

# Helping to Rebuild Queensland with Survey and Spatial Data

**Alex Cowdery**

AAM

[a.cowdery@aamgroup.com](mailto:a.cowdery@aamgroup.com)

## ABSTRACT

*In 2011 many parts of eastern Australia were affected by natural disasters such as flooding and tropical storms. Timely, accurate and comprehensive spatial data was required to help government representatives to assess the damage, prioritise resources, and help to rebuild infrastructure, communities and homes. This paper reviews some of the technologies used to perform these tasks across Queensland.*

**KEYWORDS:** *Yasi, infrastructure, Queensland, Aerial Imagery, Web Mapping Services.*

## 1 INTRODUCTION

AAM Pty Ltd is a company which supplied rapid-response aerial imagery to the Queensland Government for a number of natural disasters that occurred in Queensland (Qld) in 2010 and 2011. From inland floods to post Tropical Cyclone Yasi, rapid response image products were captured within hours of the disasters and supplied within several days for the priority areas.

These rapid-response, post-disaster products were one of the vital foundation datasets embraced for immediate disaster assessment and prioritising emergency response efforts by Qld Fire and Rescue Service, Emergency Management Qld, Police and other agencies. A combination of sequential and parallel team work, in association with leading-edge technologies for data capture and data distribution, ensured post-disaster aerial imagery was in the hands of the key personnel in the devastated areas within several days of the events.

## 2 CYCLONE YASI OVERVIEW

Tropical Cyclone Yasi (Figure 1) was a tropical cyclone that made landfall in northern Queensland in the early hours of Thursday, 3 February 2011. Yasi was the size of the East Coast of Australia, and caused an estimated \$3.6 billion in damage, making it the costliest tropical cyclone to hit Australia on record. Cyclone Yasi made landfall at Mission Beach and wind gusts were estimated to have reached 290 kilometres per hour, leaving significant and widespread damage. A storm surge estimated to have reached 7.0 metres destroyed structures along the coast and pushed up to 300 metres inland.

In the hours after the storm's passage, police were unable to venture beyond their station grounds as the situation had yet to be declared safe. Beaches had lost sand and most structures at Mission Beach were damaged. Residents described the aftermath as a scene of mass destruction and an unknown number of homes were completely destroyed. Due to the

available preparation time and mass evacuations, fortunately Yasi was not directly responsible for any fatalities.



Figure 1: Satellite image of Yasi off the east coast of Queensland on 2 February 2011 (Photo Source: NASA).

## 2.1 AAM's Planning Input to the Yasi Project

AAM's input to the project context was:

- Short notice for flight planning and system mobilisation.
- Extremely challenging weather conditions for aerial survey.
- Specific requests for image capture, i.e. immediately after disaster or at peak flood.

Table 1 lists examples of the short response times essential during this project.

Table 1: Example of short response times for Post Tropical Cyclone Yasi project.

DERM released request for quote	Wed Feb 2, 10am
Tropical Cyclone Yasi hit land	Thurs Feb 3
AAM awarded contract	Thurs Feb 3, 5.15pm
Successful aerial capture of priority areas	Sat Feb 5
First imagery delivered to Qld Govt	Mon Feb 7

Teams of AAM personnel worked long hours for several weeks. The aerial survey teams worked in difficult conditions to successfully exploit the small gaps in the poor weather conditions to capture imagery, while office-based teams worked in parallel to process the data for delivery within two days of capture for the priority areas. Figure 2 illustrates the conditions faced during data capture.



Figure 2: Very low cloud bases, high winds and steep terrain were some of the conditions faced by the aircrews during the post Yasi data capture over 23 sites.

## 2.2 AAM's Data Capture and Processing for the Yasi Project

From the diverse collection of digital cameras owned by AAM, a large format, Zeiss Intergraph Digital Mapping Camera (DMC) was selected based on the need to:

- Fly slow under a very low cloud base.
- Deliver high-resolution imagery with minimal or no clouds.
- Supply mosaics within a few days of data capture.

The use of multiple 64-bit workstations and experienced data analysts ensured the provision of multi-resolution, compressed products for distribution via the ftp and HDD mechanisms. Figure 3 provides an example of the 50 cm rapid mosaics created from the 5 cm imagery captured (Figure 4). Ground photography only captures part of the picture (Figure 5).

Given the initial priorities of the users were assessing the extent and severity of the damage / event, rapid mosaics were compiled and dispatched. In parallel production, the more time-consuming tasks involving aesthetics (colour balancing) and precision orthorectification were undertaken. These rapid image products were generated at multiple resolutions and multiple compression formats (ecw, jpg2000) to aid distribution to agencies with a range of software environments and data preferences.

