Project Charon

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Abstract

Championed by the ancient Greek ferryman, this proposal outlines an expedition from WSU Nirimba Fields to radioactive territories like Maralinga and Plumbago to study rare Maralingite, develop terrestrial and aerial gamma-radiation maps, sample, analyse, culture and metagenomically sequence geotagged soils. Searching for undiscovered melanized polyextremophiles with broad industrial applications from radioprotective prophylactics and bioremediation to nuclear forensics.

Overview

Atomic attitudes remain dominated by reckless competition. Even before the only two wartime demonstrations, scientists globally sprinted towards nuclear catalysis. From 1953 (Monte Bello Islands, Emu Fields) and 1963 (Maralinga), the British led several independent nuclear tests on Australian soil. Their infamy stemming from systemic negligence of long-term safety and habitability whilst dismissing indigenous inhabitants or landmarks (*ABC News* 2020). This testing necessitated by new plutonium refinement techniques and the characteristic instability of higher Pu-239/240 ratios (Tynan 2022). The silver lining radionucleotide "hot particle" dust still freely scattered across dry sand and absorbed by fauna (Johansen 2014; Cook 2021) after two expensive and incompetent vitrification and burial cleanups failed (Parkinson, 2002) and traditional *Anangu* ownership was restored. The latest state-sponsored environmental surveys did not perform microbiome analysis and insisted on future aerial radiological surveys.

Critically, the persistent contamination could facilitate radiotrophic adaptation seen at other contaminated sites, perhaps readapting a typically UV-resistant mechanism for electron scavenging purposes (Durrell 1960; Dadachova 2007; Malo 2019; Tiquia-Arashiro 2019; Seckbach 2021). Discovering interspecies eumelanin variations could break ground for effective general pre-exposure radioprotectors. Data gathered from irresponsible non-fissile 'minor' detonations and burnings have implications across nuclear-powered space exploration. Not just confirming adaptive melanisation, potentially supplying novel culturable nucleotide-metabolising organisms for bio-assisted decontaminations, hot particle nucleation data and comparisons to exotic environments in Martian, Lunar, orbital or other terrestrial disasters. Wackier interpretations extend to the controversial prehistoric Martian nuclear activity (Johnson 2020).

Military vehicle survivability post-detonation, shockwave and temporary induced radioactivity may not permanently disable certain hardware. Of the six Mustang fighters flown from RAAF Tocumwal, the one rescued from the desert 15 years later and flown back to repair facilities—marked the only aviation recovery mission of its kind.

This paper compiles existing information on persistent radiological contamination, documented Major/Minor tests, their approximate locations and prospective radiotrophic gardens coupled with an exploratory outline, permits, transport requirements and government contacts.

Timeline

After Britain poached Ernest William Tritterton from the Manhattan project, they fired a weapon off Monte Bello's lagoon inside the HMS Plym to examine ship-based attacks. Len Beadell later surveyed the South Australian desert to identify locations with ideal weather conditions (Beadell 1988). The British immediately invaded the emu-printed claypan and within one month fired two Totem and several minor Kitten tests (testing shorter half-life fission), later developing two tactical Monte Bello Mosaic experiments to determine the traditional fission bombs' lower plutonium limits. Although Emu Field was always a temporary site, these tests were so dirty and toxic they had to relocate to permanent test facilities downwind with broader planning, superior decontamination, cutting edge laboratories and working water supply whilst being closer to existing railways, roads and Victorian/NSW RAAF Aerodromes. This transition between Emu Fields and Maralinga continued with 6 major detonations and >50 minor tests—of which the 'Vixen/VX' trials were most threatening. The controlled incineration and non-fissile detonation of enriched pyrophoric material simulated nuclear accidents and scattered 22kg of weapons-grade plutonium and radioactive debris across 3000km² (Cunneen 2024). Importantly, Emu Fields did not surpass arbitrary thresholds for cleanup and is still highly contaminated by fission products. [Detonation dramatization]

OPERATION and Location	Date and TIME (GMT)	Site	Type	Geographical Coordinates	Height at detonation (m)	Approx. Yield (kt)
HURRICANE; Monte Bello Is., WA	3 Oct. 1952 0000Z*	Lagoon of 12m depth off *Main Bay*, Trimouille Island.	CSB; in HMS Plym	Lat. 20°24'30"S Long. 115°33'50"E	-2.7	25
TOTEM; Emu Field, SA	14 Oct. 1953 2130Z	T1.	NSB: MS Tower.	-	31	10
	26 Oct. 1953 2130Z	T2.	NSB: MS Tower.	-	31	8
MOSAIC; Monte Bello Is.	16 May 1956 0350Z	G1: Trimouille Island.	NSB: Al. Tower.	Lat. 20°23'00.06"S Long. 115°32'47.98"E	31	15
	19 June 1956 0214Z	G2: Alpha Island.	NSB: Al. Tower.	Lat. 20°24'26.42"S Long. 115°32'03.36"E	31	60
BUFFALO; Maralinga Range, SA	27 Sept. 1956 0730Z	One Tree.	NSB: Al. Tower.	-	31	15
	4 Oct. 1956 0700Z	Marcoo.	CSB: at ground surface.	-	0.2	1.5
	11 Oct. 1956 0557Z	Kite.	Airburst: freefall.	-	150	3
	21 Oct. 1956 1435Z	Breakaway.	NSB: Al. Tower.	-	31	10
ANTLER; Maralinga Range, SA	14 Sept. 1957 0505Z	Tadje.	NSB: Al. Tower.	-	31	1
	25 Sept. 1957 0030Z	Biak.	NSB: Al. Tower.	-	31	6
	9 Oct. 1957 0645Z	Taranaki.	Airburst: Balloon System Borne.	-	300	25

Figure 1: List of British Atomic Weapons Tests within Australia. [Adapted from MoD Report No SFS/A/26 with some inclusions of data from TR049.]

Cloud 9 Fallout

Most concerning isotopes were Strontium-90 (28y λ), Iodine-131 (8d λ). Strontium is biologically confused with calcium. Unless competing with regular iodine, radioactive iodine-131 will replace depot thyroid quantitates and cause cancer. Despite political pressures suppressing iodine-131 fears at the time (Townsend 2006), these immediate hazards mostly vanished over 60y. The major contaminants are still U/Pu nanoparticles with trace intermediate decay products.

Fig 1. Totem-1 detonation

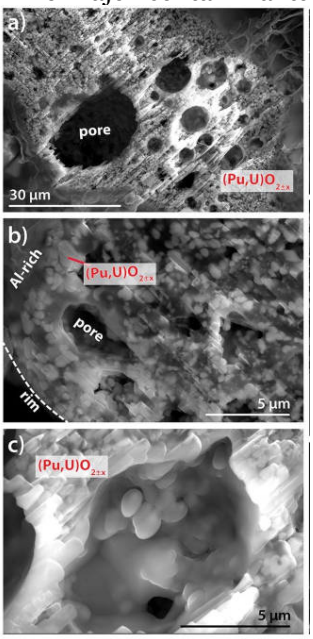


Fig 2. Maralinga's Plutonium nanoparticles (Cook 2021)

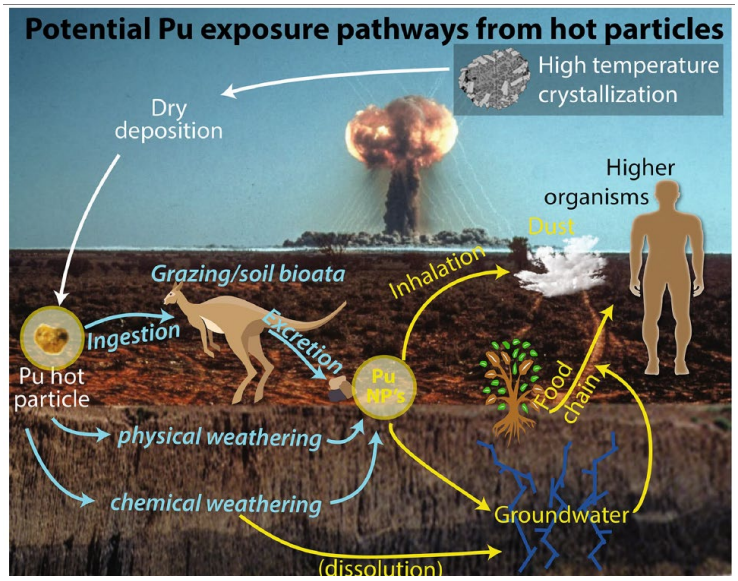


Fig 3. Dust distribution cycle (Cook 2021)

