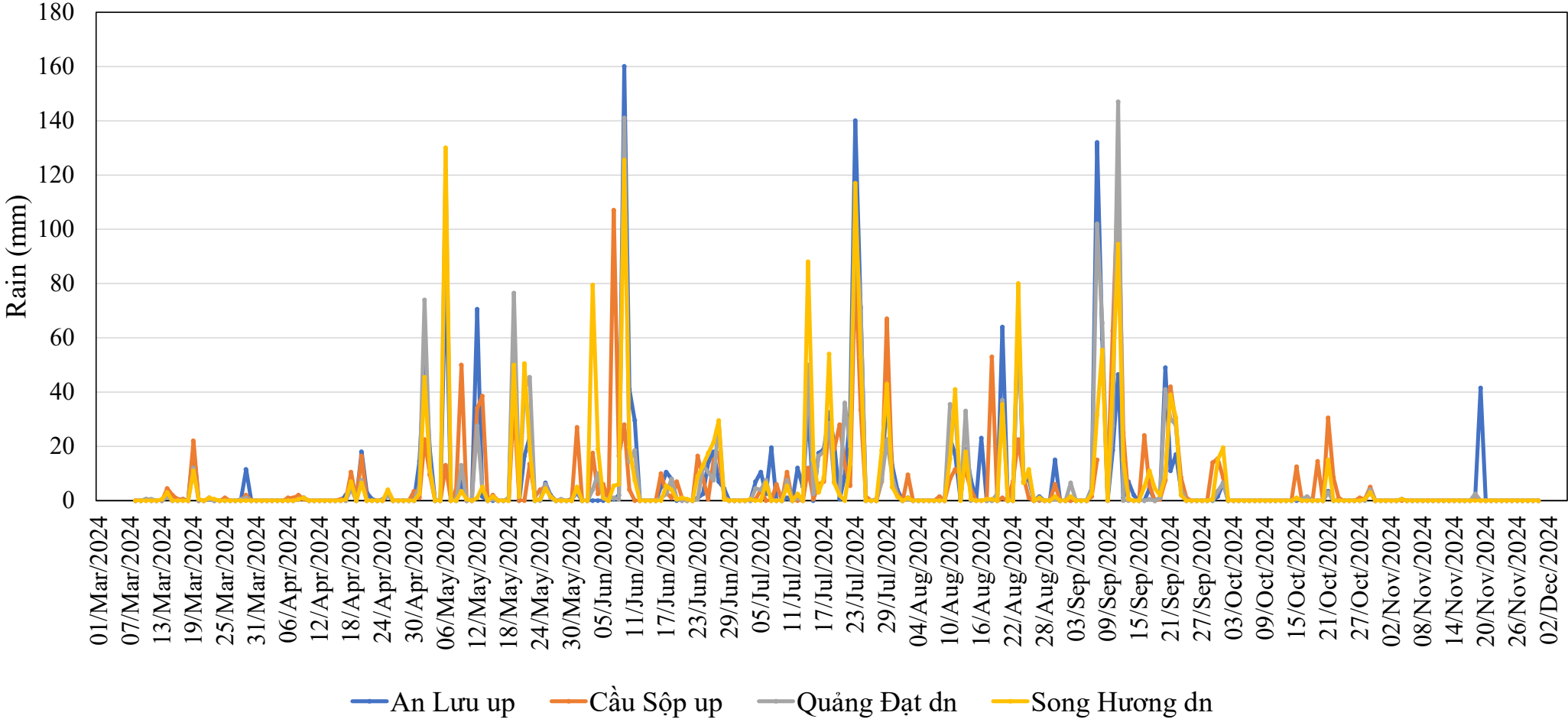
Water level trend in Hai Duong IMC from 1 March to 30 November, 2024



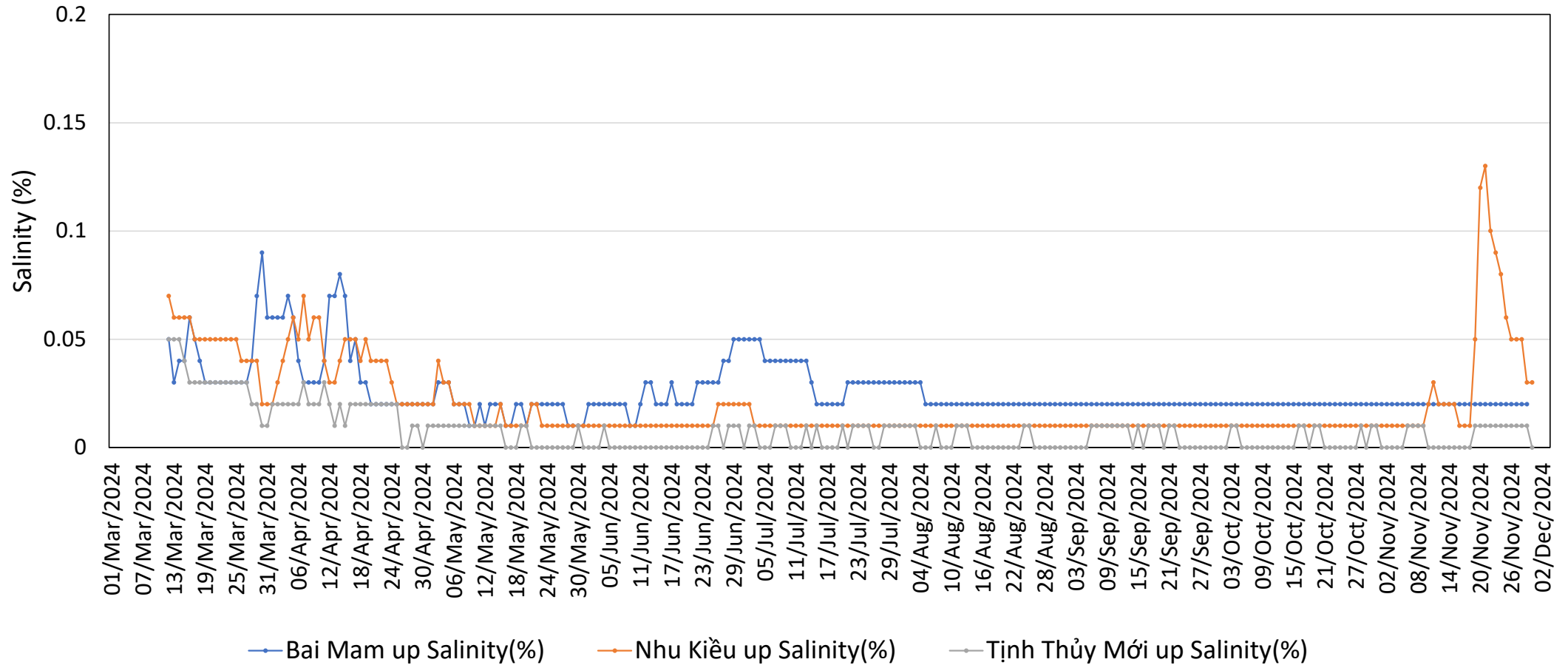
Rainfall trend in An Hai IMC from 1 March to 30 November, 2024



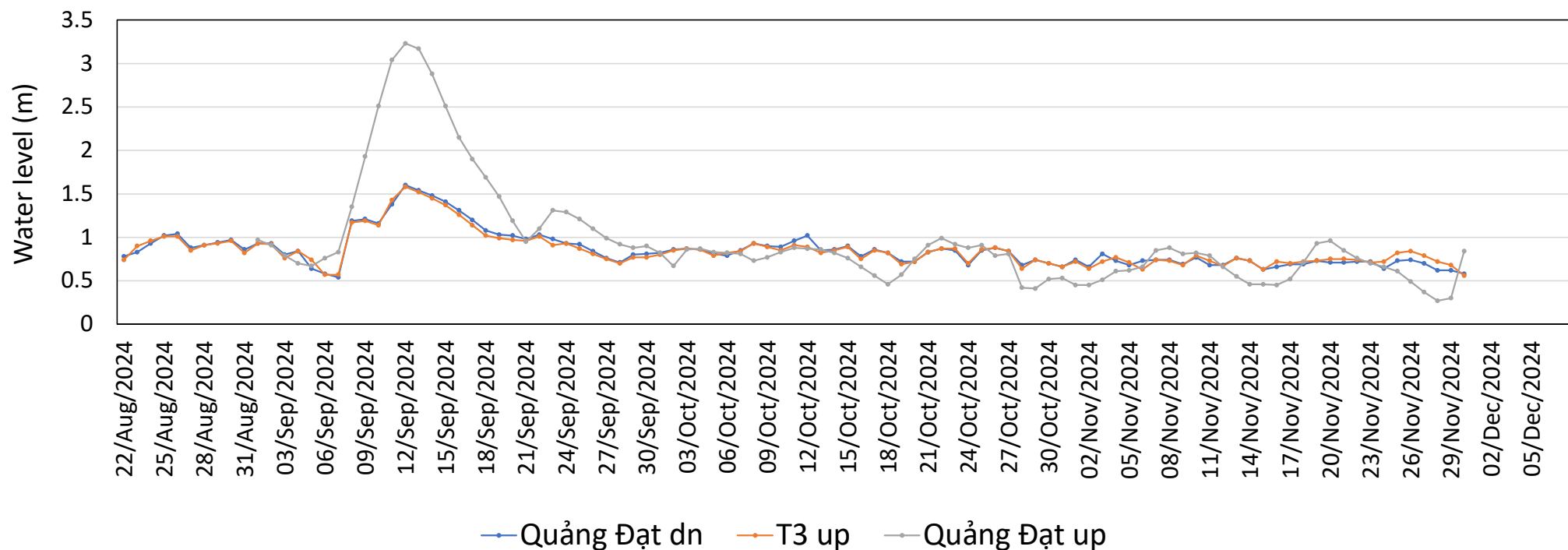
Rainfall trend in Hai Duong IMC from 1 March to 30 November, 2024



