Improving Resilience with Floodwise

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ABSTRACT

Brisbane has significant flooding from a variety of sources, River, Creek, Overland flow and Storm Surge. River flooding and storm surge involve the Bureau of Meteorology providing timely warning. Creek flooding and overland flow have been left in the “too hard” basket. Small creeks can rise 2 to 6 meters within one to six hours of heavy rain with a flood occurring without warning.

Brisbane City Council has met this challenge in a unique way through FloodWise. Every five minutes, every day the telemetry network is examined, summarised and the results displayed on the web. This interface provides information in a simple, meaningful way, allowing both internal and external users to respond appropriately to these events and minimise flood impacts. Automatic SMS messages and emails react to a variety of pre-defined triggers alerting managers and operational staff to impending events.

The use of FloodWise has lowered some operational costs. In the case of flash flooding, it has allowed a more efficient use of Council’s workforce and provides management with the information it needs to appropriately respond to the event. Information includes areas of significant rainfall, flooded roads and critical infrastructure and flooded communities.

The success led to the expansion of FloodWise to the whole of South East Queensland (including Tweed Shire Council). Community engagement is currently being undertaken with Business soon to follow.

FloodWise can not only improve the resilience of a Council and its community to flash flooding but also prepares them well for the predicted effects of climate change.

1. INTRODUCTION

Many Councils have developed flood studies for their creeks and river systems in order to put in place flood mitigation schemes and planning controls to reduce their ever burgeoning flood damage bill and community disruption. It has been a requirement in some States through acts of Parliament or Policy statements for planning Authorities and Emergency Management Authorities to be better prepared both in understanding flood threat and dealing with disasters (which include flood). All the work and study have not removed flooding. Communities continue to live in low lying areas that were developed prior to this increased understanding are still subject to flooding.

Brisbane has significant flooding from a variety of sources, River, Creek, Overland flow and Storm Surge. The Bureau of Meteorology provides timely warning on river flooding and storm surge. Creek flooding and overland flow have been left in the “too hard” basket. Small creeks can rise 2 to 6 meters within one to six hours of heavy rain with a flood occurring without warning. An event occurred in Brisbane in 2001 that caused Brisbane City Council to investigate ways to improve its responsiveness. A large thunderstorm caused flash flooding to many creek systems severely affecting more than half of Brisbane. It caused significant
damage and disruption. Brisbane City Council has met this challenge in a unique way through FloodWise. The system was deployed in 2003 and was tested soon after by another event in 2004. The success of FloodWise within Brisbane City Council led other surrounding Councils to request access to this technology. In 2008 a successful bid for funding led to the rollout of FloodWise to all Councils in South East Queensland. Tweed Shire Council was also included. This development provided the ability for each council to view not only their own information but also neighbouring council’s details which provides valuable data of an approaching storm. Each Council can learn from the others on ways to improve responsiveness. Brisbane City Council has benefited from the SEQ deployment. There has been a significant change where all levels of government openly share their data and thus benefit from the significant increase in information.

2. THE FLOODWISE INNOVATION

On the afternoon of 9th March 2001, a flash flood occurred in Brisbane that caught both the community and Brisbane City Council (BCC) off guard. The intense storm lasted only three hours but many creeks rose up to four metres in 1.5 hours. Major flash flooding occurred on a number of creeks. Roads were cut and peak hour traffic chaos ensued. Radar images showed little movement, making it impossible to predict how long the storm would last. Constructing a situation report was also impossible as the report was out of date before it was finished. It was following the storm, when reports of house flooding came in, that the full extent of the event was realised.

Over thirty creeks pass through the city. The combined length is around 240 kilometres. Creeks can flood within one to ten hours following heavy rainfall (depending on the catchment size). Most Creeks flood within two hours after heavy rain. There are pockets of residential development where less than a one in five year event can cause flood damage. Many road creek crossings are cut in less than a two-year event. BCC’s call centre is inundated with requests for assistance when flash floods occur.