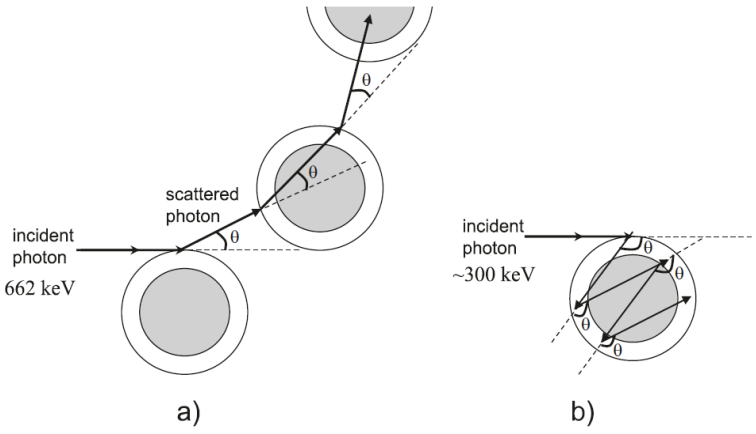
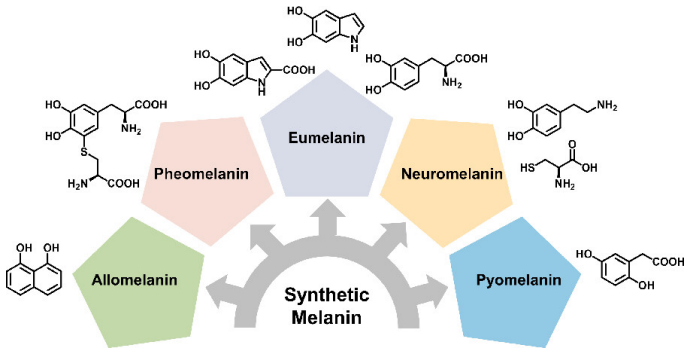


Fig 4. Proposed melanin sphere Compton scattering (Dadachova 2008)

Curious Creatures

The melanized or darkly pigmented fungi around Nevada test sites/Death Valley, Antarctica, Chernobyl, Uranium mines, and nuclear reactor water reservoirs are abundant (MacGregor 2024; Van Eesbeeck 2021). Dadachova 2019 proposes black fungi coating Chernobyl reactor No. 4's walls and cable conduits exhibit thick extracellular melanin layers that absorb or refract high energy particles and scavenge ejected electrons to enhance intracellular processes, incentivising growth *towards* ionizing radiation (Liu 2022). Durrell 1960 did not log collection areas but with many naturally radioactive hot or cold desert regions readily accessible, it's imperative we understand these extremophiles holistically. Additionally, the unprecedented radioprotective and antioxidant qualities of intravenous eumelanin in rats, ISS experiments growing radiation shielding (future ISRU/ELMs), potent antibacterial and antidiabetic properties spotlight the need to categorize fungal melanin's chemomechanical characteristics for emergency, industrial, aeronautical, astrobiological and astropharmaological applications (Shunk2020; Liu2022).



Molecular engineering advancements increased mice survivability of 6Gy total body irradiation from 12% to 100% with novel seleno-melanin nanoparticles, whilst other studies compare the protective qualities or economic scalable harvesting of melanin—further emphasizing why we must understand their mechanisms (Deng 2025).

Additional precedent for proxy radiotrophism lays thriving 2.8km below sea level in a South African gold mine, respirating hydrogen sourced from deep subterranean decay splitting water molecules (Lin 2006; Chivian 2008).

Fascinatingly, there are also several heavy metal bacterial reducers who can respirate U/Pu NPs into less soluble oxidation states, with ongoing research enhancing bioremediation and nuclear forensic applications

(MacGregor 2024). These *Geobacter* species and others like *Deinococcus radiodurans* were found at abandoned Australian, Mexican Uranium mines and Chernobyl's red forest (Tibolla 2025; Mumtaz 2013). Meta-sequencing unique species at decommissioned weapons testing ranges could further this work (Macgregor 2024). Studies quantifying microbial reactions to ionizing radiation (including open reactor pools) place broad preferential growth starting around 750kBq/m² with species-dependent exposure limits. Making areas of Emu Fields and Maralinga comparatively mild.

Mice Survival		
Group	Live (%)	Dead (%)
0 Gy	100	0
γ-ray	12.5	87.5
0 Gy+ 7.5 mg kg^{-1} SeMNPs-4	100	0
γ-ray+ 7.5 mg kg^{-1} SeMNPs-4	100	0
γ-ray+ 30 mg kg^{-1} DA NPs	33.3	66.7

Fig 4. Melanin increasing rodent radiation survivability

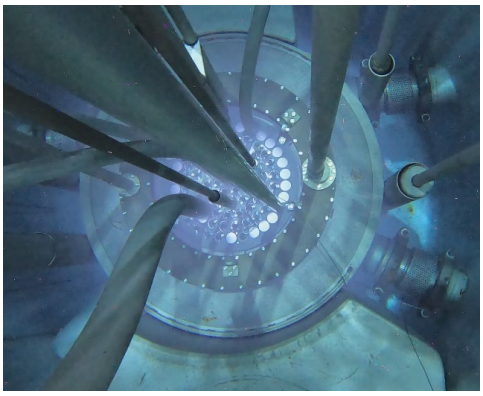


Fig 5. The JSI TRIGA Mk II reactor regularly cleaned of corrosive microbial biofilm (Bratkic 2022)

Fig 7. Isolated culture of Chernobyl's melanized fungi (Zhandanova 2000)

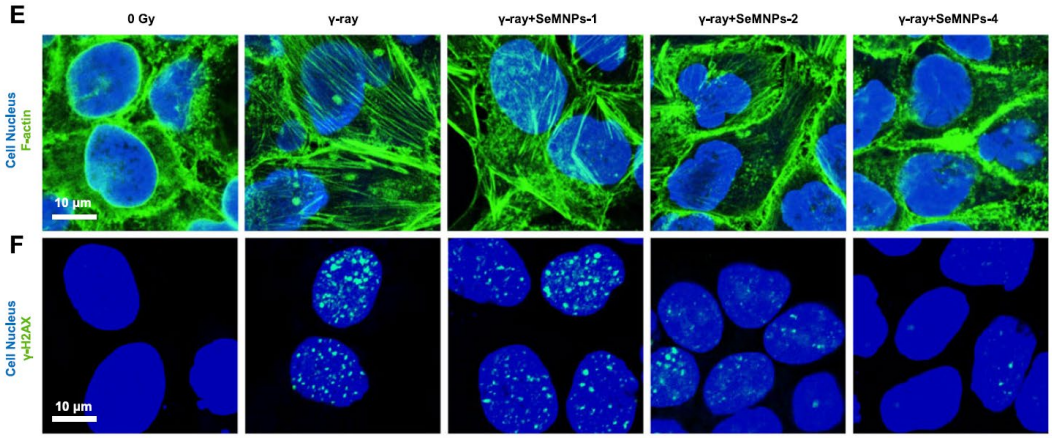


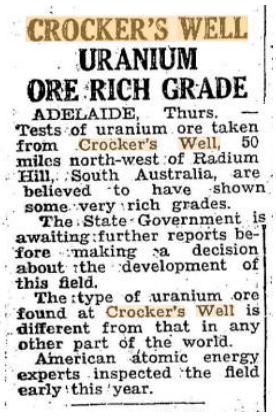
Fig 6. Selenium-MelaninNanoParticles (SeMNP) protecting irradiated cells from catastrophic damage

Radiotolerant Atlas					
Threshold	**Est. (kBq/m²)**	**Est. Dose**	**Organisms**	**Location**	**Source**
Growth Enhancement	**≤750 kBq/m²**	**0.05 mSv/h** (500x background)	*C. sphaerospermum, W. dermatitidis, C. neoformans*	Lab	Dadachova (2007)
Radiotropism	**NA**	Directed growth towards ionizing beam	*P. hirsutum, C. cladosporioides*	Lab	Zhdanova (2004)
Damaged Reactor	**6,000 - 33,000 kBq/m²**	**0.4 - 2.2 mSv/h**	*C. sphaerospermum, P. hirsutum*	Reactor No. 4	Zhdanova (2000)
LEO Growth	**NA**	~21% growth advantage observed on the ISS	*C. sphaerospermum*	ISS	Shunk (2020)
Fallout Zone	**NA**	2y post-detonation	*Stemphylium ssp, Cladosporium ssp, Phoma ssp*	Nevada Site	Durrell (1960)
Highly Contaminated Soil	**≤30,000 kBq/m²**	^{137}Cs Plume depositions	Diverse soil microbiome, including stress-tolerant fungi	Red Forest	Menezes (2024)
Max (Lab)	**≤540,000,000 kBq/m²**	**36 Sv/h**	*D. radiodurans, E. coli* (mutant), *T. mucoides*	Lab	Shuryak 2017)
Max (Fungi)	**NA**	**55.8 kSv**	*C. antarcticus*	Lab	Pacelli (2021)
Extreme Resistance	**NA**	**>5 kSv (LD10)**	*C. cladosporioides, Alternaria tenuis*	Lab	Dadachova (2008)
Maralinga Plumes (^{137}Cs)	**13 kBq/m²**	Surface contam.	*(Unknown)*	Maralinga	Cunneen (2024)
Maralinga "Minor" (^{241}Am)	**≤122 kBq/m²**	Surface contam.	*(Unknown)*	Taranaki	Cunneen (2024)
Emu Fields	**≤140 kBq/m²**	Surface contam.	*(Unknown)*	Emu Fields	

Alternative Locations

Crocker's Well

Introduced by Peter Beckwith, this site west of the prohibited Radium Hill and populated Broken Hill, was probed extensively and later abandoned for other promising Uranium deposits. Preliminary reports paint tables of rich superficial fractures and veins brimming with Brannerite (Th/U), davidite, quartz, phlogopite, apatite, rutile, sericite, fluorite, monazite and trace metal ores (copper) (Dart). Familiarising ourselves with the diverse geologies of this site could help narrow the conditions, specific minerals and elemental concentrations associated with Australian radiotrophs. Notably, U_3O_8, ThO_2



CROCKER'S WELL
URANIUM
ORE RICH GRADE

ADELAIDE, Thurs. — Tests of uranium ore taken from Crocker's Well, 50 miles north-west of Radium Hill, South Australia, are believed to have shown some very rich grades.