Salinity trend in An Hai IMC from 1 March to 30 November, 2024

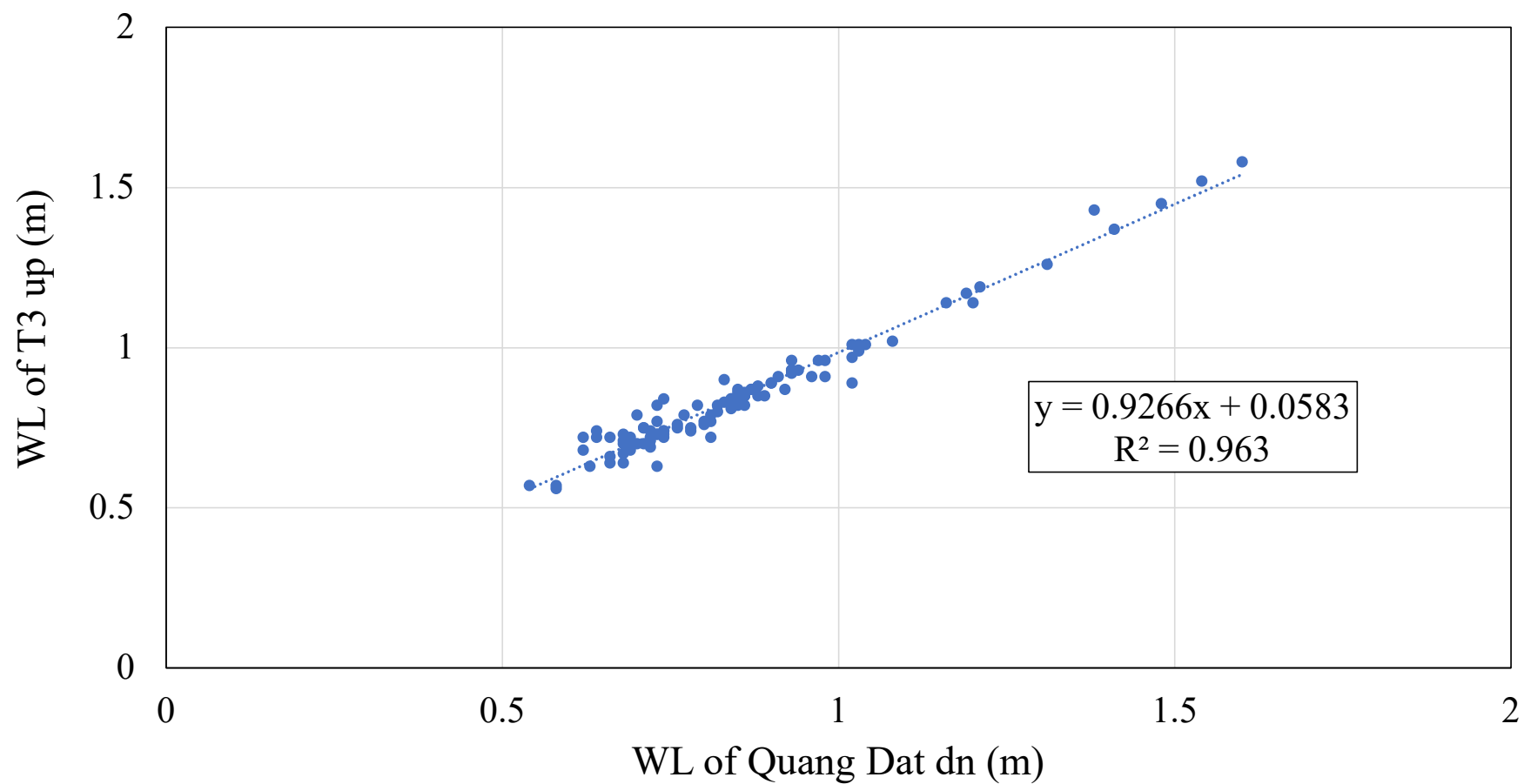


Comparison of Quang Dat Gate with T3 Gate from 22 August to 30 November, 2024



- The river water level upstream of Quang Dat gate of Hai Duong IMC fluctuates greatly, but the TM water level downstream of Quang Dat gate and the TM water level upstream of T3 gate of An Hai IMC are almost synchronized.

Correlation of Quang Dat Gate (downstream) and T3 Gate (upstream)

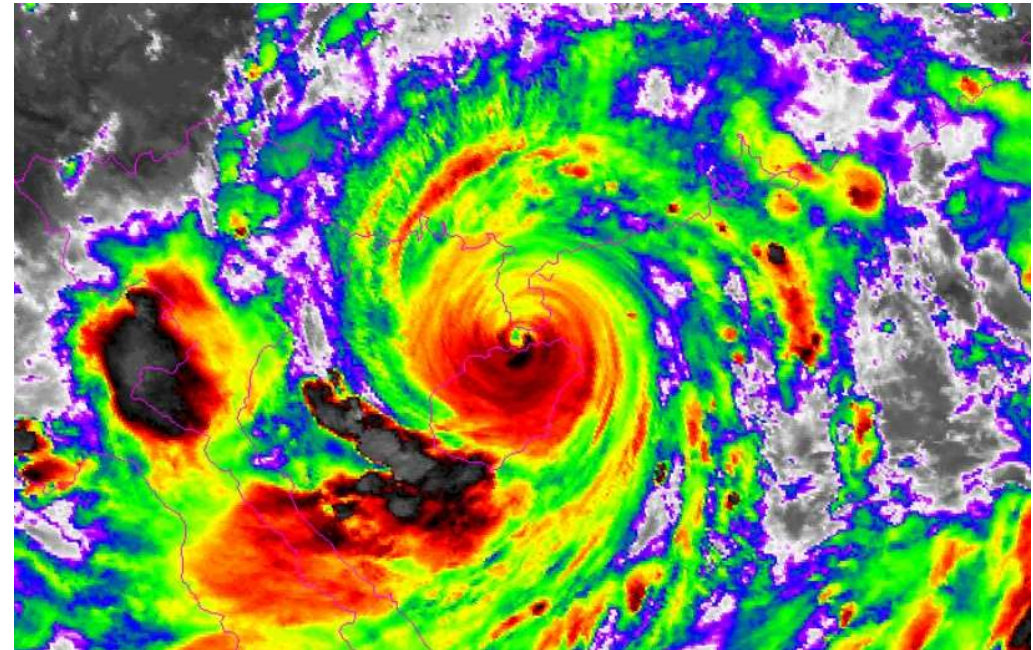


Typhoon Yagi (07 September, 2024)

After making landfall on September 7, Yagi killed at least 254 people, injured 820 and left 82 missing in Vietnam.



Map plotting the storm's track and intensity, according to the Saffir–Simpson scale

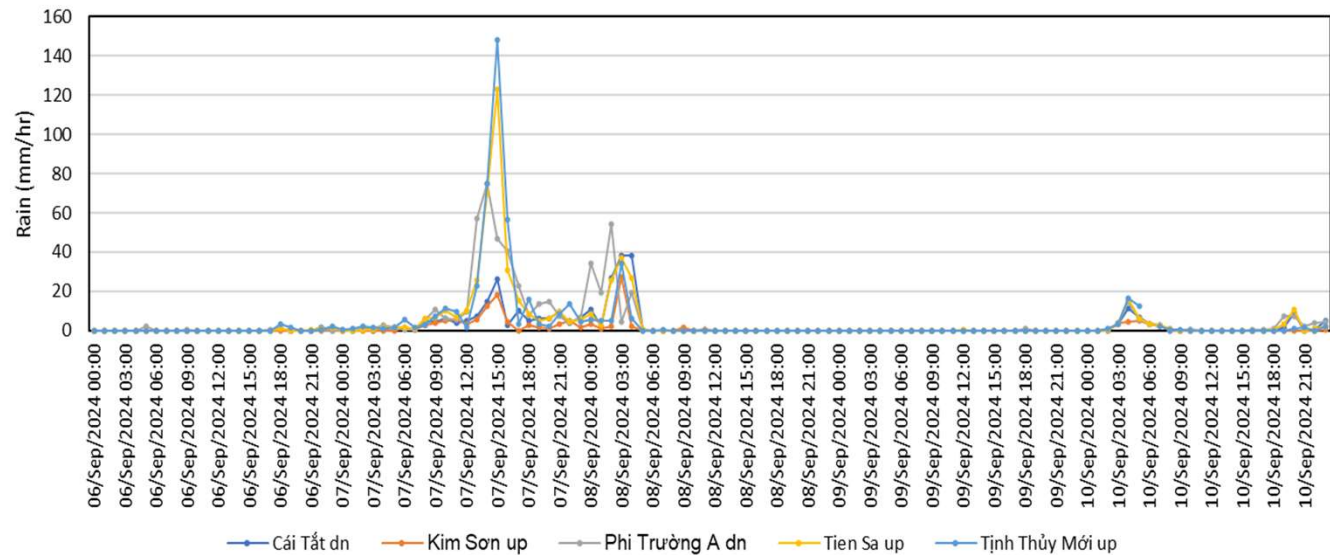


Typhoon Yagi making landfall over Hainan on September 6



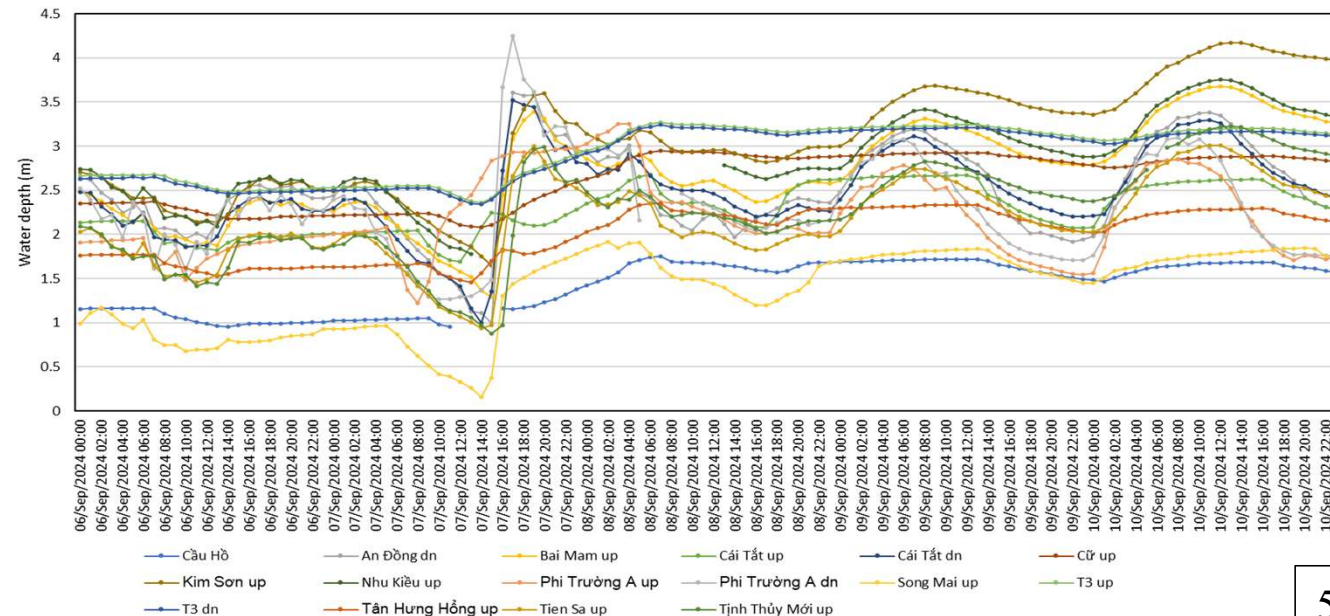
TM rainfall data

Hourly TM rainfall at An Hai IMC before and after the landing of Typhoon Yagi (00:00 September 06 to 23:00 September 10, 2024) maximum more than 148 mm/hour



TM water depth data

Hourly TM water depth fluctuations before and after the landing of Typhoon Yagi (00:00 September 06 to 23:00 September 10, 2020) maximum water rise was 2.98 m at “Phi Trường A dn”



ASEAN Seminar in JAIF2 (09 -12 Sep. 2024)



Site visit by ASEAN participants

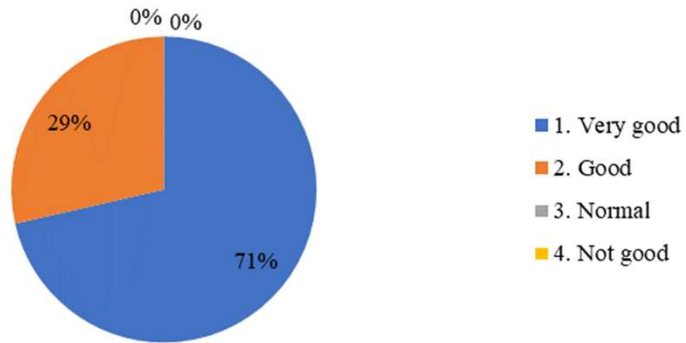


The number of participants from countries other than Vietnam was **29 people from eight ASEAN Member States**.

