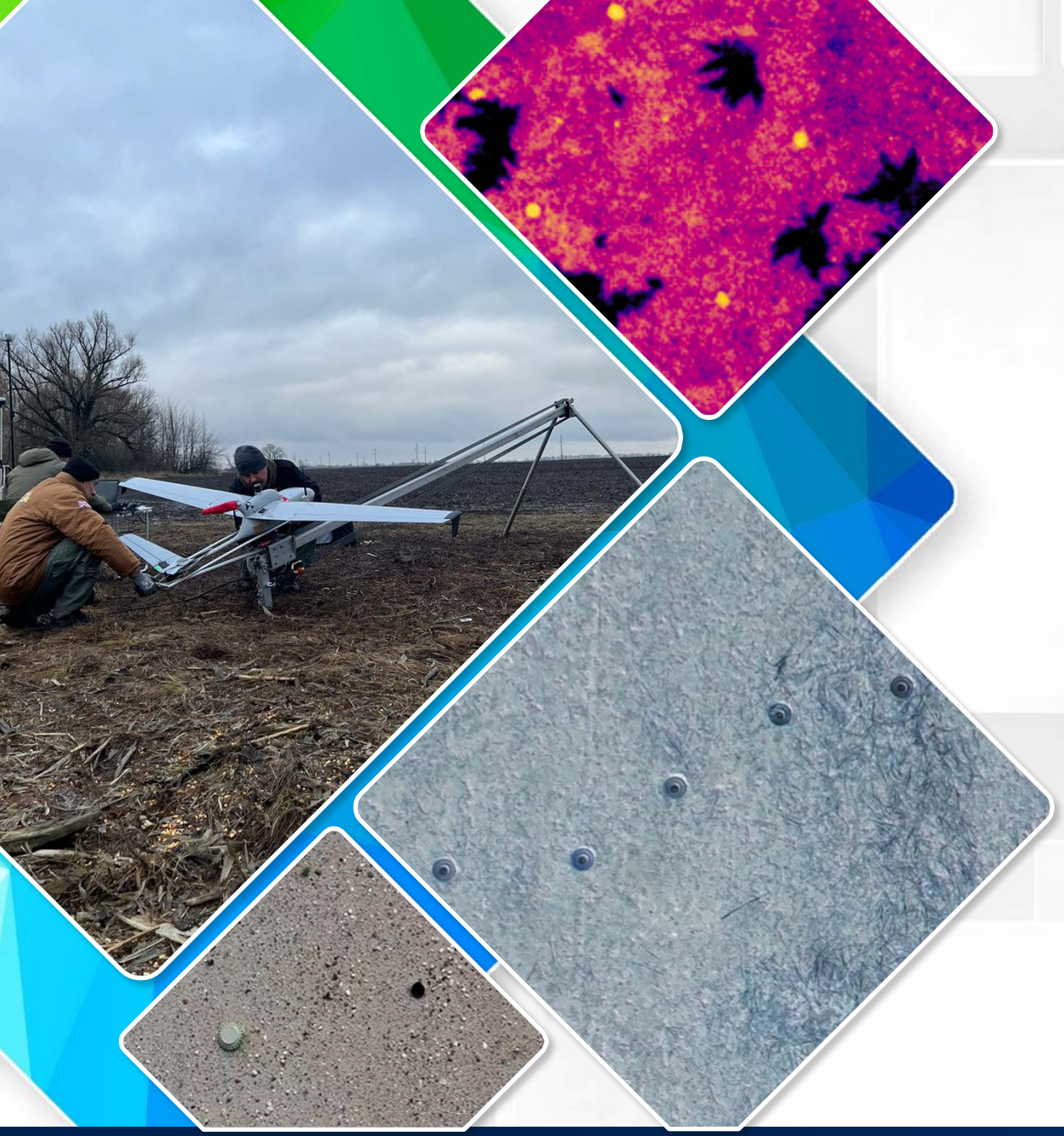


TETRA TECH

Remote Aerial Minefield Survey (RAMS)

D. Denman, D. Houghton and S. Priestley

20th International Mine Action Symposium

Dubrovnik, Croatia

April 2024

RAMS - Overview

RAMS™ is designed to support Non-Technical Survey of Suspected Hazardous Areas (SHAs) believed to be contaminated with Explosive Remnants of War (ERW) &/or Landmines.

By identifying confirmed hazardous areas (CHAs) earlier in the land release program, stakeholders can focus demining and unexploded ordnance (UXO) clearance assets on known contaminated areas.

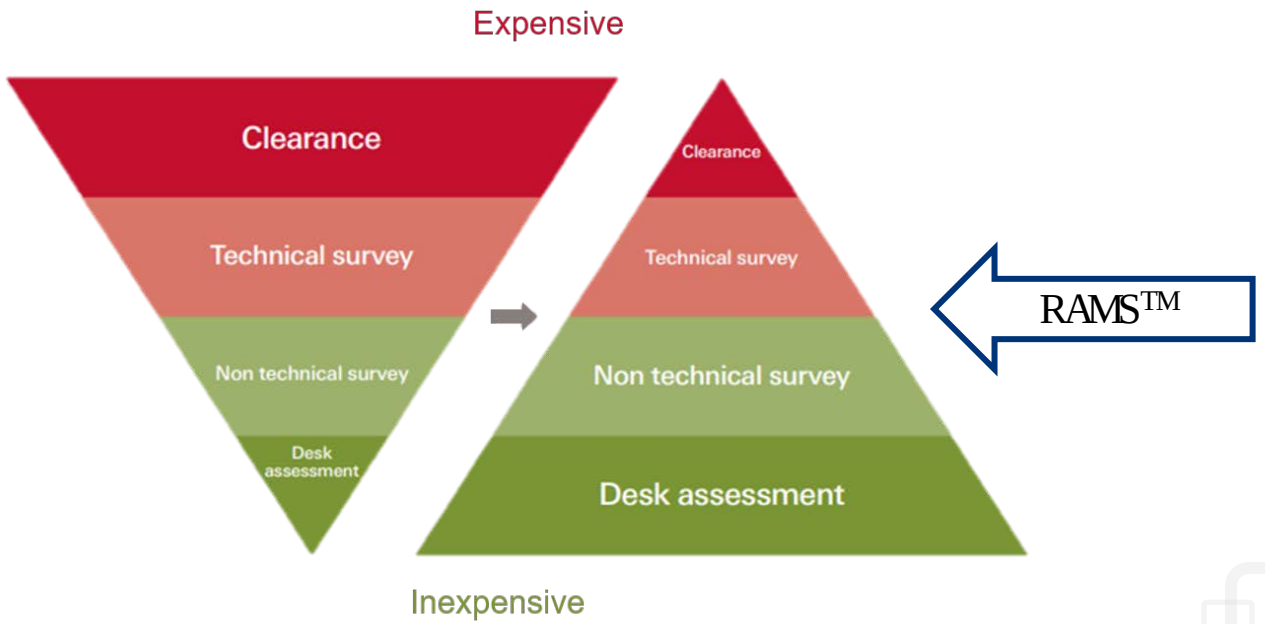
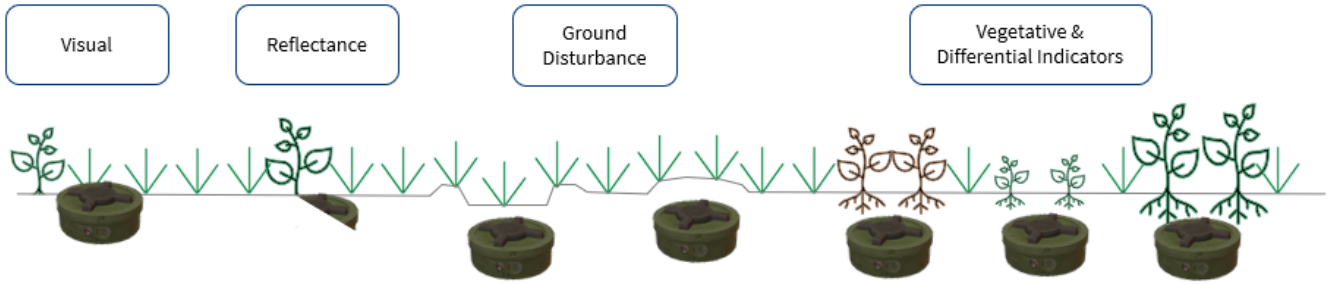


***Image** – GICHD, Evolution of the Land Release Pyramid*

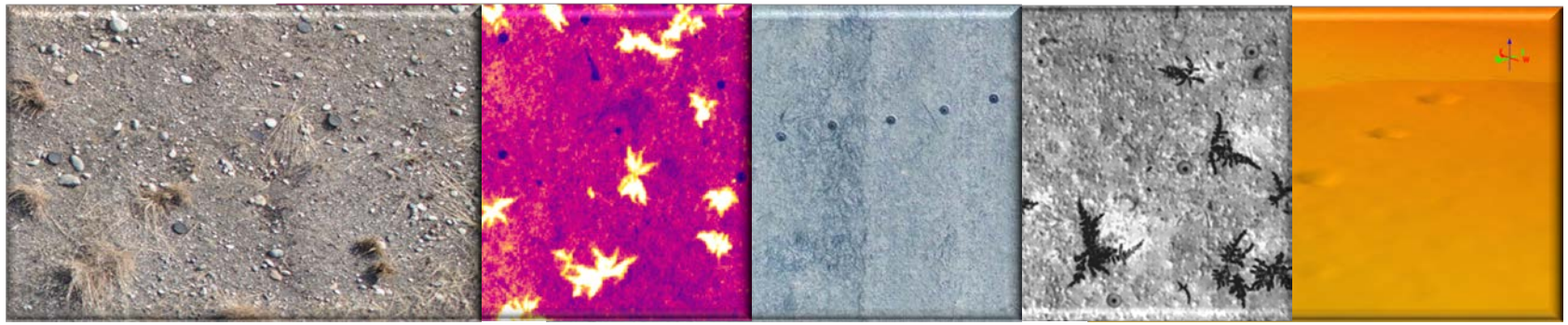
RAMS is trademarked and patented in the UK, EU, and USA

RAMS – How Does it Work?

The payloads used by RAMS™ identify surface ERW directly, or by their reflectance, when partial covered by soil or vegetation. Buried ERW is identified by disturbance to the soil and vegetation above them.



RAMS™ Datasets

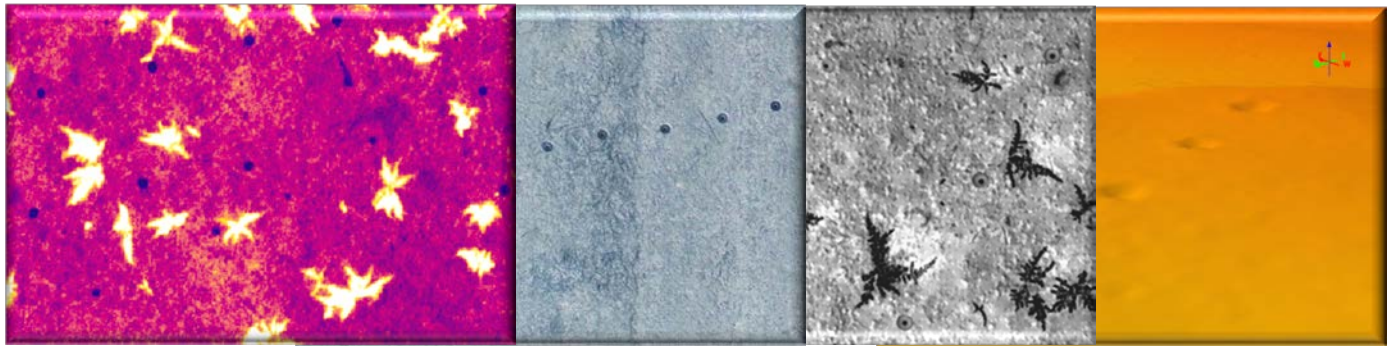


RAMS – How Does it Work?