The State Government is awaiting further reports before making a decision about the development of this field.

The type of uranium ore found at Crocker's Well is different from that in any other part of the world.

American atomic energy experts inspected the field early this year.

Ranger Uranium Mine

The retired Ranger Uranium mine near Jabiru, east of Darwin, detailed in *Yellowcake and Crocodiles* (Lea and Zehner, 1986) formed the interdisciplinary bedrock for Mumtaz's 2013 visit to calculate residual groundwater U contamination and inspect preferred $UO_2(NO_3)_2$ growth medium concentrations. Noting soil fungi outcompeted bacteria and withstood higher radiation doses. Mumtaz' study is one of very few works investigating Australian radiotrophs.

Ranger's Uranium mine			
Species	**Subspecies**	**Similarity**	**Sp. Number**
Bacillus	**B. mycoides/subtilis/megatarium**	**99-100%**	**4/9**
Lysinibacillus		**100%**	**4**
Klebsiella		**99%**	**4**
Paenibacillus		**100%**	**2**
Aspergillus terreus		**100%**	
Aspergillus flavus		**100%**	
Cryptococcus laurentii		**100%**	
Penicillium verrucu-losum		**99%**	
Curvularias sp.		**100%**	
Paecilomyces sp.		**100%**	
Alternaria sp.		**100%**	

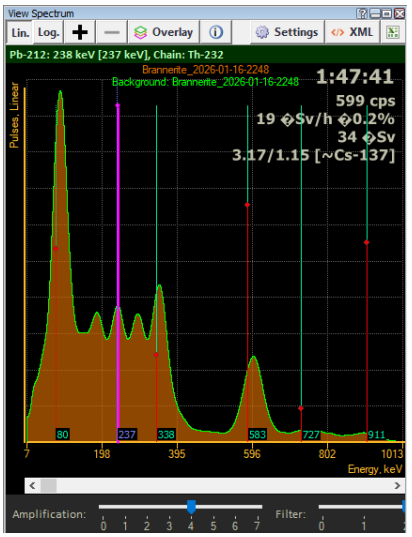
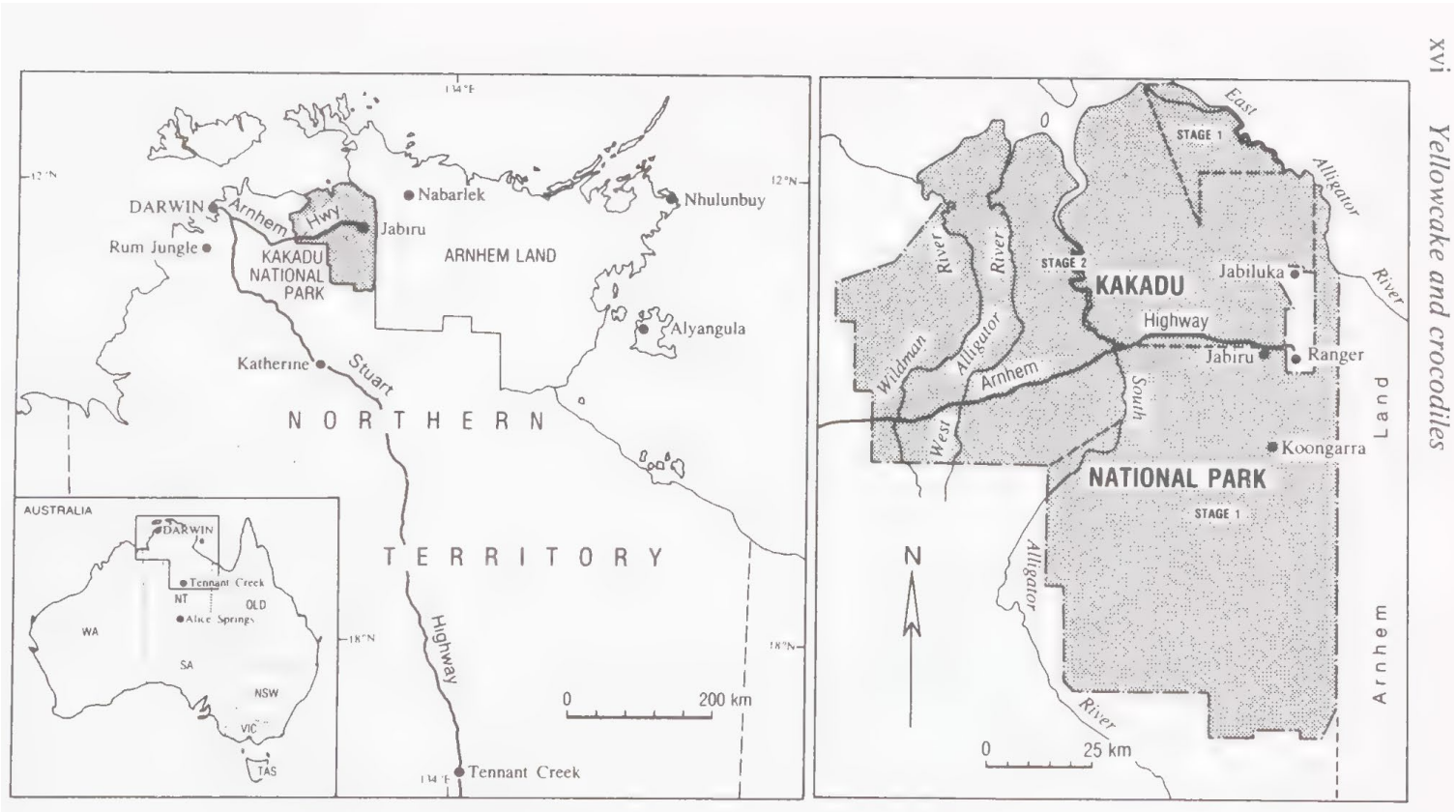


Fig 7-9. Brannerite samples and spectrum



Map 1 *Location of Jabiru.*

Methods

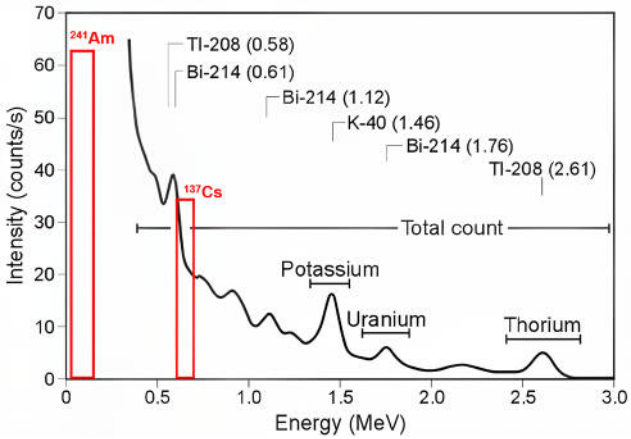
Ibrayev 2026 group demonstrated high-resolution radiation mapping can be accomplished with commercial equipment and third party spectroscopy, we'd like to extend their work into the biological realm. Mapping the goldilocks zones of other radioresilient/trophic species to the most irradiated areas [insert visual goldilocks zone of radiotrophic species with references, establish LD50 Gy/mSv/CPS limits of radiotrophs and the annotated ArcGIS maps of the contamination—Rum Jungle, using Ibrayev's regression].

High-energy photons below <0.667MeV might, according to Dadachova's cellular model, be another narrow dimension (as is the thickness of the melanin biofilm on the ISS). *Cyptoccocus neoformans* blooms in >500x background (2.4mSv). Dadachova's collection method included sterile cotton swabbing of contaminated regions, stamping onto antibiotic-impregnated and free Malt Agar petri dishes (3 days later). These plates are incubated for 30-60d at room temperature with regular inspections. Separated into higher and lower radiation areas. (Dadachova 2004; Tibolla 2025).

Mumtaz 2013 mentions core samplers of 5cm diameter and 10cm depth. 10g soil samples added to 5mL of sterile distilled water and shaken, 1uL slurry diluted with 100uL distilled water and poured onto culture (Luria-Bertani [Bacto-Tryptone, yeast extract and sodium chloride]) media plates. Incubated at 37°C for 28hr and stored at 4°C. Genomic CAN isolated from 2mL of liquid culture using a MoBio UltraClean™ microbial DNA isolation kit (Gene-works, SA, Australia) and stored at -20°C for future use. A novel addition could be radiochromic pigments painted onto the underside of our dish or agar medium (depending on the exact setup).

