



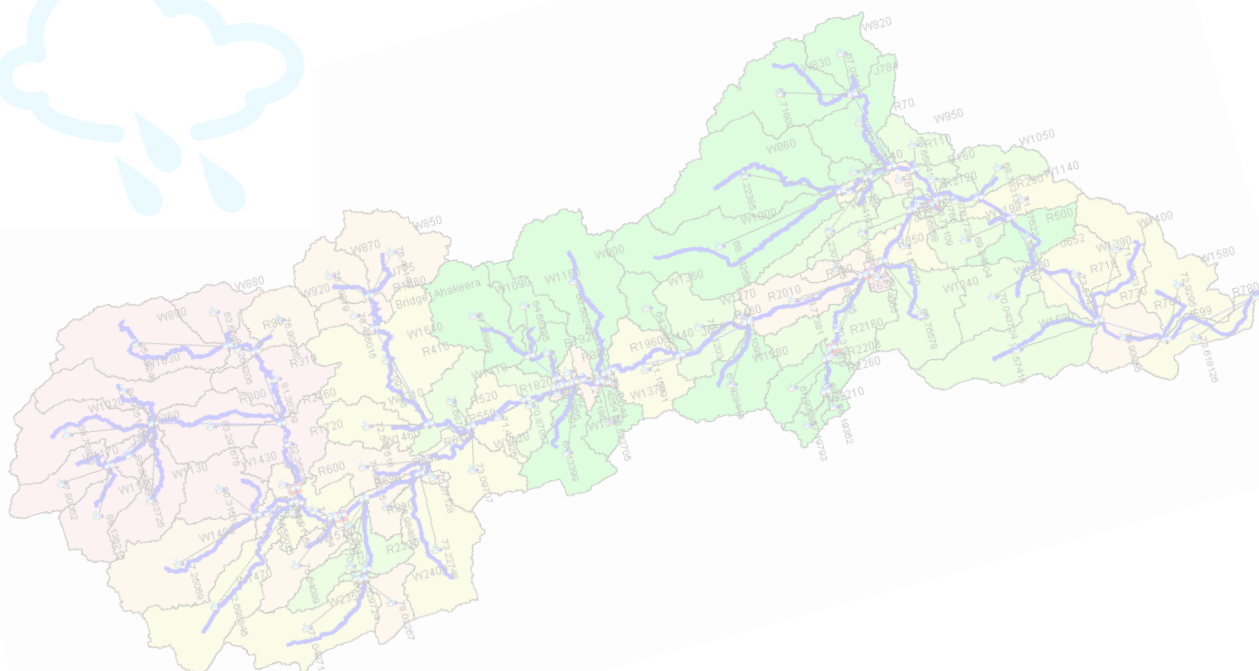
7th Framework Programme
Marie Skłodowska-Curie action (IAPP)
call: FP7-People-2013-IAPP



Intelligent Bridge Assessment Maintenance and Management System

WR.01

Bridge SMS Weather report for 2nd September 2017



September 2017



Cork
County Council
Comhairle Contae Chorcaí



Project partners: UNIVERSITY COLLEGE CORK, CORK, IRELAND
UNIVERSITY OF ZAGREB FACULTY OF CIVIL ENGINEERING, CROATIA
ARCTIS d.o.o., CROATIA
CORK COUNTY COUNCIL, IRELAND
INFRAESTRUTURAS DE PORTUGAL, PORTUGAL

Project title: **Intelligent Bridge Assessment
Maintenance and Management
System (BRIDGE SMS)**



Project code: 612517

Funds: FP7-PEOPLE-2013-IAPP - Marie Curie Action: "Industry-Academia Partnerships and Pathways"

Duration: From 2015-01-01 to 2018-12-31

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Report title: WR.01 Bridge SMS Weather report for 2nd September 2017

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Summary:

"Intelligent Bridge Assessment Maintenance and Management System" (Bridge SMS) (Grant no: 612517) is a European Commission, Marie Curie 7th Framework Programme funded Project, under the Industry Academia Partnerships and Pathways (IAPP) call: FP7-People-2013-IAPP. BRIDGE SMS is a software application that empowers engineers and key personnel to predict, identify and prepare for potentially destructive flood events. BRIDGE SMS is robust and efficient tool designed to lower maintenance/planning costs and to provide more secured bridge management/operation. BRIDGE SMS is focused, but not limited to scour / flood risk (Qualitative and Quantitative scour risk), extension of structure assessment and inspection (above water line) is possible. BRIDGE SMS would be management tool (and decision support system) providing bridge historic data, current bridge status (measured real time data from gauges, ongoing maintenance, scaffolding etc.) and future data (Flood early warning system, recommendations and mitigation measures). System will also develop mobile phone / tablets application for inspectors (standard inspection forms and photographs would be possible to upload into the BRIDGE SMS system directly from the surveys).