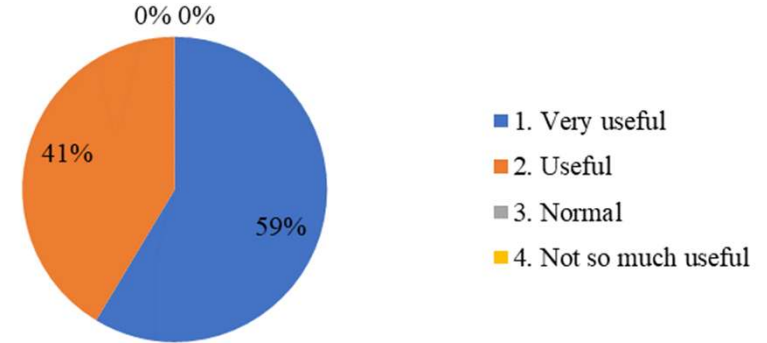


Evaluation of ASEAN Seminar by participants

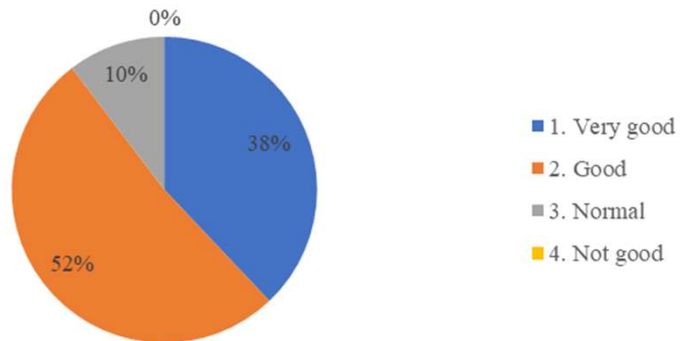
Q1 ASEAN seminar as a whole



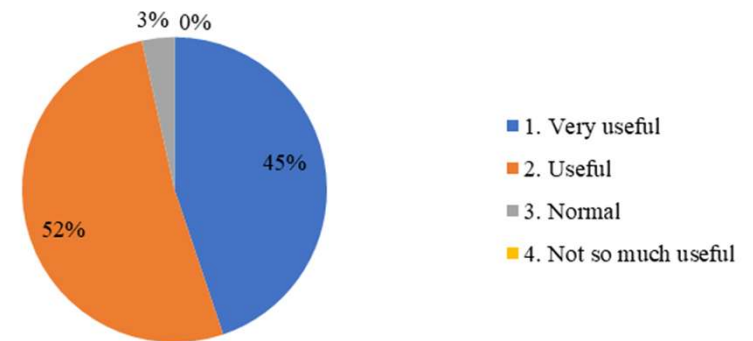
Q2 ASEAN seminar presentations



Q4 Field trip Impression as a whole



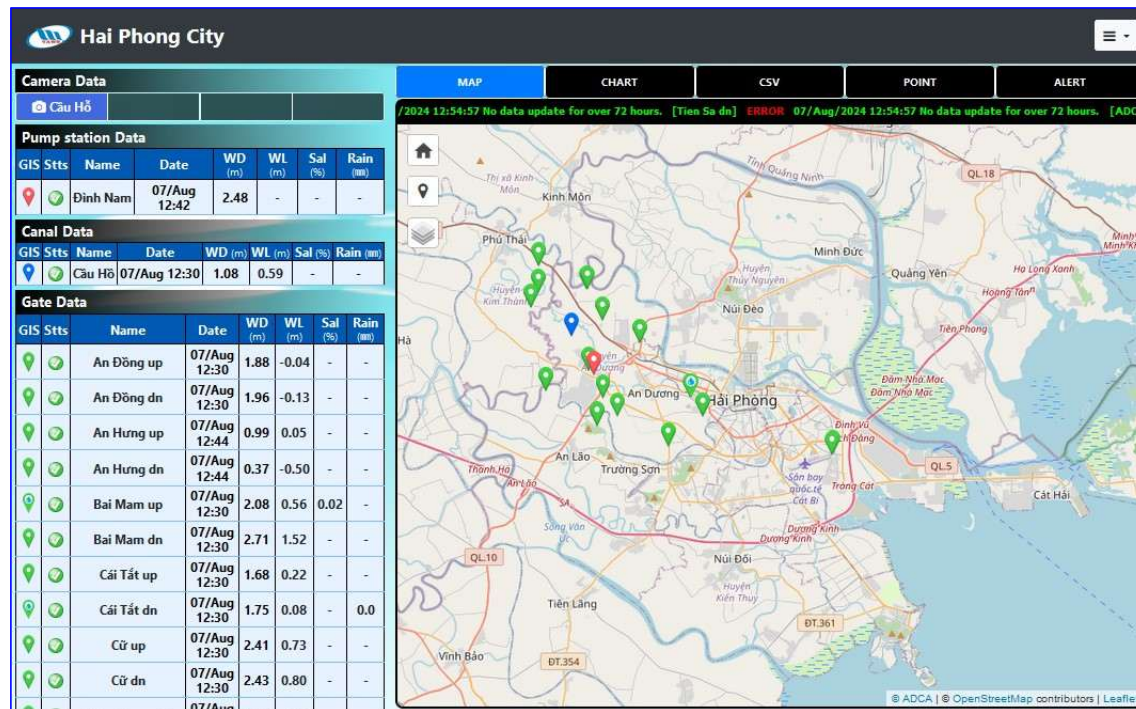
Q5 Field trip contents



Development of VAWR System

Development of TM data display system (VAWR system)

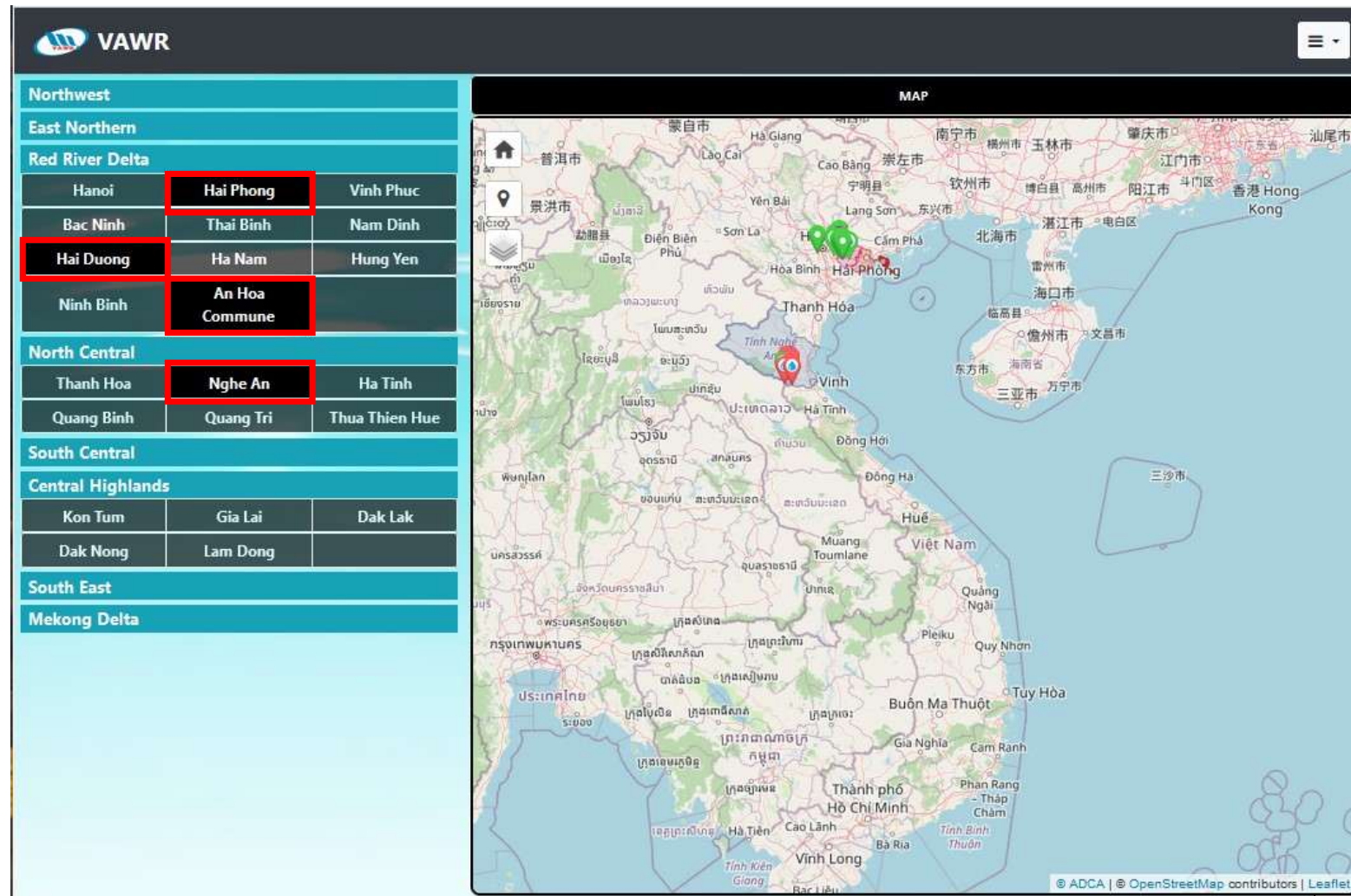
Top page
(PC display)



Smartphone
display

Reception of TM data from all over the country, integrated display and database creation

- The VAWR system was developed on AWS and has been transferred to the VAWR server.
- Currently, it is used in Nghe An Province, Hai Phong City, Hai Duong Province, and An Hoa Commune, where the test area is located, but it is possible to collect and display TM data from all over the country in an integrated manner.
- It is also integrated with the irrigation facility management (asset management) system.



Touch “Chart”

1. Select target TM in “Sensor”
2. Select rain TM in “Rain data”
3. Select “day” in Interval
4. Select start date from calendar
5. Select end date from calendar

6. Touch “Submit” in “Create chart”
7. If necessary, touch “Download” in “CSV”. The CSV file of selected data will be downloaded.

