AUDALIA RESOURCES LIMITED

MEDCALF PROJECT

GEOMORPHOLOGY OF THE MARIANTHUS AQUILONARIS SUB-POPULATIONS

BREMER RANGE

WEST AUSTRALIA

Prepared by:

Word Technical Services Group Pty Limited

December 2019

About the Authors

Brent Butler (Managing Director of World Technical Services Group Pty Ltd)

Mr. Butler is a geologist who brings over 30 years of international industry experience in exploration, resource modelling and mining. He actively engages in property acquisitions, development and divestment and has been involved in several mine developments, both open cut and underground mines.

Mr. Butler has served on several Boards of listed companies in Canada and Australia. Recent roles include having worked for Kinross Gold Corporation for 8 years in Canada, USA, Brazil, Chile and Africa. Mr. Butler formed his consultancy Company during 2016 and currently serves as a President, CEO and Director of TSX-Power Metals Corp and TSX-listed Superior Mining International Corp. and CEO and Executive Director of ASX-listed Audalia Resources Limited.

Mr. Butler holds a Bachelor of Science degree from the Otago University of Dunedin, New Zealand (1983) and is Fellow Member of the Australasian Mining and Metallurgy (AusImm) and Member of the Prospectors and Developers Association of Canada, and is a Fellow Member of the Society of Economic Geology (SEG) USA and the Geological Society of London (FGS).

Terry Taylor (now retired)

Mr. Taylor is a geologist who brings over 40 years geological mapping, prospecting and associated drilling programs over greenfield and brownfield areas

Mr Taylor was employed for 30 years with Carpentaria Exploration / MIM Exploration and then since has contracted for Lynas Gold, Titan Resources, Red Back Mining, Cullen Resources, MIM Exploration, Gullewa Gold, Kinross Gold Australia, Sipa Resources, ATW Gold, Thundelara and Audalia Resources.

Mr Taylor has mapped in Western Australia's Yilgarn Craton, Pilbara Craton and Proterozoic basins, Queensland's Mt Isa Inlier and Townsville hinterland and Northern Territories Pine Creek Geosyncline.

Mr Taylor was the Audalia consulting Geologist from 2011 to 2018 and has extensively mapped Mining lease M63/656. He has also mapped the regional areas of Exploration licences E63/1133 and E63/1134 to the east of M63/656.

Mr Taylor holds Master of Science from the University of Western Australia (1984), A Bachelor of Science from Melbourne University (1984) and Diploma of Civil Engineering, Swinburne Technical College, Melbourne (1962).

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1. INTRODUCTION

World Technical Services Group Pty Ltd (WTSG) was commissioned by Audalia Resources Limited (proponent) to complete a baseline Geomorphology Report for their Medcalf vanadium titanium and iron project located in the Lake Johnson area of West Australia.

A Threatened species listed under Part 2 of the *Biodiversity Conservation Act 2016* (*Marianthus aquilonaris*) has been identified in the project area. Ecological assessments of the mine site have identified four sub-populations (1a – 1d) with the project area located on M63/656.

Marianthus aquilonaris was first found in the Bremer Range, Lake Johnson by Gilbert and Tobin during 1960's.

Marianthus aquilonaris is described as an erect, straggly shrub to 1.6 m high with hairy stems, alternate, elliptic to oblong leaves, a glabrous calyx and a pale blue and white corolla. Flowers appear between September and October (Figure 1).

This report forms part of the Audalia Public Environmental Review Document that will be submitted to the Environmental Protection Authority (EPA) to seek environmental approvals for the project.

Figure 1: Image of *Marianthus aquilonaris* (T)

2. LOCATION

The Medcalf Project is located 470km east of Perth, West Australia (Figure 2). Access to the project is via the Coolgardie Esperance Highway some 54km south of Norseman via a 4m wide access track. The project is reached after travelling west 83.6km along this track (Figure 3).