No of Pages:

4

Project web site: www.bridgesms.eu

Meteorological forecast

MetÉireann issued 36-hour meteorological forecast for Cork Co. on 31st August 2017. Forecast indicated that on Saturday, 2nd September 48mm of rain is expected. The 6-hour rain distribution was given, See Figure 1 (28mm of rain was expected from noon to 6pm with additional 20mm from 6pm to midnight).

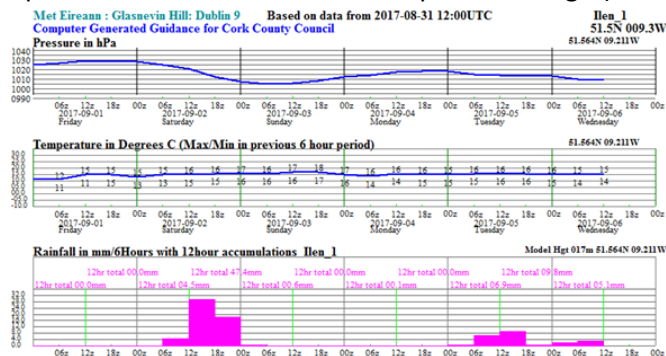


Figure 1. MetÉireann predicted rain for Co.Cork.

Observed rain on Bandon Catchment

A 15-minute rainfall data from three rain gauges was available. The location of rain gauges is shown in Figure 2. The station named WILD1 uses METOS double spoon tipping bucket, with 0.2mm resolution and 200cm² funnel. The stations WILD2 and RPS use Casella tipping bucket, with 0.2mm resolution and 400cm² funnel. The Weather Information Recording device (WILD) consists of data logger and telemetry system developed under Bridge SMS consortium. Observed and predicted rainfall from MetÉireann forecast match accurately (Table 1).

Table 1. Comparison of observed and predicted rain.

	Rainfall [mm]			
	12-18	18-24	0-3	Total
MetÉireann	28.0	20.0	0	48.0
WILD1	17.4	25.8	8.6	51.8
WILD2	8.2	12.2	1	21.4
RPS	23.8	24.4	1.2	49.4
Cork Airport	11.2	27.4	3.2	41.8
Roches Point	5.6	20.2	10.6	36.4
Sherkin Isl.	21.2	10.3	1.5	33.0

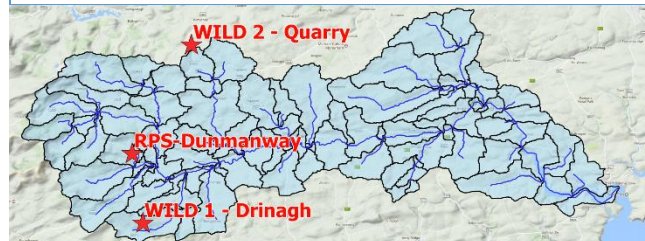


Figure 2. Location of rainfall observations.

Flood Now-casting

Hydrological HEC-HMS (US Army Corps of Engineers) model of Bandon Catchment was used for flood forecast. The model layout with location of control points is shown in Figure 7. Two approaches for flood forecast were used (Now-casting and Forecasting). Flood Now-casting uses recorded rainfall as input in the hydrological model (Figure 3). The results for three control points from Flood Now-casting are shown in Figure 4 below.

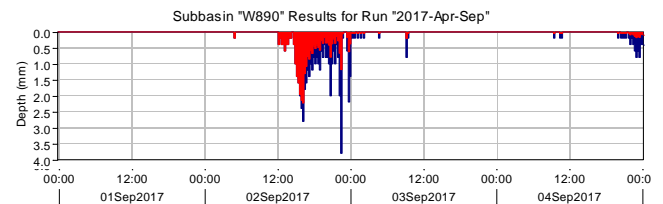


Figure 3. Input rainfall (observed at WILD rain gauge).