■ Water depth (m)

■ Water level (m)

■ Rain (mm)



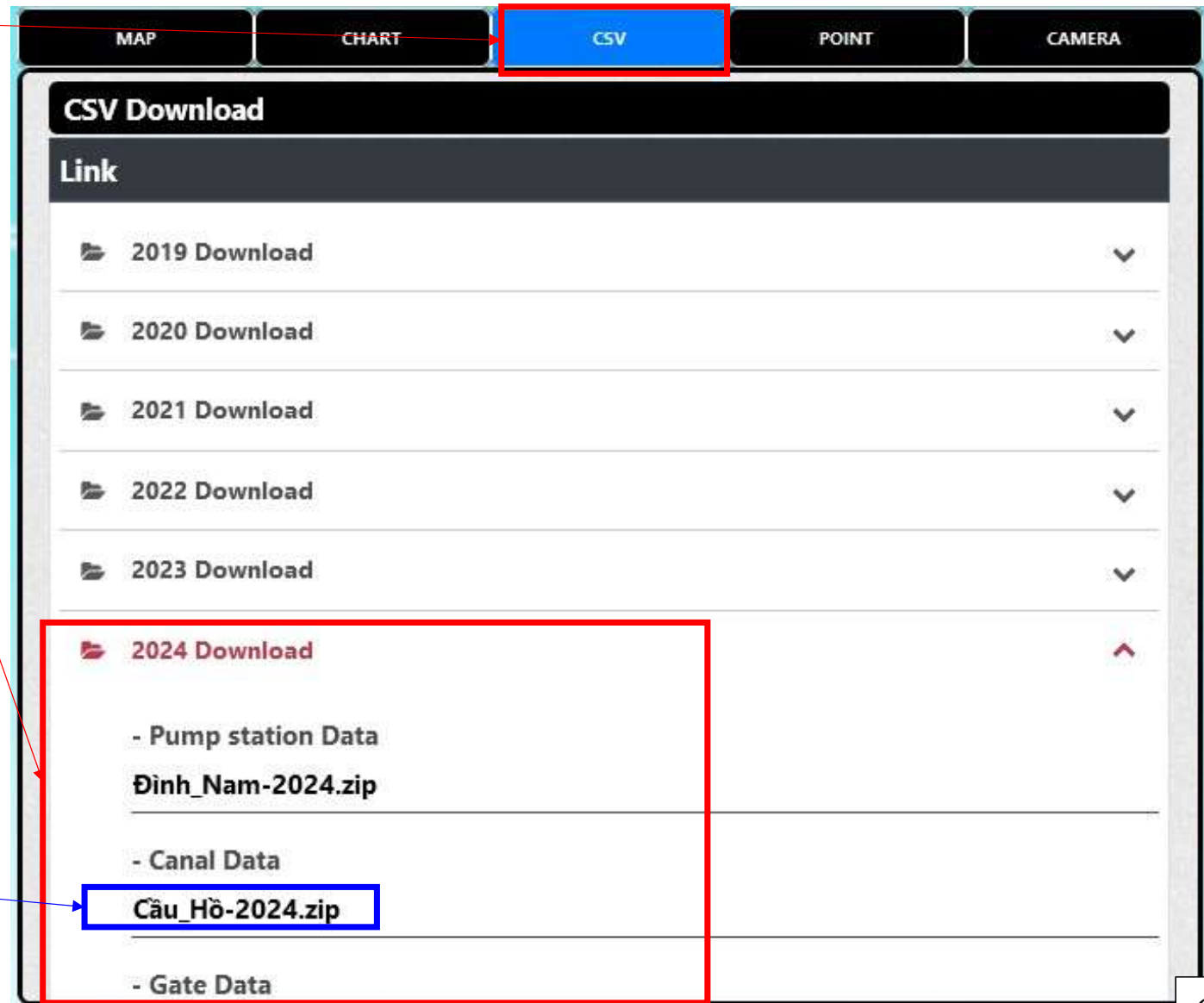
Touch “CSV”

CSV files (ZIP files) are divided in 3 groups:

1. Pump station data
2. Canal data
3. Gate data

* CSV data are raw data of 5 to 10 minutes interval.

If touched the name of ZIP file, the CSV file will be downloaded.



Touch "POINT"

1. Select a TM name in "Sensor"
2. Select day in "Interval"

Select number of data to be displayed in the smartphone.

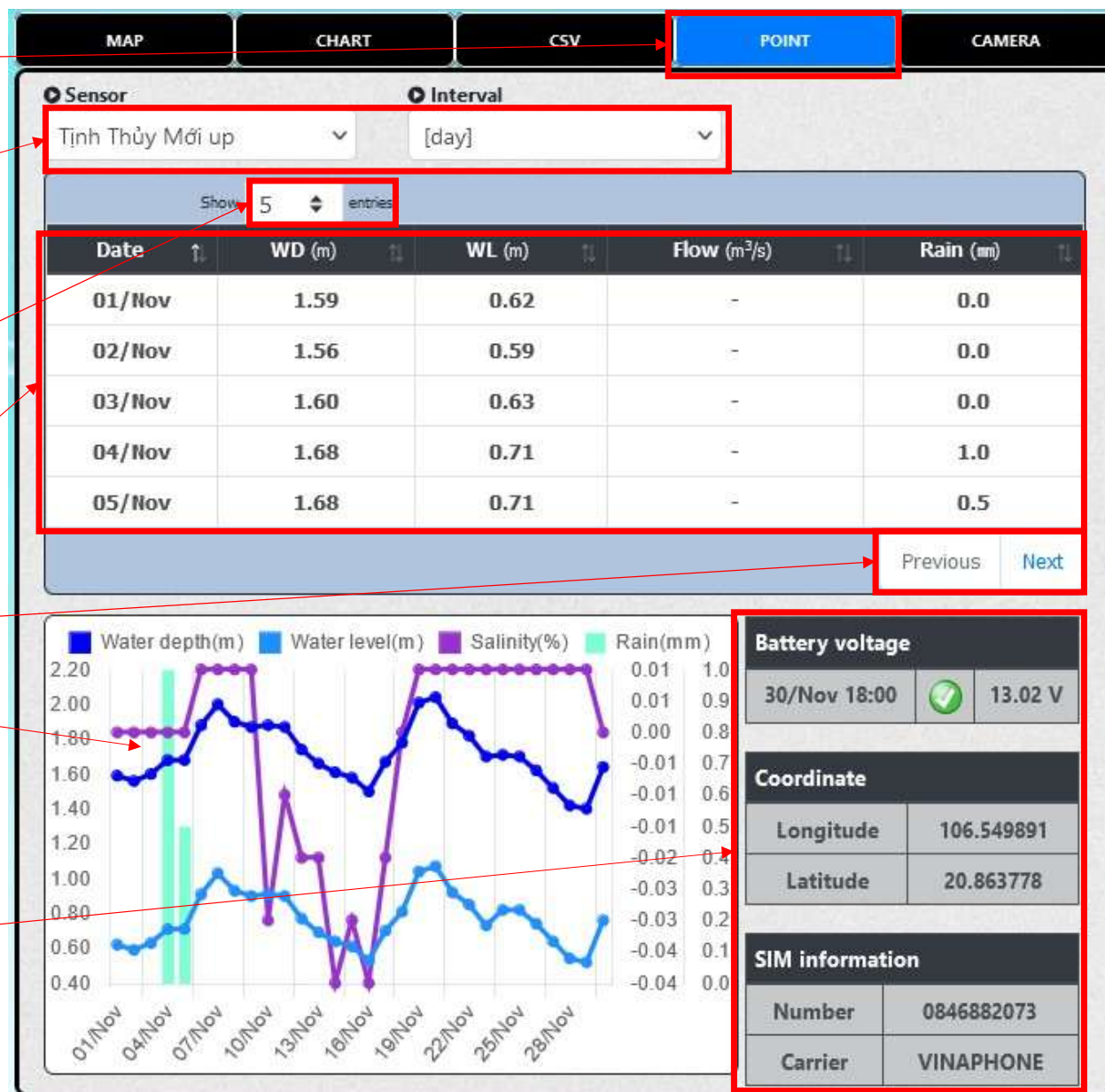
The data of the present month.

Change data page.

The graph of the present month.

TM Point data

- Battery voltage
- Coordinates
- SIM information



Touch “CAMERA”

1. Select a TM name in “Camera”
2. Select day in “Date”

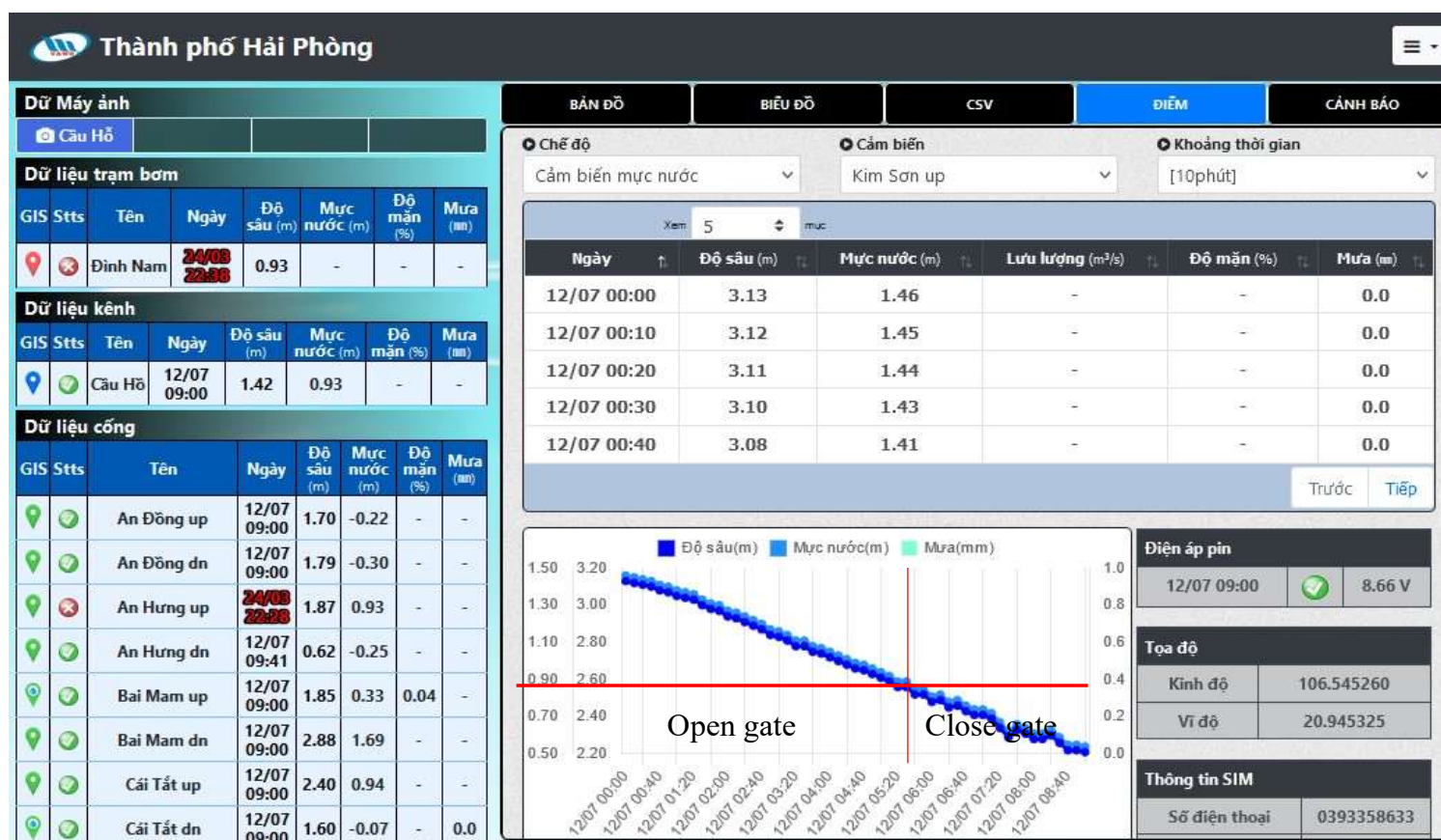
3. Touch “Submit” in “Photo display”
4. If necessary, touch “Download” in “Photo”. The JPG file of the day will be downloaded.