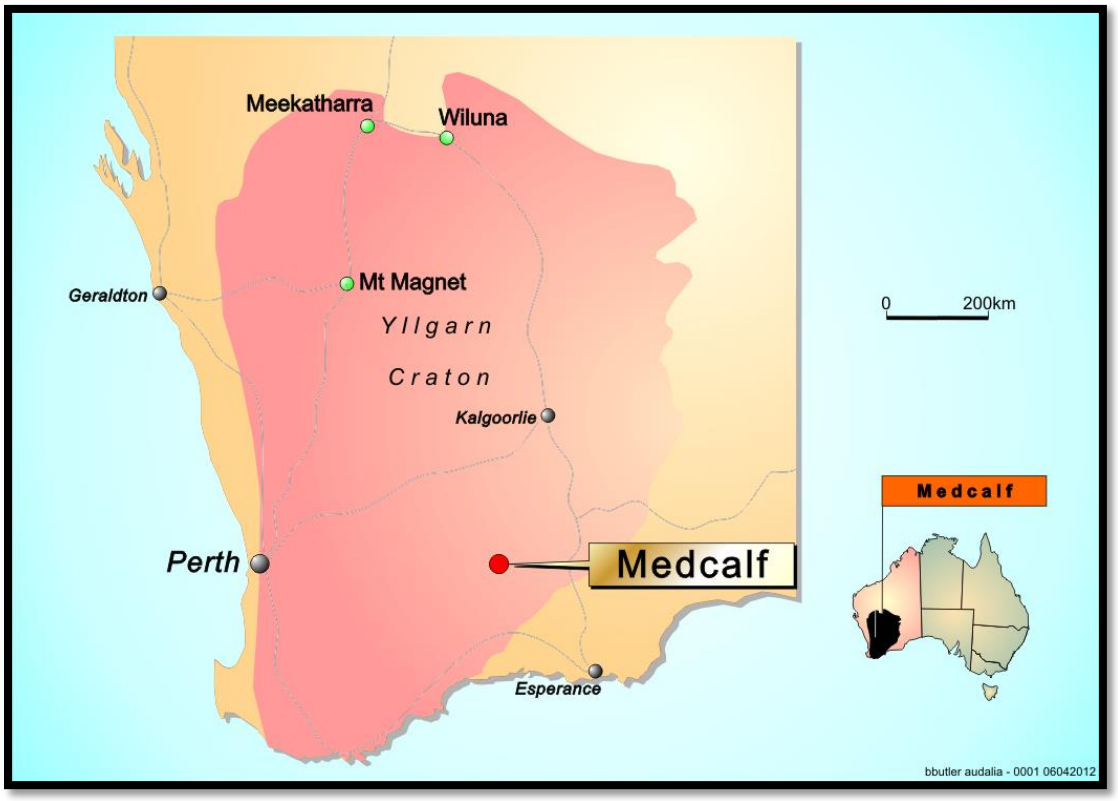

Figure 2 – Regional Location Map

3. PROJECT LOCATION AND PROPOSAL DESCRIPTION

The proposed mining Project lies within granted Mining Lease M63/656 located approximately 100 kilometres southwest of the township of Norseman, West Australia (Figure 3).