Lloyd 2025 clarifies the use of NCBI's BLAST network for genome analysis and agrees with Mumtaz that >99% similarity is considered the same species.

Notably, we should expect fungal species near peak radioactivity. The Radiacode 110 can perform field isotope spectroscopy and aerial radiometry (if strapped to commercial drone undercarriage and flown ~3.5m above contaminated regions), with several open source Radiacode-specific mapping software (Andreev 2021; brianzhouzc 2024; igmrlm 2023). The AlphaHound AB+G is an alternative with clearer field readings and no Bluetooth functionality. Automated UAVs are approachable extreme environment probes ("Mapping Radiation in Chernobyl" 2021). Combining these approaches can pinpoint additional AOIs and quantify specimen exposure in realtime.



The author (as of 2026-03-19) owns a working, tinted VW 2008 Passat Sedan, valid NSW P1 License and several willing volunteers with long equipment laundry lists—however, unanimous Perth interviewees insisted remote off-roading requires rugged 4WDs, water tanks and emergency SOS/GPS devices.

Occupational hazards stem from UV exposure and hazardous dust, federal guidelines mandate adequate skin, eye PPE and non-stick alcohol-based sunscreen in the presence of loose particulate. Workwear stores suggested breathable polyester and vented attire. Necessary lead-lined (high Z-ion) containers can be improvised. Explicit nuclear hazard symbols are not required by federal or state law when transporting small academic quantities, we should use clear signage but avoid alarming onlookers (ARPANSA.gov.au). Contacting the Maralinga Tjarutja traditional landowners, local governments and obtaining research permits from the Australian Defence Force may be necessary.

Although soil sampling techniques are not standardized across geographies—1cm-diameter, 10cm-deep cores seem feasible and fast across our identified regions (Lloyd 2025; Ibrayev 2026). The 2003 *Rehabilitation of Former Nuclear Test Sites at Emu and Maralinga* includes descriptions of waste burial grounds with warning sign specifications and it'd be a strange twist of fate if we find melanised lichens growing on those plinths.

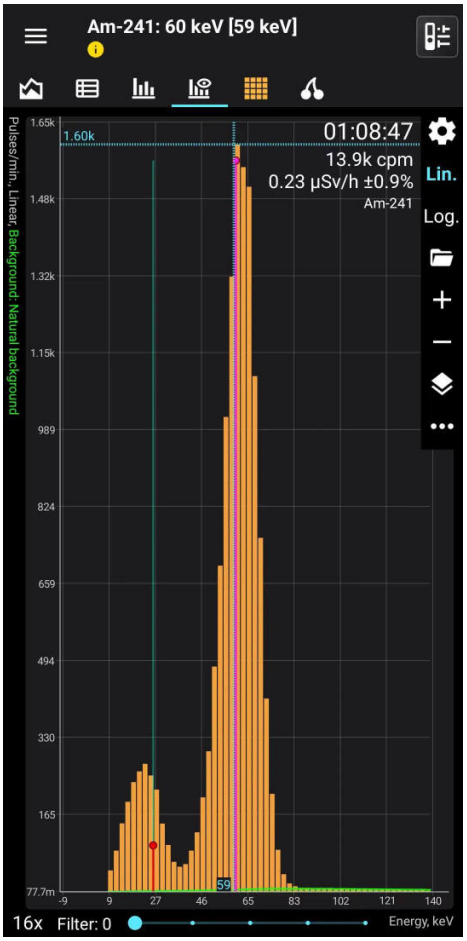


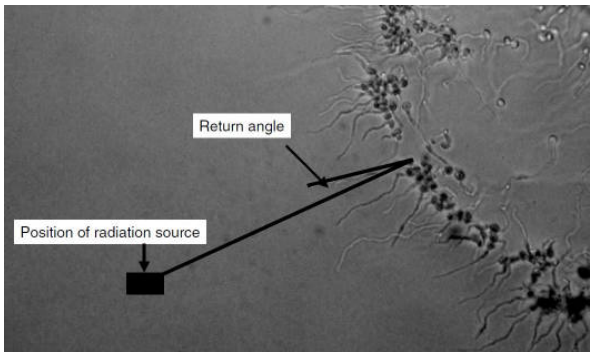
Fig 7. Radiacode Am-141 Spectrograph

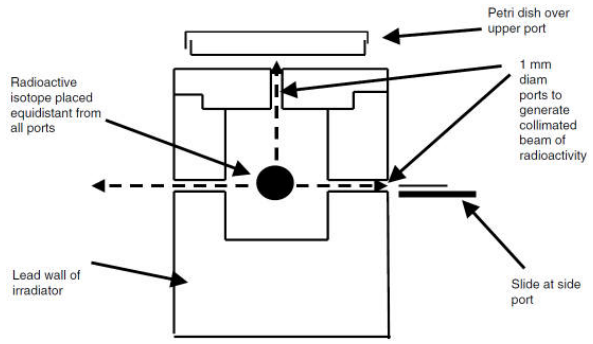
Collection

We'll cotton swab interest areas, carefully bottling surrounding dust before taking 10-4cm soil core samples. All samples must be explicitly labelled, geotagged and hermetically sealed in an insulated lead-lined box during transport (max 30°C). Field microscopes and metagenomic equipment whilst available are prohibitively expensive, all effort must be given to preserve specimens. Ibrayev 2026 highlights 4-week storage times to allow radon buildup, replacing and equalizing the escaping U-chain gases. Plumbago's high Thorium content should make this unnecessary. Additional soil samples should be taken for later gamma spectroscopy.

Cultivation

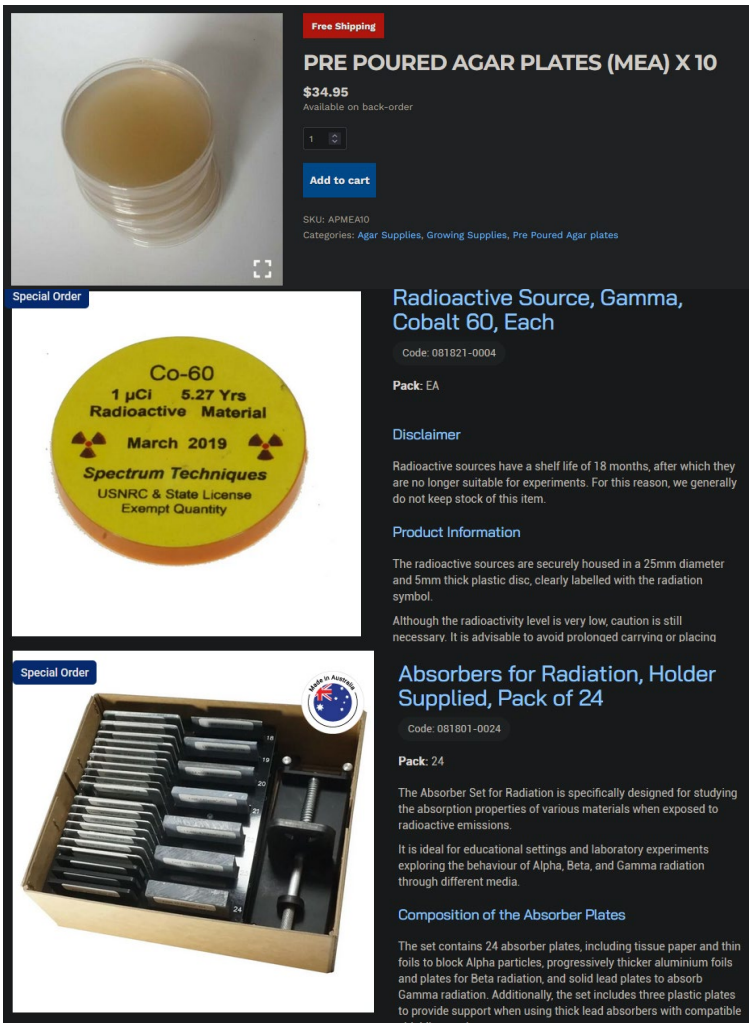
Protocols taught in WSU Microbiology 1 will be used to cultivate specimens across various media (examples). After obtaining several different kinds of radioactive sources (incl. ores, minerals and educational isotopes), we'll simulate typical environments (Chernobyl, Ranger Uranium Mine, reactor pools) by placing petri dishes above an improvised lead-shielded mechanism(s) (Zhdanova2004) to observe and quantify growth. We expect fungal hyphae to extend *toward* sources with darker pigmentation and faster growth (measured by dry biomass) than unirradiated controls.





