CTCN assistance in Thailand

Strengthening Bangkok's Early Warning System to respond to climate induced flooding

Deliverable 2 (Activity 1.2.1) Mapping and understanding of the existing BMA data management system

Draft final 1st February 2017

This report has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)

Approved by

26-09-2017

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Contents

1 Bangkok - hydrologic and hydraulic location

Bangkok is located at the downstream end of several rivers draining most parts of Thailand. The main river, discharging into the Bay of Thailand is Chao Phraya. The close vicinity of the sea and the flat landscape give tidal variations and flow reversals for the river in the Bangkok region.

The city is in general also very flat. Due to the close vicinity of the sea, the expected climate change generated sea level rise poses an additional risk. Within the city, a high groundwater table further add to the drainage challenges as it generates a significant unwanted inflow to the drainage system.

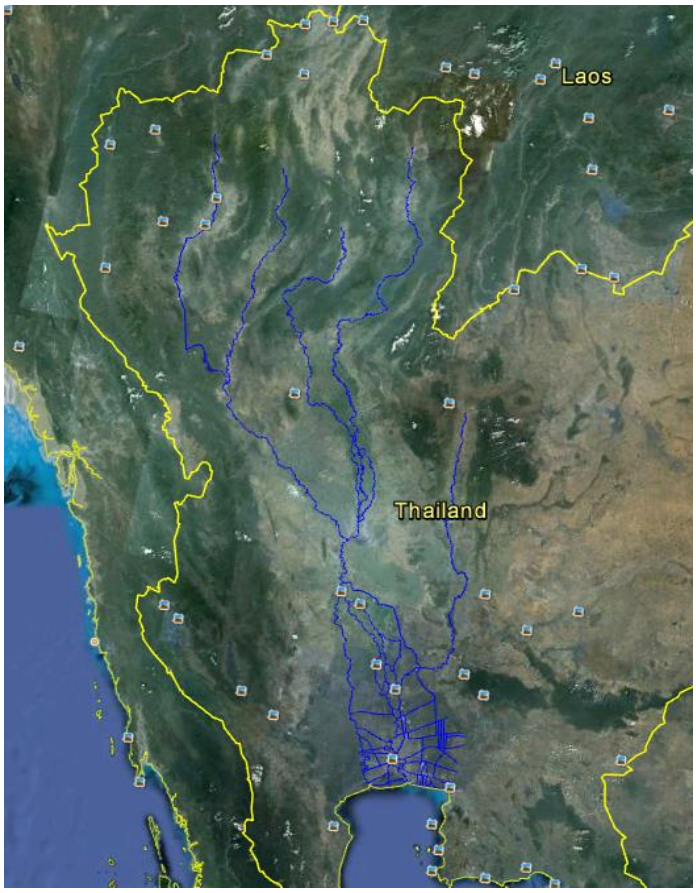

Fig. 1 - The main rivers of northwest and central Thailand

Major rivers:	
Chao Phraya	380 km
Thachin	315 km
Noi	168 km
Chainat-pasak	132 km
Pasak	150 km
Lopburi	95 km
Saensaeb	74 km
Raphiphat	60 km
Prawet-buri-rom	60 km
Rangsit	54 km
Hokwa-sai-lang	54 km
Samrong	52 km
PhrayaBanlue	43 km
Prapimol	37 km
Chai-talae	33 km

2 Sukhumvit demonstration area

The area is approximately 30 km^2 (5 km * 6 km), mainly a residential, hotel and small business district. The population is estimated to 240,000. More detailed census data were not available. The district is drained by a combination of gravity pipes and around 20 larger pumping station. It is a combined drainage system (mixed sewage, infiltration and rainwater) with no wastewater treatment, except inlet grids at the pumping stations.

The infiltration rates are likely to be high due to the high groundwater table. It has not been possible to get fully quantified numbers for the infiltration volumes. A significant part of the pipe and pumping flow capacity is used by the infiltrating groundwater. Confirmed data about infiltration is not available, but we will try to derive some more accurate estimates based on detailed pump records to be logged during February 2017.