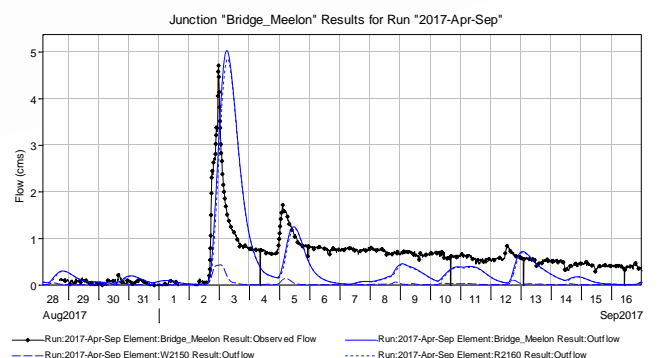
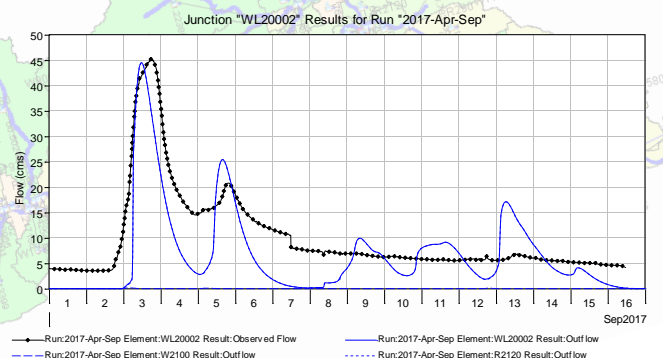
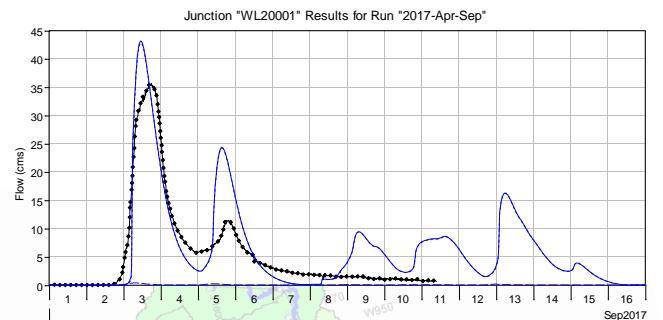


Figure 4. Now-casting results and observed flows.

Flood Forecasting

MetÉireann issued forecast for 2nd September 2017 on 31st August 2017, 48 hours before rainfall event started. MetÉireann predicted rainfall was used as input in the hydrological model in order to obtain flood warning as early as possible.

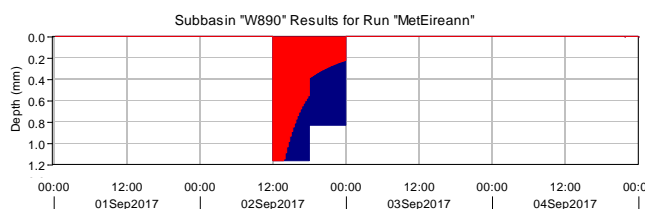


Figure 5. Input rainfall (MetÉireann forecast).