TETRA TECH

RGB

High-resolution imagery used for direct identification of surface hazards

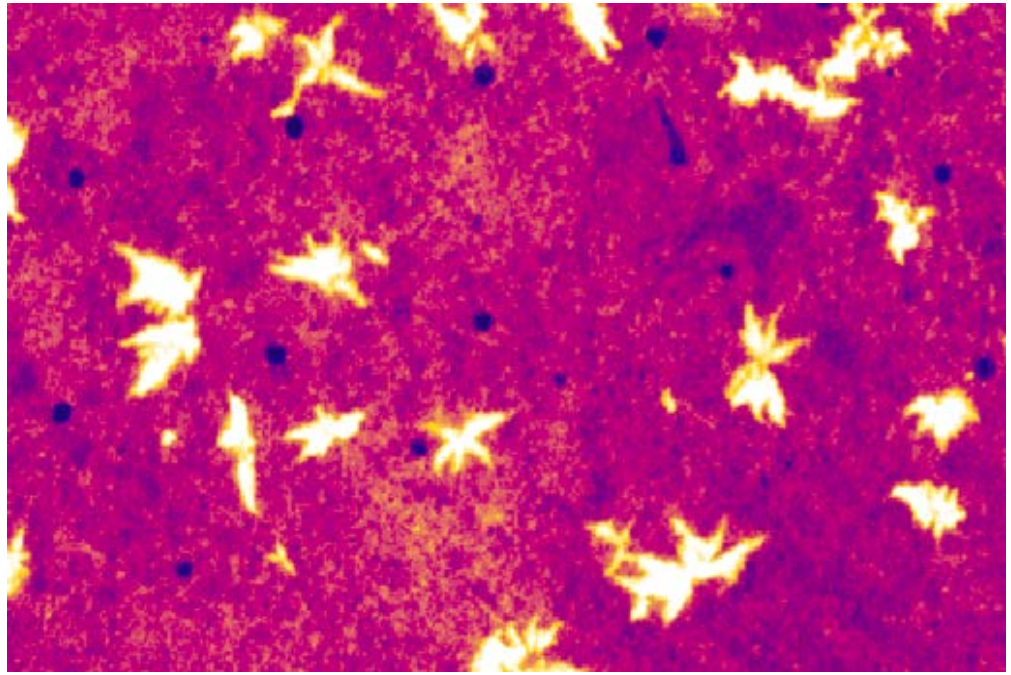


RAMS – How Does it Work?

TETRA TECH

Multispectral

Proprietary indices designed to highlight the location of on-surface, partially covered, and buried hazards

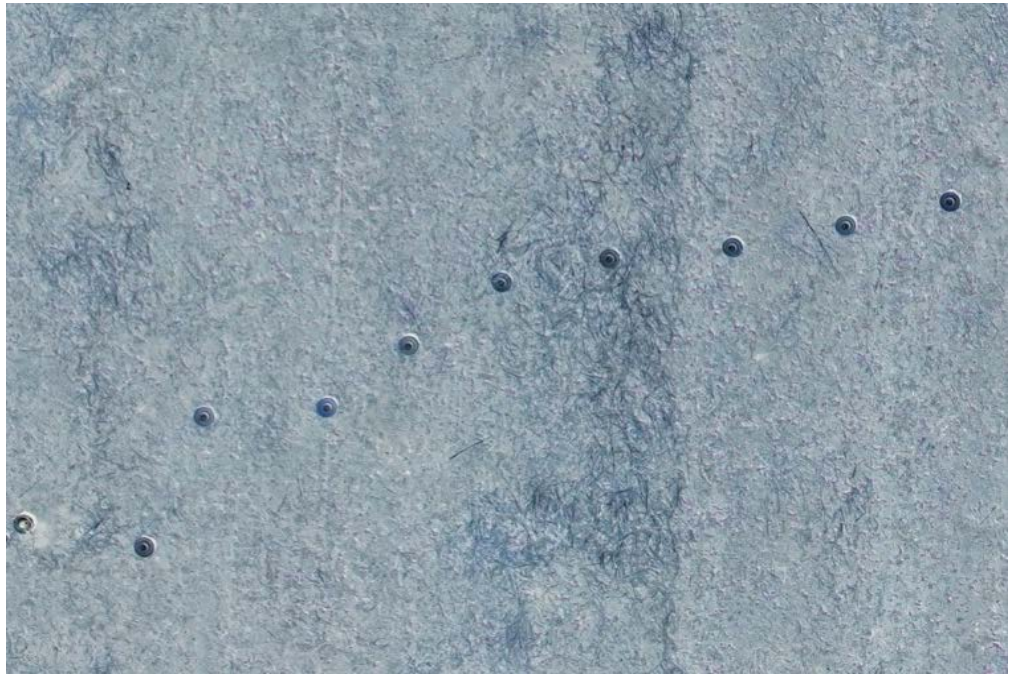


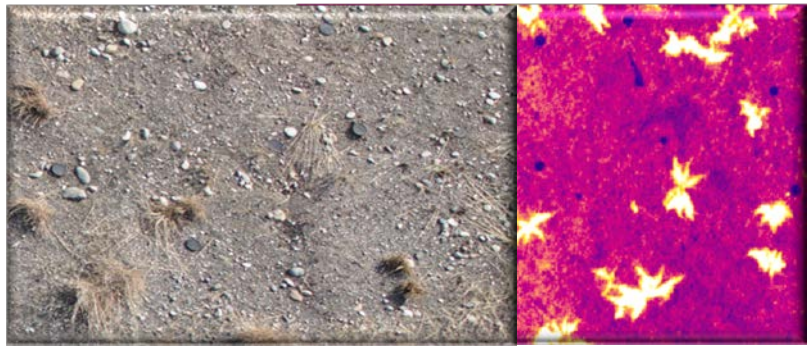
RAMS – How Does it Work?

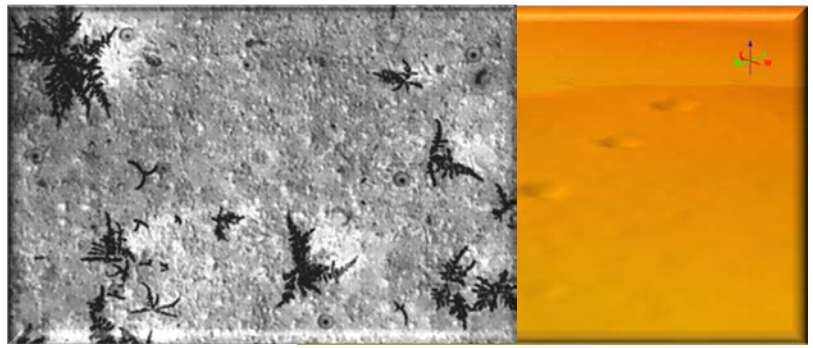
TETRA TECH

Colour Corrected

Developed during operations in Ukraine, by using a reduced colour palette it highlights the shape, shine, and silhouette of hazards





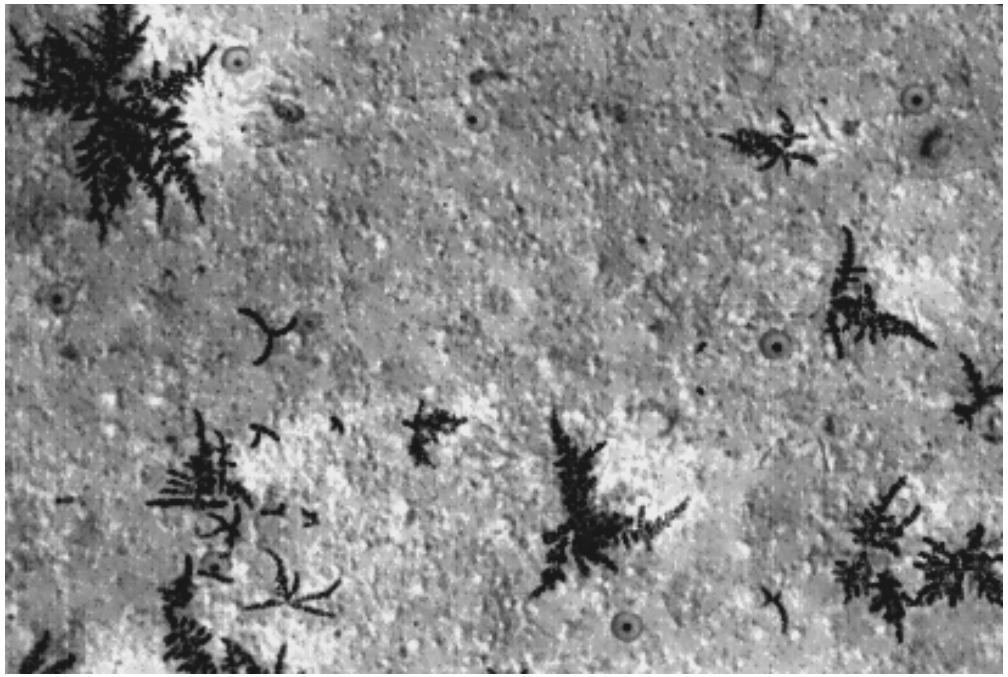


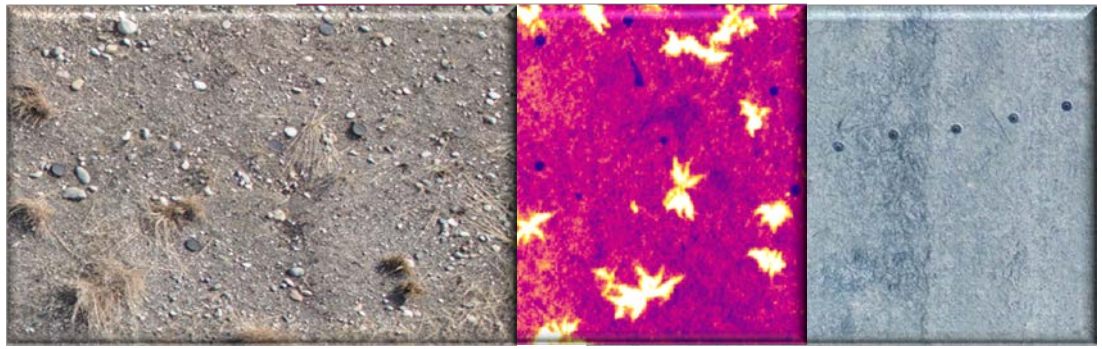
RAMS – How Does it Work?

TETRA TECH

Thermal

Identification of surface and shallow (2-3mm) buried hazards. Usage is limited to daylight hours (dawn/dusk period)



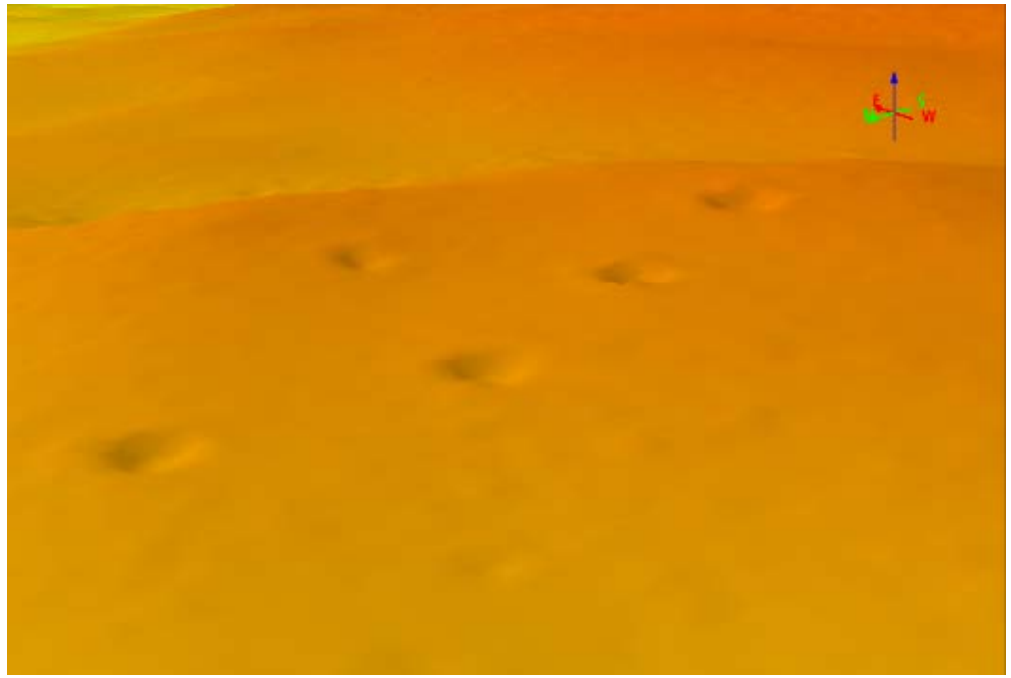


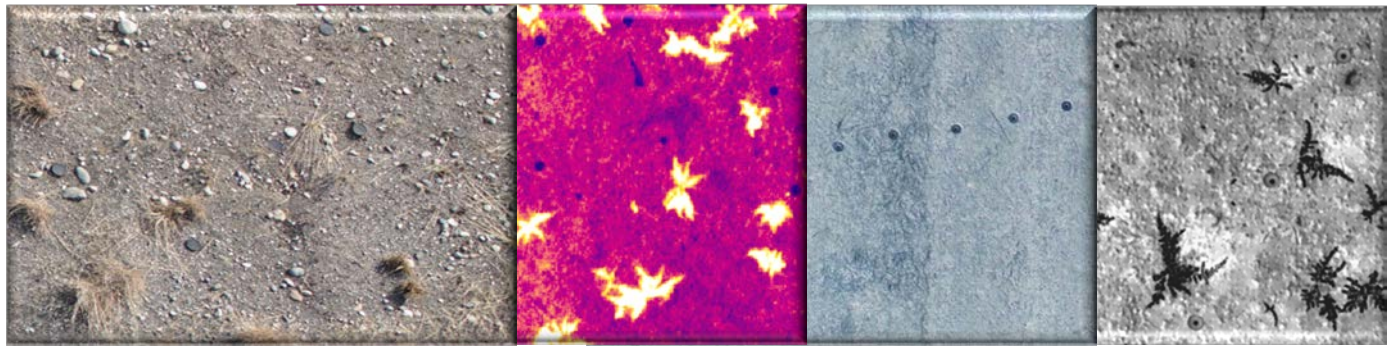
RAMS – How Does it Work?

TETRA TECH

LiDAR

Light Detection and Ranging remote sensing of hazard indicators, such as craters. LiDAR can penetrate most types of vegetation