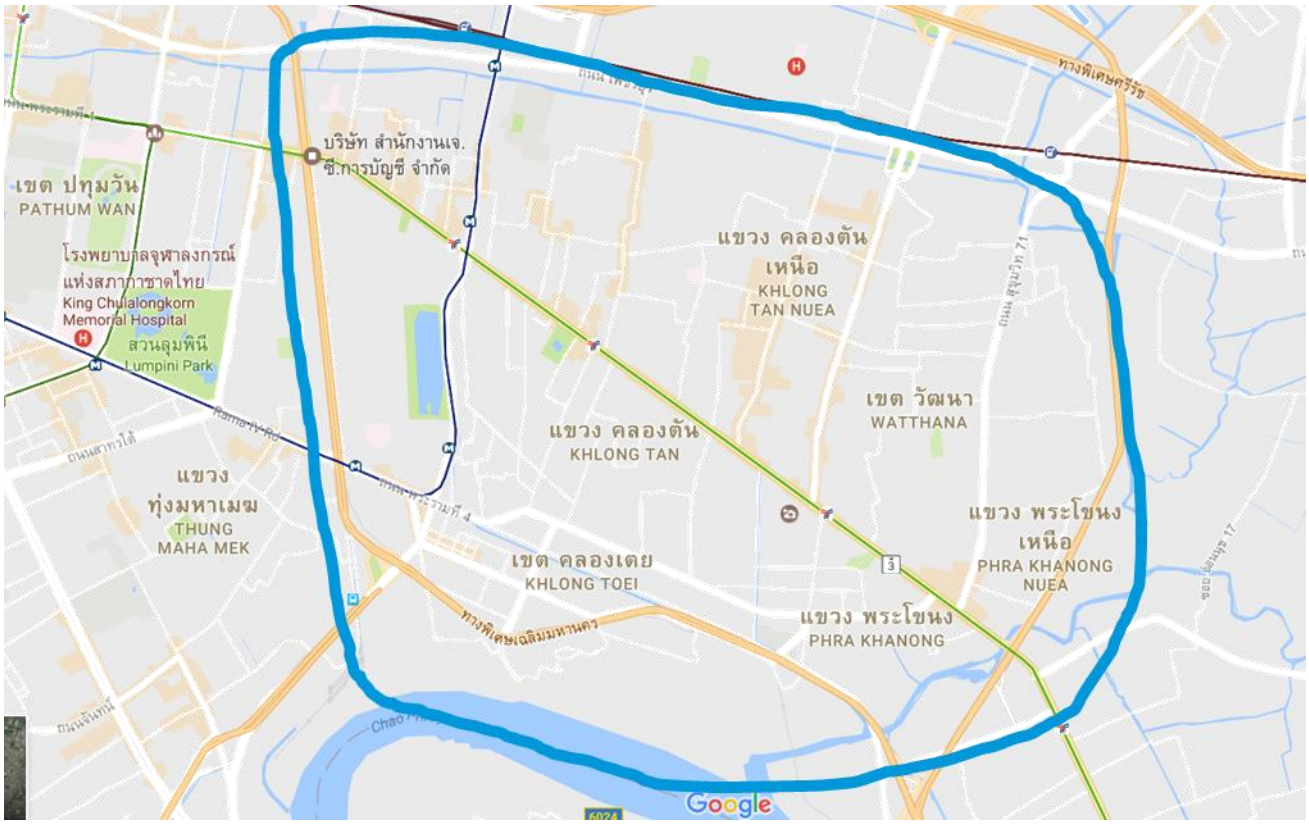

Fig. 2 - The Sukhumvit demonstration area, approximately 30 km2 and an estimated population of 240,000

3 BMA - governing organisation for drainage of Bangkok.

Bangkok Metropolitan Administration (BMA) provides the drainage services to the city. Water supply is provided by another, independent organization, MWA. The Drainage Department consists of a number of different sub-departments responsible for planning and design, maintenance and operation. BMA operates a citywide SCADA system, logging and reporting rainfall intensities and canal water levels in more than 50 locations throughout the city. Parts of this SCADA system is to be renewed or upgraded in the coming years.

All the measured data are displayed on a web site (http://weather.bangkok.go.th/scada/). BMA also operates some weather radars, but these are not calibrated and hence not useful for the current technical assistance. As an alternative source for short-term rainfall forecast data, BMA has entered an agreement with Hydro and Agro Informatics Institute (HAII) and Department of Royal Rainmaking and Agricultural Aviation, DRRAA, who will sustain the project with rainfall radar data.