Melanin Extraction and Synthesis

Microbes melanogenate differently (intra/extracellular synthesis and cell wall incorporation) therefore, the most important aspect of any black fungus is characterizing its unique polyextremeophilic mechanisms and reproducing them at scale. Commercial feasibility requires reliable extractions before engineering higher yields. Müjdeci 2021 used waste products (specifically carrot peels) to grow economically viable melanin and recent developments upcycling plastic waste into melanin's metabolic precursors presents an intriguing bioengineering opportunity (Royer 2026). The lab preparation of standard, accidental and advanced melanin are outlined in Project Joyous. We can use melanin's paramagnetic free unpaired electrons to confirm



Class	Melanin Uses	Sources
Physics	Radioprotection	Cordero2017; Panzella2018; Revskaya2012
	Antioxidation	Cordero2020; Jacobson1995; Qi2019
	Photoprotection	Solaro2016
	Biosorbent	Cordero2017; Eisenman2012
Biology	Metabolic modulation	Lee218; Shi2018
	Antidiabetic	Lee2014; Lu2020
	Hepatoprotection	Shi2018; Hou2021
	Antitumor	Marcovici2022
	Probiotic	
	Semiconductor	
	Dyeing	Venil2020; Panzella2018
	Packaging material	Lopuswicz2021
	Bioremediation	
	Drug delivery	Xuzubbo2021; Wang2020

Correspondents

No man is an island, so I'm grateful or eager to communicate with these experts, suppliers and landowners. Remaining confident University and familial contacts in America and Europe could facilitate thorough specimen and/or data analysis.

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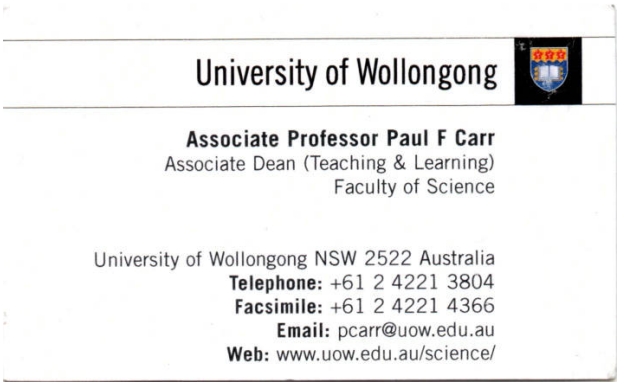
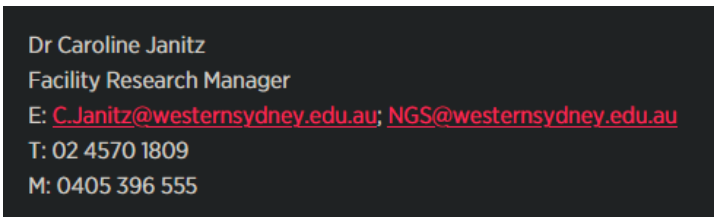
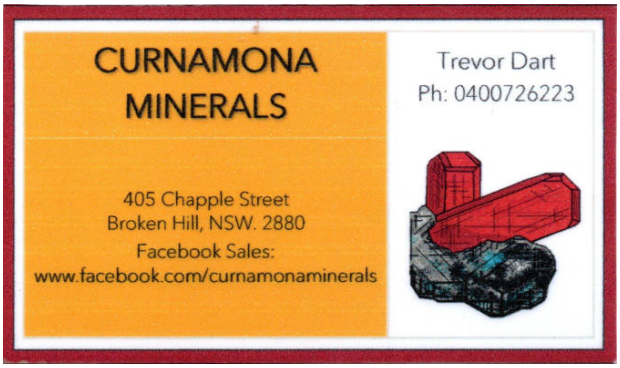
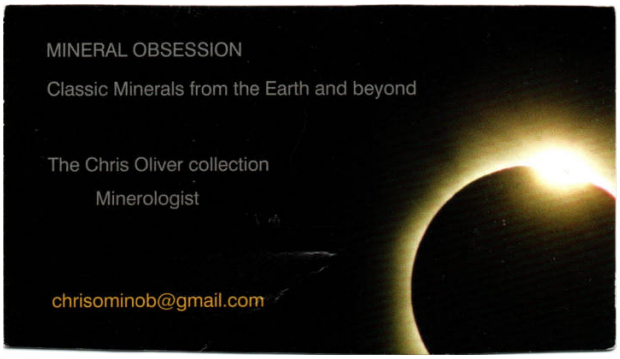








The Journey Google Earth directions:

from: [redacted] to: The Australian National University, Peter Baume Building, 42 Linnaeus Way, Acton ACT 2601

from: The Australian National University, Peter Baume Building, 42 Linnaeus Way, Acton ACT 2601 to: 13 Olive Rd, Devon Meadows VIC 3977

from: 13 Olive Rd, Devon Meadows VIC 3977 to: Woodend VIC 3442

from: Woodend VIC 3442 to: Lake Tyrrell VIC 3533

from: Lake Tyrrell VIC 3533 to: -34.717078,139.033300

from: -34.717078,139.033300 to: -34.616667,139.066667

from: -34.616667,139.066667 to: Adelaide SA

from: Moonaree SA 5717 to: Maralinga SA 5690

Fig 8-9. Plinth details and waste burial illustrations

LOCATION	BURIAL TRENCH	ID No.	BURIAL DATE	TRENCH CO-ORDINATES/DESCRIPTION
TARANAKI	CONTAMINATED SOIL	C1	1996-97	1. 750 132 E 6689 802 N 2. 750 134 E 6689 644 N 3. 750 360 E 6689 804 N 4. 750 355 E 6689 645 N
TARANAKI	ISV	C5	1997-99	1. 750 266 E 6689 621 N 2. 750 265 E 6689 561 N 3. 750 442 E 6689 605 N 4. 750 433 E 6689 563 N
TARANAKI	CONTAMINATED DEBRIS	C9	1999	1. 749 868 E 6690 398 N 2. 749 863 E 6690 338 N 3. 749 903 E 6690 395 N 4. 749 898 E 6690 335 N
WEWAK	CONTAMINATED SOIL	C13	1997	1. 761 633 E 6682 761 N 2. 761 699 E 6682 663 N 3. 761 707 E 6682 813 N 4. 761 775 E 6682 718 N
TM 100/101	CONTAMINATED SOIL	C17	1997	1. 767 895 E 6679 249 N 2. 767 932 E 6679 123 N 3. 767 981 E 6679 276 N 4. 768 024 E 6679 149 N
MARCOO	N/a	C21	1967	ON 4th OCTOBER 1956 A 1.5 KILOTON NUCLEAR DEVICE WAS EXPLODED ON THE GROUND AT THIS SITE LEAVING A CRATER 40 METRES DEEP WHICH WAS BACKFILLED DURING OPERATION BRUMBY IN 1967.

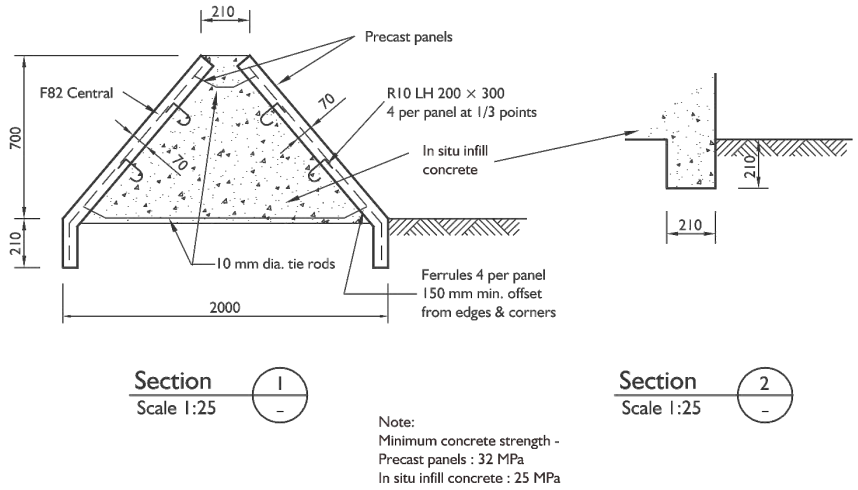
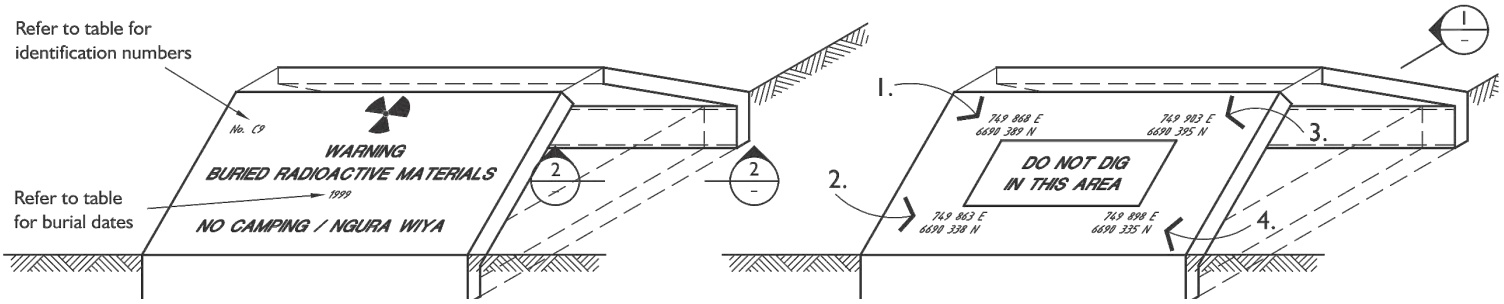


Figure 6.8 Design of trench warning plinth.