Photos taken every 30 minutes,
48 photos per day.

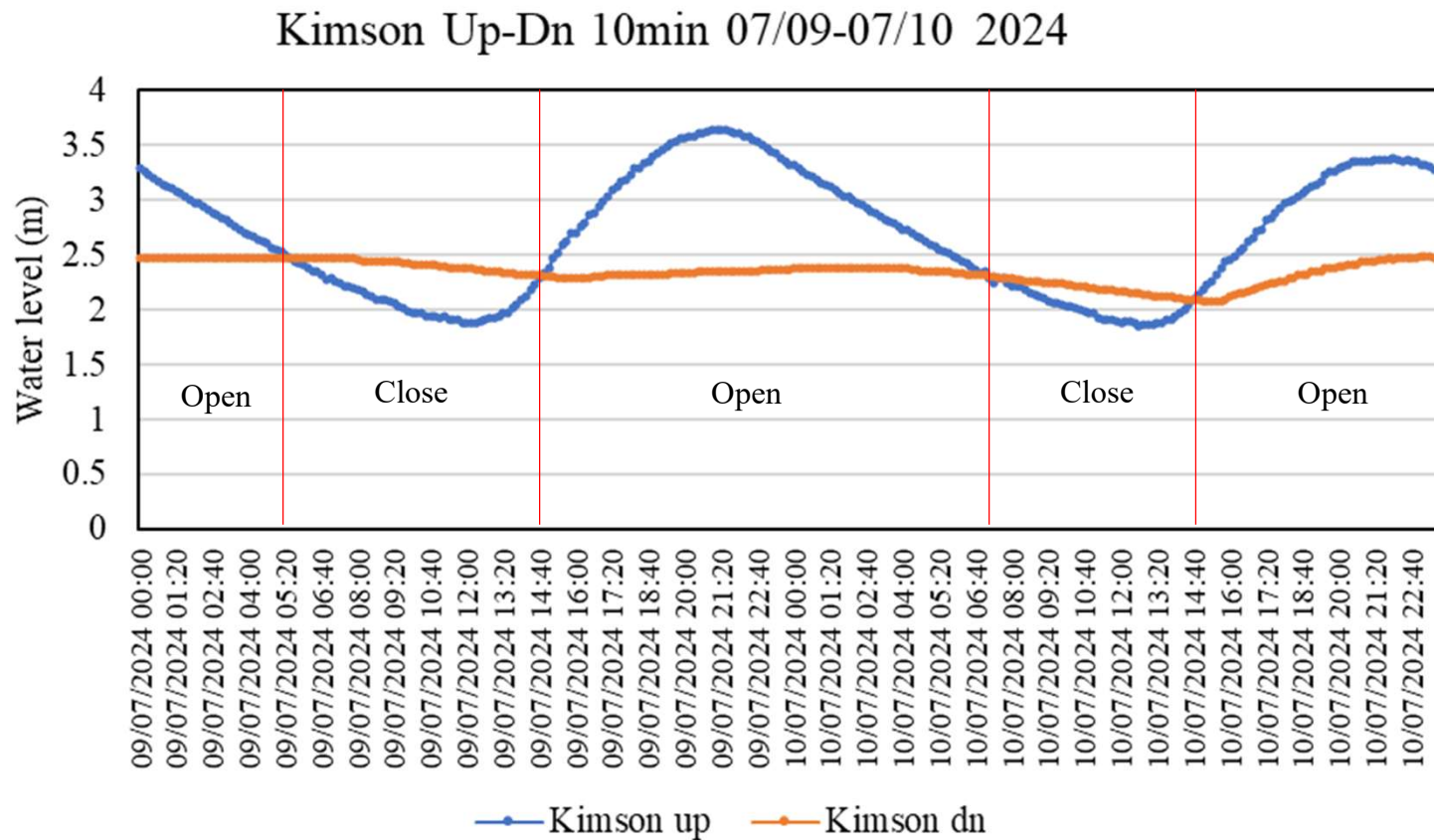
The interface displays a grid of photos taken every 30 minutes on 12/Oct/2024. The photos are arranged in a 4x4 grid. The first 15 photos are dark, while the last photo (07:40) is a color image of a bridge over water.

12/Oct/2024 00:10	12/Oct/2024 00:40	12/Oct/2024 01:10	12/Oct/2024 01:40
12/Oct/2024 02:10	12/Oct/2024 02:40	12/Oct/2024 03:10	12/Oct/2024 03:40
12/Oct/2024 04:10	12/Oct/2024 04:40	12/Oct/2024 05:10	12/Oct/2024 05:40
12/Oct/2024 06:10	12/Oct/2024 06:40	12/Oct/2024 07:10	12/Oct/2024 07:40

- Touch the "POINT" tab and select "Kimson up" and "10min" to display and graph water level data for 10-minute intervals starting at 00:00 on the current day.
- For example, if the water level threshold is set to 2.6m, the gate keeper opens the gate when the water level is above 2.6m and closes it before the water level falls below 2.6m, allowing the canal downstream of the gate to continue to fill with water.

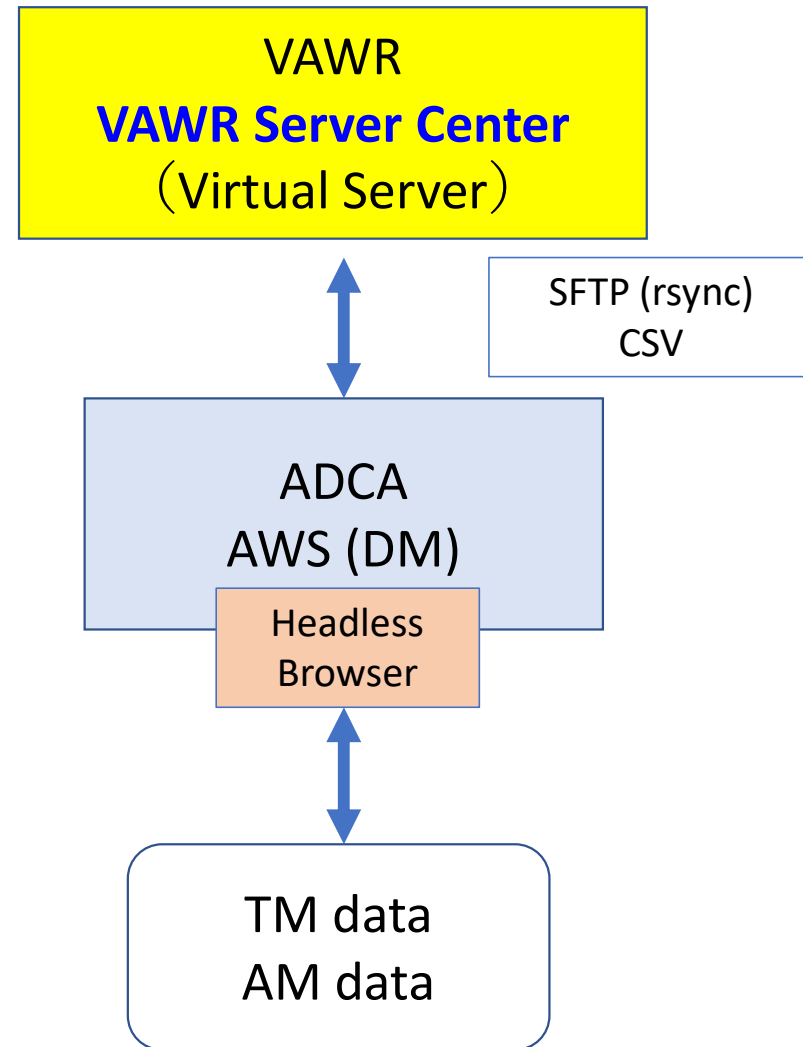


- A graph of water level fluctuations at Kimson Up and Dn over two days from 00:00 on July 9th to 24:00 on July 10th.
- The gates are assumed to be closed, so the upstream and downstream water levels reverse twice a day due to the influence of the tides. The gates need to be operated so that they open when the upstream water level is high and close when it is low.