Fig.3 - Web page with access to BMA data stations

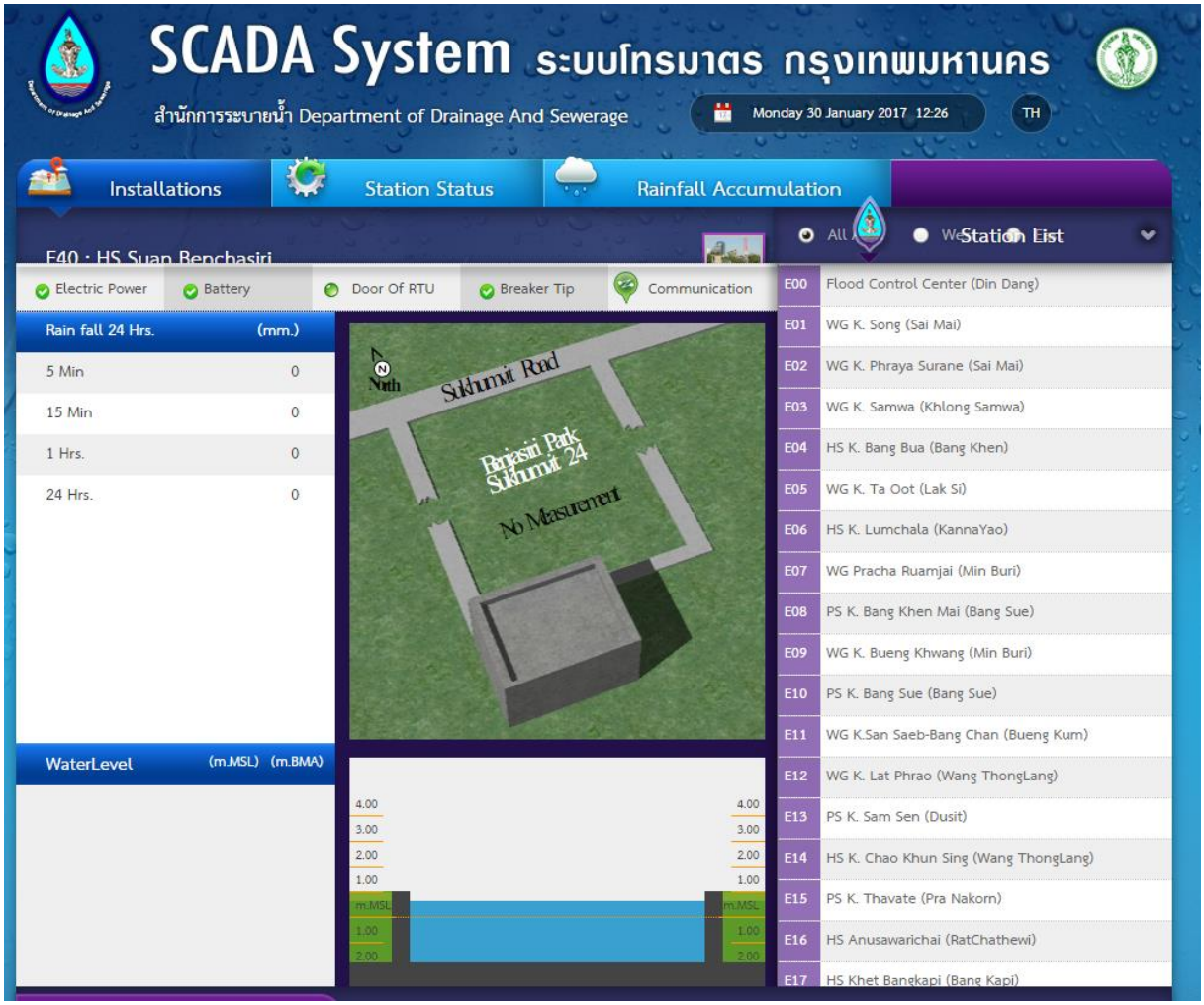

Fig. 4 – Web page zoom – pumping station

4 SCADA system and data transfer to the forecast system

The online SCADA system logs rainfall data and water level in the canals with 5-15 minutes interval. Data from the SCADA have been replicated to the forecast system at DHI since November 2016. The initial transfer mode was based on the web-scraping principle, as the only feasible solution due to various constraints within BMA. Web-scraping is not an optimal data capture and transfer method, and the capture rate has been around 80%, too low for an operational system. The data transfer is now, end of January 2017, being replaced with a direct file transfer from BMA to DHI. The changed method is likely to increase the data coverage to 95+ % of the time.