BCC currently has 40 water level telemetry gauges and 60 telemetry rainfall gauges. The network was initially installed to assist calibration of computer models used in flood studies. These were then used to set development control levels and define flood corridors. It was also hoped that the telemetry data and computer models could be used for flash flood forecasting. Telemetry data was collected on non-networked computers, with the data only available to limited BCC staff. The focus was on improving the infrastructure by enlarging stormwater pipes, removing thick vegetation that caused flood constrictions and prioritising maintenance programs.

The way to improve Council responsiveness in a flash flood situation is to provide relevant information to all operational areas of the Council quickly. In addition operational staff needs to be alerted to the situation. The FloodWise innovation was to process the gauge data to provide real information. Incorporate this with data based on Flood Studies, other field observations from maximum height gauges and surveyed debris marks, as well as operational officer knowledge. Then create relationships to practical ways to improve response to flash flooding. All this data is held in a database for use on a web page and in eMail and/or SMS message to users.

Every five minutes, every day the telemetry network is examined, summarised and the results displayed on the web. This interface provides information in a simple, meaningful way, allowing both internal and external users to respond appropriately to these events and thereby minimise flood impacts. Automatic SMS messages and emails react to a variety of pre-defined triggers alerting mangers and operational staff to impending events.

Since the inclusion of South East Queensland including Tweed Shire Council, FloodWise monitors an area that is approximately 330km wide and 340km long. This area contains just
over 400 rain gauges and over 200 water level gauges

3. FLOODWISE SYSTEM OVERVIEW

Hydrometric data collected on the Bureau of Meteorology’s (BoM) Environmental program is extracted and converted into operational information and stored on a database. A graphical web interface (a sample shown on Figure 1) provides this information to all users.

3.1 Rainfall
Rainfall gauges are displayed on a map. Floating over the gauge activates a dropdown table showing, among other things, the rainfall return period for various durations. The gauge icon itself can show a variety of selected details. The background colour of the gauge varies depending on the amount of rainfall, making it easy to get a picture of the distribution of heavy rain. Double clicking the gauge shows the hyetograph over the last 24 hours.

Full colour rainfall contour maps (Figure 2) are also available. They are coloured such that an area reddens as the threat of flood increases: the deeper the red the worse the problem.

3.2 Stream Height
Stream height gauges, indicating water level, are displayed on a similar map. The background colour of the gauge relates to the minor, moderate, major levels used in BoM warnings. Double clicking the gauge produces a stage hydrograph that can also show the level of a nearby significant structure (e.g. spillway or bridge deck). This hydrograph page is used to view the start of flooding level of all flooding relationships.

3.3 Flooded Roads
Symbols on a map show the location of roads being monitored. These roads are associated with telemetered stream gauges. Symbols are colour coded (black – gauge not functioning, green – road open, yellow – road will flood in next 30 minutes and red – road flooded). Floating over the symbol produces an inset “street directory style” map showing the location of the crossing and surrounding roads. Double clicking the symbol produces the gauge
hydrograph together with a horizontal line representing the transposed road level.

3.4 Critical Infrastructure
This is similar to flooded roads. Critical infrastructure can include a privacy tag to limit its view to selected users.

3.5 Flooded Areas
Similar to flooded roads except when the symbol is clicked a full screen “street directory style” map (Figure 5), shaded to depict the current flood inundation of the area, is displayed.

The amount of inundation is linked to the associated gauge. Users can move the flood up or down to see changes to the inundation area with suspected changes in water level.

3.6 SMS/ Email Alerts
Alerts can be set up on any of the collected and processed data. Currently there are 240 different alerts. FloodWise automatically sends out approximately 25,000 SMS person messages per year. (One message to 6x people = six person messages)

4. CURRENT USES

Many different groups use flood information but all start the same way. The Bureau of Meteorology will issue a storm warning. This warning is sent to FloodWise and is forwarded to selected users as an eMail or a cut down version for SMS. Some users will then log onto the Bureau’s Radar site to see where the storm is and how fast it is approaching. They will then log onto FloodWise and manoeuvre within the various gauges within the storm centre. For the Council within the storm, the rainfall intensity provides the earliest warning on what to expect.