Within 10 days of project commencement AAM collected:

- Data over 23 sites.
- More than 500 km<sup>2</sup> of data.
- More than 6000 frames of almost cloud-free imagery.
- Most capture at 5 cm GSD (i.e. just below the clouds).



Figure 3: AAM imagery as supplied by Web Mapping Service in the ERDAS Apollo Environment.



Figure 4: Example of the Cardwell 5 cm imagery that was acquired.



Figure 5: Ground photography of the same site does not capture the complete picture (sourced from the Courier Mail website).

### 3 USES OF IMAGERY

AAM imagery formed the foundation dataset for a range of applications to which many agencies value-added, e.g.

- Qld Fire and Rescue Service (QFRS): Immediate assessment of damage (Figures 6-9).
- Centrelink: Confirmation of claims made for disaster relief funding in areas impacted by the disaster.
- Tax Office: Confirmation of which properties were impacted, so claims such as “I lost all of my receipts” and “all of my tax paperwork was destroyed” can be validated, as well as identification of individuals that may need more time to pay tax bills as their properties were affected by the disaster.
- Qld Reconstruction Authority: The communication tool and planning base for prioritising reconstruction of buildings, roads, rail, etc. (Figure 10).

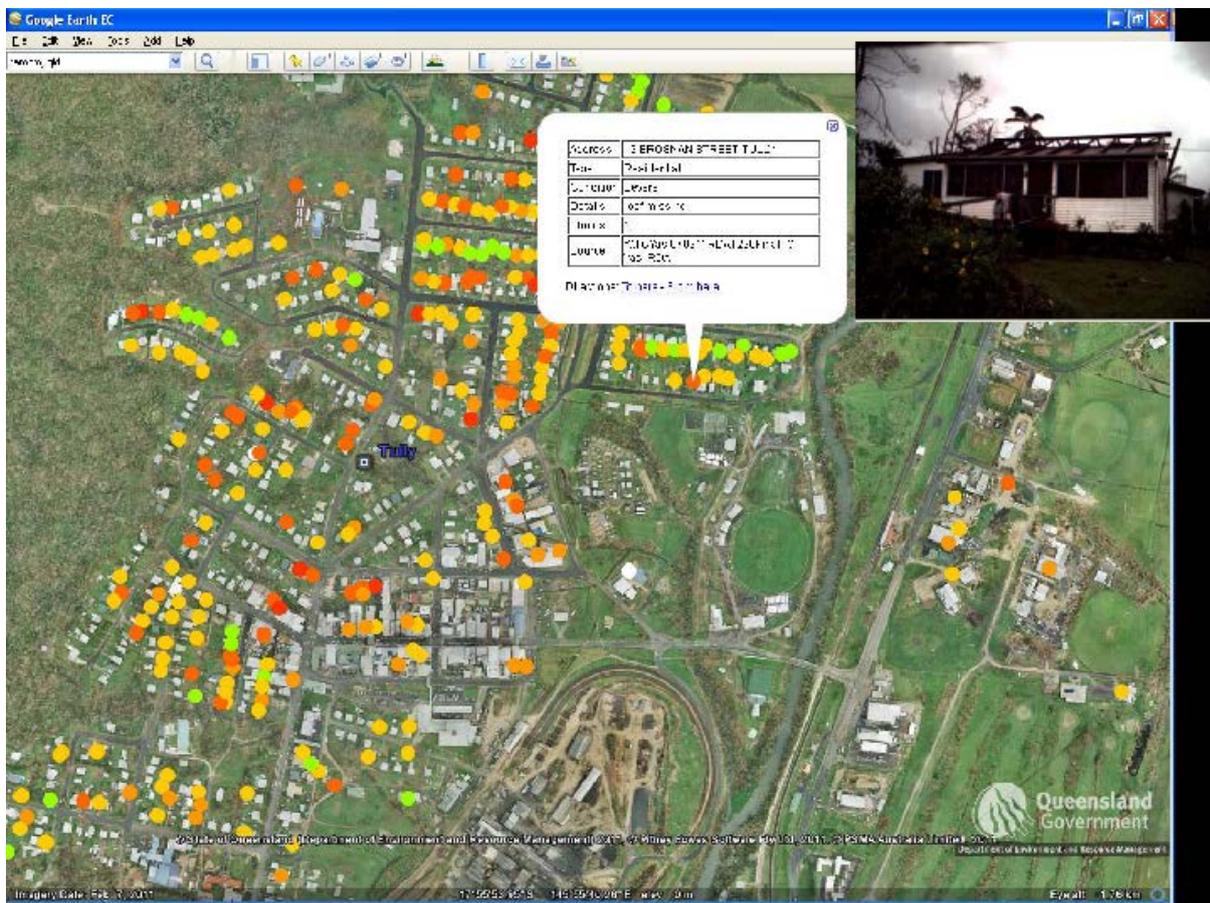


Figure 6: AAM imagery utilised to aid on ground damage assessment (Photo Source: DERM).