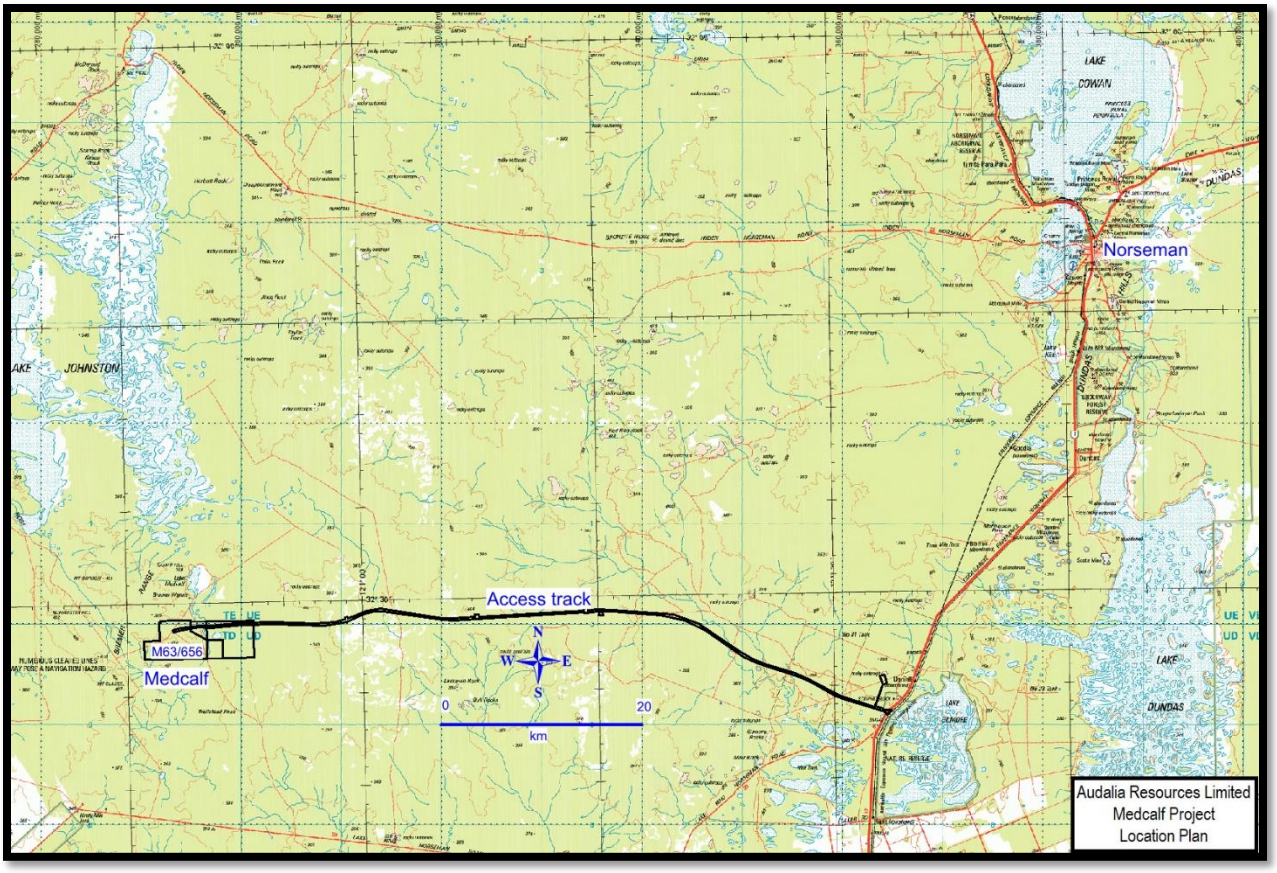

Figure 3 – Project Location Map

The Medcalf Project is in an arid area with low, variable rainfall and high evaporation. Average annual rainfall is approximately 360 mm/year. Evaporation exceeds rainfall in every month of the year. Rainfall occurs all year round, but more rain tends to be received during winter (May to September). Large events tend to occur in summer, mainly from January to March.

The area is prone to bush fires of which there have been 12 since 1991. The project area was completely burnt out during 2010 and the most recent fire this year (2019) was 4km west of the project and burnt over a distance of 60km north and south of the project (Figure 4).

Marianthus aquilonaris experienced a mass germination event after the 2010 fires. *Marianthus aquilonaris* could be a nursing plant for soil conditioning and appears to excel after major fire events with the competition wiped out for several years.

As years go by post-fire, and more plants begin to grow in the area, the *Marianthus aquilonaris* becomes challenged with competing plants (Figures 5 and 6).