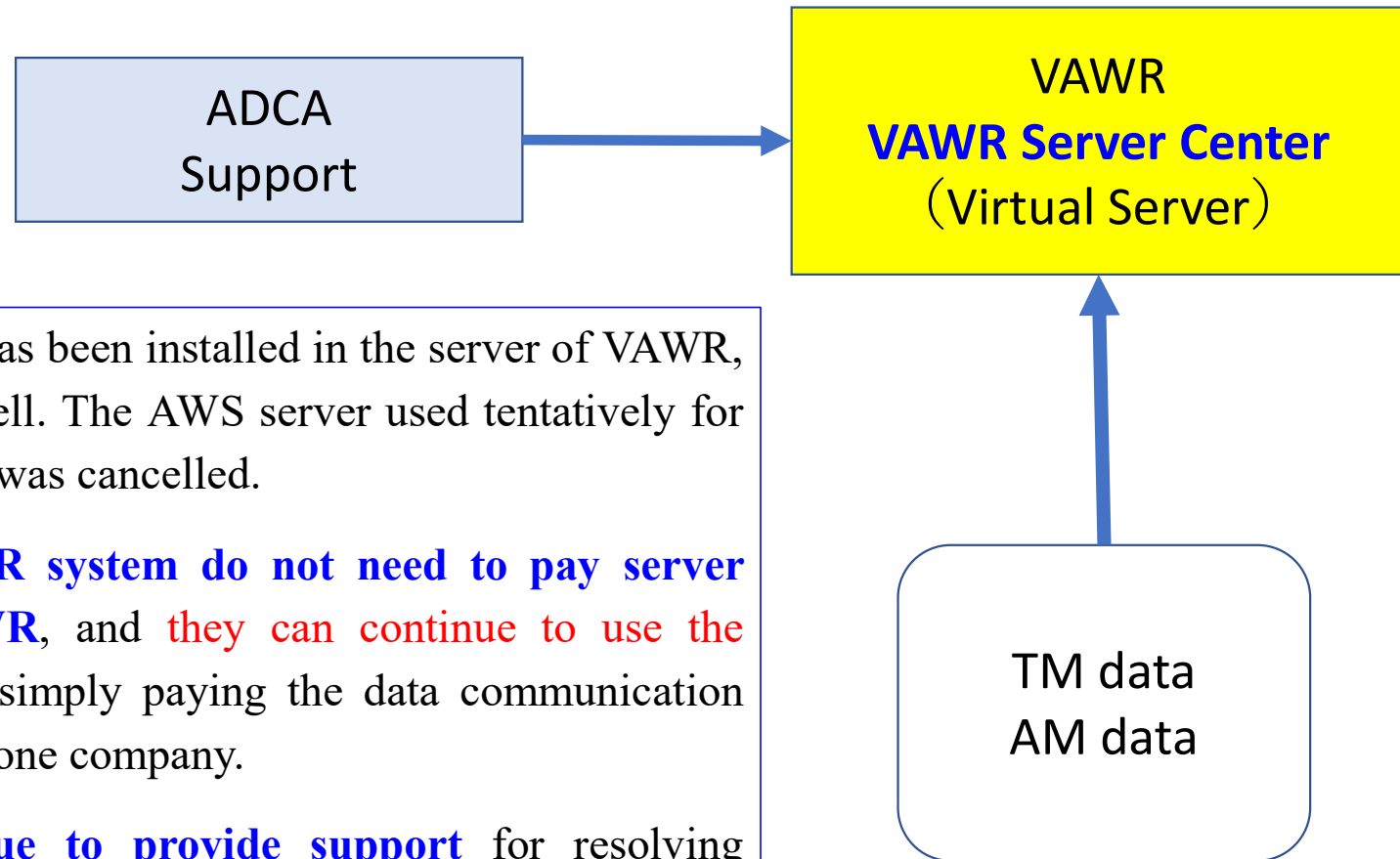


Data integration structure (Before November 2024) (Integrate various ICT data in one system)

- SFTP : SSH File Transfer Protocol
- SSH : secure shell
- rsync : a utility for efficiently transferring and synchronizing files between a computer and a storage drive



Data integration structure (**After November of 2024**)



- The VAWR system has been installed in the server of VAWR, and been working well. The AWS server used tentatively for system development was cancelled.
- The users of VAWR system do not need to pay server usage fees of VAWR, and they can continue to use the system as usual by simply paying the data communication fees to the mobile phone company.
- ADCA will continue to provide support for resolving problems, if any, of the VAWR system in the virtual server and improving correction values for the time being.

Developed Documents

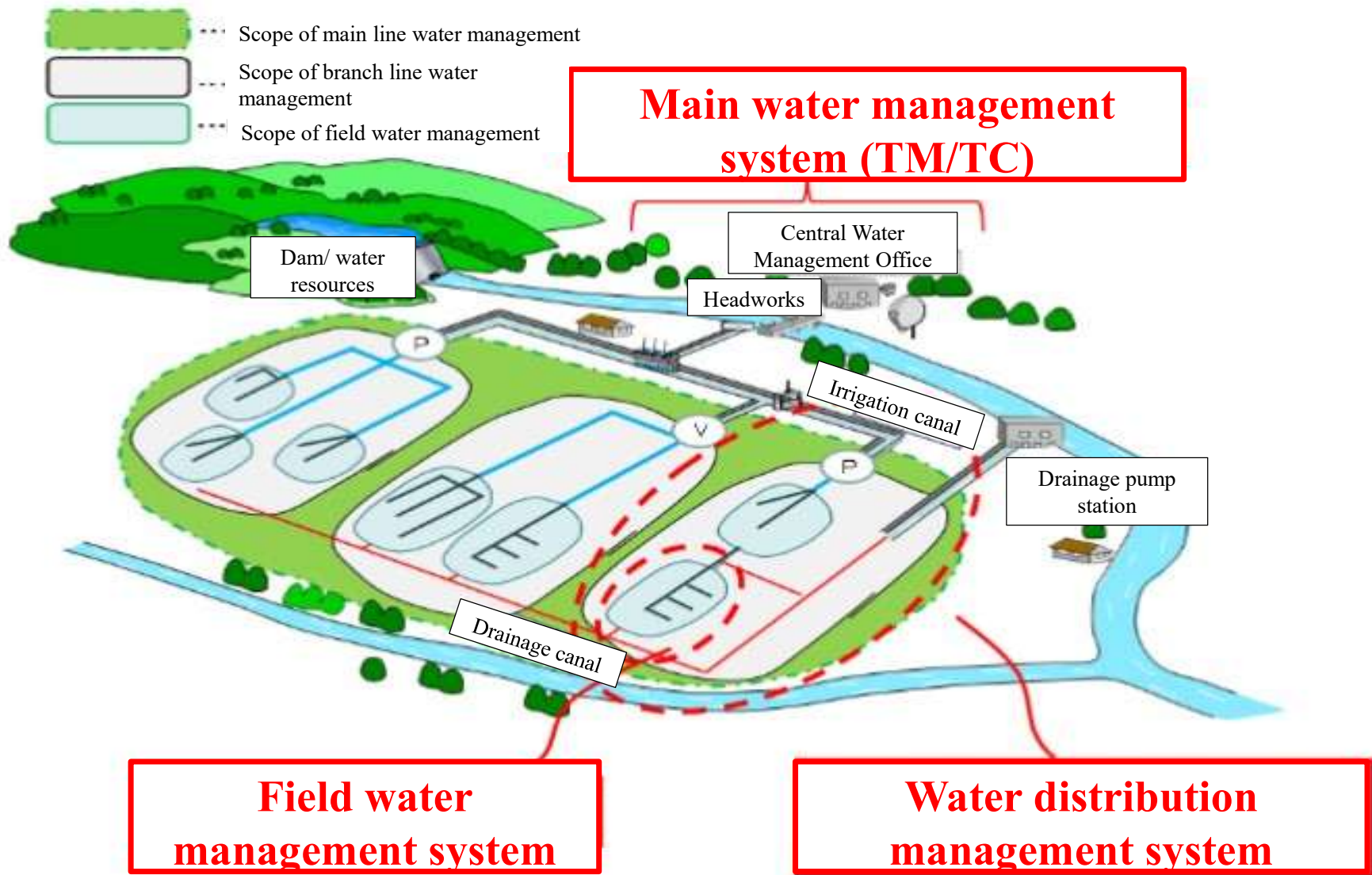
1. **Guideline for planning ICT use** in irrigation and drainage project, March 2025 (Draft)
2. **Manual**- Telemetry for Irrigation Water Management Equipment, System, Data analysis, Operation and Maintenance, September 2024 (JAIF2)
3. **Power Point Slides**
 - 1) Use of ADCA System TM for An Hai IMC and Hai Duong IMC
 - 2) Analysis of TM data
 - 3) Maintenance of TM Equipment

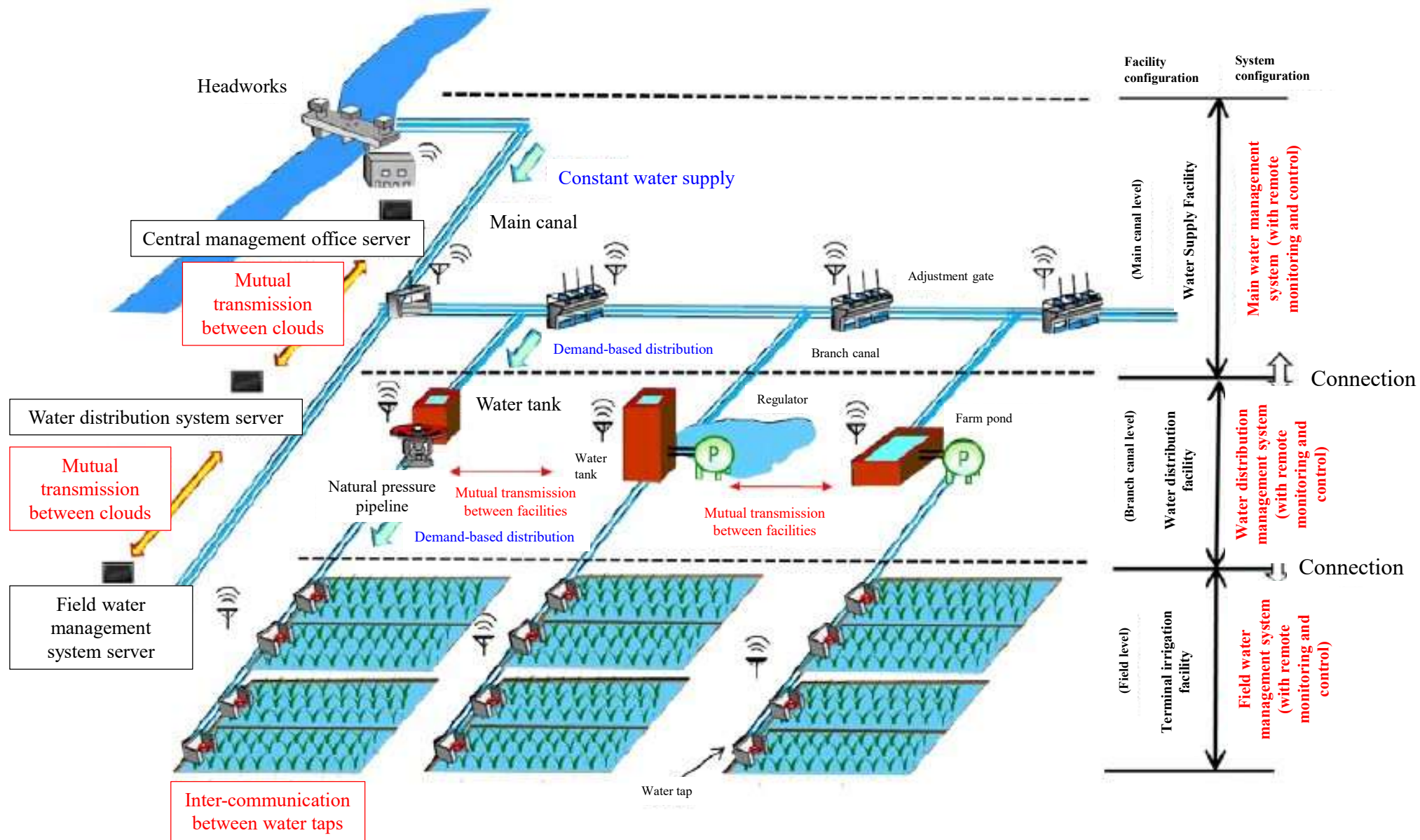
Guideline for planning ICT use in irrigation and drainage project, March 2025 (Draft)

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Image (1) of “Guideline for planning ICT use in irrigation and drainage project”





Future Development

Strengthening Hoa Lac Research and Training Center

(1) Irrigation water management

- **Establishment of an ICT center** at the VAWR Research and Training Center to serve as the hub for ICT water management nationwide.
- Establishment of water management technology using ICT data from the VAWR system in the **10 Red River Delta Provinces**.
- Establishment of an integrated and efficient water management model using ICT data and PIM in order to establish an appropriate ISF collection system in the **10 Red River Delta Provinces**.
- **Enhancement of training on ICT water management** and PIM.