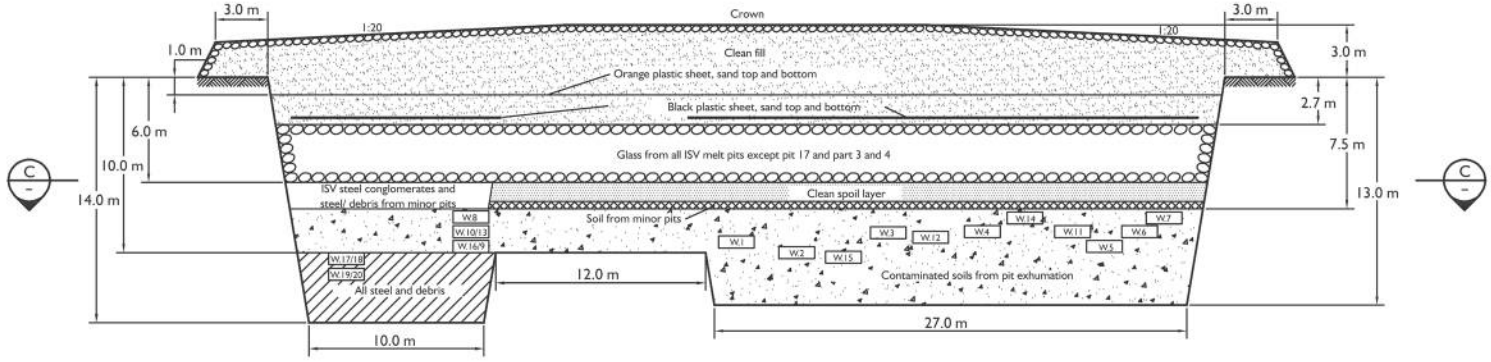
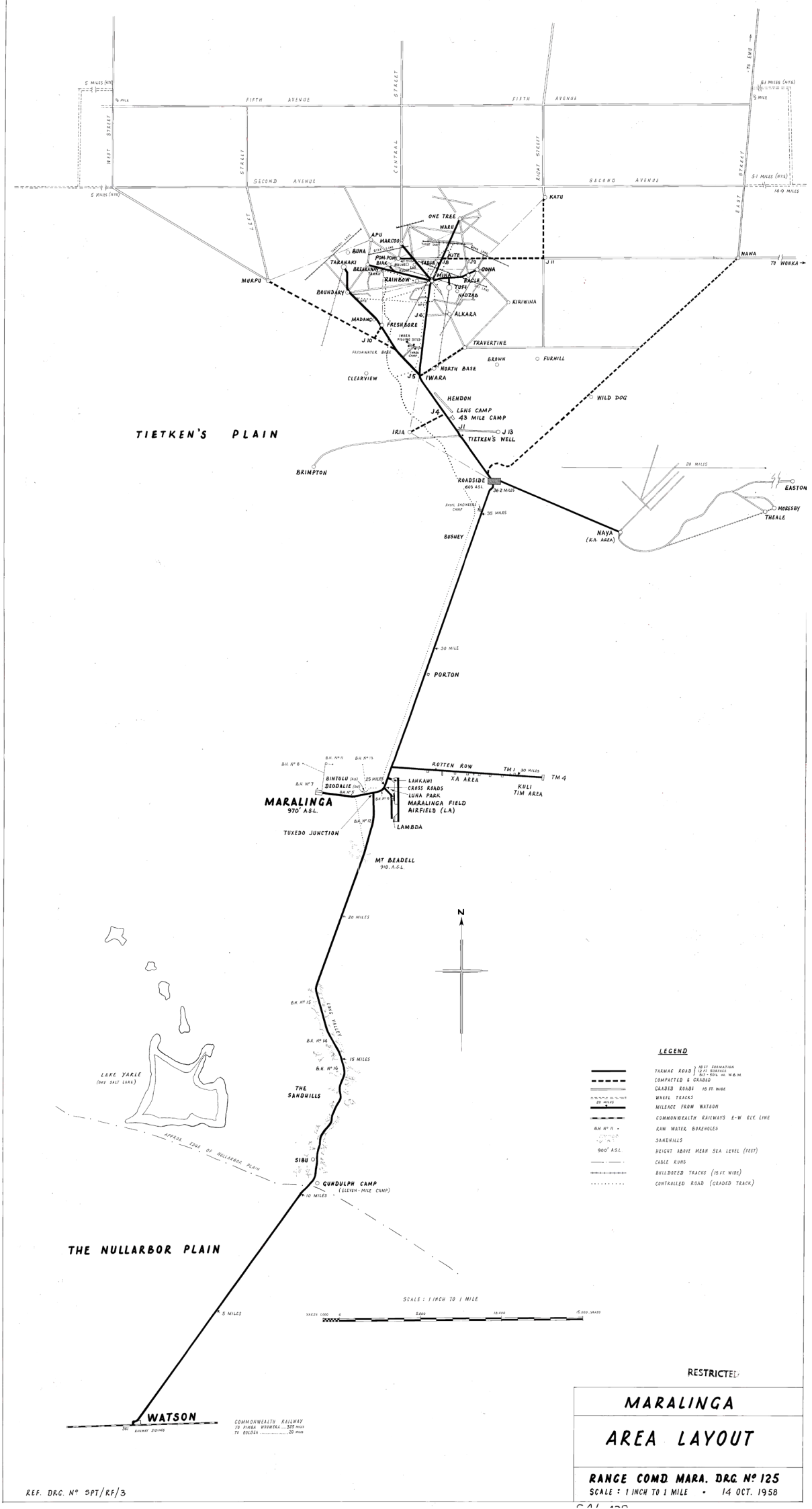


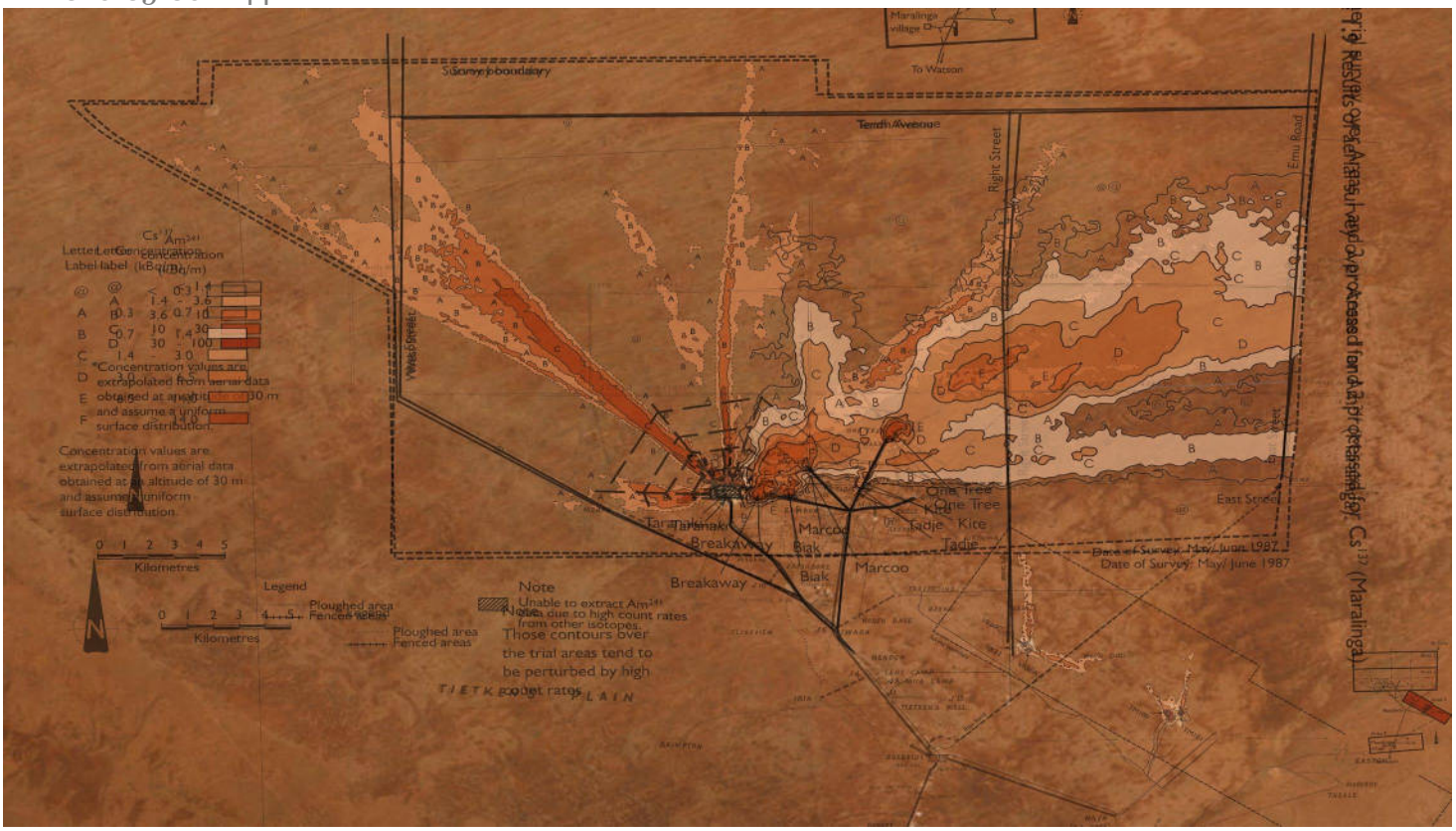
Figure 4.21 Long section of debris burial trench.