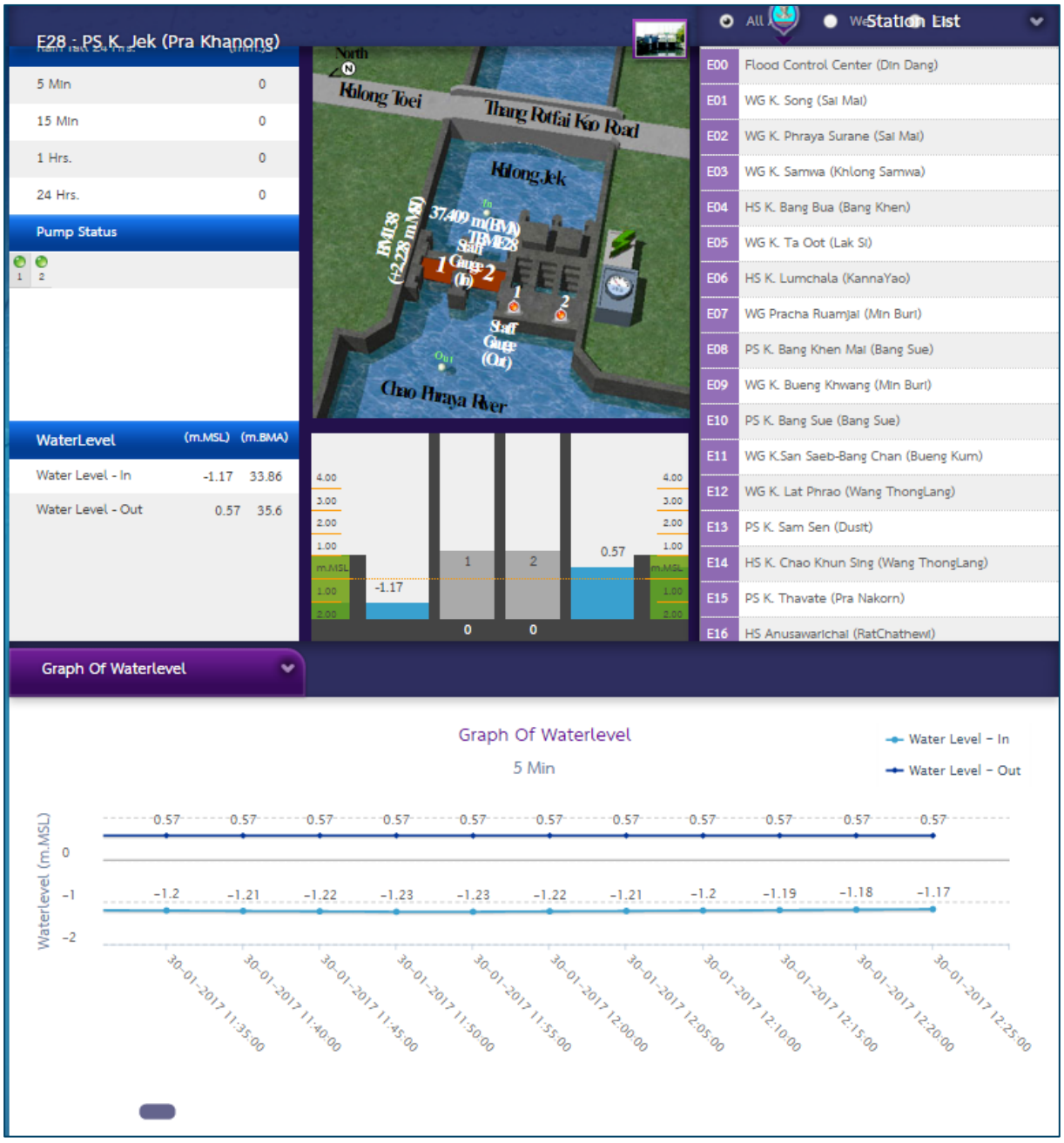

Fig. 5 – Pump station details including water levels in river Chao Phraya

The weather radars operated by DRRAA cover the entire country, with two radars having overlapping coverage for the Sukhumvit area in the central part of Bangkok. The radars provide rainfall intensities with a 1 * 1 km^2 resolution every 5 minutes. The radar images are processed by HAII to provide 1h, 2h and 3h forecast. The forecasts are updated every 30 minutes. The radar and forecast data are transferred to BMA and subsequently transferred and replicated to DHI's server.

