GABANINTHA VANADIUM PROJECT

EP Act s38 Referral: Supporting Information

Part B: Appendices

REV C

INTEGRATE SUSTAINABILITY PTY LTD

Appendices

APPENDIX A – THIRD PARTY AUTHORISATION

APPENDIX A-1: Relationship between Technology Metals Australia Limited and The KOP Ventures Pty Ltd

TECHNOLOGY METALS AUSTRALIA LIMITED

Annual Financial Report

30 June 2017

ASX : TMT

Suite 9, 330 Churchill Avenue, Subiaco WA 6008 I PO Box 866, Subiaco WA 6904 P - 61 8 6489 1600 I F - 61 8 6489 1601 I ABN 64 612 531 389

CORPORATE INFORMATION

ABN 64 612 531 389

Directors
Mr Michael Fry (Non-executive Chairman)
Mr Ian Prentice (Executive Director)
Mr Sonu Cheema (Non-executive Director)

Company secretary
Mr Sonu Cheema

Registered office
Suite 9, 330 Churchill Avenue
Subiaco, WA 6008

Principal place of business
Suite 9, 330 Churchill Avenue
Subiaco, WA 6008

Share register
Security Transfer Registrars Pty Ltd
770 Canning Highway
Applecross, WA 6153

Solicitors
Eaton Hall, Corporate & Commercial Lawyers
Unit 9, 628-630 Newcastle Street
Leederville, WA 6007

Bankers
National Australia Bank Ltd
1st Floor, 1238, Hay Street
West Perth, WA 6005

Auditors
HLB Mann Judd
Level 4, 130 Stirling Street
Perth, WA 6000

Securities Exchange Listing
Technology Metals Australia Limited shares are listed on the Australian Securities Exchange (ASX: TMT)

DIRECTORS' REPORT

The directors of Technology Metals Australia Limited (**ASX: TMT)** (**Company** or **Technology Metals**) submit herewith the annual report of the Company and the entities it controlled during the period ("the Group") for the period from incorporation on 20 May 2016 to 30 June 2017. In order to comply with the provisions of the Corporations Act 2001, the Directors report as follows:

Directors
The names of Directors who held office during or since the end of the period and until the date of this report are as follows. Directors were in office for this entire period unless otherwise stated.

Mr Michael Fry
Non-Executive Chairman
Appointed 20 May 2016

Mr Fry holds a Bachelor of Commerce degree from the University of Western Australia, is a Fellow of the Financial Services Institute of Australasia, and is a past member of the Australian Stock Exchange. Mr Fry has extensive corporate and commercial experience, financial and capital market knowledge and a background in corporate treasury management.

Mr Fry is currently Non-Executive Chairman of ASX listed Brookside Energy Limited with a focus on oil and gas exploration and production onshore mid-continent region of USA; Non-Executive Chairman of Challenger Energy Limited that is focusing on oil and gas exploration opportunities in South Africa and Non-Executive Chairman of ASX listed Norwest Energy NL that has assets in Australia and the United Kingdom with an operational focus on the northern Perth Basin.

In the 3 years immediately before the end of the financial year, Mr Fry also served as a Director of the following listed companies:
Brookside Energy Limited (Current)
Challenger Energy Limited (Current)
Norwest Energy NL (Current)

Mr Ian Prentice
Executive Director
Appointed 20 May 2016

Mr Prentice has extensive global resource industry and equity capital markets experience, with a proven track record of high quality corporate management and technical excellence. His broad ranging 25 year-plus career extends from exploration and operational roles across a variety of commodities to the listing and management of ASX-listed resource companies. Mr Prentice has served as a Director for a number of ASX-listed resource companies, with activities ranging from exploration and project acquisition in Asia and Africa through to gold production in Australia.

Mr Prentice has broad experience in identifying and reviewing resource projects for potential acquisition. Mr Prentice is a Member of the Australasian Institute of Mining and Metallurgy and holds a Bachelor of Science (Geology) from the University of Western Australia.

In the 3 years immediately before the end of the financial year, Mr Prentice also served as a Director of the following listed companies:
Fraser Range Metals Group Limited (resigned 16 February 2017)
Merah Resources Limited (resigned 30 October 2014)

Mr Sonu Cheema
Non-Executive Director and Company Secretary
Appointed 20 May 2016

Mr Cheema holds the position of Accountant for Cicero Corporate Services Pty Ltd and has over 10 years' experience working with public and private companies in Australia and abroad. Roles and responsibilities held by Mr Cheema include completion and preparation of management and ASX financial reports, investor relations, initial public offer, mergers and acquisitions, management of capital raising activities and auditor liaison. Currently Mr Cheema is also Company Secretary for Corizon Limited (ASX: CIZ), Intiger Group Limited

DIRECTORS' REPORT (continued)

(ASX: IAM) and Yojee Limited (ASX: YOJ). Mr Cheema has completed a Bachelor of Commerce majoring in Accounting at Curtin University and is a member of CPA Australia.

In the 3 years immediately before the end of the financial year, Mr Cheema also served as a Director of the following listed companies:
Initger Group Limited (Resigned 17 August 2016)

Interests in the shares, options and convertible notes of the Company and related bodies corporate
The following relevant interests in shares and options of the Company or a related body corporate were held by the Directors as at the date of this report.

Directors	Fully paid ordinary shares Number	Share options Number	Performance shares Number
Michael Fry	10,000	2,000,000	-
Ian Prentice	175,000	4,000,000	100,000[1]
Sonu Cheema	20,000	250,000	-

[1] Class B Performance shares

Shares under option or issued on exercise of options
At the date of this report, unissued ordinary shares or interests of the Company under option are:

Date options granted	Number of shares under option	Exercise price of option	Expiry date of option
20/12/2016	15,000,000	$0.25	31 December 2019

Details of ordinary shares issued by the Company during or since the end of the financial period as a result of the exercise of an option are:

Number of shares issued	Amount paid for the shares
10,000,000	Fully paid ordinary shares (FPO issued 4 July 2017 on conversion of 10,000,000 Class A Performance Shares. The FPO issued on conversion will be escrowed until 21 December 2018.

Share options granted to Directors and senior management
During and since the financial period, share options were granted to the following key management personnel of the Company and the entities it controlled as part of their remuneration:

Directors and executives	Number of options granted	Number of ordinary shares under option
Michael Fry	2,000,000	2,000,000
Ian Prentice	4,000,000	4,000,000
Sonu Cheema	250,000	250,000

Principal Activities
The principal activities of the entities within the Group during the period following admission to official list on the Australian Securities Exchange (ASX) on 20 December 2016 was mining exploration. The Company's primary purpose is identifying exploration projects in Australia and overseas with the aim of discovering commercially significant mineral deposits. The Company's primary exploration focus is on the Gabanintha Vanadium Project located 40km south east of Meekatharra in the mid-west region of Western Australia with the aim to develop this project to potentially supply high-quality V2O5 flake product to both the steel market and the emerging vanadium redox battery (VRB) market.

DIRECTORS' REPORT (continued)

REVIEW OF OPERATIONS

During the period ending 30 June 2017, Technology Metals Australia Limited (ASX: TMT) ("**Technology Metals**" or the "**Group**") completed the acquisition of The Kop Ventures Pty Ltd, and its wholly owned Gabanintha Vanadium Project, and successfully listed on the Australian Securities Exchange following the raising of $4.0 million (before costs of the offer) from the issue of 20 million shares at $0.20 per ordinary share via an Initial Public Offer. Technology Metals Gabanintha Vanadium Project is located 40km south east of Meekatharra in Western Australia and consists of five granted tenements and one exploration licence application.

SUMMARY

During the period ending 30 June 2017, the Company achieved significant advancement at the Gabanintha Vanadium Project ("**Project**") including a highly detailed airborne magnetic survey, a maiden wide spaced 36-hole, 3,128m Reverse Circulation ("**RC**") drilling program ("**Program**") and the estimation of a maiden Inferred Mineral Resource ("**Resource**"). The results from the RC Program, completed in March 2017, were reported in April 2017[1]. Exceptional widths and grades of vanadium ("**V_2O_5**") mineralisation were returned from the Program.

The data from the Program was used by independent geological consultants CSA Global to generate a maiden Resource estimate, reported in accordance with the JORC Code 2012, for the Northern Block of tenements at the Project[2]. The Resource estimate comfortably exceeded the Company's initial expectations confirming the position of the Project as one of the highest grade vanadium projects in the world.

OUTSTANDING MAIDEN INFERRED RESOURCE ESTIMATE

The maiden Resource estimate, reported in accordance with the JORC Code 2012, was completed by independent geological consultants CSA Global based on data from the Company's 36 hole RC drilling program completed on the Northern Block of tenements at the Project (see Figure 1). The overall Resource estimate contains 62.8Mt at 0.8% V_2O_5 and 9.7% TiO_2 including an outstanding high grade component of 29.5Mt at 1.1% V_2O_5 and 12.6% TiO_2 within the highly continuous and consistently mineralised massive magnetite basal zone within the mineralised layered mafic igneous unit.

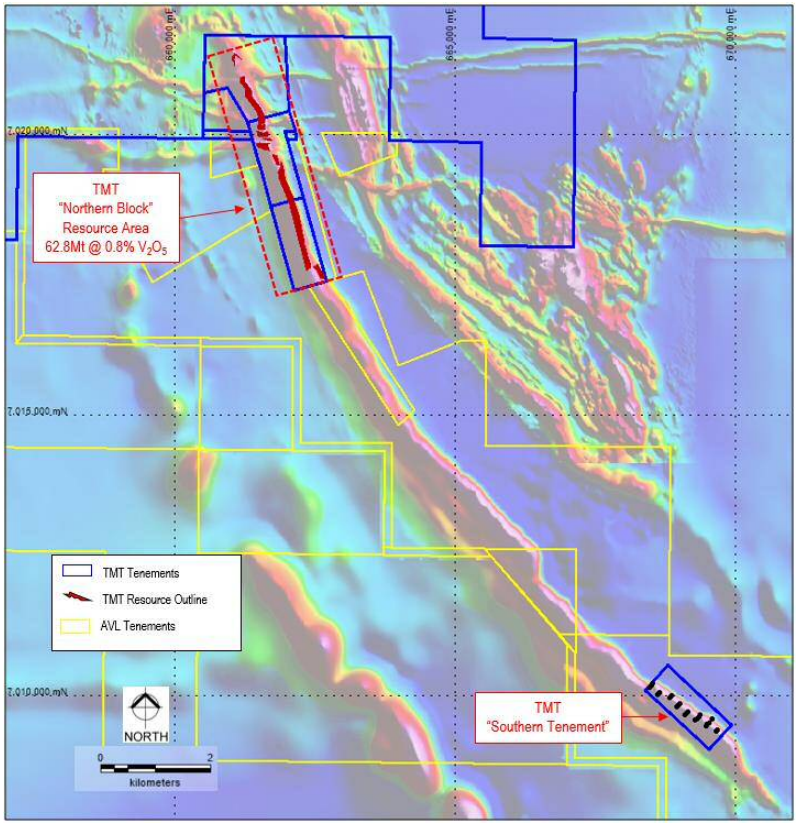

Figure1: TMT Gabanintha Vanadium Project Mineral Resource Layout

APPENDIX A-2: TMT/KOP P51/2930 Tenement Acquisition Paperwork

Purchase of Tenement – The Kop Ventures Pty Ltd

1. Parties	**The Kop Ventures Pty Ltd** (ACN 604 932 676) of Suite 9, 330 Churchill Avenue, Subiaco, Western Australia (**Company**); and **Peter Wiltshire** of 4 Liesham Crescent, Baldivis, Western Australia (**Seller**).
2. Proposed Transaction	By this binding terms sheet (**Terms Sheet**), the Company hereby offers to buy, and the Seller hereby offers to sell, tenement P51/2930 granted under the *Mining Act 1978 (WA)* (**Tenement**) (and associated mining information), free of encumbrances and any other interests of third parties, in exchange for payment of the Purchase Price, in accordance with the terms and conditions of this Terms Sheet (**Proposed Transaction**).
3. Binding Terms Sheet	This Terms Sheet constitutes legal, valid and binding obligations and, subject to any necessary stamping and registration, is enforceable in accordance with its terms.
4. Purchase Price	The Purchase Price shall be:
5. Completion	

Executed by the parties as a deed:

Executed by **The Kop Ventures Pty Ltd (ACN 604 932 676)** in accordance with section 127 of the Corporations Act:)

Director/Company Secretary	Director
Sonu Cheema	Ian Prentice
Name of Director/Company Secretary	Name of Director

Signed by **Peter Wiltshire** in the presence of:)

Signature of Peter Wiltshire	Jason Bennett
	Name of witness
Signature of witness	847 MARMION ST COTTESLOE WA 6011
	Address of witness

APPENDIX B – BASELINE STUDIES

APPENDIX B-1: Integrate Sustainability – Materials Characterisation Pilot Study

APPENDIX B-2: Hydrologia – Preliminary Surface Water Study

APPENDIX B-3: AQ2 – Preliminary Mine Dewatering Assessment

APPENDIX B-4: AQ2 – Preliminary Water Supply Assessment

APPENDIX B-5: Biologic Environmental Survey – Reconnaissance Flora and Vegetation Survey

APPENDIX B-6: Biologic Environmental Survey – Targeted Vertebrate Fauna and SRE Assessment

APPENDIX B-7: Biologic Environmental Survey – Subterranean Fauna Preliminary Report (Phase 1)

APPENDIX B-8: Terra Rosa - An Archaeological and Ethnographic Heritage Survey for the purposes of exploration drilling was completed E51/1510-I, P51/2944, and P51/2943

APPENDIX B-9: Terra Rosa - Report on an archaeological and ethnographic work area clearance survey of the Gabanintha Project Area, with Yugunga-Nya Traditional Owners and prepared for The KOP Ventures Pty Ltd

APPENDIX B-10: Environmental Technologies & Analytics Air Emissions Information for Referral Memorandum

APPENDIX B-11: IBSA Data package (electronic information)

APPENDIX B-1: Integrate Sustainability – Materials Characterisation Pilot Study

Memorandum

To: Ian Prentice – Technology Metals Australia

CC: PFS Project Team

From: Belinda Bastow / Lawson Brandis – Integrate Sustainability

Date: 29/05/2018

Re: Gabanintha Vanadium Project – Material Characterisation Pilot Study

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1. Introduction

A material characterisation pilot study was undertaken as part of the Gabanintha 2018 Prefeasibility Study. The Project team selected nine samples covering the significant material domains within the deposit. This pilot study focused on the identification of material at risk of metal leaching and acid run-off. No assessment has been completed on the occurrence of fibrous mineral, radiation, erosion potential dispersion or salinity.

Table 1 provides a summary of the material type, and geology/compositions of each sample and Appendix 1 provides a detailed breakdown of the samples with sample depth, vanadium grade, minor element composition, material type and geological description.

Table 1: Material Characterisation Samples

Test No.	Sample ID	Hole ID	Material	Geology
1	T23005	GBDD002	Waste OX	Very weathered medium grained dolerite saprolite with very high clay content from replaced (pseudomorphed outlines), kaolin, possible smectite, iron oxide stain after pyroxenes, minor remnant magnetism in magnetite pseudomorphs (now dark oxides), trace g
2	T23543	GBDD007	Clay	White and purple clay and hematite stained weathered dolerite saprolite WEATHERED DOLERITE
	T23544	GBDD007	Clay	White and purple clay and hematite stained weathered dolerite saprolite WEATHERED DOLERITE
3	T23019	GBDD002	Waste TR	Medium grey and orange iron oxide stained in fractures and groundmass replaced by chlorite with weathered crumbly zones and iron oxide in fractures. WEAKLY WEATHERED DOLERITE
4	T23085	GBDD002	Waste FR	White and grey plagioclase rich medium grained dolerite with coarse semi-pervasive silica and patchy chlorite, disseminated magnetite generally 1-3mm, 1% pyrite FRESH SILICIFIED DOLERITE
5	T23183	GBDD001	LG TR	Fine grained magnetite with minor silicate in groundmass and basalt inclusions FRESH FINE MASSIVE MAGNETITE
6	T23064	GBDD002	LG FR	Dark grey medium-coarse dolerite with strongly disseminated and semi-pervasive magnetite (to 50%) with grains often touching and 3-4mm in size. FRESH DOLERITE WITH SEMI-PERVASIVE MAGNETITE
7	T23111	GBDD002	HG FR	Dark grey-black massive magnetite with euhedral possibly separated by fine chlorite and minor <1cm bands of carbonate altered? Basalt. FRESH MASSIVE MAGNETITE
8	Comp 1 N-mags		Tails	Fresh non-magnetic composite
9	Comp 2 N-mags		Tails	Transitional non-magnetic composite

Samples were prepared and submitted to ALS Environmental for the following analysis:

- pH (soils)
- Electrical Conductivity @25°
- NAG (pH 4.5)
- NAG (pH 7.0)
- ANC as H_2SO_4
- Moisture (Dried @ 105-110°C)
- Sulfur - Total as S (LECO)
- Heavy Metals - Total Metals by ICP-AES (Ca, Cr, Co, Mo, As, Pb, Se)

1.1. Acid Base Accounting

The pilot material characterisation assessment of samples from Gabanintha involved a series of static laboratory tests to evaluate the balance between acid generation processes and acid neutralising processing. The values generated from acid-based accounting include maximum potential acidity (MPA) and the acid neutralising capacity (ANC) and the difference between MPA and ANC to generate net acid producing potential (NAPP).

1.1.1. Acid Neutralising Capacity (ANC)

The acid produced by waste through pyrite oxidation can react with naturally occurring acid neutralising minerals present within a sample. The ANC is a measurement of the inherent buffering capacity of the sample. The sample is reacted with a known volume of acid at a pH of <1 for 1 to 2 hours. The amount of acid neutralised is calculated by titration.

1.1.2. Net Acid Production Potential (NAPP)

NAPP is a theoretical calculation used to indicate if a material has potential to generate acid rock drainage (ARD). It represents the balance between maximum potential acidity (MPA) of a sample and its capacity to neutralise acid (ANC). If the MPA is less than the ANC, then the NAPP is negative, which indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, if the MPA exceeds the ANC, then the NAPP is positive, which indicates that the material may be acid generating.

1.1.3. Maximum Potential Acidity (MPA)

The MPA a sample can generate may be determined from the sample sulphur content. The use of the total sulphur assay to estimate the MPA is a conservative approach because some sulphur may occur in forms other than pyrite. Sulphate-sulphur and native sulphur, for example, are non-acid generating sulphur forms while some sulphur may occur as other metal sulphides (e.g. covellite, chalcocite, sphalerite, galena) may yield less acidity than pyrite when oxidised or, in some cases, may be non-acid generating or acid consuming.

1.2. Trace Metals

Metals in samples are typically screened by comparing them with crustal averages, or against contaminated soil trigger values for environmental protection. The trace metal concentrations in the samples were compared with the average crustal abundance for each element (Bowen, 1979) and ecological investigation level established via the Department of Water and Environmental Regulation (then Department of Environment and Conservation) *Assessment Levels for Soil, Sediment and Water* Contaminated Sites Management Series (2010).

2. Results

This section summarises the laboratory results in terms of their potential to generate acid run-off, leach metals and the material's potential risk to the environment as it contains above ecological investigation levels of key metals. A copy of the laboratory results and associated paperwork are included in Appendix 2.

Laboratory results for pH, total sulphur (S), acid neutralising capacity (ANC), net acid generation (NAG) pH, net acid producing potential (NAPP) and NAG (pH 4.5 and pH 7) classification are presented in Table 2.

The ANC of the waste samples ranged from <0.5 to 43.4 kg H_2SO_4/t. Four NAPP results were negative, and five samples were positive, with a range of -15.3 to 17.4 (Table 2).

Table 2: Acid Base Accounting Results

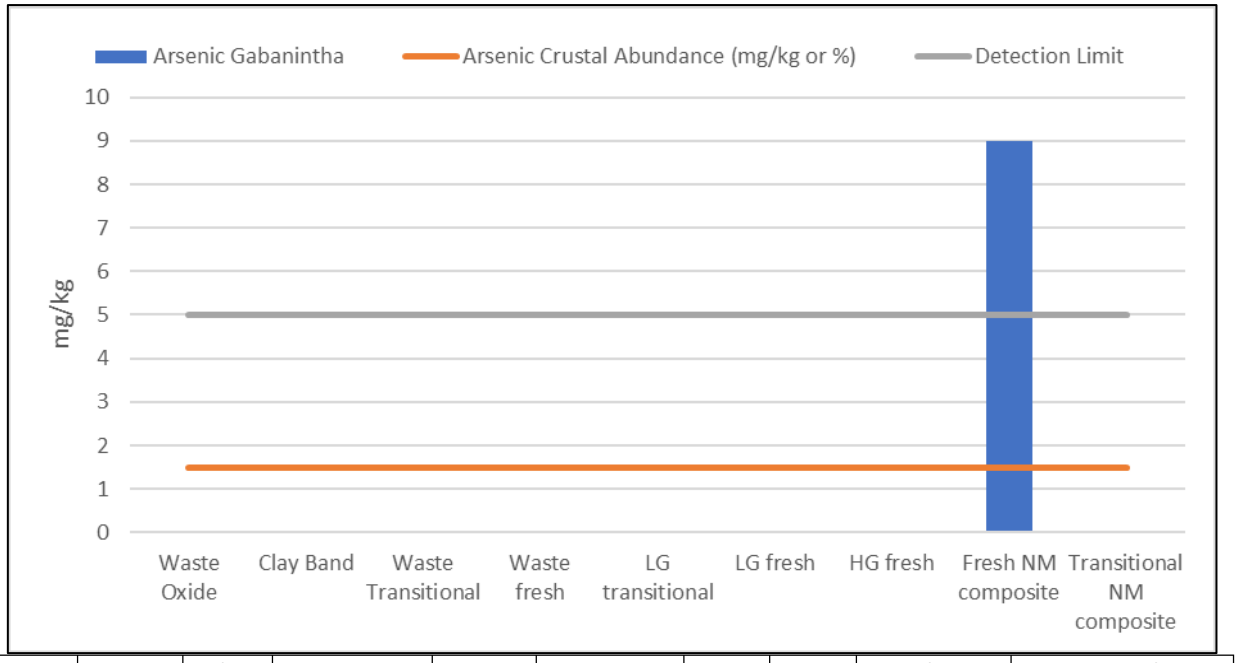
Sample ID	Sample Description	pH	Total S%	NAPP	NAG pH	NAG as kg H_2SO_4/t to pH 4.5	NAG as kg H_2SO_4/t to pH 7	ANC	MPA
T23005	Waste Oxide	6.5	0.57	17.4	7.1	<0.1	<0.1	<0.5	17.44
T23543	Clay Band	6.4	0.03	0.9	5.4	<0.1	16.3	<0.5	0.92
T23019	Waste Transitional material	8.9	0.02	-11.8	9.6	<0.1	<0.1	12.4	0.61
T23085	Waste fresh material	9.1	0.3	-3.6	3.8	1.3	3.1	12.8	9.18
T23183	Low grade transitional	9	0.16	-15.3	6.7	<0.1	1	20.2	4.90
T23064	Low grade fresh	8.6	0.35	<0.5	4	0.9	3.2	10.6	10.71
T23111	High grade fresh	7	0.36	3.2	3.7	2.1	4.2	7.8	11.02
Comp 1 N-mags	Fresh non-magnetic composite	7.6	1.4	-0.6	8.2	<0.1	<0.1	43.4	42.84
Comp 2 N-mags	Transitional non-magnetic composite	8.2	0.16	-1.2	5.8	<0.1	1.9	6.1	4.90

2.1. Trace Metals

Cadmium (Cd), Lead (Pb), Molybdenum (Mo) and Selenium (Se) levels were all below the detection limit for the tests conducted (Table 3). Results for Arsenic, Chromium and Cobalt are displayed in Figure 1, Figure 2 and Figure 3 respectively, with any blank sections reflective of results below the limit of detection.

Table 3: Metals at Gabanintha Below Detection Limits

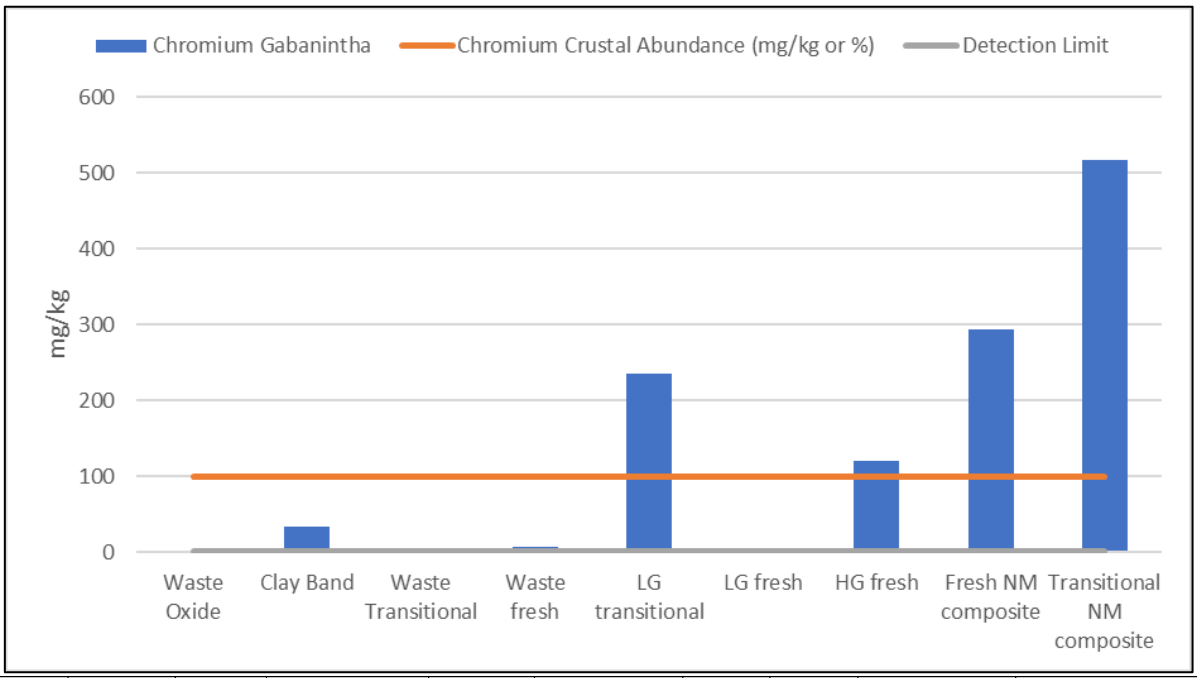
Metal	Limit of Detection (mg/kg)	Samples (mg/kg)								
		Waste Oxide	Clay Band	Waste Transitional	Waste fresh	LG transitional	LG fresh	HG fresh	Fresh NM composite	Transitional NM composite
Cd	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Mo	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Se	5	<5	<5	<5	<5	<5	<5	<5	<5	<5



	Waste Oxide	Clay Band	Waste Transitional	Waste fresh	LG transitional	LG fresh	HG fresh	Fresh NM composite	Transitional NM composite
mg/kg	<5	<5	<5	<5	<5	<5	<5	9	<5

Figure 1: Arsenic Levels at Gabanintha

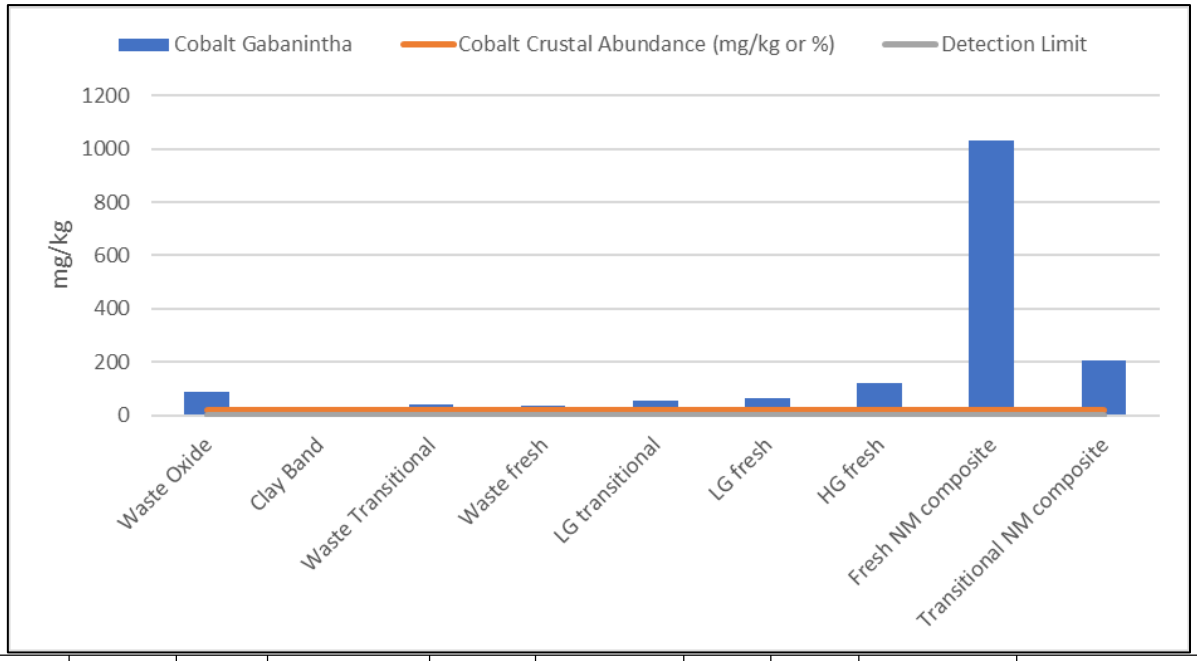
HG – High Grade; LG – Low Grade; NM – Non-magnetic



	Waste Oxide	Clay Band	Waste Transitional	Waste fresh	LG transitional	LG fresh	HG fresh	Fresh NM composite	Transitional NM composite
mg/kg	3	34	<2	7	235	<2	121	294	518

Figure 2: Chromium Levels at Gabanintha

HG – High Grade; LG – Low Grade; NM – Non-magnetic



	Waste Oxide	Clay Band	Waste Transitional	Waste fresh	LG transitional	LG fresh	HG fresh	Fresh NM composite	Transitional NM composite
mg/kg	88	5	42	36	54	64	120	1030	207

Figure 3: Cobalt Levels at Gabanintha

HG – High Grade; LG – Low Grade; NM – Non-magnetic

Table 4 shows trace metal levels at Gabanintha as compared to ecological investigation levels (Department of Environment and Conservation, 2010). All levels are compared to the assessment level for soils other than Selenium which was not available. Exceedances are shown in red, with six of the nine samples exceeding cobalt limits and the transitional non-magnetic composite material exceeding chromium limits. Chromium at Gabanintha was only measured as total chromium; it is not yet possible to determine whether the exceedance is of chromium III or VI.

Table 4: Trace Metals at Gabanintha Compared to Contaminated Sites Thresholds

	Waste Oxide	Clay Band	Waste Transitional	Waste fresh	LG transitional	LG fresh	HG fresh	Fresh NM composite	Transitional NM composite	Ecological Investigation Threshold[1]
Arsenic	<5	<5	<5	<5	<5	<5	<5	9	<5	20
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	3
Chromium[2]	3	34	<2	7	235	<2	121	294	**518**	Cr III: 400 Cr VI: 1
Cobalt	**88**	5	42	36	**54**	**64**	**120**	**1030**	**207**	50
Lead	<5	<5	<5	<5	<5	<5	<5	<5	<5	600
Molybdenum	<2	<2	<2	<2	<2	<2	<2	<2	<2	40
Selenium	<5	<5	<5	<5	<5	<5	<5	<5	<5	-

1: (Department of Environment and Conservation, 2010)

2: Chromium measured as total chromium only, all results potential exceedances depending on the type of chromium

3: Possible exceedance if Chromium VI

Further test work is required to determine the type of chromium present at Gabanintha and also to provide more robust results with a larger sample size.

2.2. Material Classification

There is no simple method to define whether mine waste containing small quantities of sulphur will produce sulphuric acid. Sulphide minerals are variable in their behaviour under oxidising conditions, and not all forms will produce sulphuric acid (H_2SO_4). Instead, a combination of approaches is often applied to more accurately classify mine waste.

Table 5 is based on the Australian Government's Guidelines on Managing Acidic and Metalliferous Drainage (Department of Industry, Tourism and Resources, 2007) and is in turn based on an earlier classification system included within the AMIRA ARD Test Handbook (Australian Minerals Industry Research Association; Ian Wark Research Institute; and Environmental Geochemistry International Pty Ltd, 2002), which is advocated by the Global Acid Rock Drainage Guidelines (GARD) published by the International Network for Acid Prevention (International Network for Acid Prevention, 2009). This classification system, based on static acid base accounting procedures and used in conjunction with geological, geochemical and mineralogical analysis can still leave materials classified as 'uncertain' where there are conflicting NAG pH and NAPP results. Uncertain materials demonstrating a NAG pH above 4.5 may be tentatively assigned as potentially NAF and those below pH 4.5 as potentially PAF – however, in such cases, further assessment, such as the use of kinetic leaching columns may be required to provide a definitive classification.

Table 5: ARD Classification Criteria

Primary Geochemical Waste Type Class	NAPP value kg H2SO4/t	NAG pH	S Content
Potentially Acid Forming (PAF)	≥10	<4.5	≥0.3%
Potentially Acid Forming – Low Capacity (PAF-LC)	0 – 10	<4.5	0.16 – 0.3%
Uncertain (UC)	0 – 5	>4.5	Not important
Uncertain (UC)	-10 – 0	<4.4	Not important
Non-Acid Forming (NAF)	-100 – 0	>4.5	Not important
Acid Consuming Materials (AC)	,-100	>4.5	Not important

As per Table 5, material classification is based on relative NAPP and NAG pH values. Results for this assessment are plotted in Figure 4. Two samples were PAF (HG fresh ore and LG fresh), four samples were NAF (LG transition, waste transitional, Fresh NM composite and Transitional NM composite), and three samples were uncertain (fresh waste, oxide waste and clay band) (Table 6).

Table 6: Gabanintha ARD Classification

Sample ID	Sample Description	ARD classification
T23005	Waste Oxide	Uncertain
T23543	Clay Band	Uncertain
T23019	Waste transitional material	NAF
T23085	Waste fresh material	Uncertain
T23183	Low grade transitional	NAF
T23064	Low grade fresh	PAF
T23111	High grade fresh	PAF
Comp 1 N-mags	Fresh non-magnetic composite	NAF
Comp 2 N-mags	Transitional non-magnetic composite	NAF

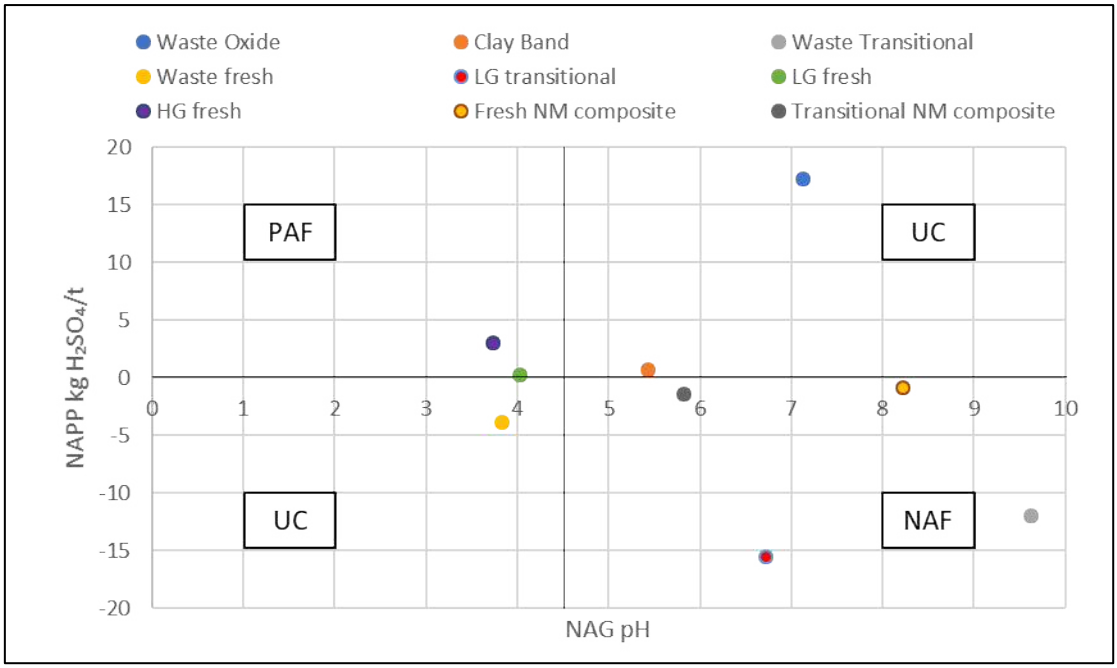


Figure 4: Plot of NAPP Versus NAG pH

HG – High Grade; LG – Low Grade; NM – Non-magnetic

3. Summary of Material Characterisation Pilot Study

In summary, the results of the pilot material characterisation study indicate that:

- High grade and low grade fresh material are potentially acid forming.
- Fresh and transitional non-magnetic material, as well as low grade and waste transitional materials are likely to be non-acid forming.
- Acid forming potential of clay band, waste oxide and waste fresh material is uncertain.
- Trace metals levels for some samples returned elevated levels of arsenic, chromium and cobalt. A more detailed investigation into chromium levels at the Project is required to determine whether chromium VI is a potential issue.

A larger study which investigates both acid generating potential, metal leachates, material salinity, dispersion, fibrous mineral and other problematic material, with samples across all geological types, is required to characterise material at the Gabanintha Vanadium Project accurately.

References

Australian Minerals Industry Research Association; Ian Wark Research Institute; and Environmental Geochemistry International Pty Ltd. (2002). *ARD Test Handbook: Project 387A Prediction and Kinetic Control of Acid Mine Drainage.*

Bowen, H. J. (1979). *Environmental Chemistry of the Elements.* New York: Academic Press.

Department of Environment and Conservation. (2010). *Assessment Levels for Soil, Sediment and Water.* Contaminated Sites Management Series.

Department of Industry, Tourism and Resources. (2007). *Managing Acid and Metalliferous Drainage.*

International Network for Acid Prevention. (2009). *Global Acid Rock Drainage (GARD) Guide.* Retrieved May 24, 2018, from http://www.gardguide.com

Appendix 1 Material Characterisation Sample ID, Geology and Element Composition.

Test No.	Sample ID	Hole ID	Depth_ From	Depth_ To	Al2O3_pct	Co pct	Fe pct	Ni pct	SiO_2 pct	TiO_2 pct	V_2O_5 pct	LOI pct	Material	Geology Description
1	T23005	GBDD002	4	5	12.48	0.013	21.36	0.029	36.35	3.06	0.207	7.74	Waste OX	Very weathered medium grained dolerite saprolite with very high clay content from replaced (pseudomorphed outlines), kaolin, possible smectite, iron oxide stain after pyroxenes, minor remnant magnetism in magnetite pseudomorphs (now dark oxides), trace g
2	T23543	GBDD007	19	20	28.57	-0.005	13.76	0.031	33.87	6.19	0.334	10.54	Clay	White and purple clay and hematite stained weathered dolerite saprolite WEATHERED DOLERITE
	T23544	GBDD007	20	21	29.63	-0.005	11.83	0.023	34.93	6.3	0.32	10.97	Clay	White and purple clay and hematite stained weathered dolerite saprolite WEATHERED DOLERITE
3	T23019	GBDD002	18	19	12.53	0.006	16.71	0.006	40.43	3.48	0.206	3.17	Waste TR	Medium grey and orange iron oxide stained in fractures and groundmass replaced by chlorite with weathered crumbly zones and iron oxide in fractures. WEAKLY WEATHERED DOLERITE
4	T23085	GBDD002	78	79	16.38	0.007	14.89	0.023	41.69	3.43	0.207	1.11	Waste FR	White and grey plagioclase rich medium grained dolerite with coarse semi-pervasive silica and patchy chlorite, disseminated magnetite generally 1-3mm, 1% pyrite FRESH SILICIFIED DOLERITE
5	T23183	GBDD001	34	35	8.91	0.014	28.88	0.054	27.17	6.6	0.535	1.28	LG TR	Fine grained magnetite with minor silicate in groundmass and basalt inclusions FRESH FINE MASSIVE MAGNETITE
6	T23064	GBDD002	59	60	9.39	0.014	29.01	0.033	27.16	7.63	0.536	-0.04	LG FR	Dark grey medium-coarse dolerite with strongly disseminated and semi-pervasive magnetite (to 50%) with grains often touching and 3-4mm in size. FRESH DOLERITE WITH SEMI-PERVASIVE MAGNETITE
7	T23111	GBDD002	102	103	4.19	0.024	52.45	0.088	3.28	13.35	1.15	-1.9	HG FR	Dark grey-black massive magnetite with euhedral possibly separated by fine chlorite and minor <1cm bands of carbonate altered? Basalt. FRESH MASSIVE MAGNETITE
8		Comp 1 N-mags											Tails	Fresh non-magnetic composite
9		Comp 2 N-mags											Tails	Transitional non-magnetic composite

Appendix 2 – ALS Environmental laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1805916**	Page	: 1 of 4
Client	: **CASH SALES PERTH**	Laboratory	: Environmental Division Perth
Contact	: BRETT MORGAN	Contact	: Customer Services EP
Address	: L3, 44 Parliament Place West Perth 6005	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: 94219000	Telephone	: +61-8-9406 1301
Project	: Gavanintha Vanadium	Date Samples Received	: 11-May-2018 11:30
Order number	: ----	Date Analysis Commenced	: 15-May-2018
C-O-C number	: ----	Issue Date	: 22-May-2018 07:10
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Total S conducted by ALS Brisbane, NATA Site No. 818.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

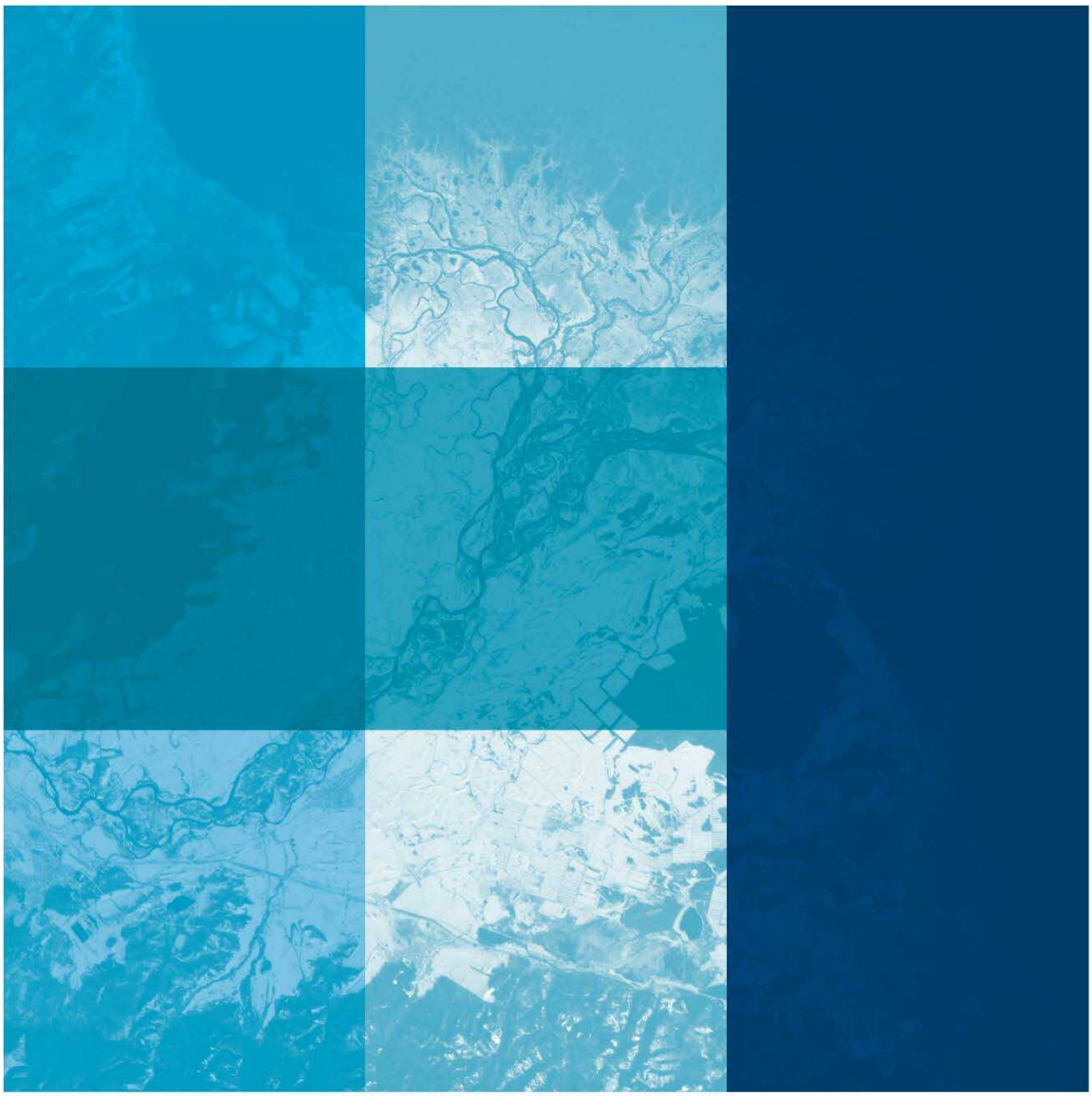
Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	T23005	T23543	T23019	T23085	T23183
			Client sampling date / time	[01-Aug-2017]	[01-Aug-2017]	[01-Aug-2017]	[01-Aug-2017]	[01-Aug-2017]
Compound	CAS Number	LOR	Unit	EP1805916-001	EP1805916-002	EP1805916-003	EP1805916-004	EP1805916-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	6.4	8.9	9.1	9.0
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	17.4	0.9	-11.8	-3.6	-15.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	6700	1620	121	69	104
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.1	5.4	9.6	3.8	6.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	1.3	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	16.3	<0.1	3.1	1.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	12.4	12.8	20.2
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	1.3	1.3	2.0
Fizz Rating	----	0	Fizz Unit	0	0	1	1	1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	3.8	0.6	1.2	<0.1	0.6
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.57	0.03	0.02	0.30	0.16
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	3	34	<2	7	235
Cobalt	7440-48-4	2	mg/kg	88	5	42	36	54
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	T23064	T23111	Comp 1 N-mags	Comp 2 N-mags	----
			Client sampling date / time	[01-Aug-2017]	[01-Aug-2017]	[01-Aug-2017]	[01-Aug-2017]	----
Compound	CAS Number	LOR	Unit	EP1805916-006	EP1805916-007	EP1805916-008	EP1805916-009	--------
				Result	Result	Result	Result	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**8.6**	**7.0**	**7.6**	**8.2**	**----**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	**3.2**	**-0.6**	**-1.2**	**----**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**147**	**119**	**309**	**90**	**----**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**4.0**	**3.7**	**8.2**	**5.8**	**----**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	**0.9**	**2.1**	<0.1	<0.1	**----**
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**3.2**	**4.2**	<0.1	**1.9**	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**10.6**	**7.8**	**43.4**	**6.1**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**1.1**	**0.8**	**4.4**	**0.6**	**----**
Fizz Rating	----	0	Fizz Unit	**1**	**0**	**2**	**0**	**----**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	<0.1	<0.1	**17.4**	**14.2**	**----**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.35**	**0.36**	**1.40**	**0.16**	**----**
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	**9**	<5	**----**
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	**----**
Chromium	7440-47-3	2	mg/kg	<2	**121**	**294**	**518**	**----**
Cobalt	7440-48-4	2	mg/kg	**64**	**120**	**1030**	**207**	**----**
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	**----**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	**----**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	**----**

APPENDIX B-2: Hydrologia – Preliminary Surface Water Study



Hydrologia

Report: Gabanintha surface water study

Client: Technology Metals Australia Ltd

Job number: 0100048

Date: 23 August 2018

Executive Summary

Background and scope of work

Technology Metals Australia Ltd are developing the Gabanintha Vanadium Project, which is located 40 km south of Meekatharra. The project has a number of tenements in two locations, referred to here as north and south. The project is currently undertaking environmental impact assessments and pre-feasibility studies.

This report presents an investigation into the surface water aspects of the project, involving a preliminary environmental impact assessment and an evaluation of flood risk for key site infrastructure. This document is intended to support the environmental and pre-feasibility studies.

Potential impacts

Key potential impacts relating to surface water for the project are:

- Modification of external stormwater flow paths, leading to upstream ponding, downstream shadowing or flow concentration and scour;
- Erosion of soil from disturbed areas, steep slopes and drainage infrastructure, leading to increased turbidity of stormwater discharged from site; and
- Contamination of stormwater from site activates.

Flow path modification should be undertaken carefully, using engineered structures and with particular consideration of stabilising outfalls of drains. Road crossings of drainage lines and overland flow paths will need to be appropriately designed and should aim to minimise ponding, shadowing and flow concentration.

Erosion is best controlled at or close to the source using soil conservation measures and appropriate design of drainage infrastructure.

Areas across the site that could potentially generate contaminated stormwater should be designed to appropriately manage the contamination risk. This could include systems ranging from treatment through to containment at the structure.

Preliminary flood risk assessment

Infrastructure located in the larger drainage lines and overland flow paths throughout the project area will be the most susceptible to flooding. These areas occur to the north and south of the north site and to the north and west of the south site.

The highest flood risk is likely to be for roads crossing these drainage lines and overland flow paths. The northern access corridor and the Meekatharra-Sandstone Road are likely to be impacted during even small runoff events. The southern access crosses several smaller flow paths. Consideration will need to be given to the design, construction and maintenance of the road formation and streamline crossings.

Consideration should be given to management of stormwater drainage and flood risk for infrastructure located north of the north site, including the tailings storage facility, western waste dump, workshop/plant/ROM area and airport.

There is little flood risk for the pit from local drainage lines. The pits are located on ridgelines and well away from the larger drainage lines. Stormwater control around the pits and perimeter bunding will still be required, however, to manage locally generated stormwater.

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Figures

Tables

Photos

1. Introduction

1.1 Background

Technology Metals Australia Ltd are developing the Gabanintha Vanadium Project (TMT 2018). The project is currently undertaking prefeasibility and environmental impact assessment studies.

The site is located 40 km south of Meekatharra. The site location is shown in Figure 1.

The project has a number of tenements in two locations, referred to here as north and south. Vanadium will be mined from open pits at the two locations. The ore will be trucked from the site via the Meekatharra-Sandstone Road.

The projects tenements in the north area are:

- E51/1818;
- M51/883 (pending); and
- E51/1510-I.

In the south area, the project's tenement is:

- M51/884 (pending).

Two indicative access routes from the Great Northern Highway have also been suggested, referred to as the northern and southern access.

This report presents results of an investigation into the surface water aspects of the environmental impact assessment and an evaluation of risk from flooding for key site infrastructure. It is intended to support the environmental and feasibility studies.

Legend

- Possible access areas
- Mining Licence Applications
- Tenements
- Model domain
- Catchments

Data Sources:
Catchments, model domain - Hydrologia
Tenements - Technology Metals Australia
250K topography - Geoscience Australia

Location

1:100 000 Map Sheet Location

Teraco 2545	Glengarry 2645	Mooloogool 2745
Meekatharra 2544	Gabanintha 2644	Yanganoo 2744
Reedy 2543	Nowthanna 2643	Young Downs 2743

N

SCALE 1:350,000

0 2,500 5,000 10,000 15,000 20,000 m

GDA 1994 MGA Zone 50

TECHNOLOGY METALS AUSTRALIA LIMITED

Hydrologia

Project: Gabanintha surface water study
Job no: 0100048

Figure 1
Site location and catchments

Additional Information

COMPILED: Gaia Resources	DATE: 15/06/2018	LOCN: PERTH	A3	SCALE 1:350,000
GDA 1994 MGA Zone 50	PLAN No: GR604-02_Gabanintha_Fig1_300dpi.pdf			
DOCUMENT NAME: GR604-02_Gabanintha_Fig1.mxd				

1.2 Scope of work

The scope of work was to:

- Undertake an assessment of potential environmental impacts associated with development of the Gabanintha Vanadium Project, Meekatharra; and
- Assess flood risk for mine infrastructure.

Deliverables are this report and discussion with the design and environmental teams.

1.3 Methodology

The work was undertaken in the following stages:

- Receive and review data;
- Preliminary assessment;
- Site visit;
- Assess potential impacts;
- Assess flood risk; and
- Reporting.

Receive and review data

The following data were received for use in the assessment:

- 1 m interval contour data for a limited area around the north and south sites, supplied by Technology Metals Australia;
- Tenement mapping, supplied by Technology Metals Australia;
- Indicative location and extent of site infrastructure;
- Regional digital elevation model (SRTM DEM-H) supplied by Geoscience Australia;
- Design rainfall information, from Australian Rainfall and Runoff (2016); and
- Other reports and data, as referenced throughout the report.

The work was undertaken using the available topographic data, which was limited. Topographic data available for the catchment is a one second SRTM digital elevation model, supplied by Geoscience Australia (GA 2011). This is a nation-wide ground surface model with a spatial resolution of approximately 30 m and a vertical accuracy of up to 7.6 m.

The higher resolution 1 m contour data is available for a limited area around the location of the north and south pits. No information is available on the accuracy of the contour data.

The location and extent of larger site infrastructure data was mapped conceptually. Details of structures are not available at this time,

Preliminary assessment

A preliminary assessment of flood risk for site infrastructure was undertaken early in the project to help inform the project's preliminary feasibility study. This assessment is documented in a separate report (Hydrologia 2018) and is superseded by this report.

Site visit

A site visit was undertaken by Hydrologia staff (R. Connolly) from 28-30 May 2018.

The site visit involved an inspection of the proposed mining and access areas and surrounding catchment.

Assess potential impacts

The impact assessment involved evaluating potential impacts of the project on the environment, as it relates to surface water. This included describing the existing environment, identifying potential impacts from the project and commenting on measures to manage potential impacts. The assessment relates to the development and operational stages of the mine.

This work describes the characteristics of the site area and catchment as relevant to surface water, including climate, land use, topography, drainage and runoff. The impact assessment was informed by results of the modelling undertaken as part of the flood risk assessment.

Potential impacts were assessed by considering the spatial location and extent of mine infrastructure and interaction with overland flow paths, streams and drainage lines and vegetation communities. Comments on mitigation measures are made generally considering the limited site infrastructure and mine plan information available.

Flood risk assessment

The next stage of work involved assessment of flood risk for the pit and for key infrastructure, including roads. This involved building a hydrology model for the catchments and streams contributing to the project area and a hydraulic model for larger flow paths near mine infrastructure.

Catchments and drainage lines through the study area were derived using terrain analysis. The coarser SRTM data were used for the wider catchment and the local 1 m contours for drainage around the north and south sites.

The hydrology and hydraulic modelling was undertaken using the DHI Mike SHE software (DHI 2018). The modelling used the SRTM data for the whole catchment, including the site. These data are relatively low resolution so caution should be used in interpreting results, particularly the flood extent delineation. Relatively coarse modelling was undertaken, limited by the resolution of the topographic data. Modelling assumptions are given in Appendix A.

The hydrology modelling was undertaken using methods given in Australian Rainfall and Runoff (Ball *et al.* 2016). Design rainfall data and regional flood estimates were taken from the Australian Rainfall and Runoff website (ARR 2016). The Mike SHE modelling results were cross-checked against flood peak estimates made using the Regional Flood Frequency Tool for selected catchments. It is noted, though, that the accuracy of the regional method's estimates may be affected by distance to gauged sites and catchment size. Accordingly, these flood discharge predictions are considered indicative only.

Indicative flood extent was determined from predicted flow depths using Mike SHE and the Geoscience Australia SRTM topographic data. The extent was derived using depths greater than 0.05 m. Small areas of inundation were deleted and flood extent adjusted manually in some areas for clarity.

Flood risk assessment

The flood risk assessment was undertaken by considering the location of drainage lines and indicative flood extents relative to site infrastructure. Catchment size and predicted stormwater flows were also considered.

Reporting

Results of the assessment of potential impacts and the flood risk assessment are documented in this report.

1.4 Limitations

General

This report has been prepared by Hydrologia Pty Ltd for Technology Metals Australia and may only be used and relied on by Technology Metals Australia for the purpose agreed between Hydrologia Pty Ltd and the Technology Metals Australia as set out in Section 1.2 of this report.

Hydrologia Pty Ltd otherwise disclaims responsibility to any person other than Technology Metals Australia arising in connection with this report. Hydrologia Pty Ltd also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by Hydrologia Pty Ltd in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Hydrologia Pty Ltd has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by Hydrologia Pty Ltd described in this report (refer Section 1.3 of this report). Hydrologia Pty Ltd disclaims liability arising from any of the assumptions being incorrect.

Hydrologia Pty Ltd has prepared this report on the basis of information provided by Technology Metals Australia and others who provided information to Hydrologia Pty Ltd (including Government authorities), which Hydrologia Pty Ltd has not independently verified or checked beyond the agreed scope of work. Hydrologia Pty Ltd does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Model results

Flood magnitude predictions have a probability of occurrence. For example, a predicted 1 in 100 AEP flood extent has a 1% probability of occurring or being exceeded in any given year. A flood of this magnitude could occur more than once in a year.

Floods greater than 1 in 100 AEP can occur. During such floods, impacts from flooding could be greater than indicated in this study. Conversely properties within the study area can be affected by floods of a lesser magnitude.

Indicative flood extents are predicted based on the available data and on assumptions and limitations described in our report. These extents should be read in conjunction with this report. Flood extents mapped in this report have been manipulated for clarity of presentation.

Predicted flood extent, depth, velocity and hazard is limited to within the project tenement boundaries.

The model was applied using a 50 m wide square grid cell interpolated from 1 second SRTM data provided by Geoscience Australia. Topographic and drainage features, such as swales, gutters, levees, roads, changes in land use or hydraulic roughness are not necessarily accurately represented in the model. Buildings or elevated flood levels at or in buildings are not represented in the original topographic data nor in the model. Underground pipework and culverts are not represented in the model.

Local increases in flood levels, depths and/or velocities from those predicted in this study can occur as a result of local factors. