

Unmanned vehicle technology has developed inspection and site assessment systems based on small, unmanned aerial and terrestrial robots (drones) fitted with cameras and other sensors. The Unmanned Aerial Vehicle (UAV) or Unmanned Ground Vehicle (UGV) methodologies involves vehicles manoeuvring in close proximity around buildings and bridges; or photogrammetry, relaying close-up, high-fidelity images and ground data (e.g. contour and 3d modelling) to project planners, construction managers and structural engineers for site assessment or condition reporting purposes. Ostensibly, image recording for project planning and asset management purposes.

Project planning and site monitoring has traditionally commenced with aerial, satellite or lidar imagery backed up by surveyors. UAVs' combined with mapping and CAD software provides geo referenced Orthomosaic, 3D imagery with fly through capability and highly accurate site contours.



Timeline Images has several alternate vehicles (depending on the flight parameters) using GPS signals as well as pilot assisted control for the recording of images and vehicle control. We use these vehicles for close proximity flying and observing visual cues of structural integrity and environmental effects.

UAVs can be flown on a fixed flight path using 'waypoints', filming with high definition video, or pictures, targeting specific areas of works. This facilitates direct comparison of works over time. The process improves safety as well as productivity ratios of cost, labour and time.

#### **What We Do**

- Video, orthomosaic and 3D images of structures and sites.
- Dimension and volume measurement (e.g. stockpile).
- Inspection reports can be certified by structural engineers and surveyors.

#### **Stakeholders**

- State government departments.
- Local governments.
- Structural design engineering companies.
- Construction contractors.
- Earth moving contractors.
- Other bulk works suppliers.
- Surveyors.

## Bridge and Structure Inspections

Bridge and structure inspection policies require a systematic programme of bridge inspections. Traditionally inspections involve cantilevered equipment, trucks, safety equipment, traffic control, a team of people.

UAV inspection requires two (2) people and UAV and photographic equipment.



**Figure 1: Traditional Bridge Inspection**

The benefits of UAV are:

- Revolutionary technology and system for documenting infrastructure.
- Permanent history of infrastructure condition.
- Photographic and video data link for in-office engineer interpretation.
- First person viewing of structure.
- Greater speed, download and in-house review.
- Reduced traffic disruptions.
- Significantly reduced WHS risk.
- Low cost and higher productivity ratios of between 3:1 and 5:1 compared to existing methods.
- High quality data recording and monitoring – images or video.
- Improved evaluated/documentated – ideal for future maintenance and health checks.
- Identification of defects, including fractures of 0.15 cm in size.



**Figure 2: UAV Inspection**



Figure 3: Bridge Facia



Figure 4: Bridge Facia Detail



Figure 5: Underside of Bridge



Figure 6: Bridge Detail

## Civil Works Inspection

Civil works contracts have reporting processes for project management and progress reporting. Current processes require reporting against progress milestones.

The use of UAV vehicles can improve the project reporting process by flying a fixed route over the works. Regular (e.g. monthly) reporting in this way provides a timeline and permanent record of works in progress, so that the project manager and contractor minimise any disputes and improve communication. The use of UAV vehicles also allows the confirmation of contractor performance for ancillary works such as environmental and stormwater management.

The benefits of UAV are:

- Image and data documentation of works progress.
- Specific commentary can be added, issues highlighted.
- Permanent history of works timeline.
- Photographic and video data link for contractor and project manager interpretation.
- Common point of communication.
- Minimises disputes.
- Greater speed, download and in-house review.
- High definition.
- Reduced work disruptions.
- Significantly reduced WHS risk.
- Improved evaluated/documentated contract management- ideal for future maintenance and health checks.