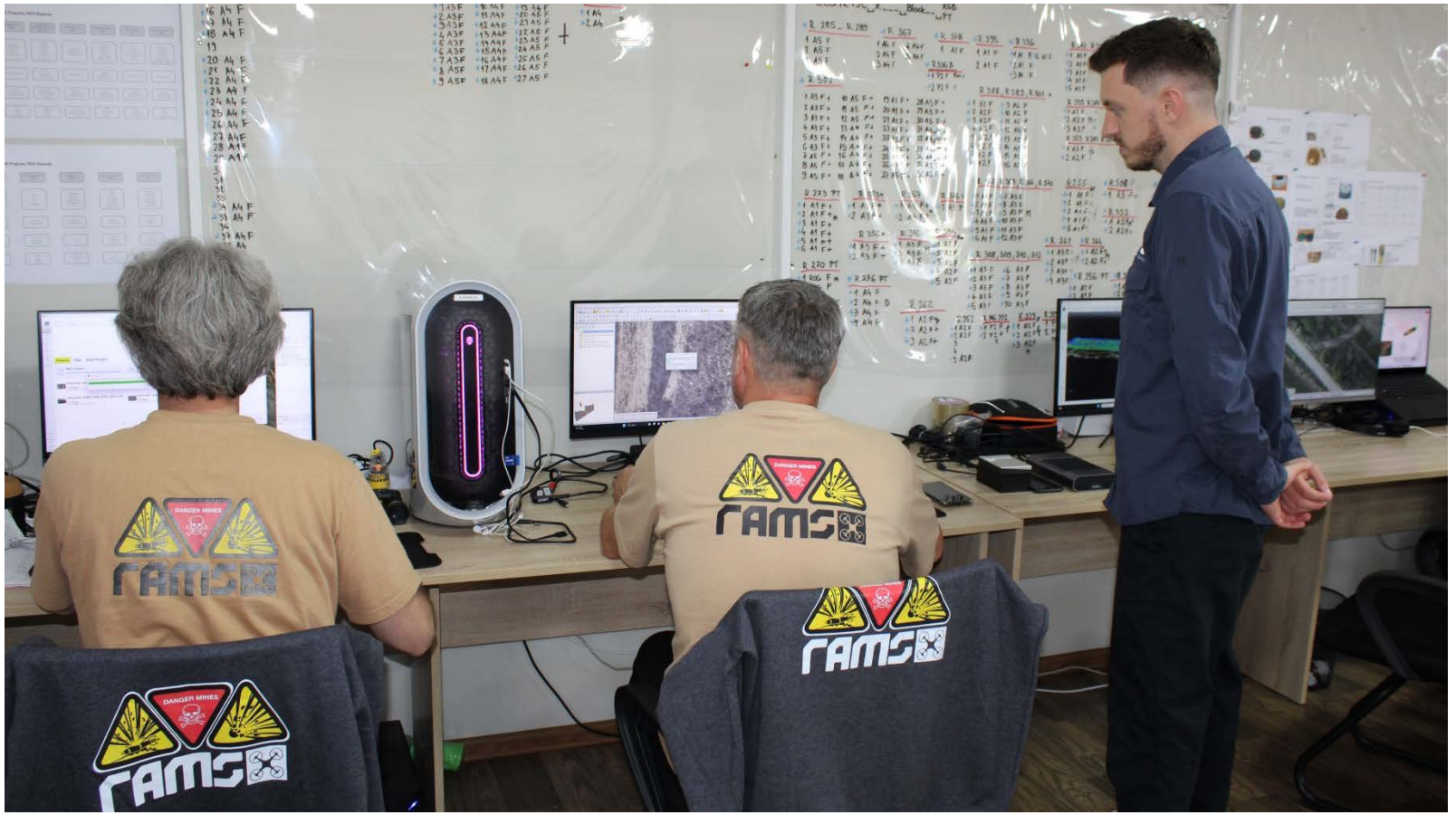


TETRA TECH

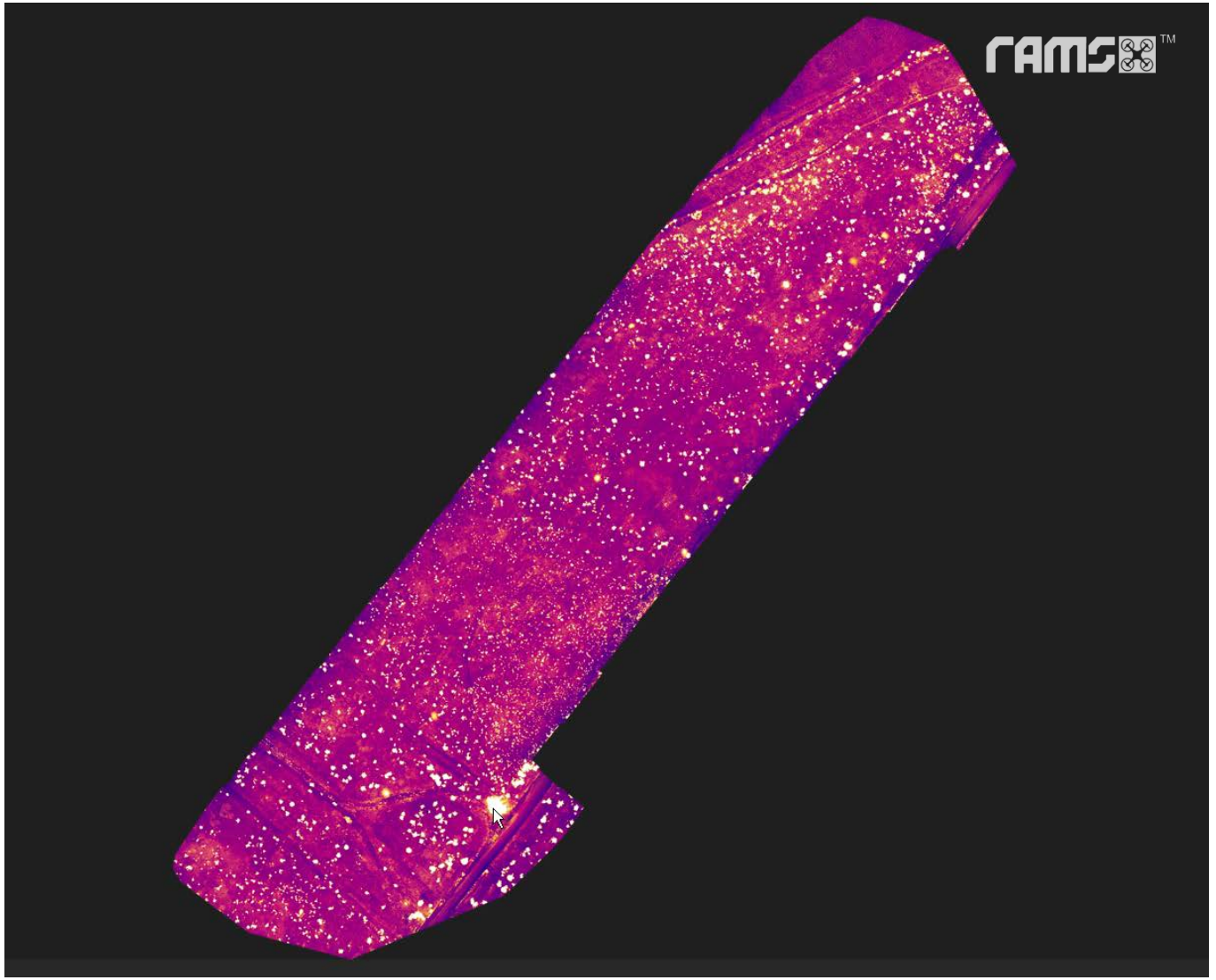
RAMS Workflow

Data Collection

Data Processing



Data Processing



Data Processing

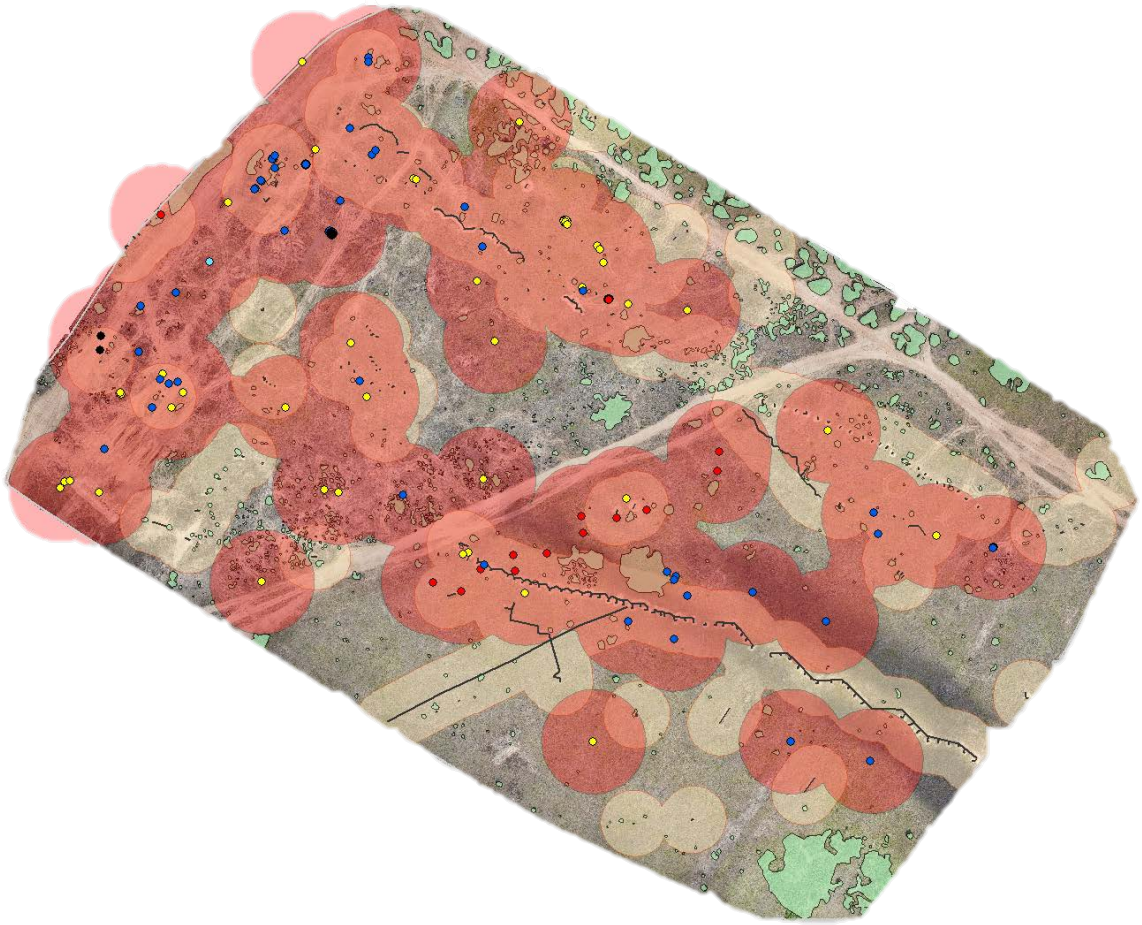
TETRA TECH

Land Classification

How to Use RAMS Data

RAMS Dataset

Issued after completion of survey

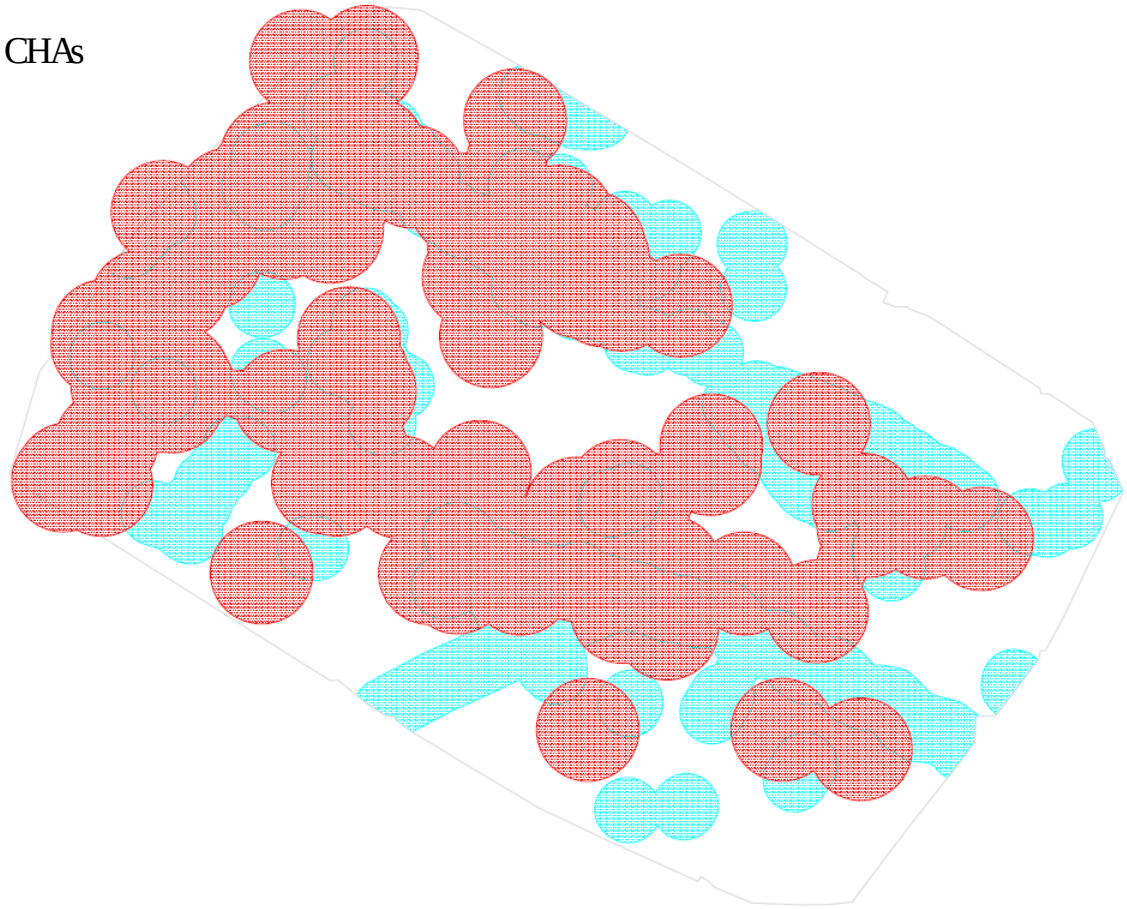


How to Use RAMS Data

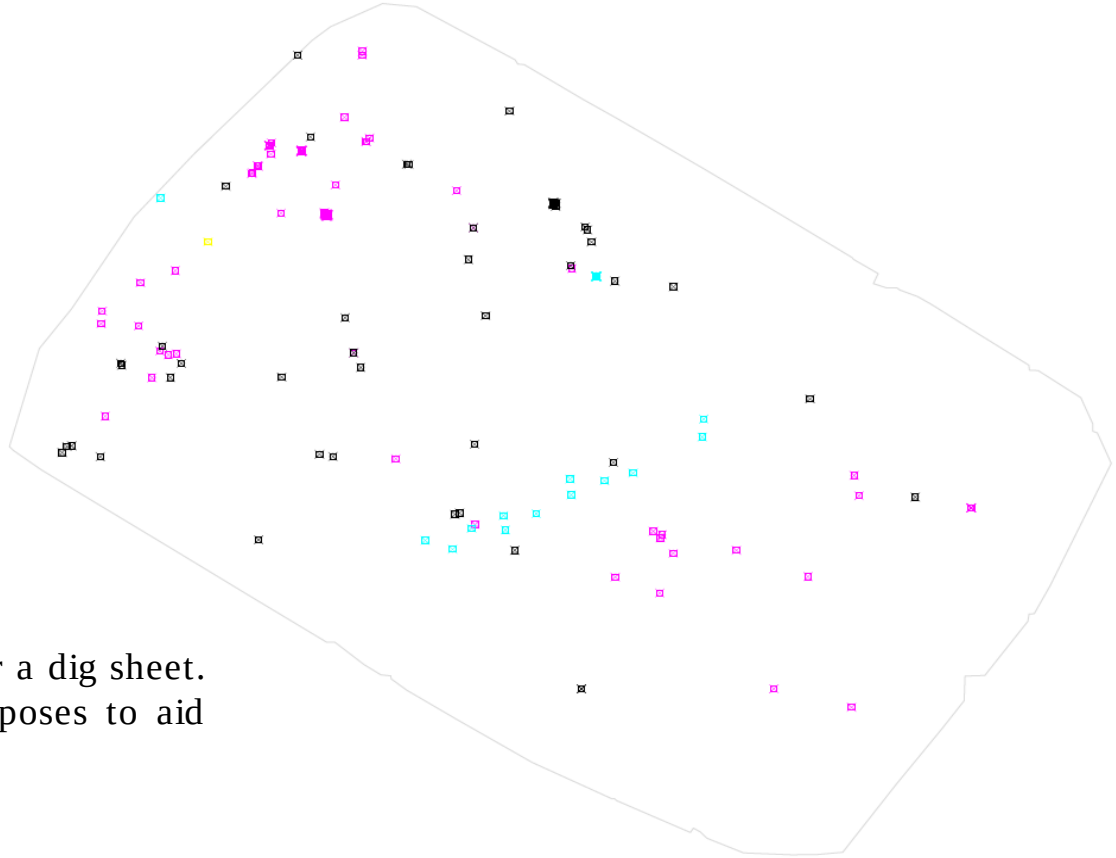
Hazard Buffers

Primary source of information that identifies CHAs within the survey area.