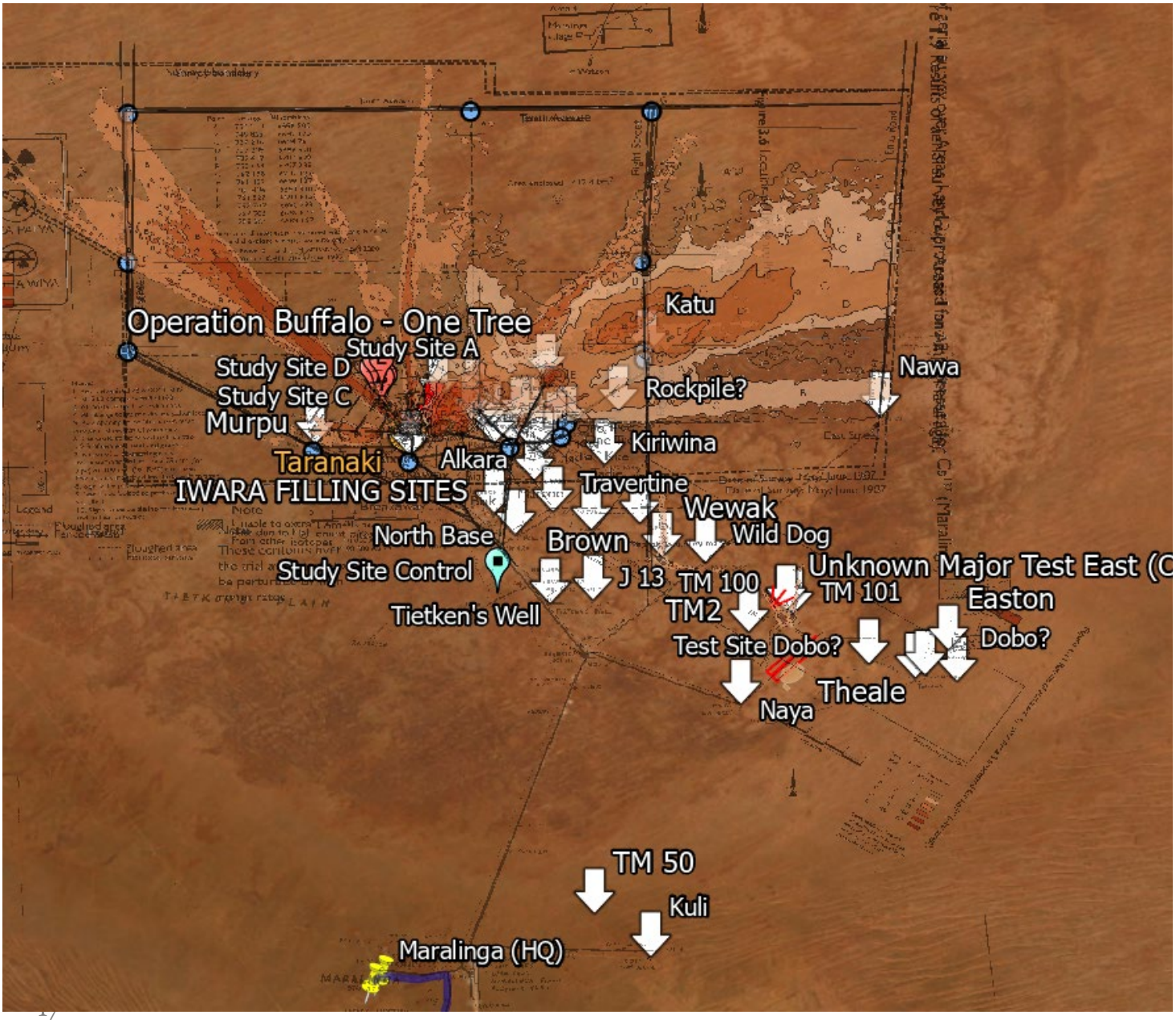
SOURCE: GHD DRAWING 231/400140/04
martoo19.dwg

Fig 10-13. The following are partially declassified maps of Maralinga from the Royal Australian Archives and other maps superimposed upon satellite imagery that I failed to dramatically improve the clarity of.

The last are my current trip plans, the long coastal drive.




Survey boundary
Tenth Avenue
Right Street
Emu Road
East Street
One Tree
Kite
Jadje
Marcoo
Biak
Breakaway
Taranaki
Date of Survey: May/ June 1987
Kilometres
Legend
Ploughed area
Fenced areas
Note
Those contours over the trial areas tend to be perturbed by high


Operation Buffalo - One Tree
Study Site A
Study Site D
Study Site C
Murpu
Taranaki
Alkara
IWARA FILLING SITES
Katu
Rockpile?
Nawa
Kiriwina
Travertine
Wewak
Wild Dog
North Base
Brown
Study Site Control
Tietken's Well
J 13
TM 100
TM 101
TM2
Unknown Major Test East (C
Easton
Dobo?
Test Site Dobo?
Theale
Naya
TM 50
Kuli
Maralinga (HQ)

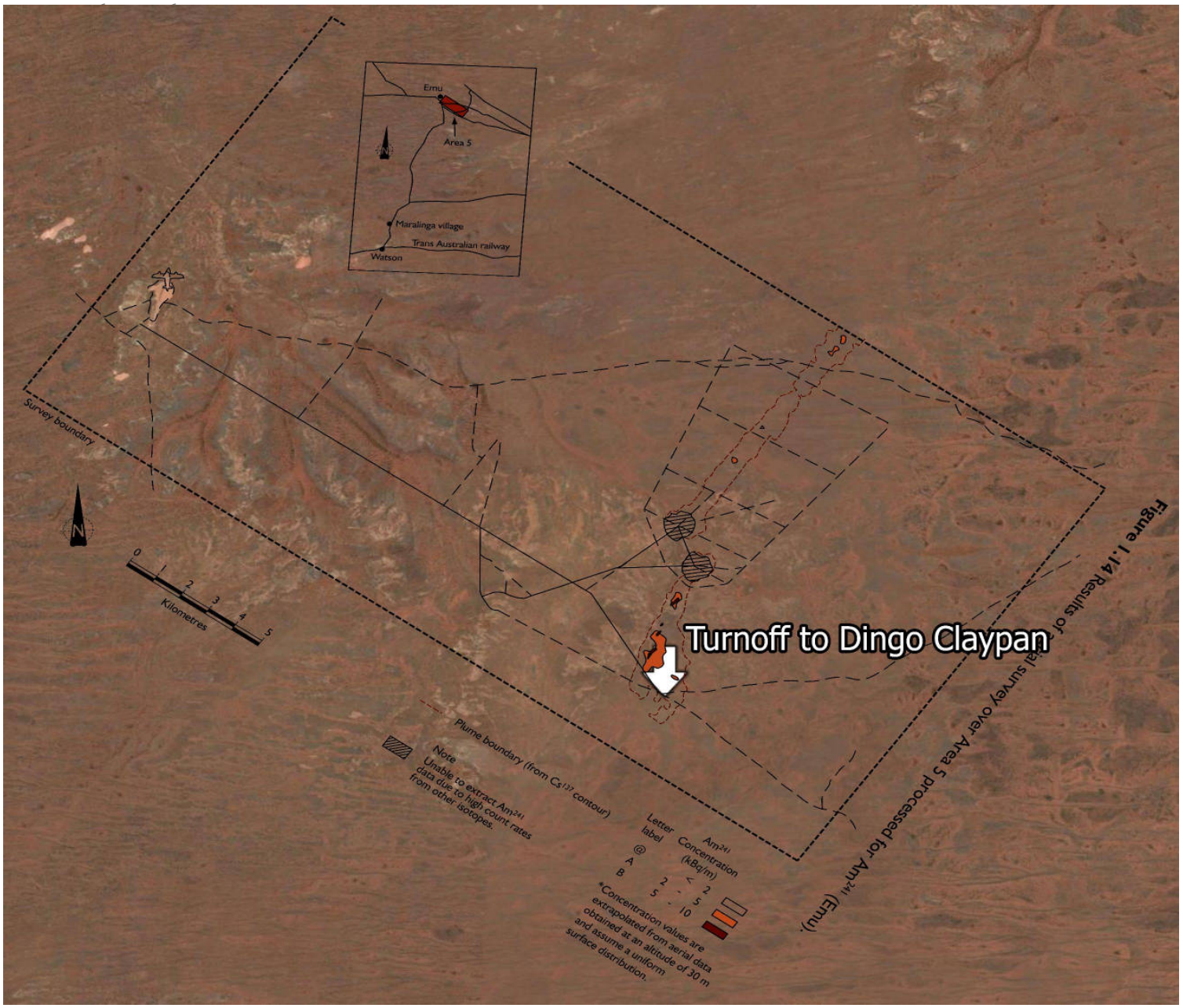


Figure 1.14 Results of aerial survey over Area 5 processed for Am^{241} (Emu).

