



# WORLD OF **DRONES** CONGRESS™ 2018

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## **Drones: Enhancing work safety**

***Verification of drinking water reservoir integrity using ROV drones***

**Andrea Clement (Seqwater)**

***Maximising opportunity - A case study in the emerging application of UAV at Holcim's Beenleigh Quarry***

**David Arnott (Holcim (Australia) Pty Ltd)**

***Drone enhanced safety for structural inspection Balaclava Island case study***

**Fred Doyle (RoadTek, Department of Transport and Main Roads)**

***Removing people from hazards***

***Rob Korbee (PowerFox)***

***Drones at Amrun***

**Quinton Johannes, Joanna Winters and Rob McHattie (Bechtel Australia)**





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# Drones: Enhancing work safety

***Verification of drinking water reservoir integrity using ROV drones***

**Andrea Clement (Seqwater)**



ROV  
INNOVATIONS

# Introduction

- Seqwater supplies >3 M people with drinking water
  - 26 dams and 51 weirs
  - 37 water treatment plants and Gold Coast Desalination Plant
  - 600+ kilometres of network operations including **77 Drinking Water Reservoirs**



# Contents

- Why is asset integrity surveillance so important?
- How does ROV technology contribute to our asset management system
- Limitations, Challenges & Key learnings
- Outcomes





# Water quality issues- organic matter

Sanitary integrity  
protects drinking water  
from intrusion of  
pathogens



# Water quality issues- organic matter

Possible Salmonella contamination

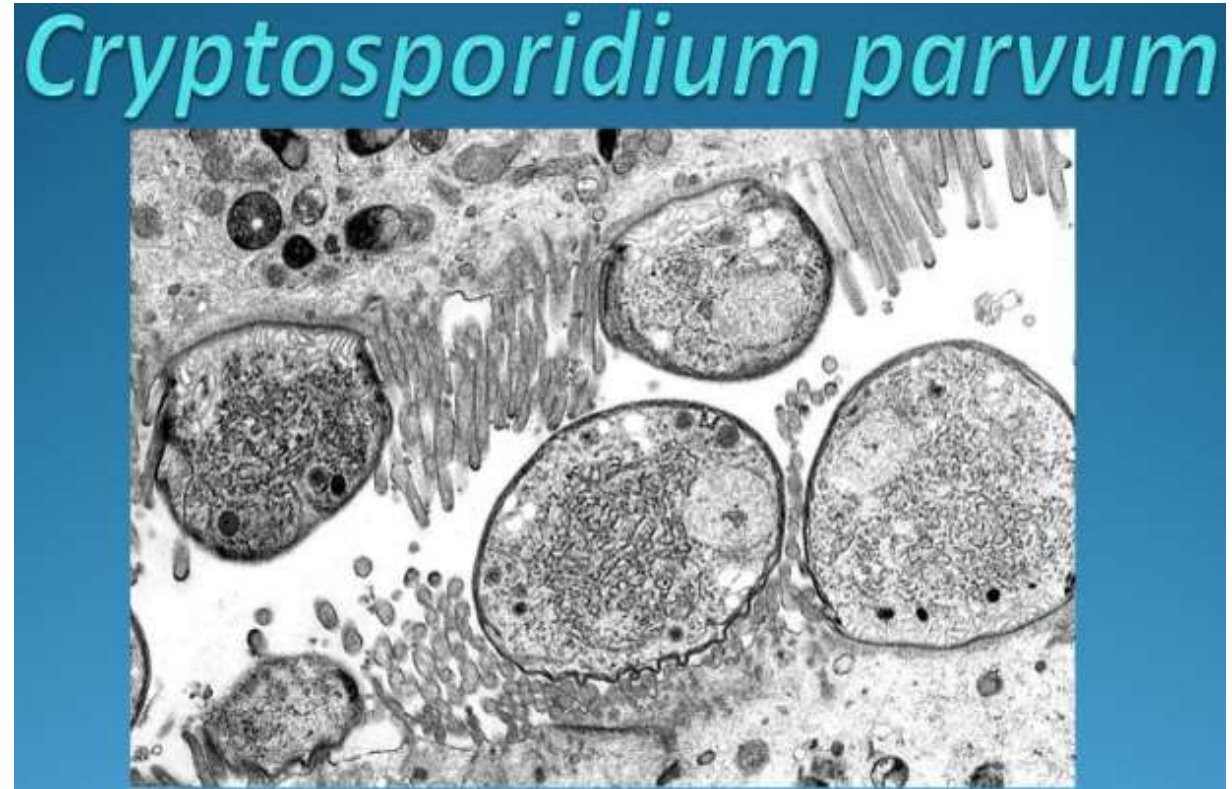
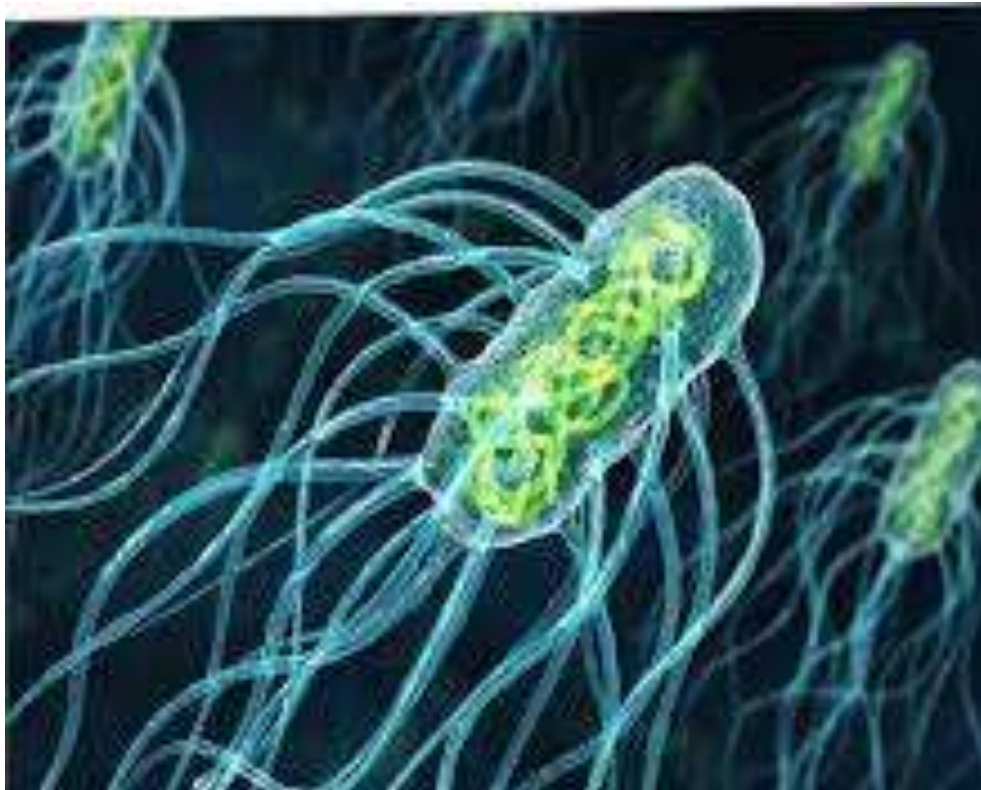