- Landmine/ERWCHA
- Defensive Position CHA



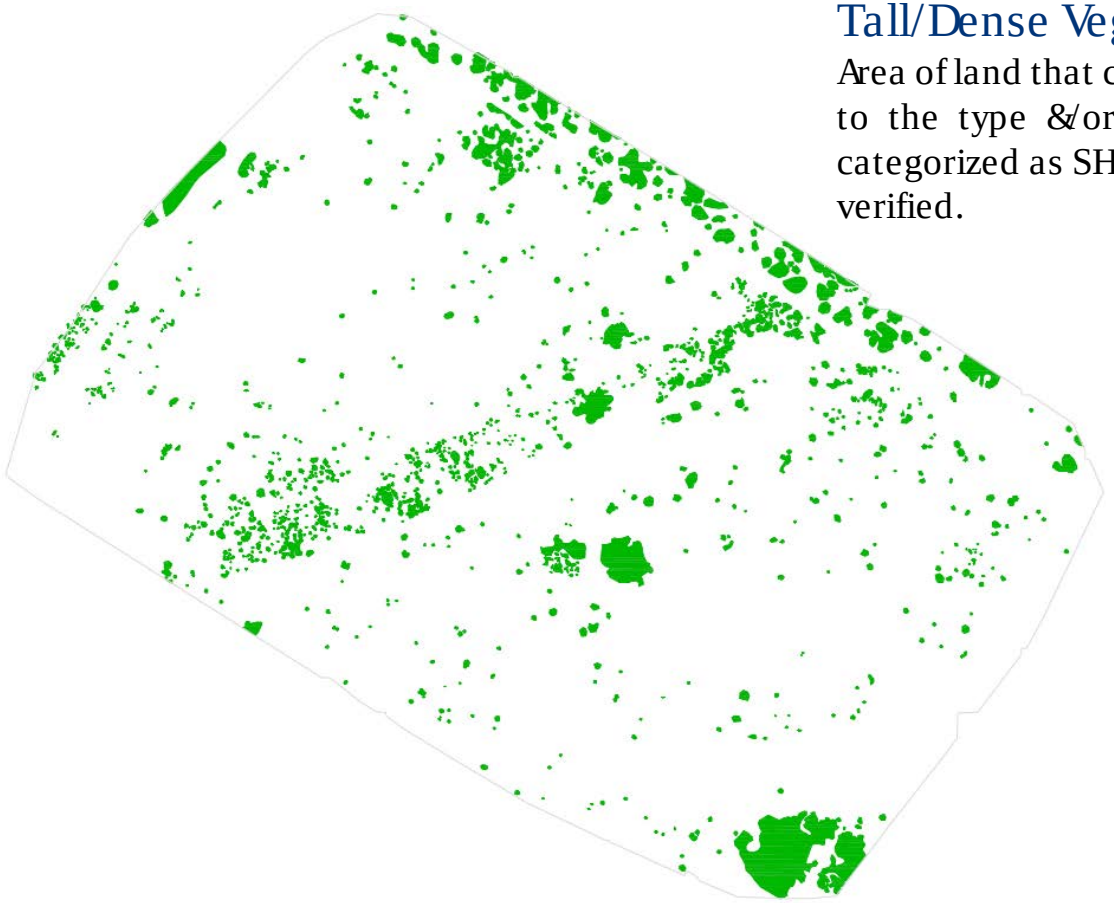
How to Use RAMS Data



Evidence Points

Should never be used as full list &/or a dig sheet. Data is shown for informational purposes to aid subsequent works.

How to Use RAMS Data



Tall/Dense Vegetation Zone(s)

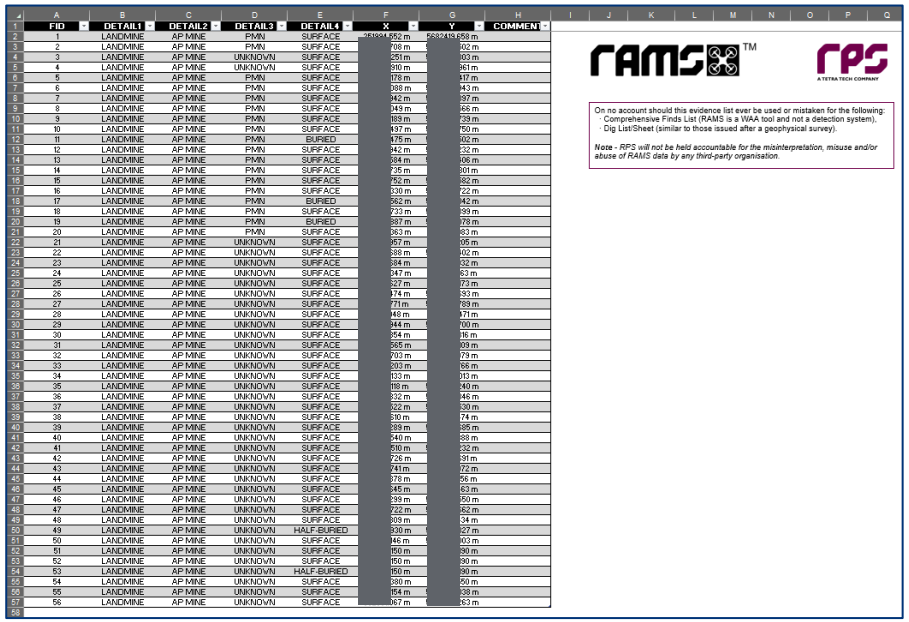
Area of land that could not be fully interrogated due to the type &/or coverage. As such, it remains categorized as SHAuntil it has been de-vegetated & verified.

RAMS – Deliverables (Task)

Shape Files

RGB Geotiff

KML Files

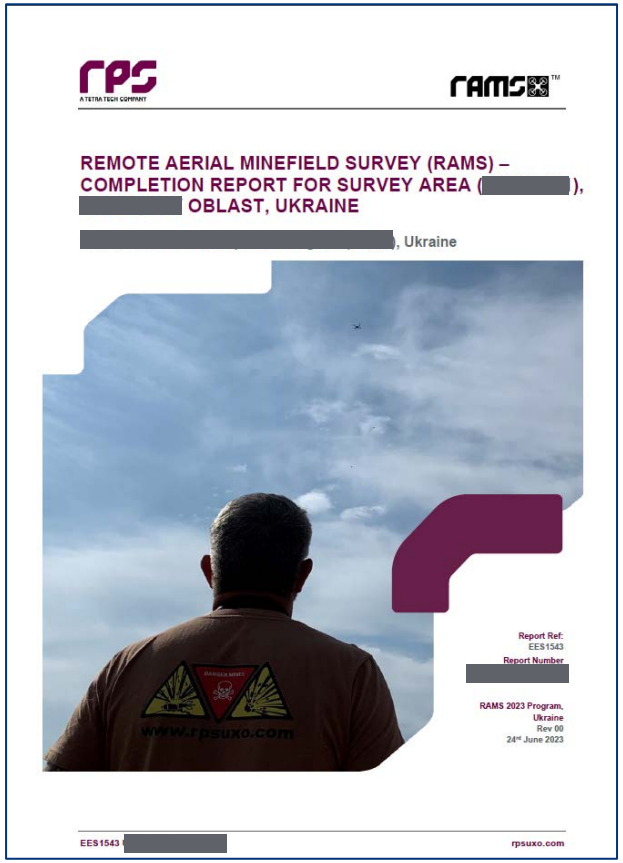


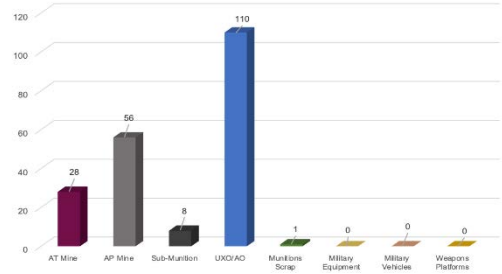
FID	DETAIL1	DETAIL2	DETAIL3	DETAIL4	X	Y	COMMENT
1	LANDMINE	AP MINE	PMN	SURFACE	[redacted] 552 m	[redacted] 658 m	
2	LANDMINE	AP MINE	PMN	SURFACE	708 m	402 m	
3	LANDMINE	AP MINE	UNKNOWN	SURFACE	251 m	493 m	
4	LANDMINE	AP MINE	UNKNOWN	SURFACE	910 m	861 m	
5	LANDMINE	AP MINE	PMN	SURFACE	178 m	417 m	
6	LANDMINE	AP MINE	PMN	SURFACE	388 m	443 m	
7	LANDMINE	AP MINE	PMN	SURFACE	942 m	497 m	
8	LANDMINE	AP MINE	PMN	SURFACE	349 m	668 m	
9	LANDMINE	AP MINE	PMN	SURFACE	188 m	739 m	
10	LANDMINE	AP MINE	PMN	SURFACE	497 m	750 m	
11	LANDMINE	AP MINE	PMN	BURIED	475 m	402 m	
12	LANDMINE	AP MINE	PMN	SURFACE	942 m	232 m	
13	LANDMINE	AP MINE	PMN	SURFACE	384 m	486 m	
14	LANDMINE	AP MINE	PMN	SURFACE	295 m	501 m	
15	LANDMINE	AP MINE	PMN	SURFACE	752 m	482 m	
16	LANDMINE	AP MINE	PMN	SURFACE	330 m	722 m	
17	LANDMINE	AP MINE	PMN	BURIED	562 m	442 m	
18	LANDMINE	AP MINE	PMN	SURFACE	233 m	599 m	
19	LANDMINE	AP MINE	PMN	BURIED	387 m	378 m	
20	LANDMINE	AP MINE	PMN	SURFACE	363 m	483 m	
21	LANDMINE	AP MINE	UNKNOWN	SURFACE	957 m	595 m	
22	LANDMINE	AP MINE	UNKNOWN	SURFACE	388 m	402 m	
23	LANDMINE	AP MINE	UNKNOWN	SURFACE	384 m	432 m	
24	LANDMINE	AP MINE	UNKNOWN	SURFACE	347 m	63 m	
25	LANDMINE	AP MINE	UNKNOWN	SURFACE	527 m	273 m	
26	LANDMINE	AP MINE	UNKNOWN	SURFACE	374 m	393 m	
27	LANDMINE	AP MINE	UNKNOWN	SURFACE	771 m	789 m	
28	LANDMINE	AP MINE	UNKNOWN	SURFACE	948 m	871 m	
29	LANDMINE	AP MINE	UNKNOWN	SURFACE	944 m	700 m	
30	LANDMINE	AP MINE	UNKNOWN	SURFACE	954 m	116 m	
31	LANDMINE	AP MINE	UNKNOWN	SURFACE	565 m	609 m	
32	LANDMINE	AP MINE	UNKNOWN	SURFACE	703 m	679 m	
33	LANDMINE	AP MINE	UNKNOWN	SURFACE	203 m	566 m	
34	LANDMINE	AP MINE	UNKNOWN	SURFACE	133 m	613 m	
35	LANDMINE	AP MINE	UNKNOWN	SURFACE	189 m	540 m	
36	LANDMINE	AP MINE	UNKNOWN	SURFACE	532 m	946 m	
37	LANDMINE	AP MINE	UNKNOWN	SURFACE	522 m	530 m	
38	LANDMINE	AP MINE	UNKNOWN	SURFACE	810 m	74 m	
39	LANDMINE	AP MINE	UNKNOWN	SURFACE	599 m	985 m	
40	LANDMINE	AP MINE	UNKNOWN	SURFACE	540 m	888 m	
41	LANDMINE	AP MINE	UNKNOWN	SURFACE	510 m	532 m	
42	LANDMINE	AP MINE	UNKNOWN	SURFACE	726 m	591 m	
43	LANDMINE	AP MINE	UNKNOWN	SURFACE	741 m	772 m	
44	LANDMINE	AP MINE	UNKNOWN	SURFACE	378 m	256 m	
45	LANDMINE	AP MINE	UNKNOWN	SURFACE	545 m	63 m	
46	LANDMINE	AP MINE	UNKNOWN	SURFACE	599 m	650 m	
47	LANDMINE	AP MINE	UNKNOWN	SURFACE	722 m	462 m	
48	LANDMINE	AP MINE	UNKNOWN	SURFACE	889 m	34 m	
49	LANDMINE	AP MINE	UNKNOWN	HALF-BURIED	930 m	627 m	
50	LANDMINE	AP MINE	UNKNOWN	SURFACE	946 m	903 m	
51	LANDMINE	AP MINE	UNKNOWN	SURFACE	950 m	990 m	
52	LANDMINE	AP MINE	UNKNOWN	SURFACE	950 m	990 m	
53	LANDMINE	AP MINE	UNKNOWN	HALF-BURIED	950 m	990 m	
54	LANDMINE	AP MINE	UNKNOWN	SURFACE	380 m	650 m	
55	LANDMINE	AP MINE	UNKNOWN	SURFACE	954 m	639 m	
56	LANDMINE	AP MINE	UNKNOWN	SURFACE	967 m	963 m	