Figure 7: Emerald imagery showing rapid damage assessment information collected by QFRS. Data as viewed from Emergency Management Qld internal mapping system.



Figure 8: St George imagery showing rapid damage assessment information collected (Source: QFRS).



<http://www.qldreconstruction.org.au/>

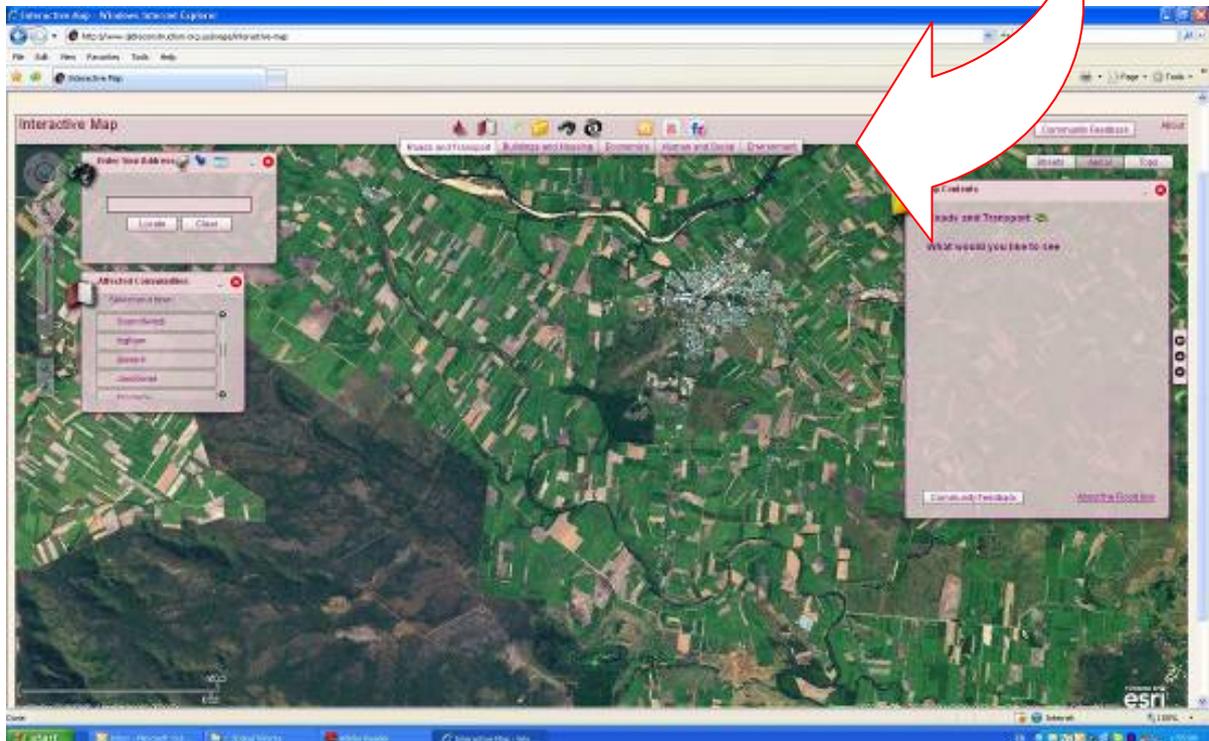


Figure 9: AAM imagery as the foundation dataset within the Qld reconstruction website.

#### **4 BENEFITS OF RAPID AERIAL IMAGERY SERVICES**

Queensland Emergency Services personnel had not received rapid response data before AAM's provision of flooded inland towns or post Cyclone Yasi. Accurate imagery of the extent and severity of the damage was a vital tool which ensured a common understanding of the situation and solid base for an informed response.

Teams of specialist AAM staff worked long hours to accelerate the flight planning, image capture, image processing, mosaic creation and delivery of datasets to the Qld Department of Environment and Recourse Management (DERM) and Emergency Management Qld.