Possible protozoans contamination



# Contamination of drinking water

- *Salmonella typhimurium* outbreak in Gideon, Missouri in 1993.
- *Cryptosporidium* outbreak in Northamptonshire, United Kingdom in 2008.

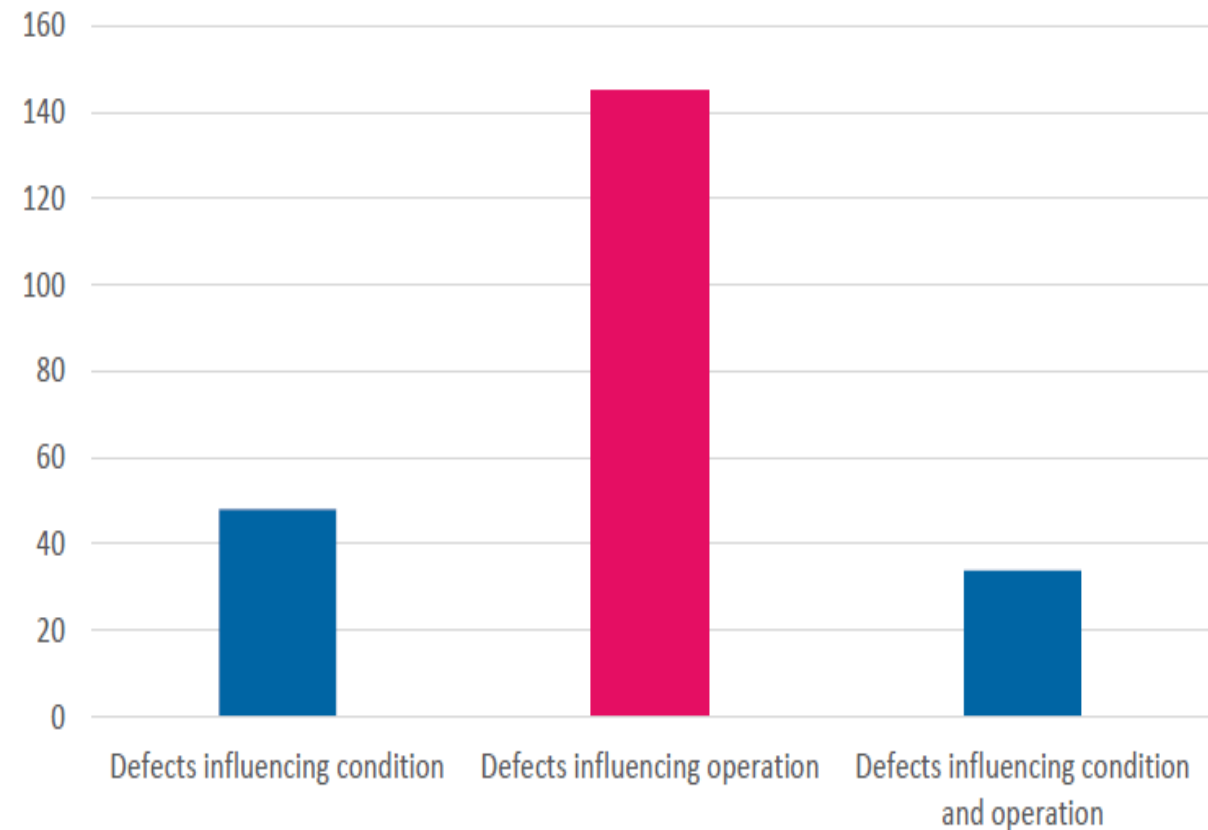


# Asset management- condition rating process

Condition rating matrix

Rating	Defects	Details	Priority
1	None	New asset	NA
2	None	Nearly new asset	NA
3	Influencing condition	Minor Maintenance	3 months
4	Influencing operation	Major maintenance	1 month
5	Influencing condition & operation	Asset replacement	Immediately

Summary of defects identified



# Defects influencing condition

Overflow - Bell Siphon  
protective coating comes off



Corrosion at inlet pipe





# Defects influencing operation



Holes in reservoir roof



# Defects influencing condition and operation



Defects in roof sheeting  
Box guttering corroded and falling inside  
reservoir

Damaged baffle



# Limitations, Challenges & Key leanings

Limited ability to identify subsurface defects



Limited ability to identify breather mesh integrity





# Why ROV drones?

- Conventional surveillance methods
  - Subjective data
  - Control measures are expensive
- ROVs are an effective alternative
  - Objective data trending
  - Elimination of safety & drinking water quality risks