With the several links in this chain and the necessary data processing time, the rain forecast is likely to be 60 minutes old before they can be applied by the flood forecast system. This delay will have an effect on the timeliness of the flood warnings, but it is the best solution we can manage currently.

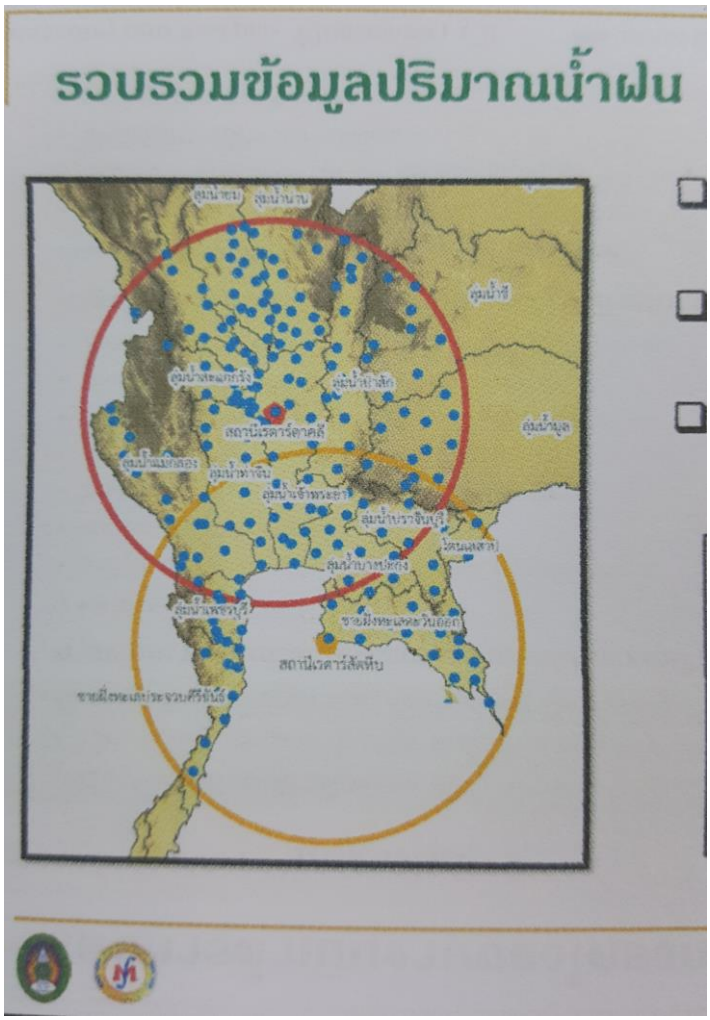

Fig. 6 – Currently two radars are operational, both cover the Bangkok area.

Fig. 7 – Complete radar network planned for implementation.

5 Conclusions and recommendations

All required data and information to establish an operational urban flood warning demonstration system is available.

This activity has identified and mapped the various data sources and identified areas where it is recommended to enhance the knowledge and data availability if BMA wants to upgrade the system to a citywide, professional early warning system.

The enhancements and additional data includes:

- **Better information on Dry Weather Flow (DWF)** - There is a significant volume of inflow and infiltration into the drainage system. This volume is only estimated on basis of general data. Information that is more accurate will improve the accuracy of the hydraulic model and hence the quality of the flood forecast.
- **More accurate elevation information** – The surface runoff into the drainage network as well as the surface flow when the drainage is surcharging are completely controlled by the slope and characteristics of the surface. A more accurate mapping will improve the accuracy of the hydraulic model and hence the quality of the flood forecast.
- **Reduce the time delay in access to SCADA information** - The current time delay of 10-20 minutes of rainfall and water level data, affects the timeliness of the forecast. A reduced delay will make the forecasts available sooner, and this give more lead time for taking prevention actions.
- **Reduce the time delay in access to radar rainfall forecast data** – A reduced delay will make the forecasts available sooner, and this give more lead time for taking prevention actions.
- **Deploy BMA radar** – Two radars were installed a few years ago. Neither of these radars are yet calibrated based on on-line ground rain gauge data. It is recommended that BMA engage in getting the radar calibrated and engage the nowcast/forecast inherent features of these radars. Inclusion of these radars will reduce the time lag and enhance the forecast timeliness.