Having captured imagery within hours of the disasters, the data had immense value to disaster relief planning, and damage assessment in addition to government planning regulations which will influence a range of government policies, future disaster strategies and continued prioritisation of resource allocation.

The AAM products and services supplied confirmed the capacity, capability and maturity of Australian companies to undertake aerial survey services under difficult circumstances and to create teams to support rapid response work using the latest generation of digital imaging technology.

On-the-fly data processing capabilities and data distribution applications illustrated the power of web mapping services (WMS) such as ERDAS. The old but reliable ecw data compression via the old and reliable ftp technology also aided the rapid transmission and receipt of data in numerous regional locations.

The image base provided a unique and common foundation for communication amongst all parties involved in numerous tasks associated with disaster response, e.g. damage assessment, prioritisation of scarce resources.

The synergy between the imagery and the subsequent on-the-ground input from Emergency Services personnel and others allows the Government and major commercial agencies in the region to aid in the allocation of resources and prioritisation of vital reconstruction.

#### **5 COMMUNITY BENEFITS**

Emergency personnel were impressed with the unprecedented speed and quality of image data available to them. The AAM methodology permitted the widespread use, access and enhanced understanding of how leading-edge geospatial digital products can better support our Emergency Response Agencies and SES volunteers.

AAM recently received a highly commended nomination at the recent Queensland Spatial Excellence Awards. The AAM contribution was informally acknowledged by personnel from the Department of Community Safety / Emergency Management Queensland and formally acknowledged in a letter shown in Figure 11.



Department of Environment  
and Resource Management

24.3.2011

**Mr Brian Nicholls**  
**General Manager**  
**AAM Pty Ltd**  
**152 Wharf St**  
**Brisbane Qld 4000**

  
Dear Mr Nicholls,

I would like to thank your company for the tremendous effort put into the imagery projects required by my Department for the recent natural disasters that Queensland has experienced.

Your company played a major role in the acquisition and prompt delivery of essential aerial imagery. The imagery is now being employed in the response and recovery efforts across the Queensland Government including the newly established Queensland Reconstruction Authority.

The Department of Environment and Resource Management recognises that, not only was the imagery acquired under very difficult circumstances but the **image quality and timely delivery of the data could not have been better**. It is not often that government agencies give praise for work well done by the private sector, but these excellent outcomes reflect very highly on your company and in particular the **dedication and experience of AAM's air crew, technical and support staff**. **Without their endeavour, the imagery would not have been available for the critical work required by the Government and the community for the disaster response.**

For your interest I have included some screen shots of AAM's imagery being utilised by the department when integrated with other departmental datasets for disaster response activities.

Could you please convey my sincere thanks to all involved? The department looks forward to working with AAM in the near future and in the longer term in other spatial data projects.

Yours sincerely

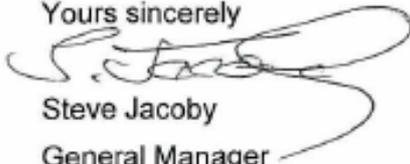
  
Steve Jacoby  
General Manager  
Spatial Information Group

Figure 10: Evidence of client endorsement.

## 6 CONCLUDING REMARKS

In short, the imagery was one vital input to view and assess the damage of natural disasters and then determine which geographic areas required the most support. New benchmarks were met by the rapid imagery projects with the Queensland government in 2010 and 2011. These were:

1. The almost immediate capture of high-resolution, post-disaster imagery for numerous locations. Mosaics of the major areas of devastation were created and delivered within two days of capture. Some previous disasters in Qld were not imaged until months after the event, e.g. Cyclone Larry.
2. Access to the imagery was possible via several mechanisms:
  - Emergency Management Queensland secure ftp site.
  - DERM secure ftp site.
  - Backup delivery on HDD.
  - Imagery was quickly made available via web mapping imagery services.
3. The Qld Government embraced a flexible and collaborative arrangement in the capture of aerial imagery to ensure its rapid capture and delivery. The Government is now reaping the rewards of imagery capture immediately after (or during) the disasters' peak levels. The imagery is now contributing to the accurate mapping of floods heights and cyclone damage extents, which are vital to long-term damage assessment and will influence a range of government policies, future disaster strategies and continued prioritisation of resource allocation.

## ACKNOWLEDGEMENTS

AAM gratefully acknowledges the following:

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- GIS screenshots supplied by the Department of Environment and Resource Management.
- AAM photos of aircrew and flying conditions: Dider, Matthius.
- AAM staff, their families and partners for working long nights, weekends and multiple public holidays to provide our capture and processing services.