# Implementation of innovative technology at Seqwater

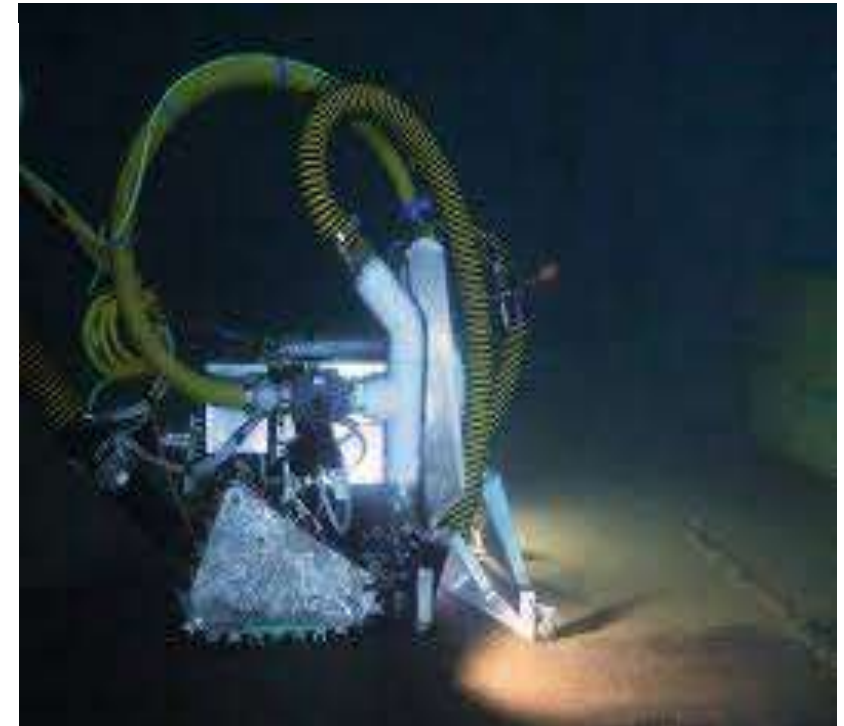
ROV to inspect the reservoir internally



UAV to inspect the reservoir externally



Robots to clean out sediments inside the reservoir



# Outcome – integrated system

- Integrated sanitary and structural integrity
  - Effective asset maintenance planning & renewal program
  - Objective and cost effective data collection & evaluation
  - Elimination of safety and water quality risks









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## **Drones: Enhancing work safety**

***Maximising opportunity - A case study in the emerging application of UAV at Holcim's Beenleigh Quarry  
David Arnott (Holcim (Australia) Pty Ltd)***

# Maximizing Safety & Opportunity

A case study in the emerging application of UAV at Holcim's Beenleigh Quarry



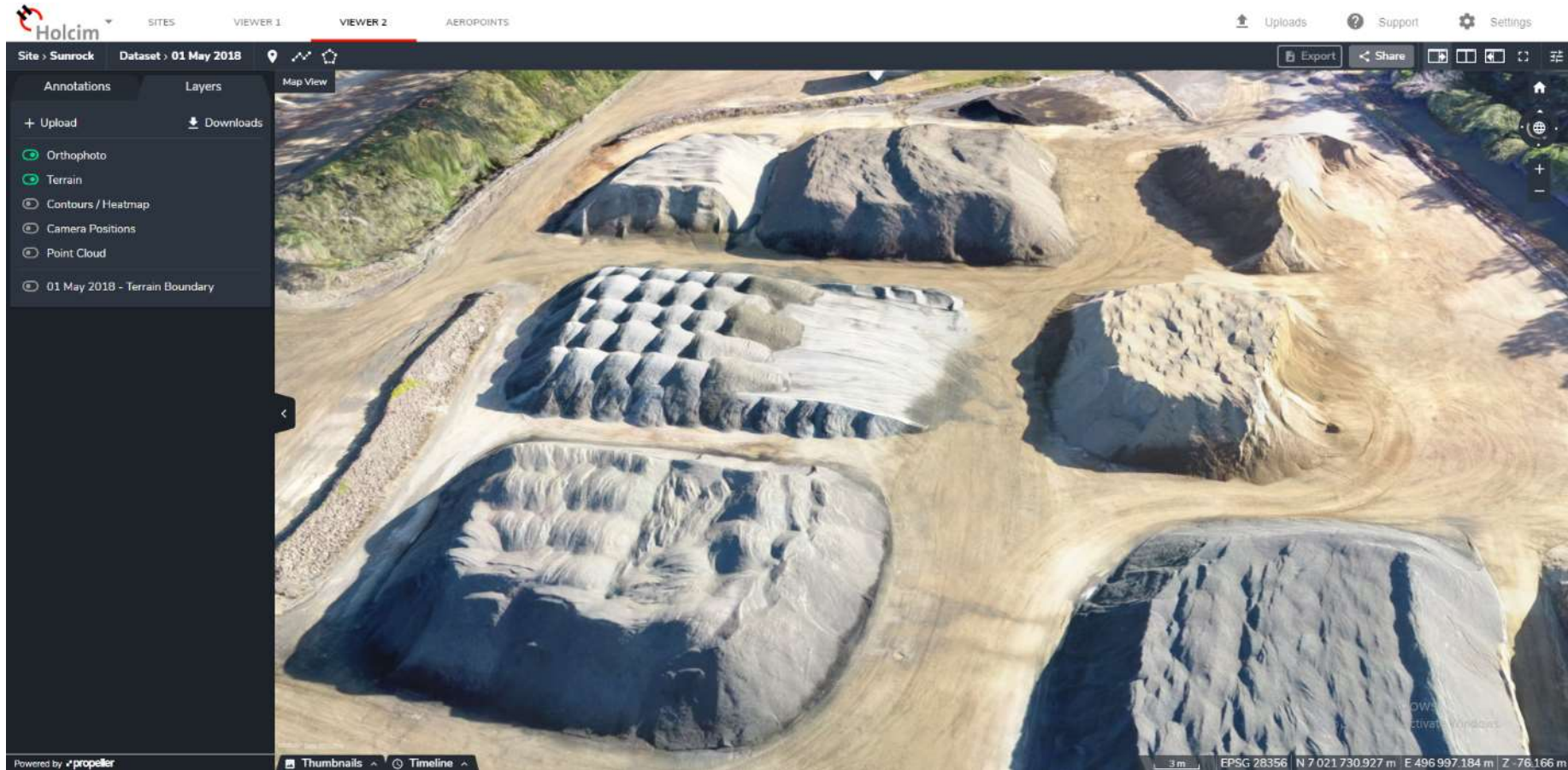


# Application of UAV technology within Holcim (Australia)

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# Stockpile management and volumetric analysis





# Adherence to mine plan and conformance to design





# Drill & Blast design and monitoring blast performance

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# Accessing inaccessible areas





# Observing hazards from afar

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# When an incident results in other potential risks