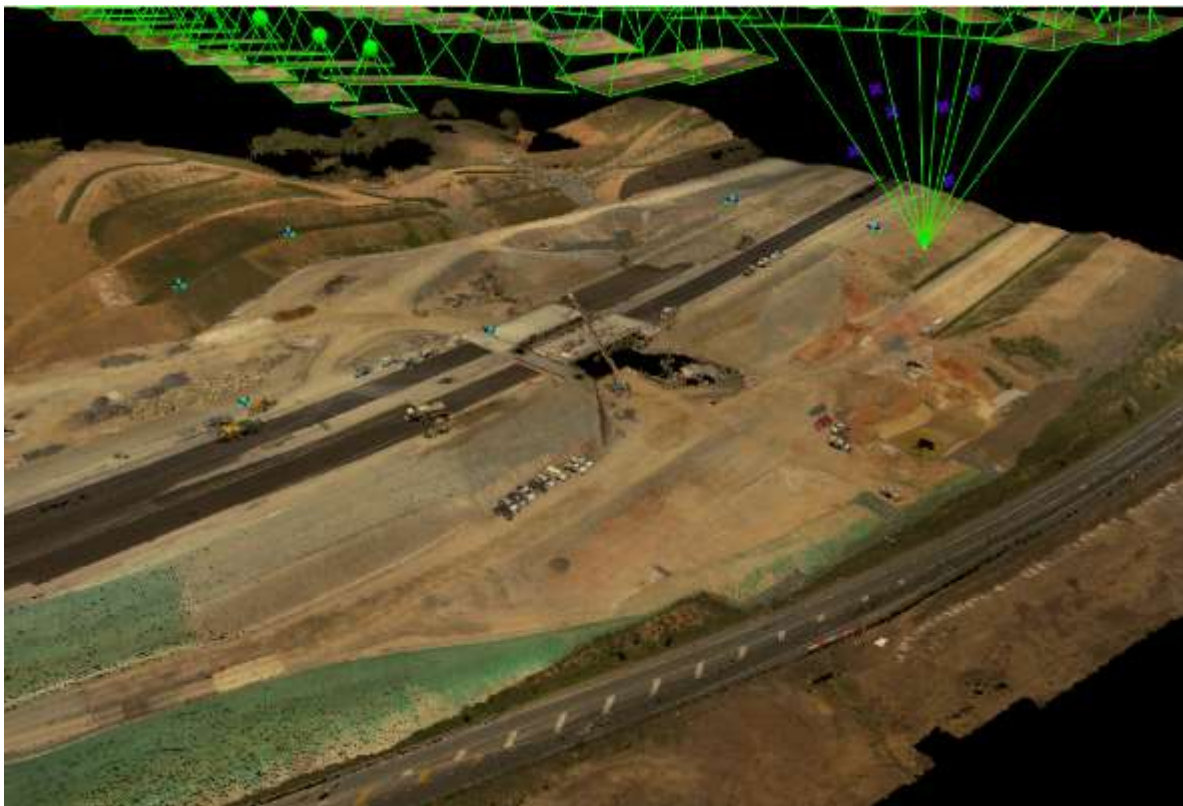


Figure 7: Cooroy Northern Grade Separated Intersection Ground Control Points in 3D Image

## Coastal and Foreshore Inspections

Local and state governments are increasingly monitoring and surveying beach and foreshore conditions.

Issues addressed include:

- Beach and foreshore erosion and replenishment.
- Pedestrian and vehicle movements.
- Infrastructure condition.

Timeline Images can provide:

- High definition 3d imagery.
- Orthomosaic images.
- Fly through and alternate view.
- Height histogram and digital image.
- Quantity calculation (e.g. sand replenishment) and distance measurement (e.g. wall face height or width).
- Erosion and break out points.
- Contour mapping.