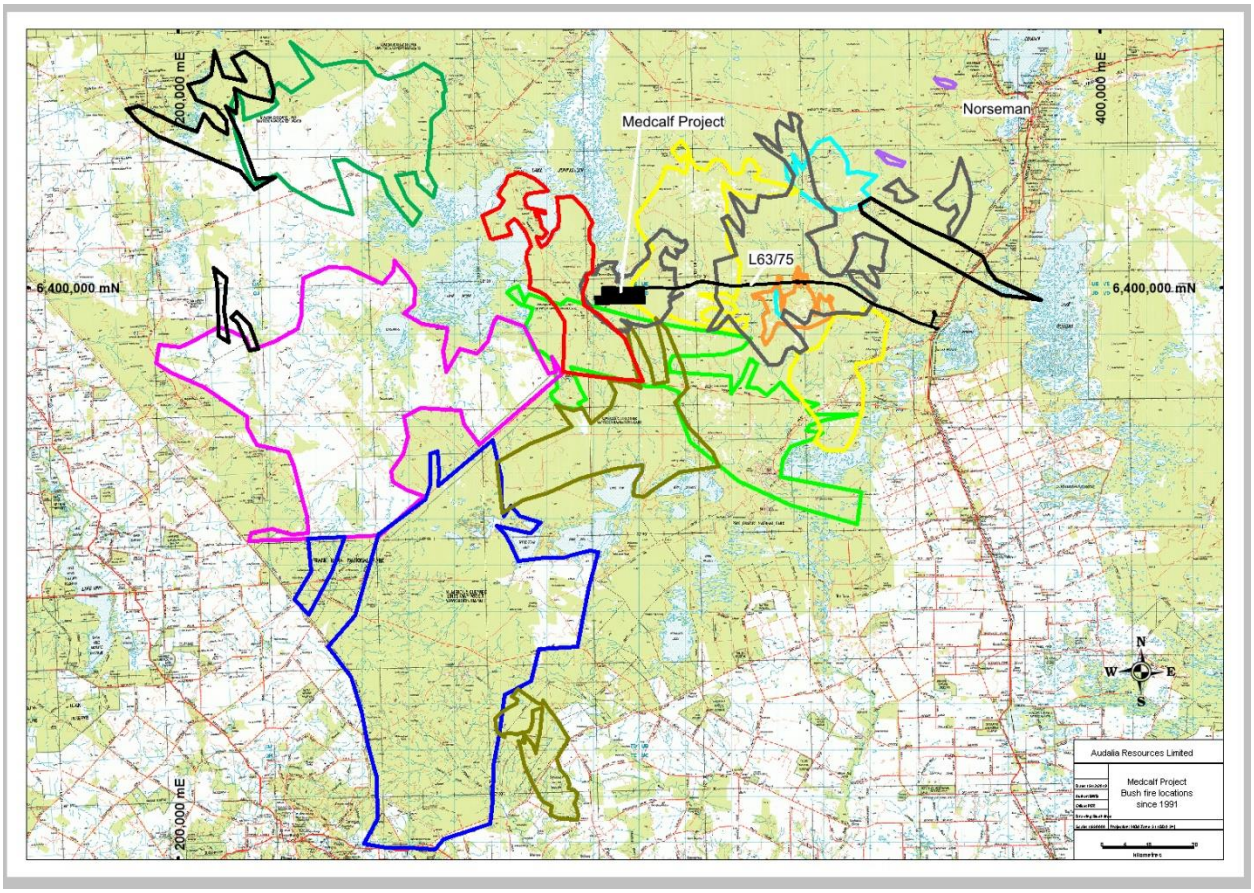

Figure 4 – Bush fires since 1991

Figure 5 – Competing plants

Figure 6 – Competing plants

The Proponent has completed their Prefeasibility Study in 2016 and have since completed additional drilling, metallurgy, flora and fauna and hydrological studies along with a mining study.

From this study, the mining proposal is to mine at a rate of 1.5Mtpa from 3 pits Vesuvius, Fuji and Egmont open cut down to a maximum depth of 50m over a mine life of 13 years (Figure 7).

Figure 7 – Proposed minesite layout

4. TOPOGRAPHY

The Medcalf Project takes its name from Lake Medcalf located 7 kilometres northeast of the mine (Figure 8). Medcalf lies within the undulating hills of the Bremer Range with Mt Gordon being the tallest elevation of 451m. The general elevation in the area is approximately 350m.

The Medcalf Project has three deposit that lie in an east west direction being Egmont, Vesuvius and Fuji all above 400m elevation with the tallest being Vesuvius peaking at

436m (Figure 9). Drainage is internal with widely spaced ephemeral watercourse draining into the playa lakes Lake Hope and Johnson to the north.

Runoff is high from the hilly areas due to the presence of exposed rocky and shallow rocky soil, with shallow sheet flow occurring from relatively small rainfall events. This sheet flow could transport loose Marianthus seeds on the ground surface downslope. Much of this runoff would infiltrate in the deeper soils downslope (Groundwater Resource Management, 2019).

This would be consistent with the mapped plant locations appearing to extend from the catchment divide downstream. Only in larger rainfall events, often during wetter periods, does runoff reach the catchment outlets via the drainage lines.

Regional groundwater level in the area is typically greater than 45 m below surface and the groundwater is hypersaline. Consequently, the *Marianthus aquilonaris* plants are unlikely to have direct interaction with the regional groundwater table (Groundwater Resource Management, 2019).

The *Marianthus aquilonaris* plants appear to have a correlation to geological structures, which indicates that the plants potentially take advantage of the aquifer recharge process, capturing persistent soil moisture from within weathered and/or fractured bedrock.