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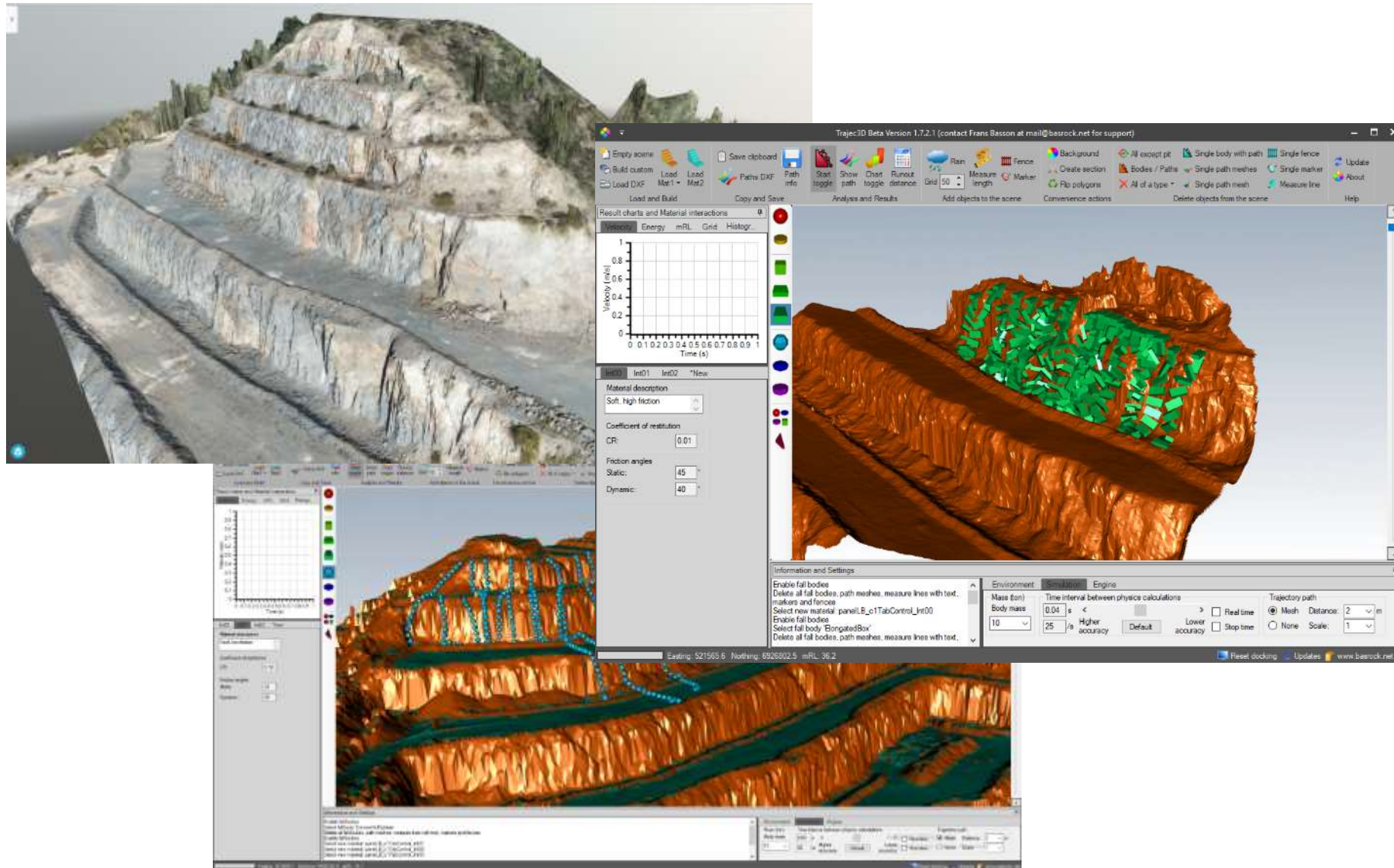
# Squeezing the Resource

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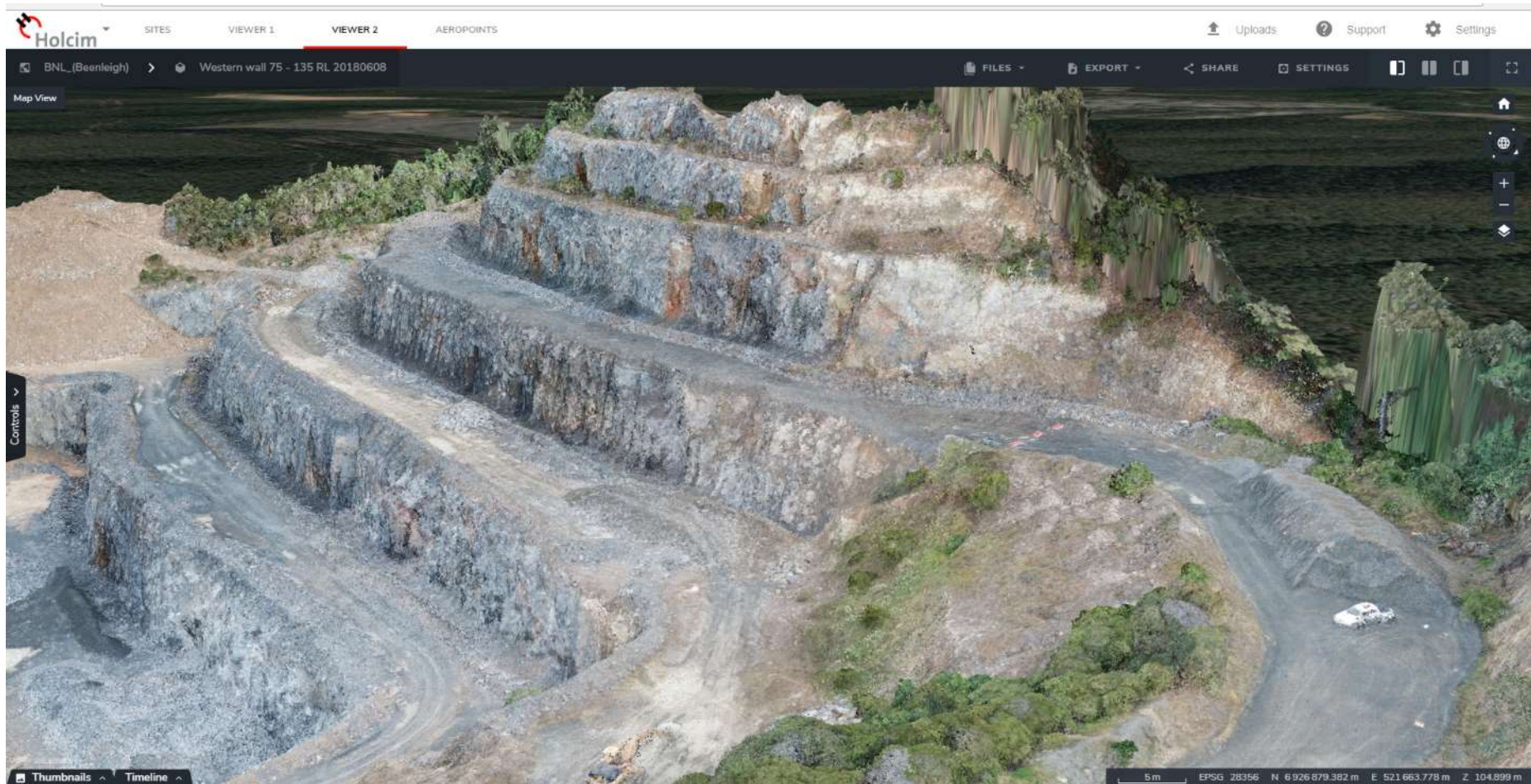