4.1 Council Users

The Web is used to further assess the extent of the problem following an alert and enact either a predetermined action plan or determine an appropriate response.

- A Design office uses the data to plan for additional data collection to improve flood and rainfall relationships, to read other non-telemetry gauges following the event (needed for a range of reasons) or report on the event. They use both Current and Historic data.
- Project Management use current information to make “on the spot” strategic decisions on projects affected by heavy rain or flash floods to minimise impacts on delivery dates.
- Sewerage Operators use Flooded Critical Infrastructure data to move Power Boards and/or pumps that can be affected by the developing flood.
- Water Supply operators use the data to warn of different treatment processes due to changes of raw water quality that will result in predefined flood situations.
- LAS (Local Asset Services and Emergence Response Units) use Flooded Road forecast as they are responsible for barricading flooded roads. They use Rainfall data to determine if a unit needs to immediately respond to a blocked drain clearance request during a storm event. They only send a unit urgently if the return period of the rainfall is less than the design capacity of the drain.
- Call Centre uses the rainfall contour map to determine which staff can be called for emergency manning, to increase staff numbers to deal with the increased emergency phone traffic of a current event.
- SES (State Emergency Service) use rainfall the contour map to determine which parts of the city are under threat from flash flooding. This allows them to better target their response.
- Traffic Control uses both the flooded road and rainfall pages for traffic control operations.
- Construction Management use historic rainfall hyetographs to determine if contractor’s wet day claims are valid.

4.8 Community

Approximately four years ago the Brisbane City Council held a task force to look at flooding in the community. The Community wanted more information and some warning.

A “Be FloodWise” campaign was developed to provide brochures to assist the Community to develop their own flood action plan. Property based data provided both design flood and historic flood profiles. A pilot to combine the Community information campaign with FloodWise is underway. The warning system is based on the following:

- Access to an Alert that initiates their flood action plan.
- Call centre scripting to back-up the warning system
- Access to ‘Live’ gauge data through FloodWise
Online training on how the system fits together

Council can get inundation maps as the emergency unfolds allowing them to formulate their assistance planning. Figure 5 shows the FloodWise inundation map. Figure 6 shows a photograph taken from the intersection of Cambridge and Elkedra Streets.

Flooded communities also have access to this inundation but have stated that they would be too busy dealing with their disaster to be playing with the internet during such a time.

A number of business operators have heard about FloodWise through the insurance industry. Businesses are encouraged to develop their flood action plans in readiness for their eventual inclusion into the automatic alerting offered to other users of FloodWise. From early discussions there is indeed an ability to help them reduce the impact of flash flooding. Business can benefit by incorporating the available information into their business continuity planning for rainfall or flood events.

5. IMPROVING RESILIENCE

The definition of resilience is “power of resuming original form after compression, power of recovery”. FloodWise has been proven to have a threefold effect on resilience. It helps users understand just how quickly a situation can change and that understanding leads to better preparation for an event. Secondly it provides timely warning of the event, to those who have specifically asked, giving them time to enact plans to minimise the consequences. Finally it provides information to assisting Authorities who can then better target their resources in helping the recovery of those affected.

6. CONCLUSION

A similar flood to the March 2001 event occurred in November 2004. It occurred on a Sunday. This time alert messages went out and sufficient officers were available to deal with the event. While the community did not have access to the system and did suffer some flood damage, BCC was in a much better position to assess and assist.

FloodWise stores the consequences of flooding and heavy rainfall within its database. This information survives staff changes. Every event adds to the knowledge base. Climate change is said to cause more violent flash flooding events though the time between these events will increase. This increases the likelihood of loss of experience and thus increases the usefulness of FloodWise.

6. TAKE HOME MESSAGES

1. FloodWise makes a difference in flash flood situations and helps flood preparedness.

2. Council operations have improved flood responsiveness with easy access to rain and flood data. There are many different ways to use this data.

3. Councils can learn from each other on how to deal with flash flood events.

4. Significant benefits are achieved with improved access to storm data and in the sharing of this data with other governmental organisations.

5. Many simple practical steps can be taken to improve flood resilience.