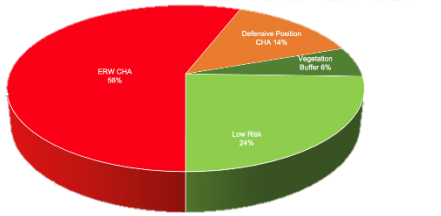
On no account should this evidence list ever be used or mistaken for the following:
- Comprehensive Finds List (RAMS is a WAA tool and not a detection system).
- Dig List/Sheet (similar to those issued after a geophysical survey).

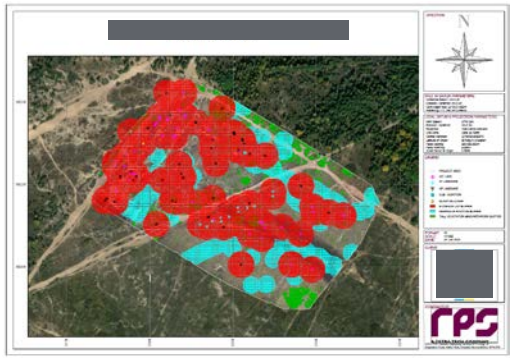
Note - RPS will not be held accountable for the misinterpretation, misuse and/or abuse of RAMS data by any third-party organisation.

MS Excel Database (Evidence List)



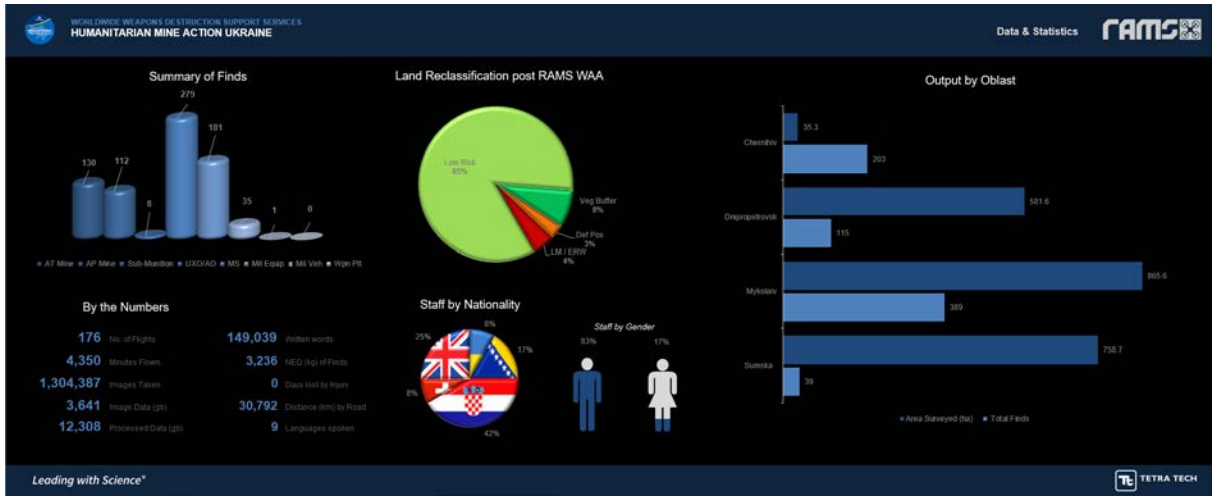




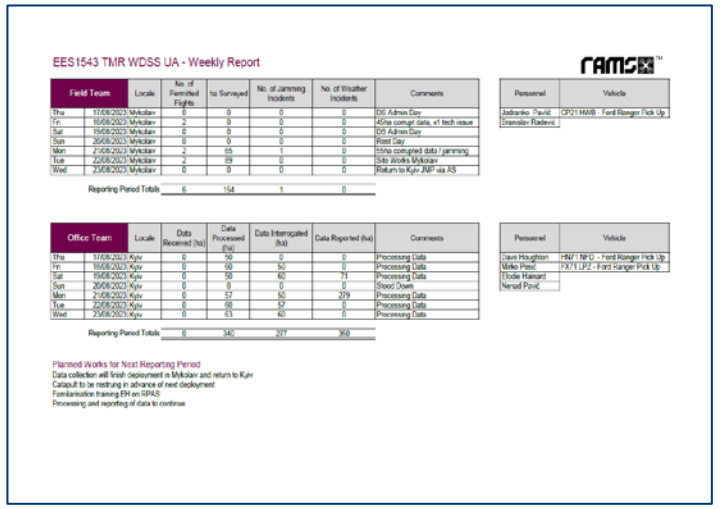


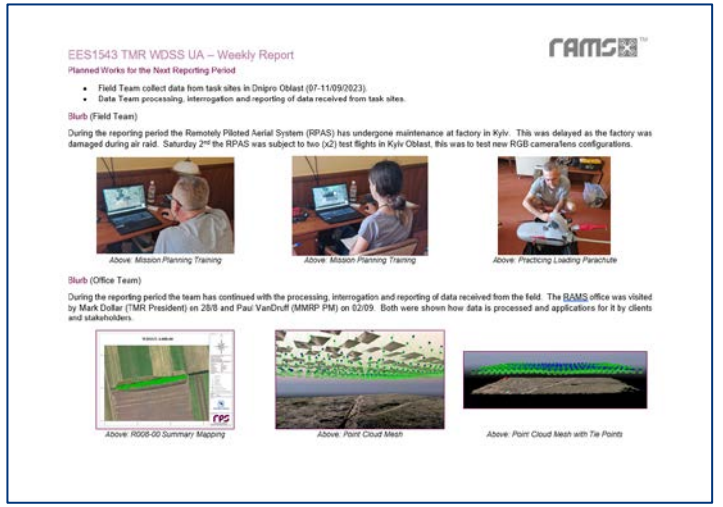
Technical Report & Interactive PDF Map

RAMS – Deliverables (Client)



Example of Project Database Dashboards (MS Excel or Power BI Format)

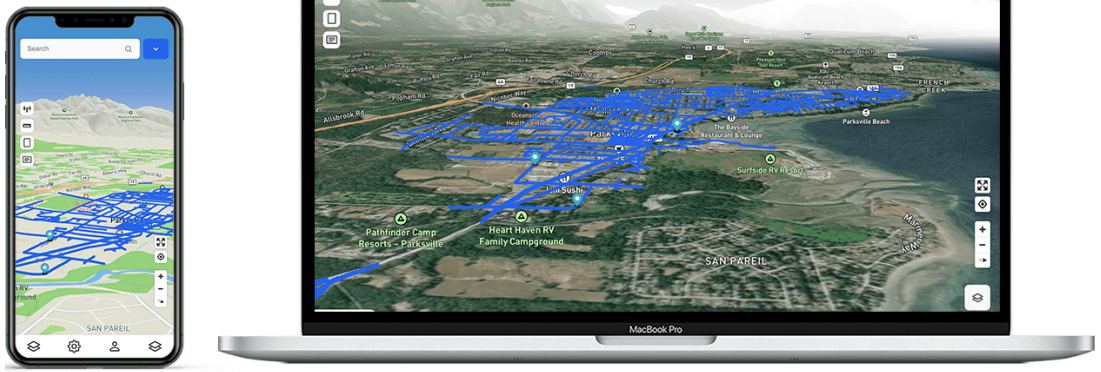


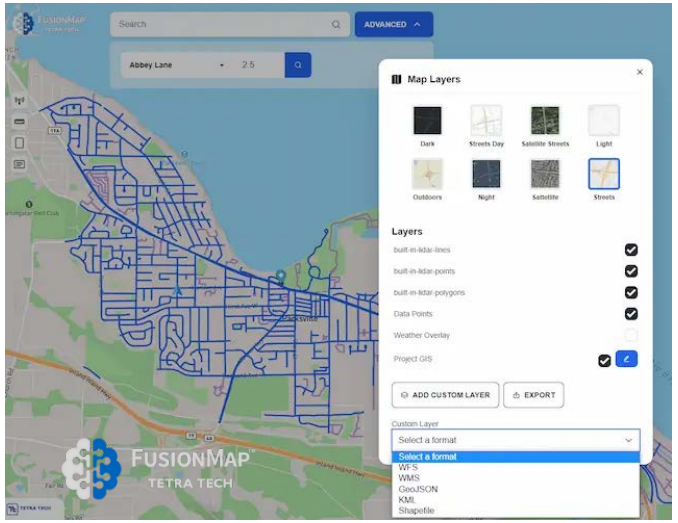


Example of Weekly Report (PDF Format)

RAMS – Deliverables (Optional)

FusionMap™ uses AI software to create a digital twin of the AOC that can be used for simulations, analysis & optimization of projects. Provisional data (pre-deployment) would be generated from satellite imagery, with subsequent high-resolution data from drone flights providing near-real-time situational information.





FusionMap is integrated with ESRI-based GIS products, so information is updated across all platforms simultaneously.

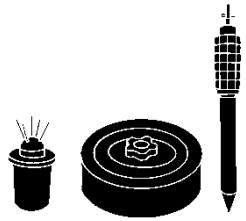
TETRA TECH

RAMS Statistics

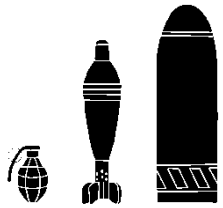
RAMS Statistics 2021 - 2023

TETRA TECH

Surveyed
642 km²

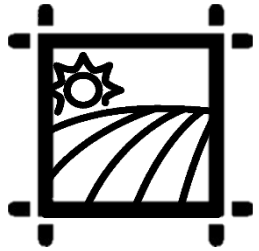


Landmines
14,694
(8,002 AT, 6,692 AP)

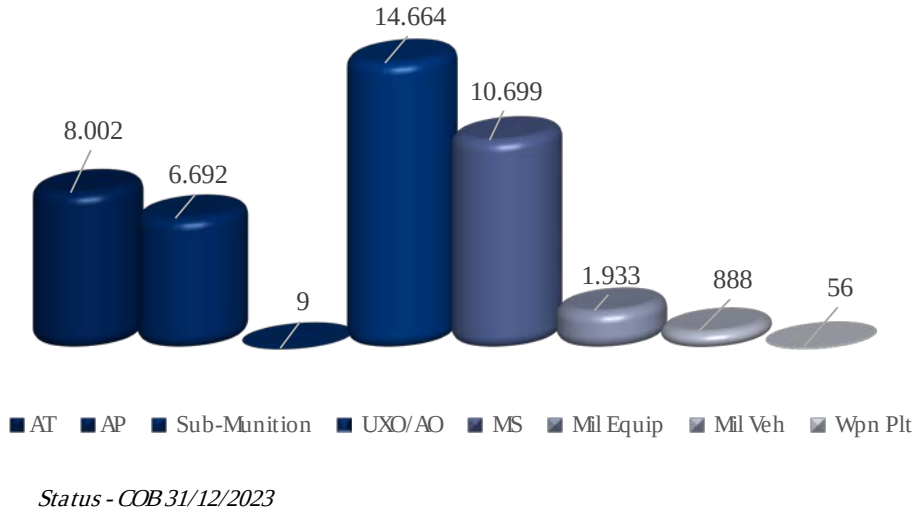


AXO/UXO
14,664

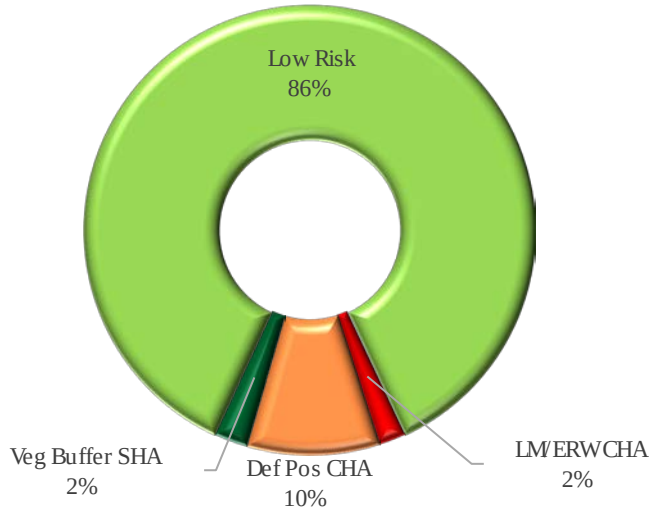
Total Finds
42,943



Low-Risk Areas
553 km²
(86%)



Status - COB 31/12/2023

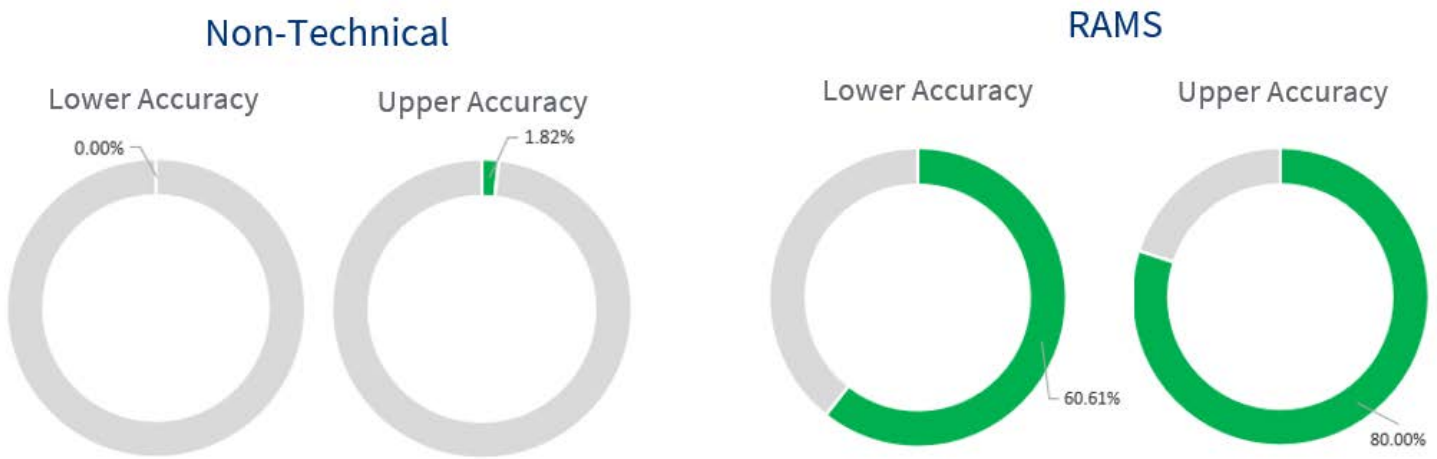


RAMS – Overview

System Accuracy

2022, the findings of x3 sites were compared post clearance, which established a RAMS™ accuracy level of 60.61 - 80.00%. Based on this review, operational changes were made.

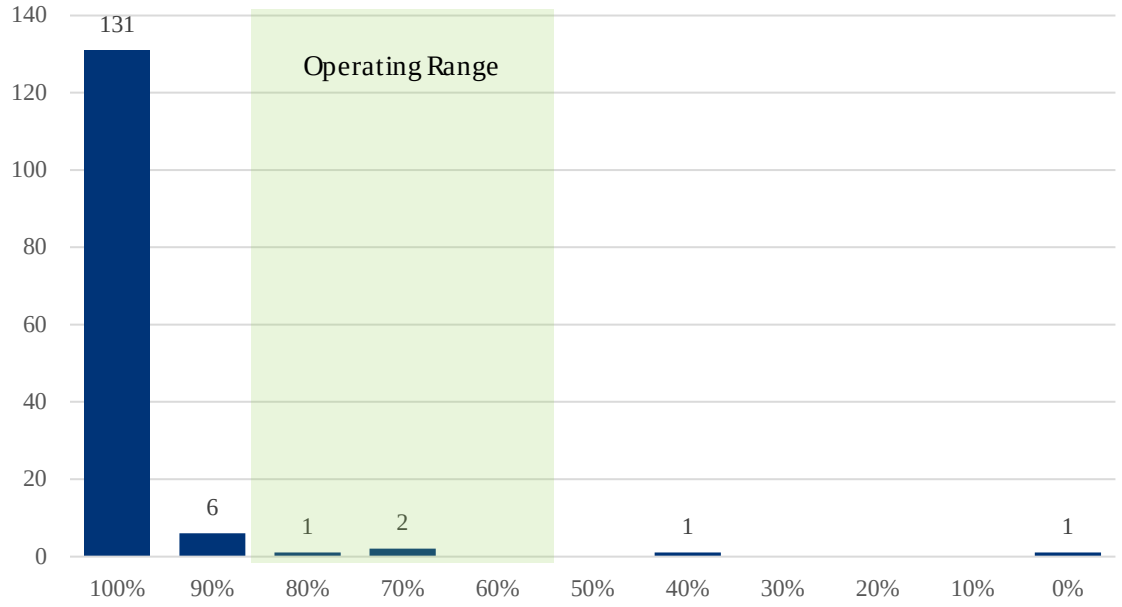
The x3 sites had also undergone an earlier conventional NTS, with an accuracy level of 0.00 - 1.82%.

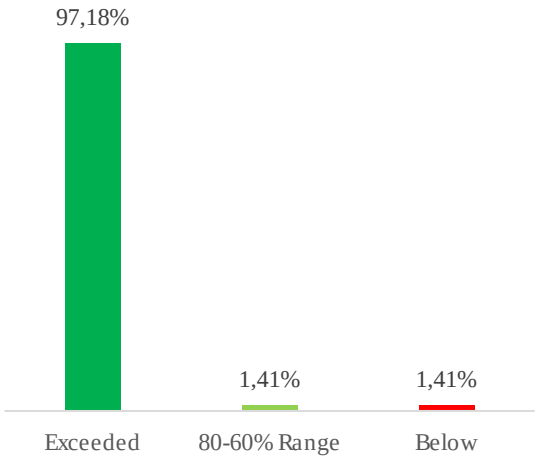


RAMS – Overview

System Accuracy

2023, a larger assessment of the findings of 142 sites (54,243ha) was conducted. This assessment established that 98% of the reviewed sites had met and, in most cases, exceeded the 2022 review.





98.59% (task sites)

RAMS Deployment Options

RAMS – Deployment Options

Full Team

Turnkey solution: full team deploys to project running independently or integrated into client's infrastructure. All team members are multiskilled, typically IMAS L3, commercial pilot, and GIS/CAD operator.

- Each RAMS flight team can survey 2km² per day with a proven accuracy exceeding 90%.

Wingspan: 2.7m

C2 Range: 25km

Flight Range: 120km

Flight Duration: ≤120min

ECM: Multifrequency (NovAtel based)

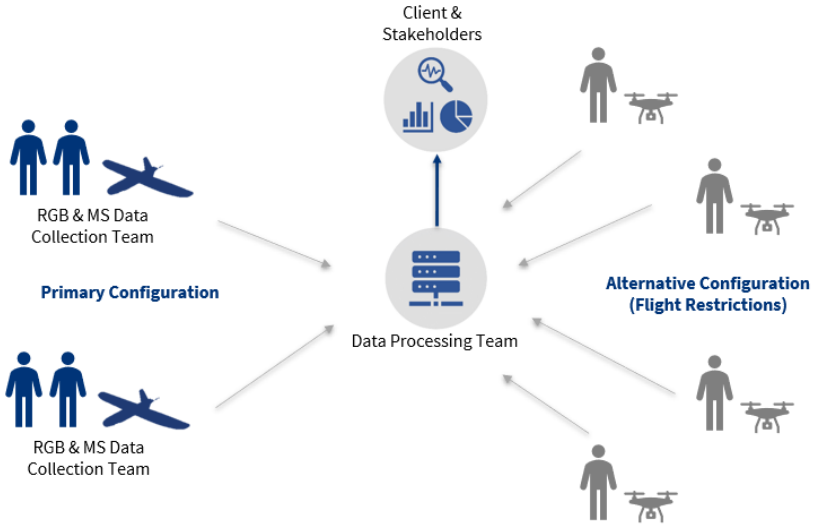
Wingspan: 1.9m²

C2 Range: 100km

Flight Range: 216km

Flight Duration: ≤60min (26kg) / ≤300min (16kg)

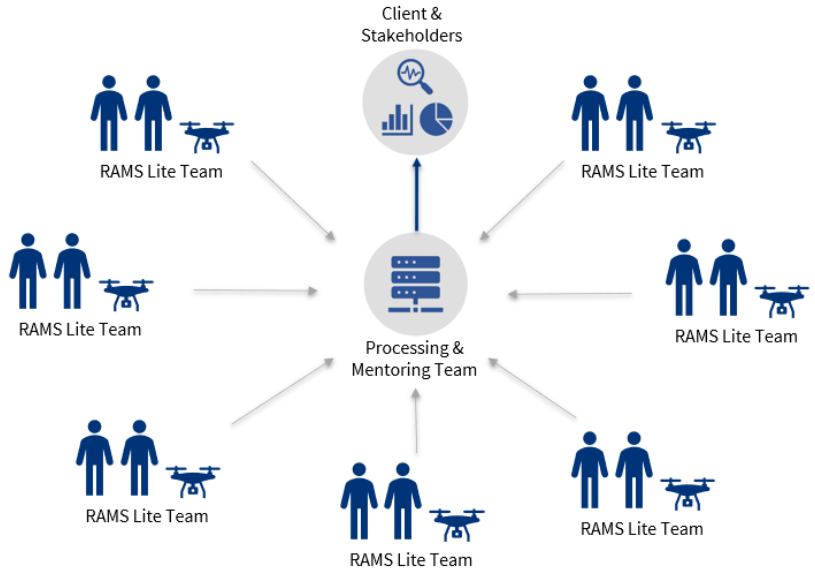
ECM: GPS 4 channel encrypted, C2 2 channel encrypted



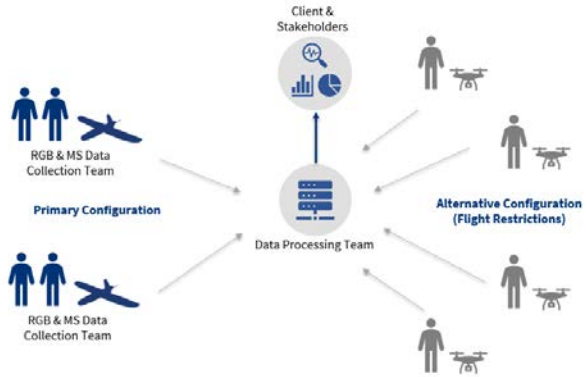
RAMS – Deployment Options

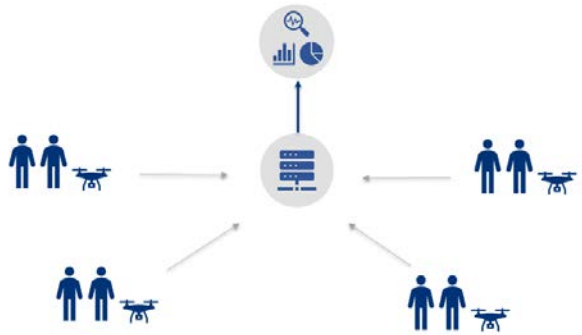
RAMS Lite

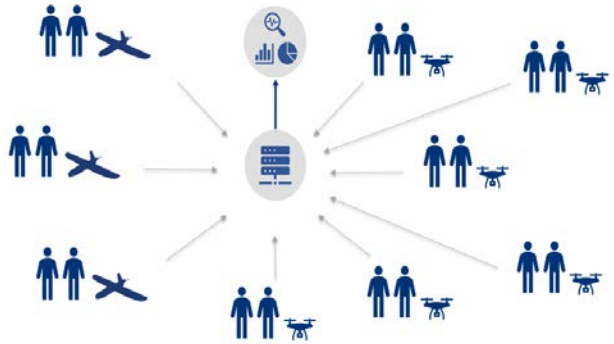
- Train & Equip organisation to operate & maintain drones & their payloads
- Additional training in data collection best practice
- Mentor flight & ground crews during the life cycle of the program.
- Collected data is processed by RAMS personnel in country at a secure processing centre



RAMS – Deployment Options







RAMS
Full Team
54,180ha*

75,882 Football Pitches

34% of Greater London

RAMS Lite
Standard
20,700ha*

28,992 Football Pitches

13% of Greater London

RAMS Hybrid
Full & Lite Teams
>74,880ha*

104,874 Football Pitches

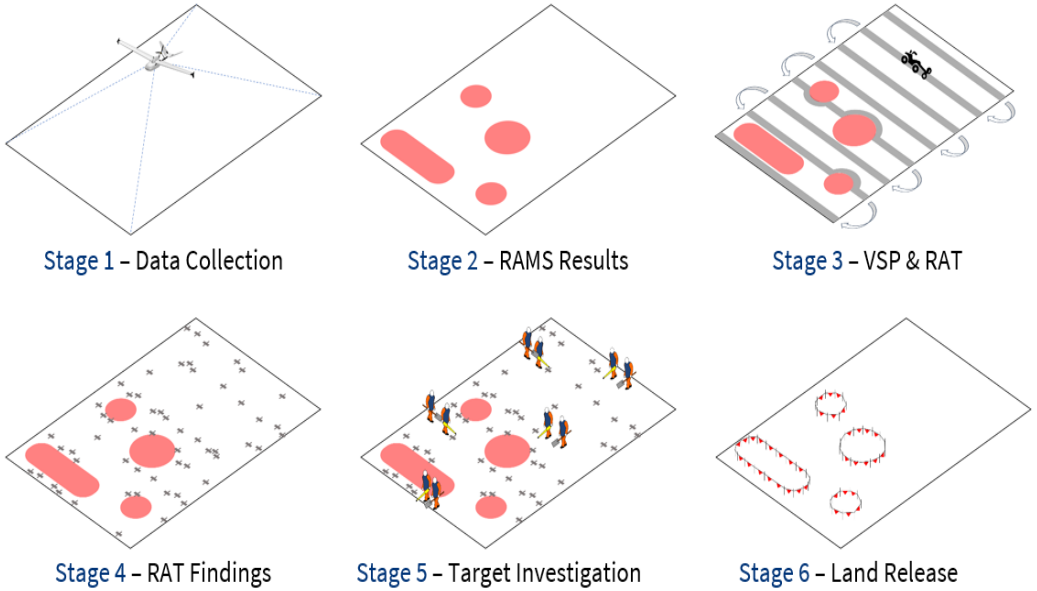
48% of Greater London

Notes
Examples based on 10-month yearly work cycle (max. 258 workdays)
(*) - based on estimated median productivity

RAMS – Deployment Options

Search Verification Release (SVR)

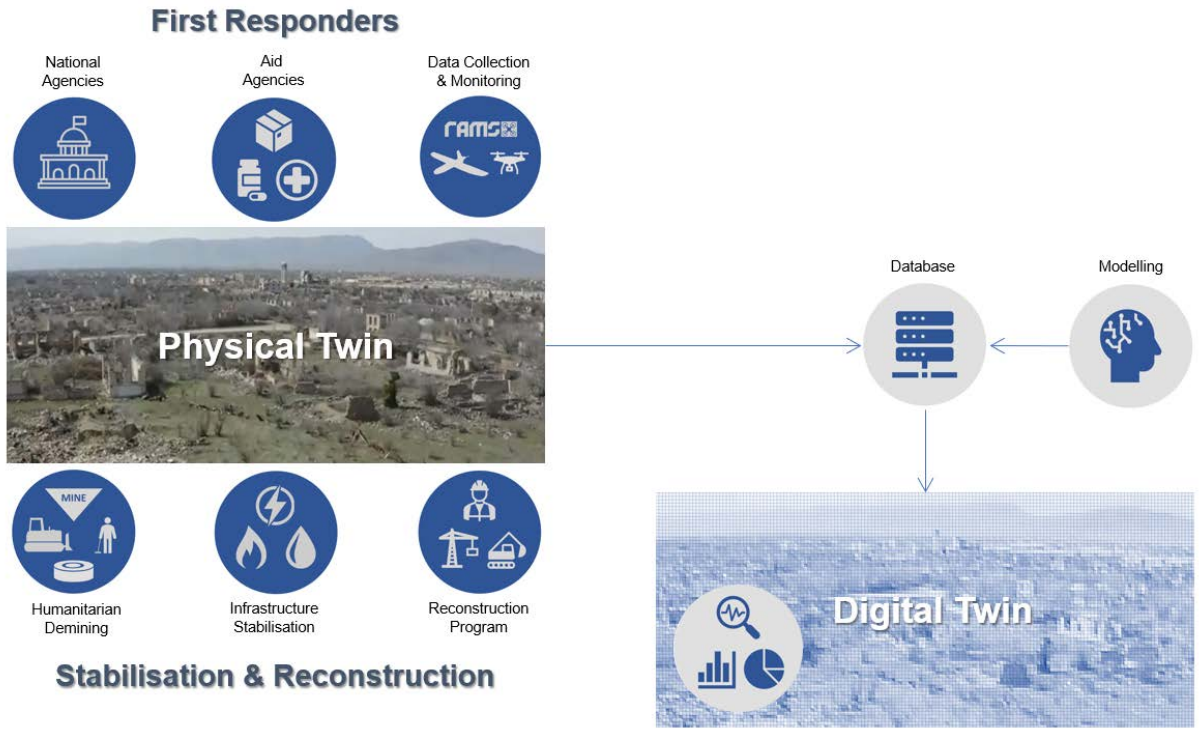
- Designed for rapid release of SHA Agricultural land
- Merges RAMS™, geophysics and visual sample plan (VSP) used in US EPA land-release process
- Approx. 24.65 times faster than traditional land release
- Each SVR team can process in the region 45,000ha



RAMS – Deployment Options

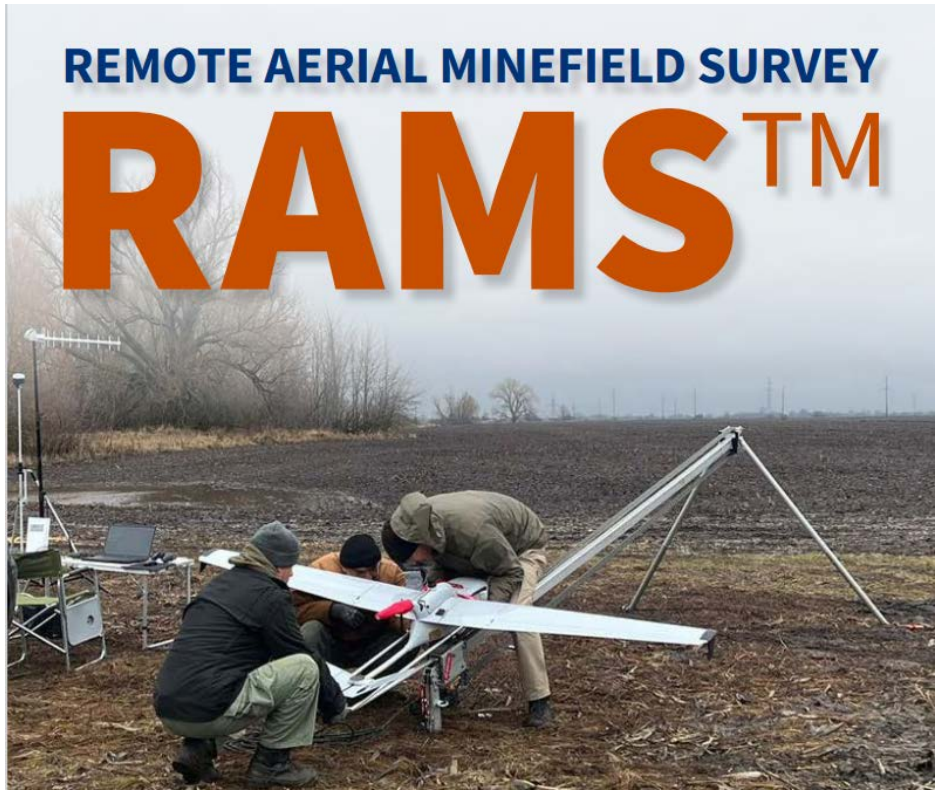
Urban Operations – Digital Twins & Interactive Maps

To assist in clearance operations of urban environments, Tetra Tech produces digital twins and interactive mapping



Thank You!

TETRA TECH



Capture the QR code to access the full article and our contact information.