# UAV adding value





# Return on investment



# Return on investment





# Change Process

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# Birds

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# Weather

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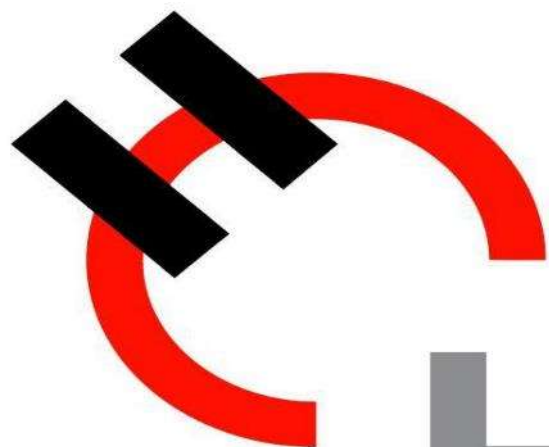
# High Voltage Power Lines





# Flight Time & Optimal Design





Holcim



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## **Drones: Enhancing work safety**

***Drone enhanced safety for structural inspection Balaclava Island case study***  
***Fred Doyle (RoadTek, Department of Transport and Main Roads)***



# Drone Enhanced Safety for Structural Inspection

## Balaclava Island Case Study

World of Drones Congress 2018

Presented by Mark Steedman

Principal Manager, Structures Management Services

RoadTek – Department of Transport and Main Roads

# About us



# values, our diversity



Customers  
first



Unleash  
potential



Be  
courageous



Ideas into  
action



Empower  
people



# Overview of Presentation

1. Background – current state and future need
2. Structures inspection – what do we do?
3. Research and development (R&D)
4. Technology and the market – what is available
5. Prototypes and field testing - terrestrial
6. Balaclava Island – case study
7. Prototypes and field testing – aerial
8. Acceptance criteria
9. Analysis of cost saving
10. Conclusion



# Background

- Inspector access is major safety issue
- RoadTek safety/innovation/customer focus
- R&D project created
- Inspection techniques with safety focus
- Investigate low cost/high tech market sector
- Prototypes and field testing
- Proof of concept
- Report

# Structures inspection

1. Ground-based inspections for difficult or dangerous to access structures
2. Air-based inspections for structures requiring access using an Under Bridge Unit or Elevated Work Platform
3. Data recording and system data entry.





# Research and development

## Scope and defining success

- Implementing technology to enable safe and cost effective solutions
- Acceptance criteria set for inspection data quality
- A simple 'need' statement for inspection devices:

**“To adopt a combination of existing ‘off the shelf’ technologies to create a “vehicle” carrying a “camera” able to safely reach ‘difficult/dangerous to access structures and structure components to provide high quality video and still images to enable structure condition assessment’.**

# Technology and the Market

- A combination of components and 'off-the-shelf' devices
- High tech – low cost (hobby)
- Flexibility to target a solution.



# Prototypes and field testing

## Terrestrial Inspection Vehicle 'evolution'





# Prototypes and field testing

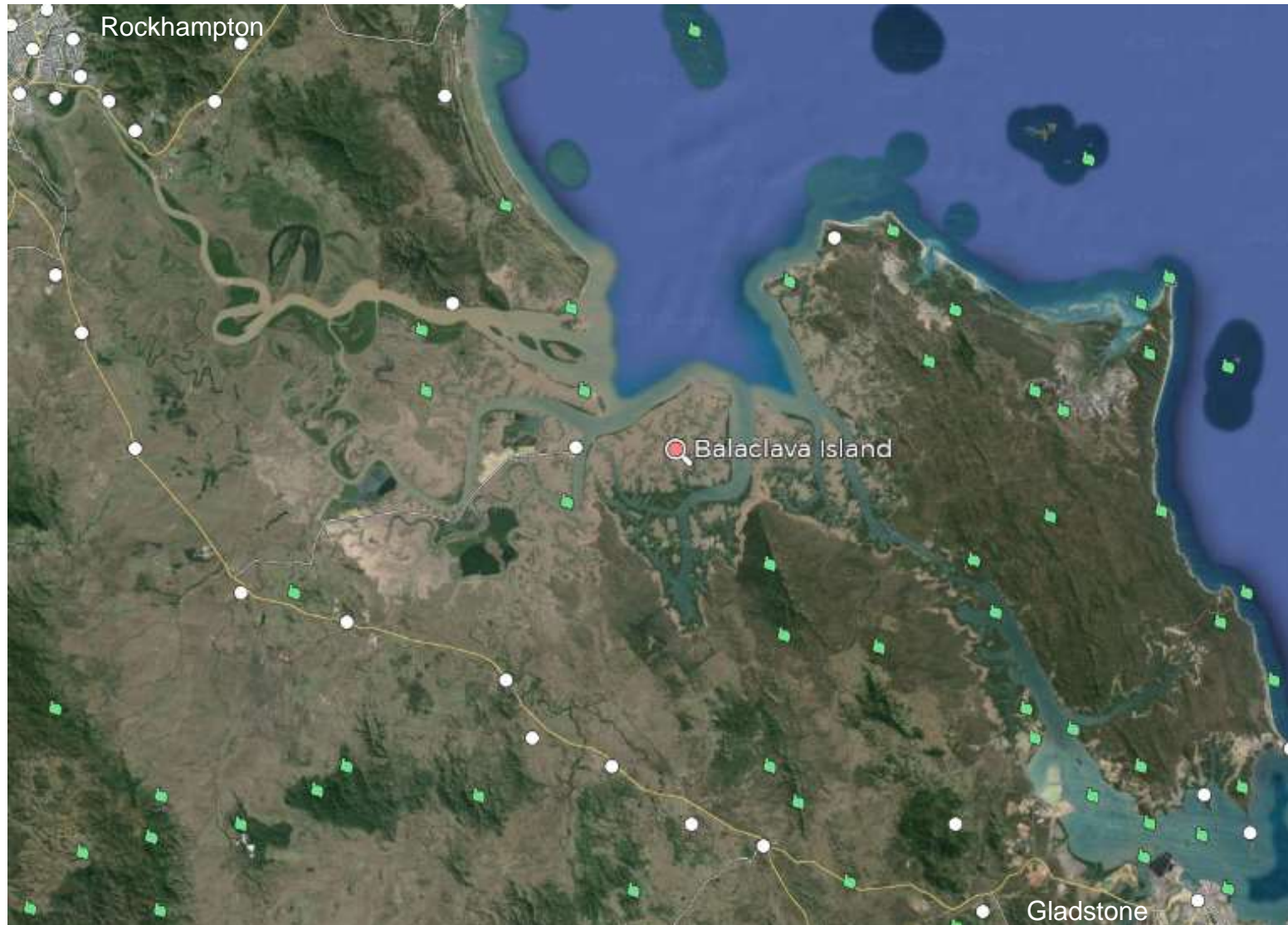
## Terrestrial Inspection Vehicle 'evolution'