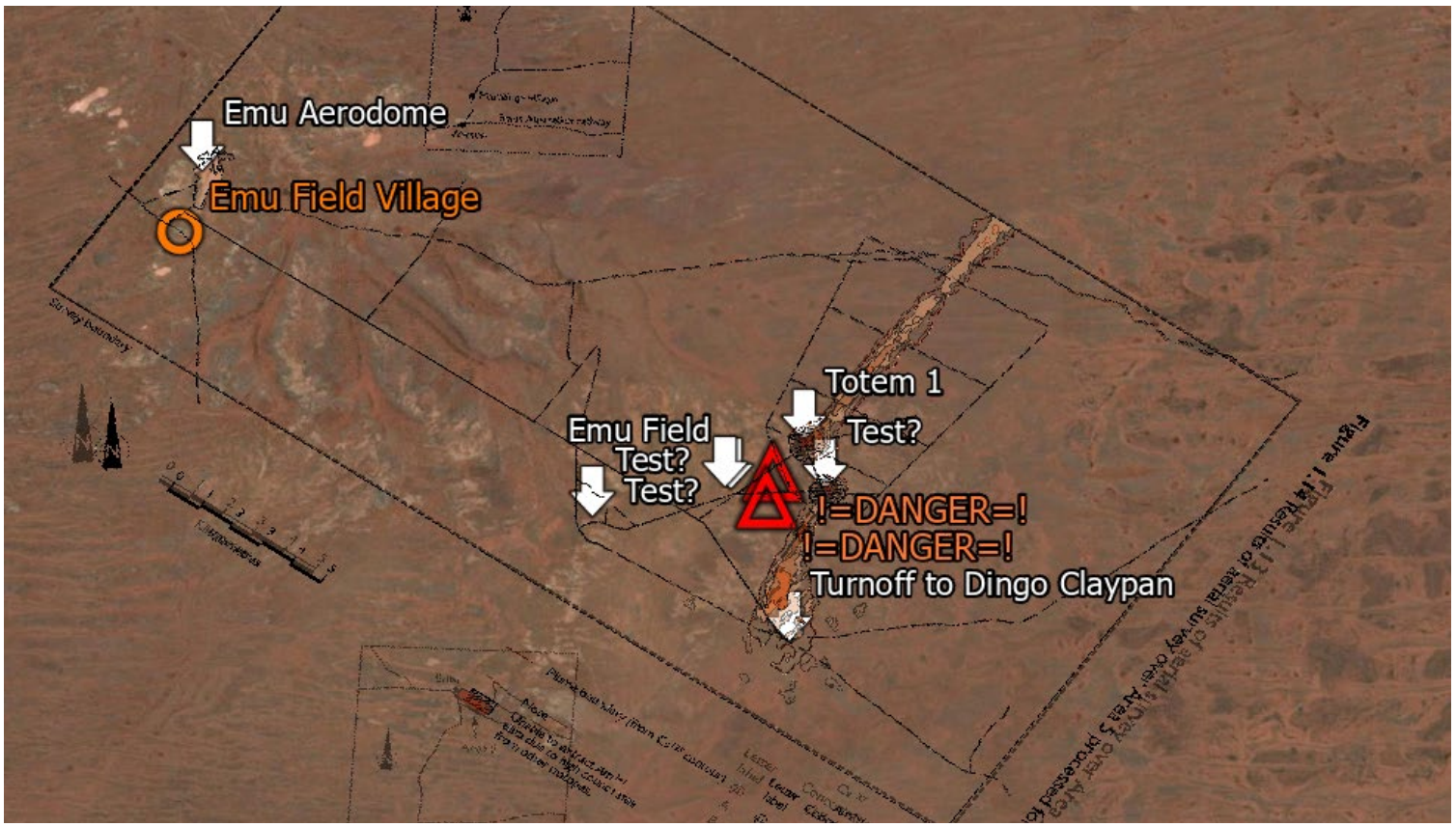
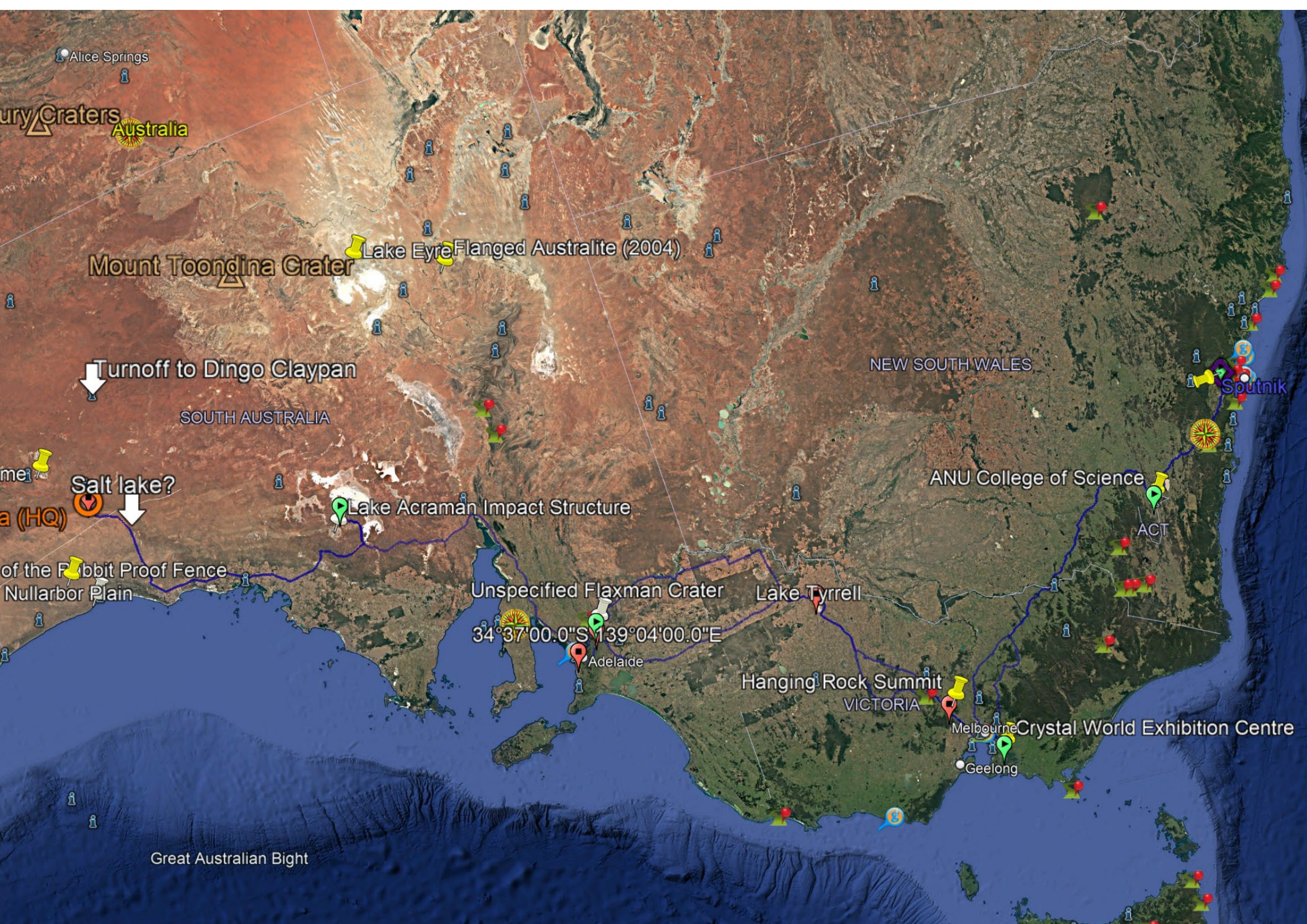


Figure 1.14 Results of aerial survey over Area 5 processed for


Alice Springs
Australia
Lake Eyre
Flanged Australite (2004)
Mount Toondina Crater
Turnoff to Dingo Claypan
SOUTH AUSTRALIA
NEW SOUTH WALES
Sputnik
Salt lake?
Lake Acraman Impact Structure
ANU College of Science
ACT
Nullarbor Plain
Unspecified Flaxman Crater
Lake Tyrrell
34°37'00.0"S 139°04'00.0"E
Adelaide
Hanging Rock Summit
VICTORIA
Melbourne
Crystal World Exhibition Centre
Geelong
Great Australian Bight

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