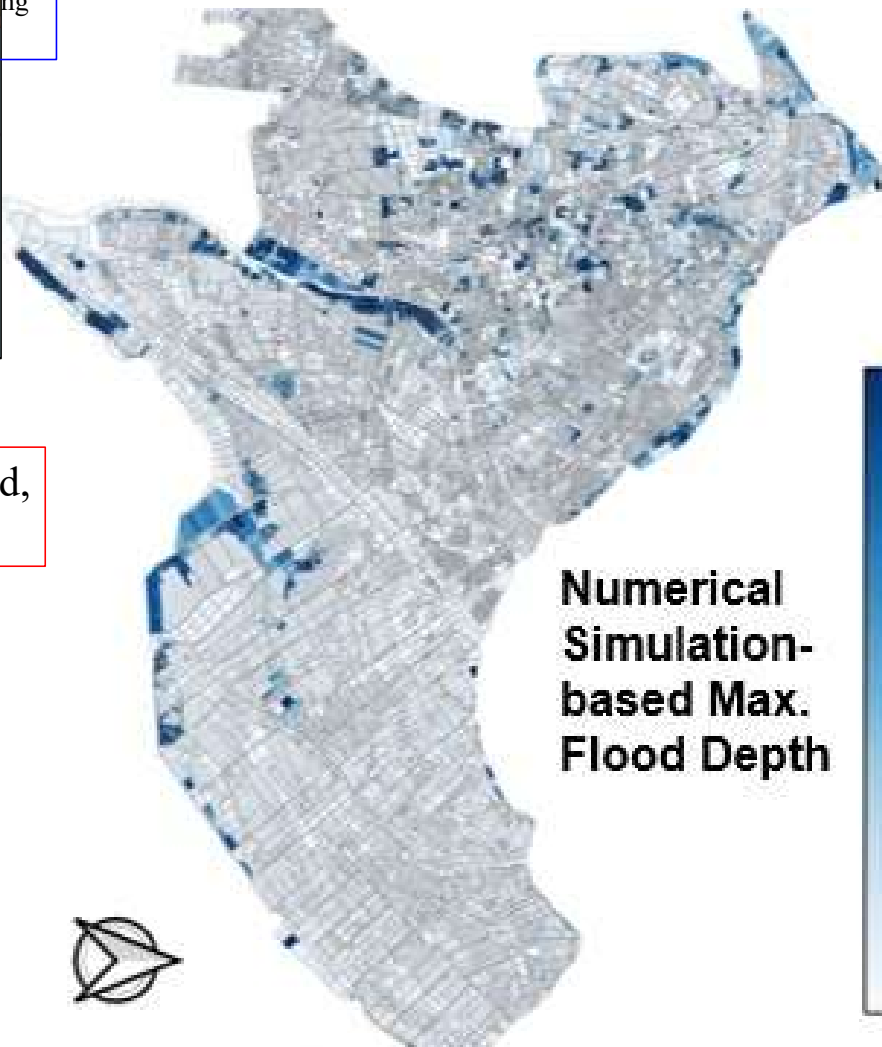
(2) Climate change response

- Expanding the use of ICT systems for monitoring paddy field water management in 10 Red River Delta Provinces
- **Establishing technologies to reduce GHG emissions from paddy fields**, such as AWD and intermittent irrigation, in 10 Red River Delta Provinces
- Applying an adaptive delta water management platform that is robust against extreme weather events, established using **Nam Dinh Province as a model**, to three provinces and cities along the Red River Delta
- **Establishing coastal protection technologies** (new construction methods for tidal dikes, tidal floodgates) in three provinces and cities along the Red River Delta

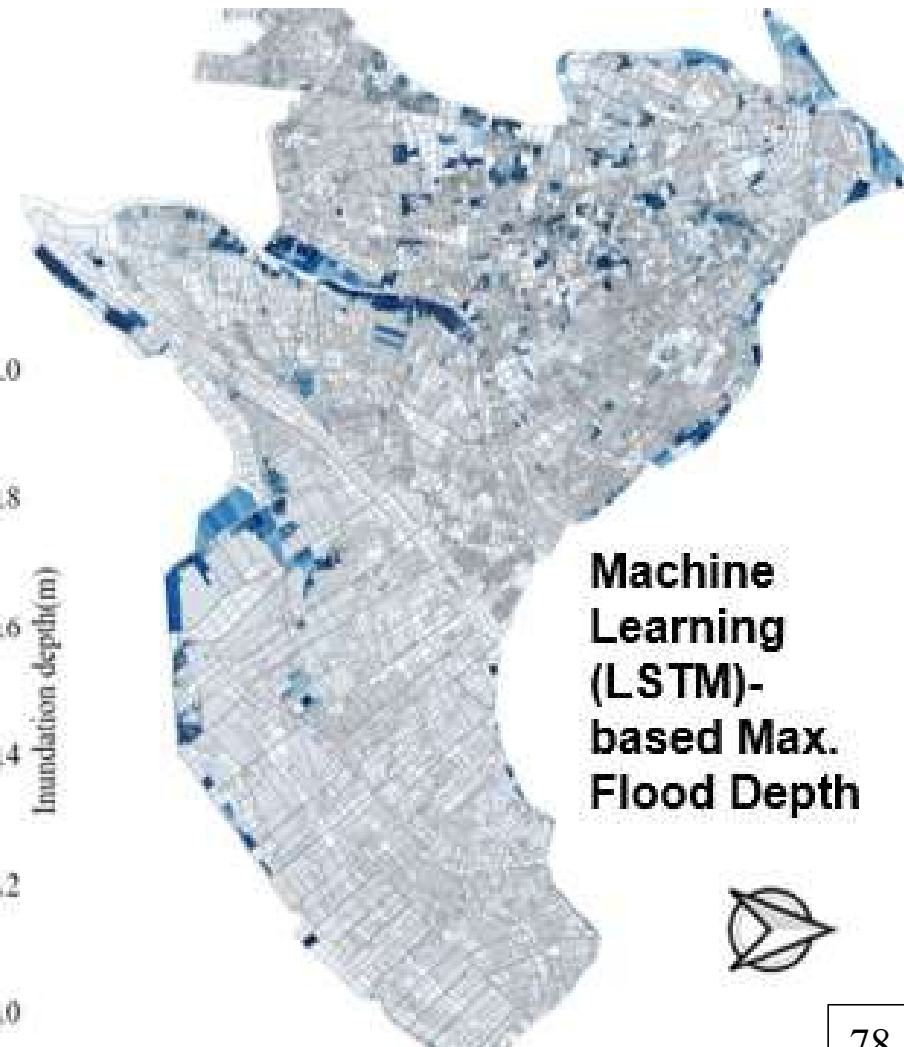
Flood simulation model developed by Niigata University



Xuan Thuy Watershed,
Nam Dinh Province

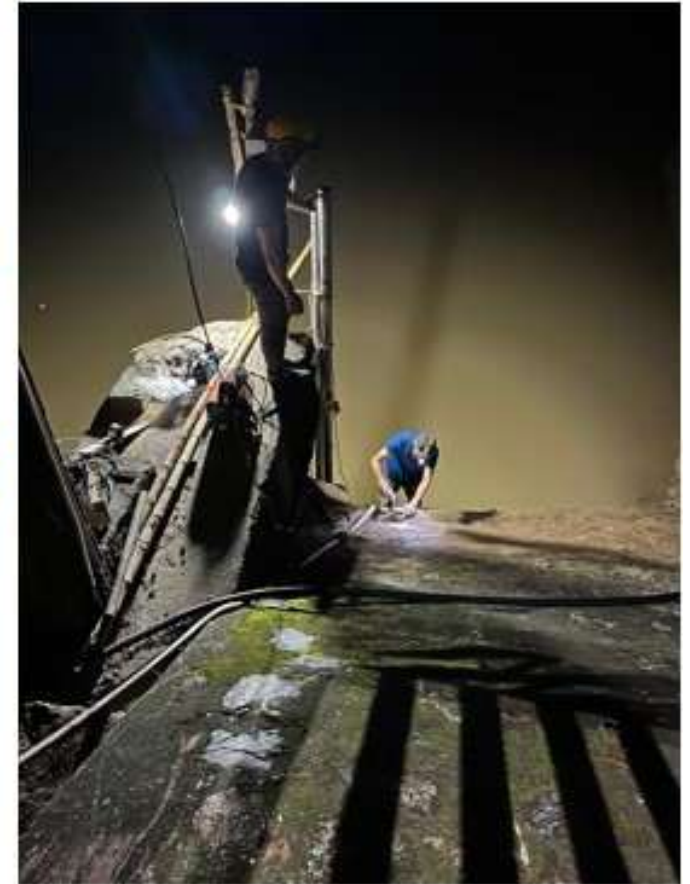


**Numerical
Simulation-
based Max.
Flood Depth**



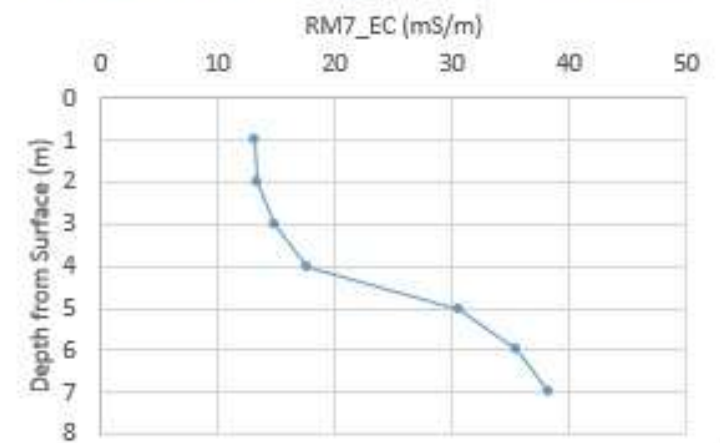
**Machine
Learning
(LSTM)-
based Max.
Flood Depth**