Figure 8 – Regional map showing location of the *Marianthus aquilonaris* sub-populations

A total of four *Marianthus aquilonaris* sub-populations (Fig 7 & 9: pop 1a-e) are located on the northern slope of Vesuvius (436mRL) over a NE-SW distance of 1.4km. The elevation of these sub-populations is listed in Table 1 below and are shown in Figure 9.

Population	Elevation (m)	Distance between pop.
1a	385	a to b 640m
1b	400	b to c 320m
1c	410	c to d 515m
1d	405	d to e 225m

Table 1 – *Marianthus aquilonaris* sub-population elevations

Figure 9 – Elevations of *Marianthus aquilonaris* sub-populations

5. GEOLOGY

5.1. Regional Geology

The Medcalf deposit is located in the Archaean Aged Lake Johnson Greenstone Belt in the southern portion of the Youanmi Terrane, part of the Yilgarn Craton (Figure 10).

This belt is a narrow north-northwest trending belt, approximately 110 km in length. It is located near the south margin of the Yilgarn Craton, midway between the southern ends of Norseman-Wiluna and the Forrestania-Southern Cross Greenstone Belts.

The eastern and northern limits of the Lake Johnston Greenstone Belt are defined by the large northwest-trending Koolyanobbing Shear Zone. To the west, the Greenstones are bound by Grantoids and Gneissic rocks which extend some 70 km west to the Forrestania-Southern Cross Greenstone Belts. To the south, the Greenstones appear to pinch out in Granites.

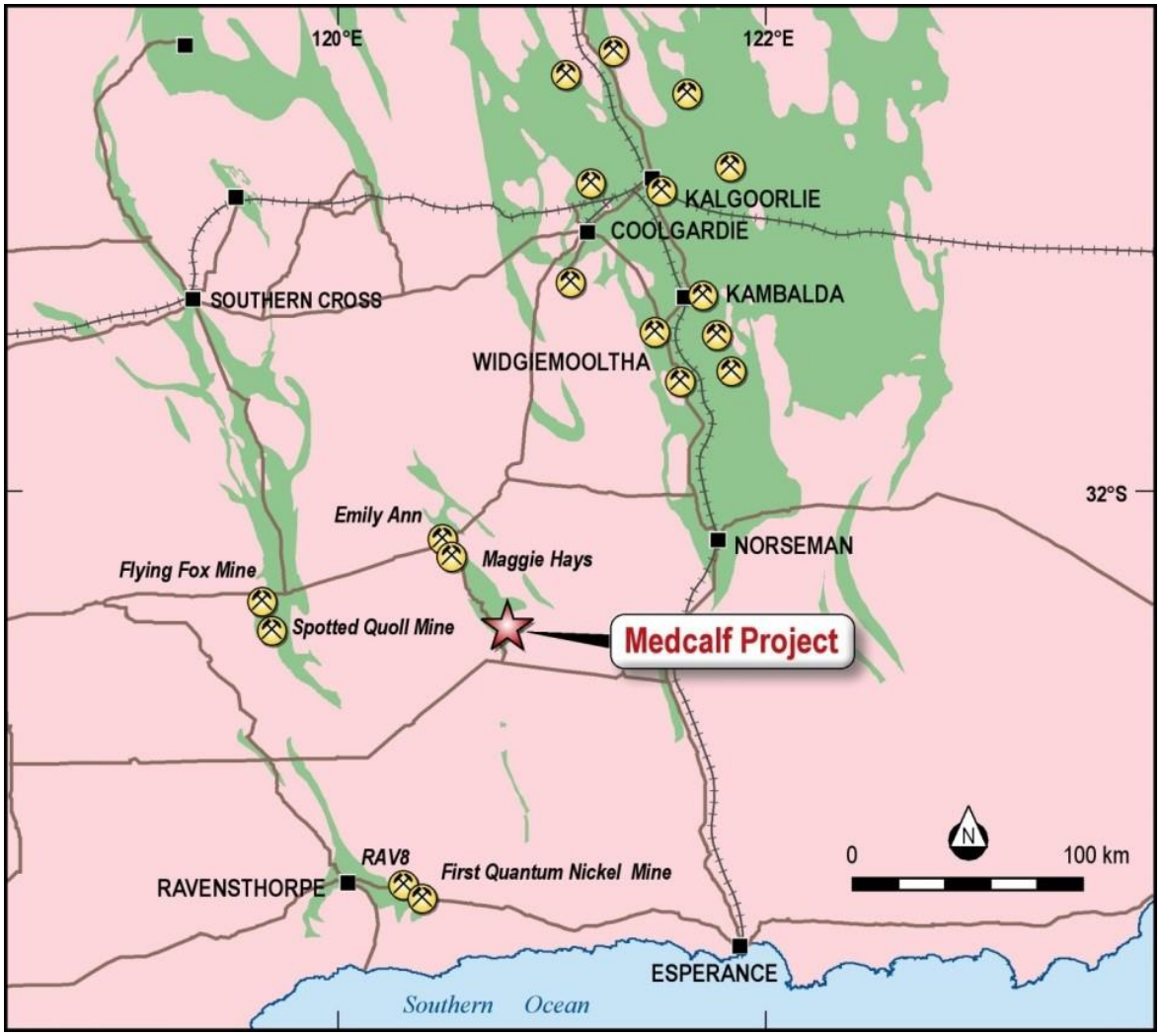

Figure 10 – Lake Johnson Greenstone belt

5.2. Local Geology

The Medcalf Project lies within the Medcalf layered sill, which is a flat lying igneous body up to 150m thick which has intruded parallel to the enclosing volcanic strata basalt, prior to regional metamorphism (Figure 11). It is a layered basic sill of the gravity differentiated type.

Figure 11 – Geological plan showing *Marianthus aquilonaris* ~~locations~~ sub-populations on M63/656 and favourable soil boundaries

The sill is comprised of an upper gabbroic zone, a middle pyroxenite zone, with a lower amphibolite zone in the footwall. Three separate zones of vanadium & titanium mineralisation have been identified within the project area and named the Vesuvius, Fiji and Egmont prospects.

In the Medcalf deposit vanadium, titanium and iron have been concentrated in a pyroxenite unit, which has subsequently been enriched in these metals through weathering and regolith formation.

In the mineralised area, the magnetite-rich sequence is deeply weathered, with +60m of saprolite showing vertical zonation of weathering minerals due to progressive weathering.

The fully developed lateritic weathering profile is divisible into four zones. Starting from the top, they are lateritic residuum, mottled zone (habitat for *Marianthus aquilonaris*), saprolite and saprock. All the vanadium, titanium and iron mineralisation lies within the saprolitic zone.

5.2.1. Stratigraphic Column

The stratigraphic column for the Medcalf sill is shown below in Table 2.

Medcalf Stratigraphic Column			
	Colour	**Rock type**	**Thickness**
		Basalt	na
Medcalf Sill		Gabbro	~50m
		Pyroxenite	~50m
		Ultramafic	~50m

Table 2 – Stratigraphic column of Medcalf sill

5.2.2. Geological cross section

The Vesuvius cross section show that the favourable environment for the Marianthus to thrive is with the in the mottled zone over the weathered basalt on the northern slope for maximum sun.

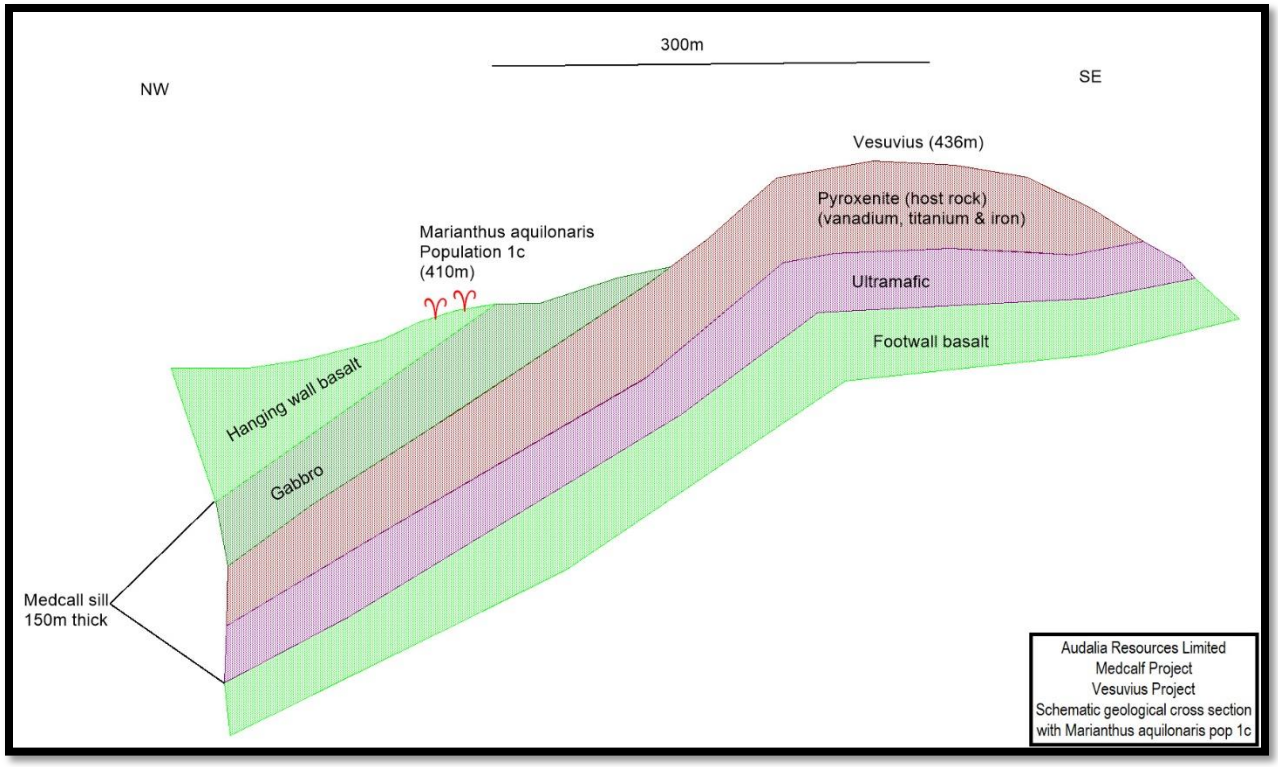

Figure 12 – Vesuvius schematic geological cross section

6. MARIANTHUS GEOLOGY AND SOIL TYPE

All four *Marianthus aquilonaris* sub-populations (1a-d) grow in the same rock type. (Figure 11) Originally the rock type was basalt which is now heavily weathered to a state of residual iron rich rock (Figures 13 – 16).

The soil type is described by Western Horticultural Consulting (2019) who inspected and sampled all four *Marianthus aquilonaris* sub-populations on M63/656, as shallow gravels over indurated mottled zone. The mottled zone in these soils (see soil boundaries in Figure 11) has been hardened by the addition of iron and it is known as limonite.

Limonite is an iron ore consisting of a mixture of hydrated iron (III) oxide-hydroxides. Between 70 and 90 % of the soil surface is covered with a scree of dark lateritic gravels and fragments of limonite rock. Limonite outcrops are common and in areas may compose up to 50 % of the soils surface.

The topsoil is generally about 10 to 15 cm thick and is a dark reddish-brown sandy loam. Topsoils and subsoils are generally acidic, with a pH(water) between 4.5 and 7. The salinity of this soil is generally low.

6.1. POPULATION 1d

7. Population 1d (Figure 13) is the most western population on M63/656 and is the furthest away from the populations (Table 1).

Figure 13 – Population 1d [redacted]

The plant is growing within the fractures of the mottled rock. There is a thin layer of transported spoil over the area.

7.1. POPULATION 1c

This population (Figure 14) lies within the western edge of the Vesuvius mineralised footprint. This is a northern facing slope and the plant grows in the mottled zone with minor transported soil.

Figure 14 - Population 1c [redacted]

7.2. POPULATION 1b

This population (Figure 15) lies within the northern edge of the Vesuvius mineralised footprint. This is a northern face slope and the plant grows in the fractures of the mottled zone and downstream in a historic costean where a family now occurs, mature to juvenile.

Figure 15 - Population 1b [redacted]

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7.3. POPULATION 1a

This population lies outside the northern edge of the Vesuvius mineralised footprint. This is a northern face slope and the plant grows in the fractures of the mottled zone (Figure 16).

Figure 16 - Population 1a [redacted]

8. CONCLUSIONS

It is very evident from the geological mapping, flora, fauna, micro hydrology and soil surveys that the *Marianthus aquilonaris* plants require the following conditions for its survival:

- Appropriate fire events;
- Open space;
- Shallow gravels over limonitic mottled zone;
- Acidic soils;
- Low salinity soils;
- Structural settings;
- Fractures to grow in;
- Presence of *Eucalyptus livida* to support pollination (refer to Pollinator study prepared by Kit Prenergast);
- Full sun (north facing slopes);
- Elevation between 380m-425m;
- Rain events for survival.

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