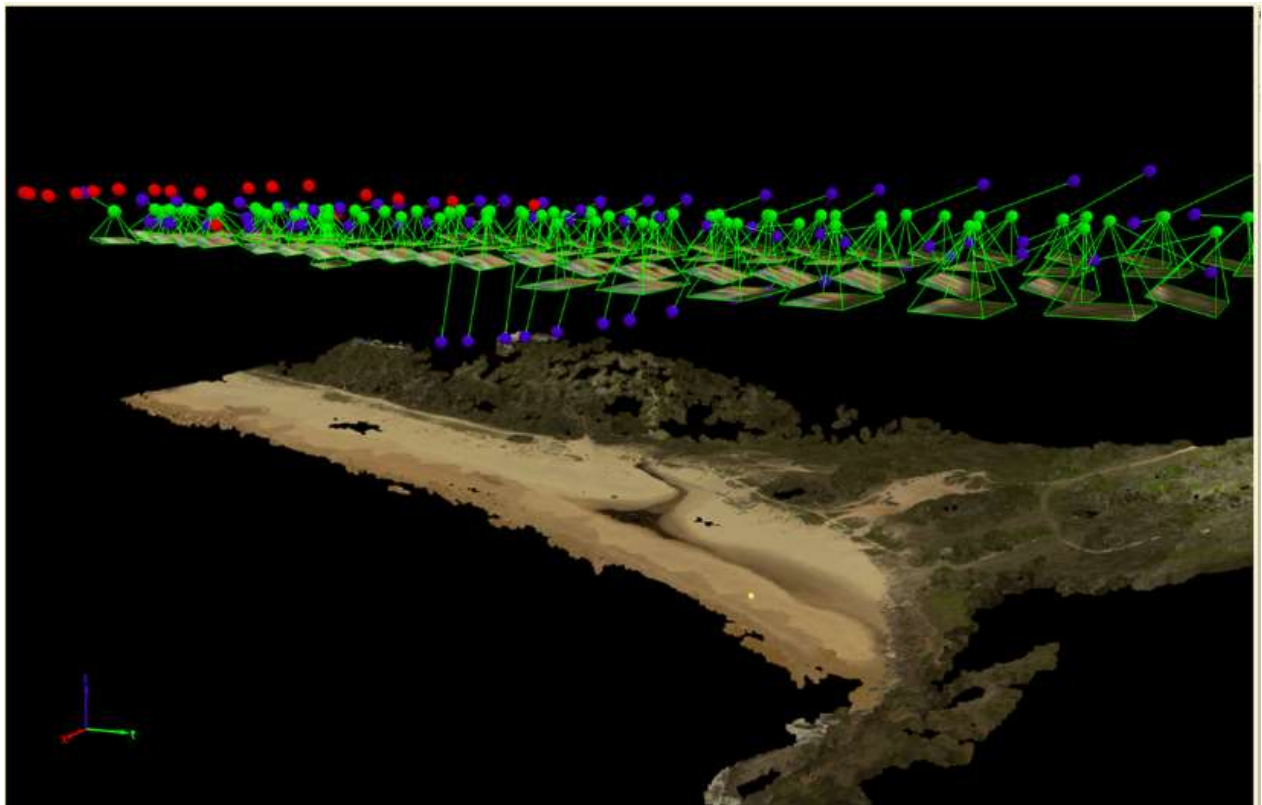


Figure 8: Cloud Point in 3D Image of Sunshine Beach

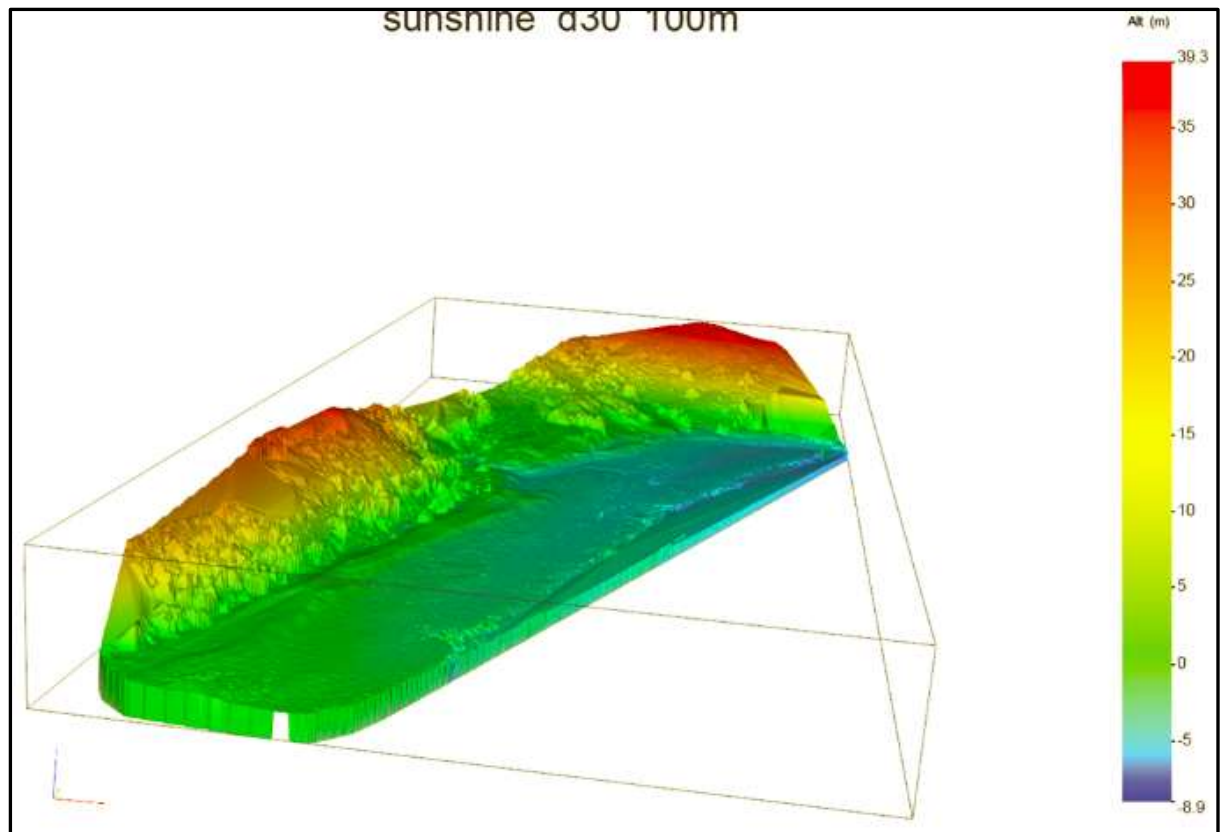


Figure 9: Sunshine Beach and Headland Heights

## Site Maintenance and Asset Management

Governments own and manage sites that are for public purposes, including:

- Waste facilities.
- Stormwater drainage.
- Quarries.
- Environmental areas, parks and recreation areas.
- Foreshore and coastal movements.
- Road corridor and at grade and grade separated interchanges.
- Structures e.g. bridges and buildings.

Timeline Images can provide:

- Orthomosaic.
- 3D rendering.
- Fly through and alternate view.
- Height histogram and digital image.
- Quantity calculation (e.g. stockpiles) and distance measurement (e.g. wall face height or width).
- Contour mapping.

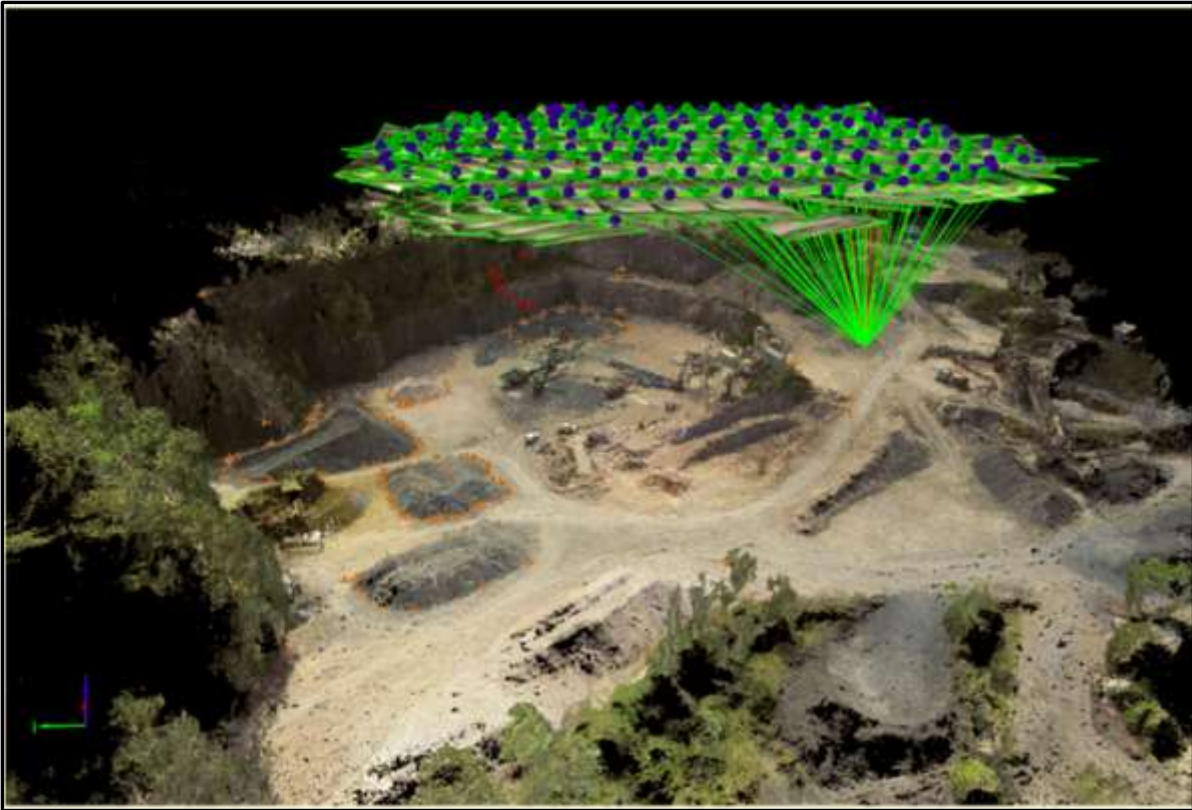


Figure 10: Image Flat Quarry Point Cloud and 3d Image with Stockpile Measurement



Figure 11: Image Flat Quarry Orthomosaic





Figure 12: Quarry Contour

## Uses of UAV and Mapping Software

### Project planning and layout:

Early detailed topographic and features data of the site improves project planning, preliminary layout and estimating. Eliminates the need for aerial photography and Lidar imagery.

### Early site detail:

The same flight plan and perspectives during the whole project.  
Improves fly through video representation.

### Project design:

Accelerates detailed design with accuracy to 2.5cm.

### Consultation demonstration:

Orthomosaic and 3D imagery.  
Fly through demonstration of existing site and overlay of proposed works.  
Highlight 'Point of Interest'.

### Construction planning and layout:

Contractors can do site layout and estimates more accurately.  
Construction layout and planning.  
Planning of drainage catchments and ponds.  
Estimates of bulk works.

### Construction monitoring and reporting:

Progress reporting.  
Comparative measurement.

### Estimating bulk works:

Stockpile and bulk works estimates.

Monitoring bulk works.

Confirming bulk works completion.

**Final inspection and reporting:**

Client copy of detailed completion.

Final fly through.

**Asset Management**

Inspection and condition reporting.

Identify structure defects and fractures to 0.15 cm.

Asset valuation.

Eliminates the need for lane closures.

Eliminates the need for cranes, trucks and teams of people.

Reduces WHS issues.

**Conclusion**

Timeline Images has invested significant resources to provide packages of hardware and software to enable high quality engineering planning, design, monitoring and asset management tools.

These tools have been field tested to provide:

- Extremely high levels of accuracy.
- Significant reductions in WHS risk.
- Ease of service and deployment.
- Significant reduction in resource use.
- Significant reduction in cost.