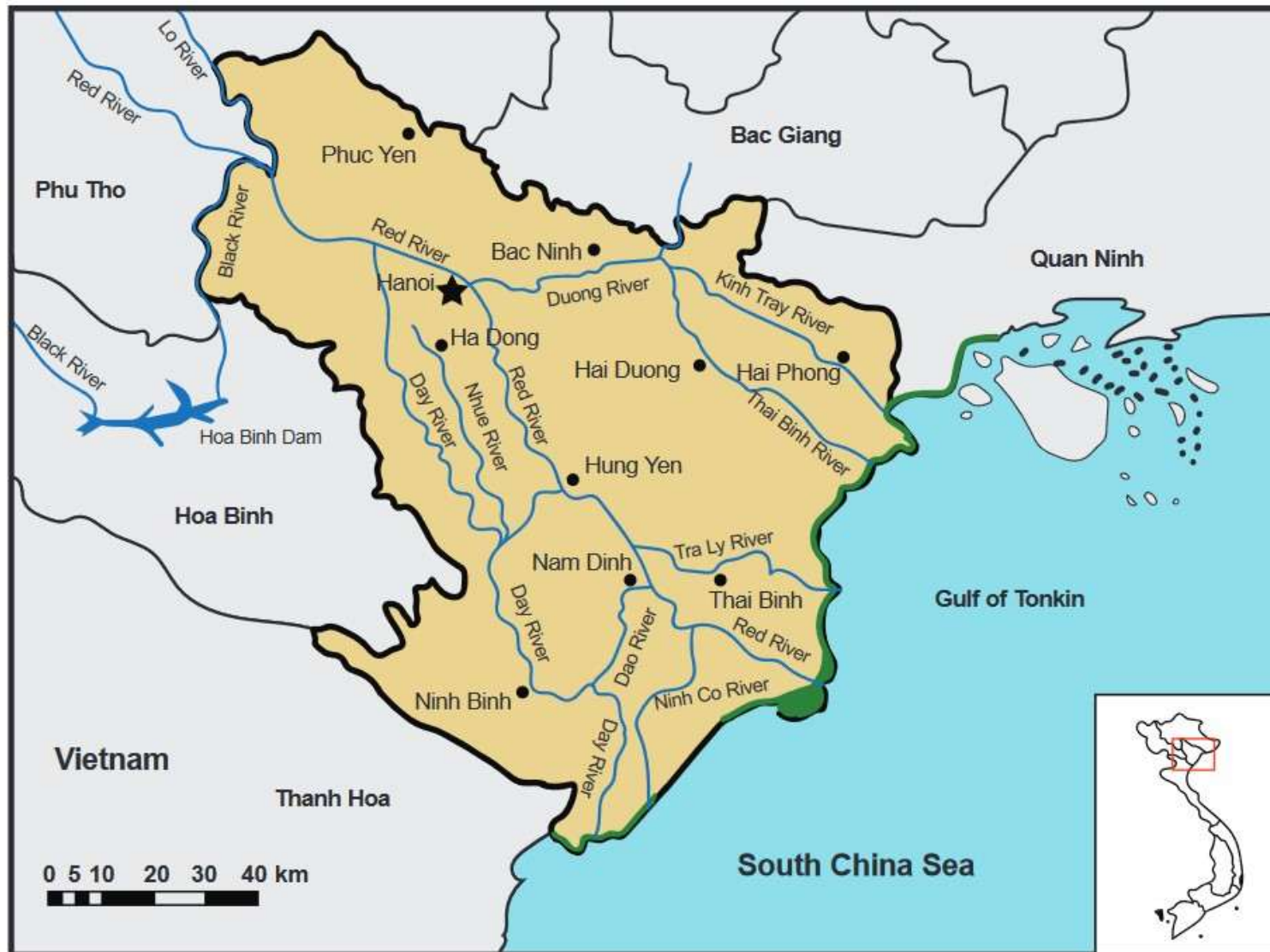
Setting TM equipment at the gate of Nam Dinh Province



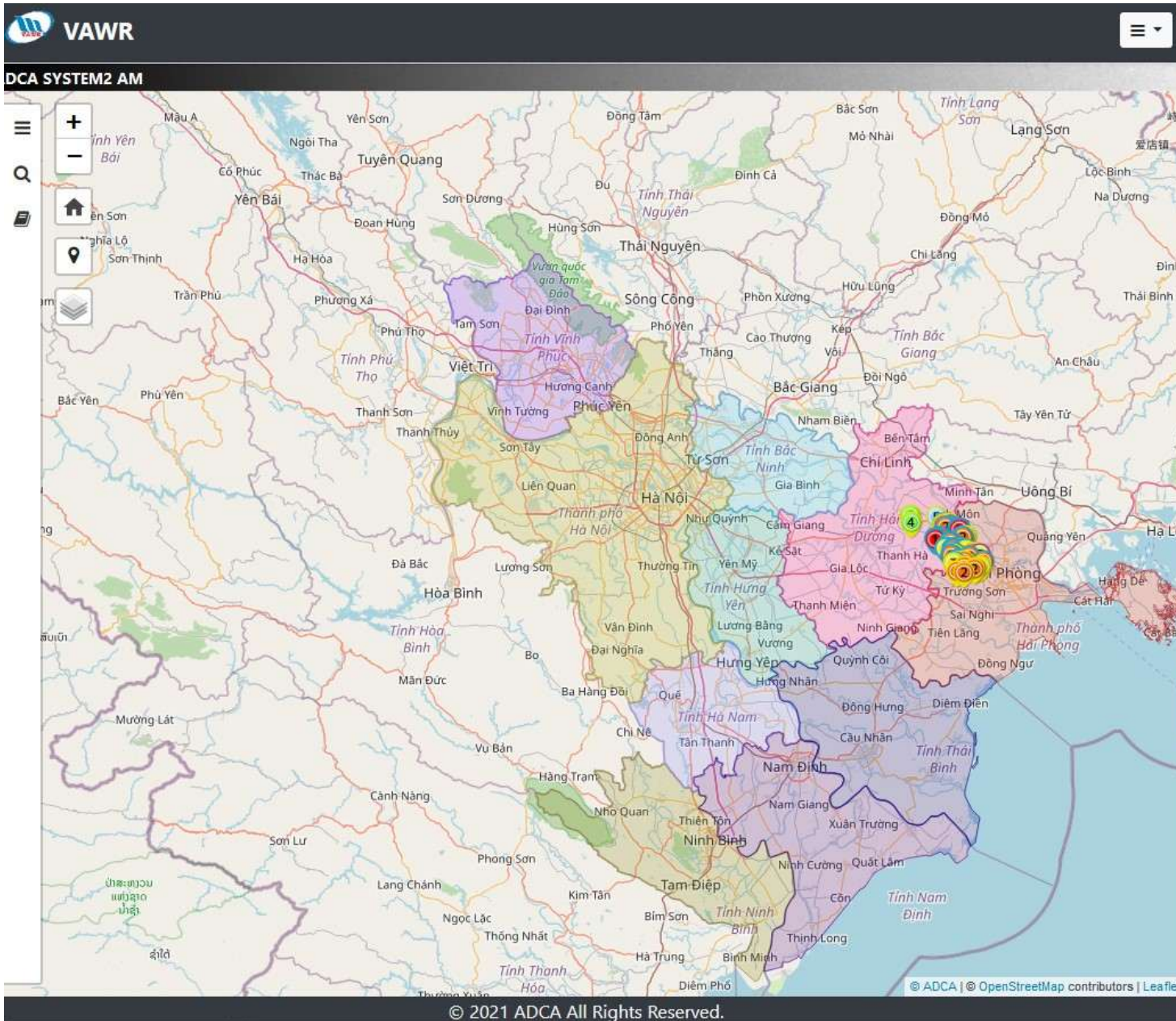
Installed by Niigata University in September 2024. TM equipment is made in the USA and has strict copyright laws, so it is difficult to integrate it into the VAWR system.

Saltwater intrusion Survey in Son Hong River



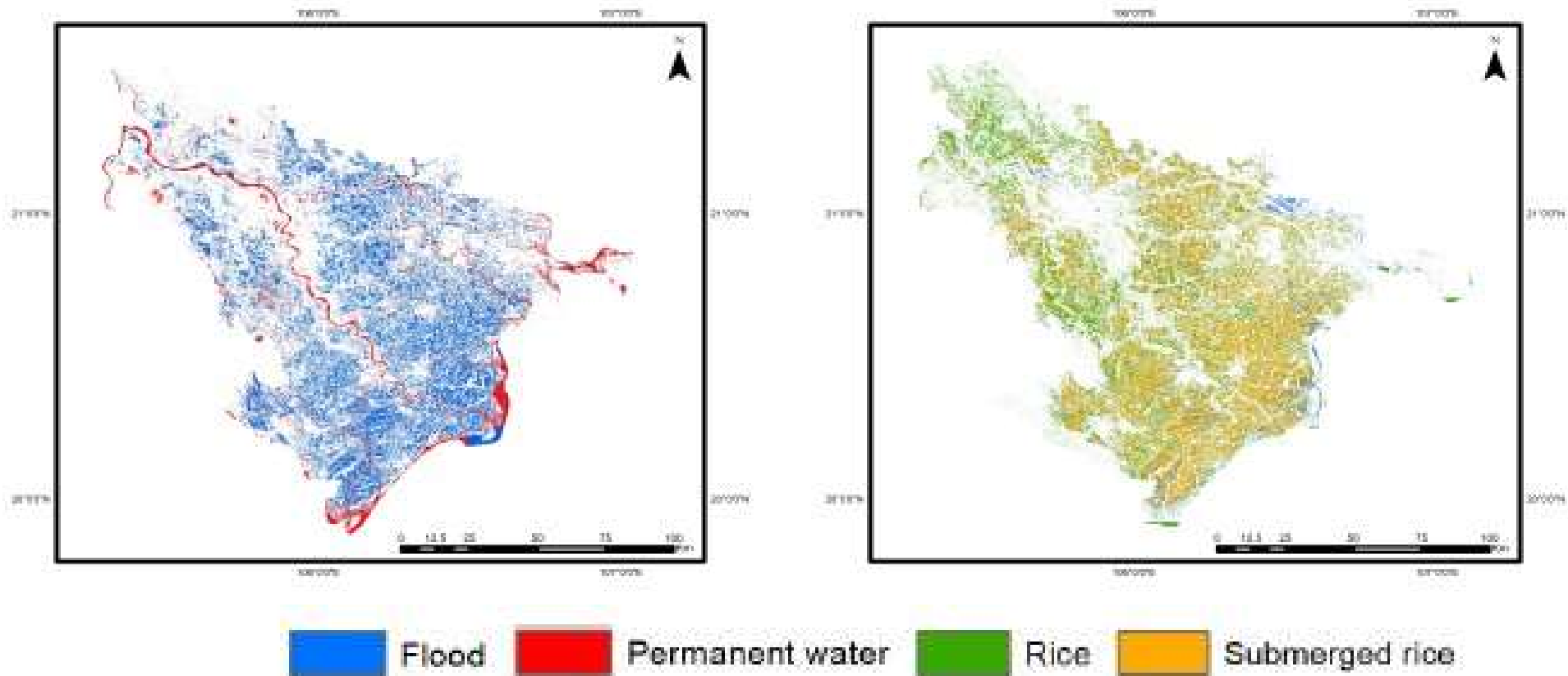


Lois Wright Morton. 2020. "Working toward sustainable agricultural intensification in the Red River Delta of Vietnam." *Journal of Soil and Water Conservation*. 75 (5) 109A-116A.





Eric Biltonen, Intizar Hussain, Doan Doan Tuan. 2004. "Pro-poor Intervention Strategies in Irrigated Agriculture in Asia." International Water Management Institute (IWMI)



22 July 2018 **Son-Tinh Storm (July 19, 2018)**

Visualization of **flood map with permanent water map** (left) and **rice map with submerged rice map** (right) on July 22, 2018 for 10 provinces in the RRD

Northern Midlands of Vietnam and provinces from Thanh Hoa to Quang Binh had heavy rains from **July 18-20**, rainfall over the whole range from **300-350mm**. Many areas had been subject to flash floods and flooding