# BalACLava Island location



Source: Mapcarta



# BalACLava Island location



# BalACLava Island history



The old tower is toppled and caught falling as it makes way for the new tower in 1932.



Lightkeepers' children at BalACLava Island pose with a good haul of mud crabs.

(L to R) Madge Kelly and Tottie Kelly pose with another girl, thought to be a daughter of Mr Graham, the Head lightkeeper, circa 1914-1916



Fred Doyle  
RoadTek's Project Manager

[http://www.lighthouses.org.au/lights/Bulletin/0503/balACLava\\_island.htm](http://www.lighthouses.org.au/lights/Bulletin/0503/balACLava_island.htm)



A king tide on BalACLava Island surrounds the lightkeeper's cottage, c. 1931



The completed rear tower, circa March 1932

# Prototypes and field testing

- Back to the R&D project





# Prototypes and field testing



Aerial Inspection Vehicle

# Prototypes and field testing



# Prototypes and field testing





# Prototypes and field testing





# Data quality and acceptance criteria

The acceptance criteria is...

- a RoadTek Senior Structures Inspector accepting the quality of the image data to enable an effective and conforming Level 2 Structure Condition Assessment to be performed.

...and was achieved.

- RoadTek was awarded the rehabilitation contract.



# Working on an island



# The final product



# The final product



Address: 928 Reedy Creek Road



# Analysis of potential cost saving

## Aerial Inspection Device

- Cost to purchase: approximately \$2000
- Drone flight time = 18 minutes total
- Recovery cost (nom): \$100 per day?
- Subcontract cost: approximately \$1500 per day?
- BalACLava Island: approximately \$250,000 to establish and operate 'traditional EWP'
- Significant 'start-up' costs for licencing and training.

# So what's next?

## Underwater Inspection Device



# Conclusion

- Need identified – improvement focused on safety and cost saving for our customers
- Open-minded approach to consider innovation and in-house development and implementation
- Important to manage perceptions!
- The potential of structures field staff has been unleashed – they are working with remotely controlled vehicles and tablet devices as routine methods to do work.

**Anyone can do this!**



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# Thank you and stay connected

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**Facebook** @TMRQld



**LinkedIn** Department of Transport and Main Roads



**Blog** [blog.tmr.qld.gov.au](http://blog.tmr.qld.gov.au)





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# Drones: Enhancing work safety

***Removing people from hazards***

**Rob Korbee (PowerFox)**

# Drones in Confined Spaces

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Removing People from Hazards

*Case Study endorsed by Millmerran Power*

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**Presented by Rob Korbee**

at

Workshop “Drones: Enhancing work safety”

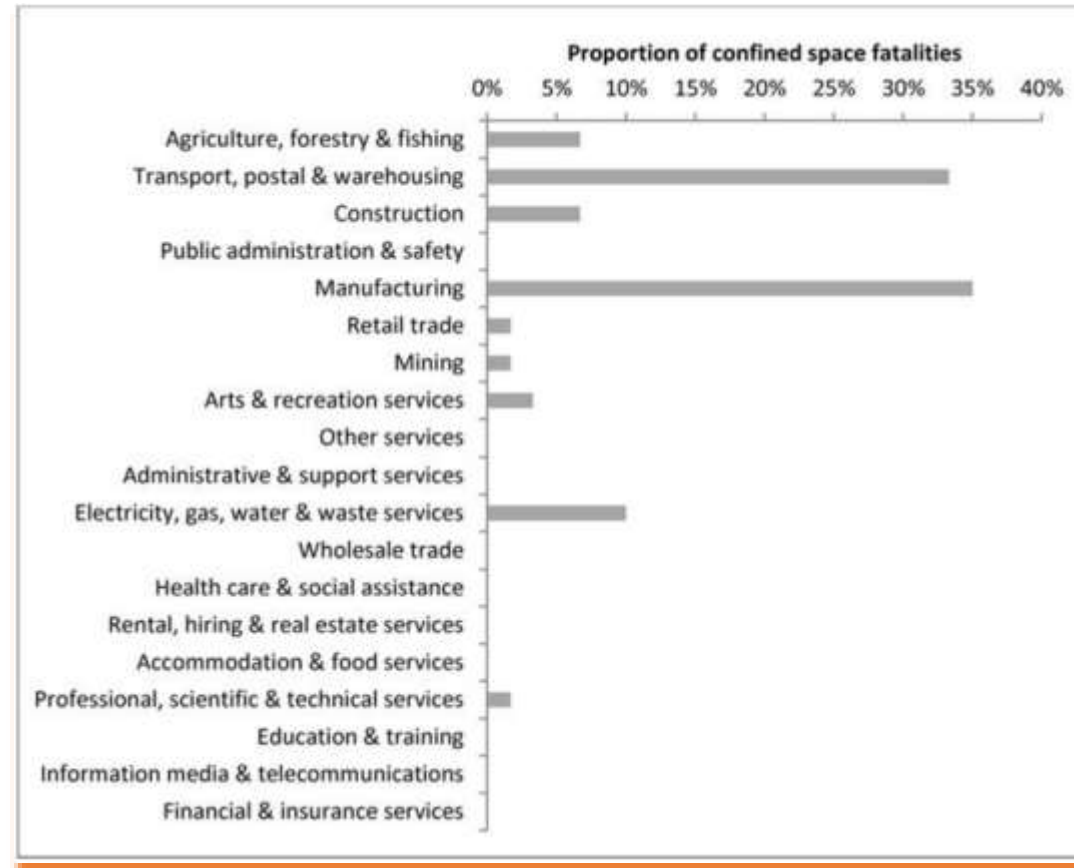
in conjunction with World of Drones Congress

9 August 2018, Brisbane Exhibition and Convention Centre



# Confined Space Fatalities (AU)

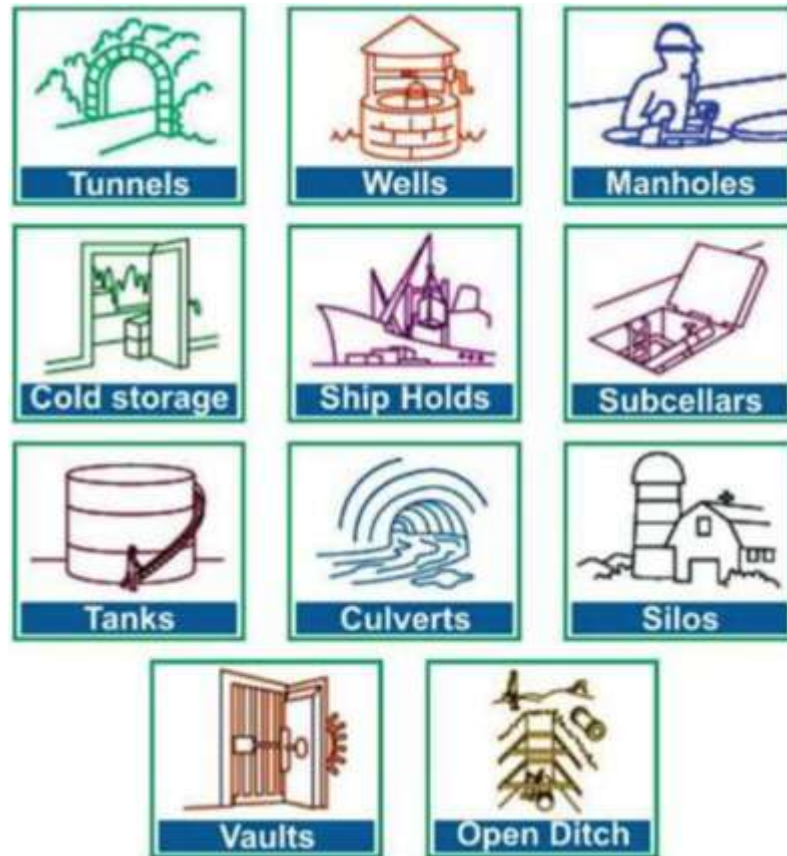
*“Fifty-nine confined space related deaths were identified over the period 2000–2012, or 0.05 deaths per 100,000 workers across Australia.”*



**Source:** “Work-related traumatic fatal injuries involving confined spaces in Australia, 2000–2012”, Jason Selman, Jeffrey Spickett, Janis Jansz and Benjamin Mullins, J Health Saf Environ 2017, 33(2): 197-215

# Hazards of Confined Spaces

Not designed for human occupation:



## Examples of hazards:

- Unsafe oxygen levels
- Chemical contaminants
- Poor visibility
- Engulfment
- Fire or explosion
- Structural hazards, slips, falls

# Why Drones?

Drones are remotely controlled and have a high potential to:

## Improve Safety:

- ✓ Physically separate people from hazards
- ✓ No entry = no Confined Space (CS) hazards
- ✓ Avoid or reduce number of, climbing and scaffolded activities

## Do things faster:

- ✓ Simpler inspection process
- ✓ Quicker than people

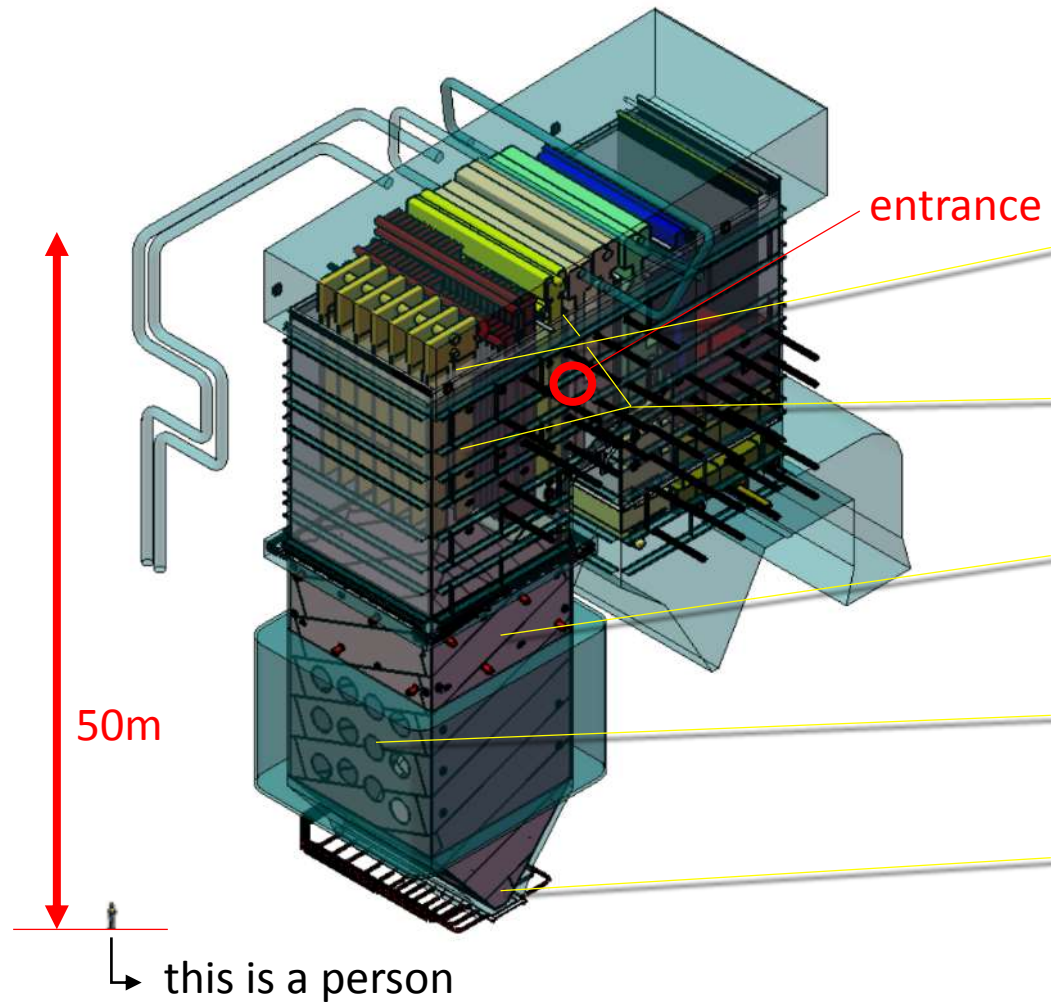






# **A Practical Case: Inspection of a Coal-Fired Boiler**

# Mission



## Inspect for visual defects:

- Roof
- Tubes
- Walls
- Burners
- Bottom

# Drone Selection

Collision-tolerant Elios to navigate through complex structures and:



- Fit through <25" manhole
- Have steel proof communication
- Stream live video feed
- Produce close-up high-res images



# Project Execution

- ✓ **Preps:** Project & flight plan, safety assessment
- ✓ **On-site:** Inspection flights  
Preliminary findings  
Raw videos
- ✓ **Off-site:** Data processing & structuring  
On-line reporting

*Typical turnaround a few days*



# Inspection Video Footage



A 3 minute compilation of flights inside the 50m tall boiler

# Results

- ✓ 30 unique drone flights (4hr flight time)
- ✓ 20 GB video recordings
- ✓ 42 documented points of interest
- ✓ 33 selected video fragments
- ✓ Summary of observations







# Value to End User

- ✓ Eliminating the need for significant scaffold (cost & time)
- ✓ A safety improvement by avoidance of some confined space entry and reduction of scaffold work
- ✓ Allowing for access to, and additional inspection of areas we would not normally get to during this outage
- ✓ Survey a lot of areas in a short time which helps in early decision making on any repair work, with a flow on effect of improved quality and reliability

***In this case, Millmerran Power was able to reduce a work scope for the next few days by an amount that paid for the drone inspection!***

# Conclusion

- ✓ *Drones can safely conduct visual inspections of Confined Spaces and, by reaching locations that would not otherwise be accessible, enhance the scope & quality of the inspection*
- ✓ *The use of drones can help reduce the frequency and duration of people being exposed to hazards within Confined Spaces*
- ✓ *The use of drones can simplify as well as speed up the process of doing & managing Confined Space work and thereby provides a good return-on-investment*

# Outlook

*There is significant future opportunity for the industry to improve safety and reduce cost using drone technology*



Seeing



Testing



Repairing

**Tanks**



**Chimneys**



**Pipes**



**Process**





# Questions?



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# Drones: Enhancing work safety

***Drones at Amrun***

**Quinton Johannes, Joanna Winters and Rob McHattie (Bechtel Australia)**

# Drones at Amrun

August 2018





# Introduction

- **Jo Winters**  
Specialist – Communities,  
Communications and  
Project Risk



- **Quinton Johannes**  
Project Site IS&T Lead



- **Rob McHattie**  
Structural Designer and  
Construction Support



# About Amrun



# About Amrun

On track to deliver a  
safe, high quality bauxite  
mining operation





# Amrun's drone program

- Self-operated drone program commenced in April 2017, with sub-contractor component.
- Used for GIS mapping, construction progress monitoring, stockpile estimations, environmental monitoring, construction inspections and punch-listing activities, photography, videography, community engagement, and more.
- Four types of drones in use:
  - ✓ Mavinci – mapping and stockpile estimations
  - ✓ Falcon 8 – hi-res images for construction inspections
  - ✓ Inspire Pro 2 – construction monitoring, progress photos, videos and environmental monitoring
  - ✓ Phantom Pro 4 – progress photos, videos and environmental monitoring.
- Eight pilots with Multirotor (25kg) and/or Fixed Wing (7kg) licences.



# Use case examples from Amrun

- **Punchlisting Communications Towers:**
- Amrun has six 70-metre tall communications towers to support site communications (radio/phone/computer networks).
- Prior to sign-off of any construction, punchlisting inspections occur to identify any outstanding works.
- Instead of sending employees up in an elevated work platform, drones were used in the first instance to identify any outstanding works.
- **Suitable drones for this task:**
  - ✓ Inspire Pro 2
- **Core benefits:**
  - ✓ Reduction in working at heights activities
  - ✓ Reduction in equipment usage (EWP)



# Use case examples from Amr

- Inspecting hard to reach places
- Amrun's Chith Export Facility required inspection of infrastructure, painting and other works underneath the jetty.
- Utilising the Falcon 8 with VR goggles, the drone team were able to work closely with Engineers to ensure the required images were capture.
- Suitable drone for this task:
  - ✓ Falcon 8 (with VR goggles)
- Core benefits:
  - ✓ Reduction in working at heights and working over water activities
  - ✓ Reduction in equipment usage (scaffolding, marine fleet)





# Use case examples from Amrun

- **Construction progress monitoring and photography/videography**
- Program enables instantaneous progress monitoring for weekly/daily/monthly construction reporting activities and supports the capturing of photos and videos for use in presentations, Project communications and videos.
- **Suitable drones for this task**
  - ✓ Phantom Pro 4
  - ✓ Inspire Pro 2
- **Core benefits**
  - ✓ Reduce reliance on third parties for photography/videography requirements (i.e. film crew, helicopter photographer).
  - ✓ Timely photography and videography activities to support reporting.



# Drones – enhancing workplace safety at Amrun

- Utilising drones at Amrun has enhanced workplace safety by eliminating the need for some high risk activities.
- It has also reduced the need to use equipment in some cases, and the reliance on third-party subcontractors.





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**Thank you for attending the**

**Drones: Enhancing work safety workshop**