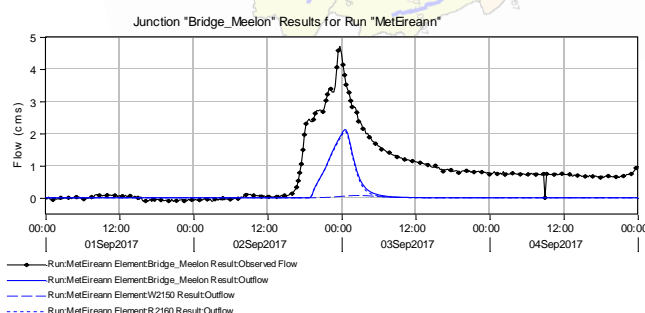
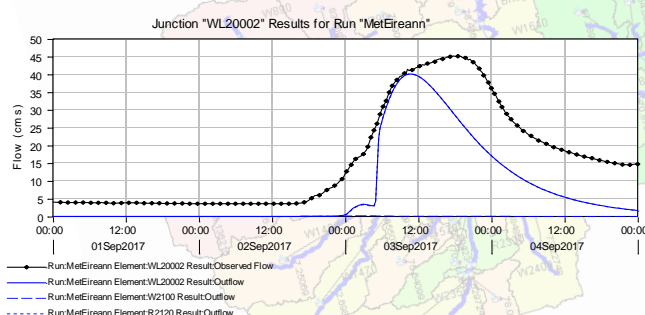
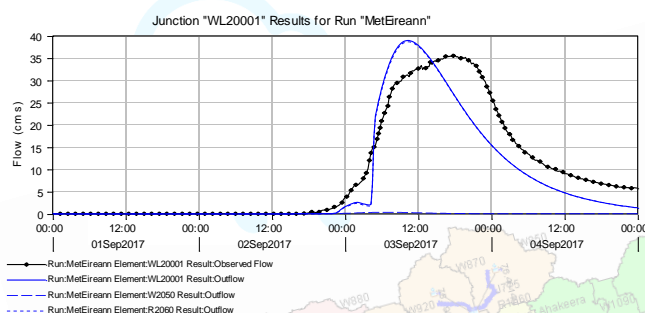
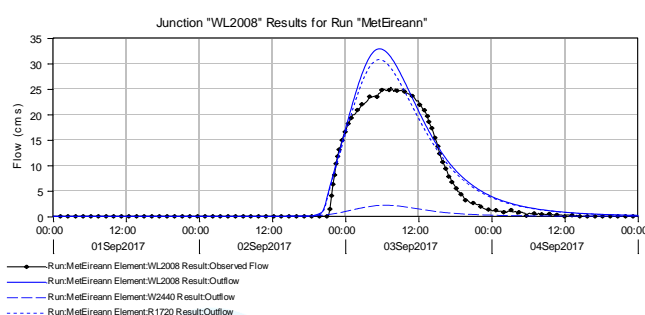


Figure 6. Forecasting results and observed flows.

Summary and Conclusions

The HEC-HMS model is developed for the purpose of flood forecast on Bandon catchment in Ireland consists of 96 sub-catchments. Total catchment area covered with the model is 591km². The model uses SCS CN for calculation of effective rainfall, SCS unit hydrograph for transformation of effective rainfall and Kinematic Wave as routing methodology in the rivers.

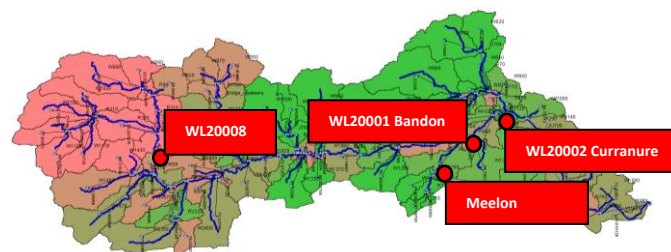


Figure 7. Hydrological HEC-HMS model used in hydrological forecast.

At 31st August 2017 MetÉireann issued weather warning with predicted rainfall of 48mm to occur in 12-hour period. The predicted rainfall was very accurate, which observed rainfall from MetÉireann (Cork Airport, Roches Point and Sherkin Island), Bridge SMS (WILD1) and RPS stations confirm (see Table 1 and Figure 3). Lower rain on station WILD2 could be due to micro-location (trees in vicinity of station). The observed discharge was obtained for three OPW stations (Long Bridge – 20008, Bandon – 20001 and Curranure – 20002). There is slight inconsistency in rating curves at stations 20008 and 20001.

Conclusions for Flood Now-casting:

- Lag time: 12 hours (**good**)
- Accuracy: up to 20% overestimation of peak flow at station 20001 (**very good**)
- Small catchments <10km² have very small lag time and require longer warmup (start of simulation two weeks before event)

Conclusions for Flood Forecasting:

- Lag time: 60 hours (**Excellent**)
- Accuracy: up to 28% overestimation of peak flow at station 20008 (**Good**). Note that the largest difference can be due to rating curve inaccuracy.
- Small catchments <10km² need to use combination of recorded and predicted rainfall as they require longer warmup (start of simulation two weeks before event)

*Ratings: **Excellent** – **very good** – **good** – **poor**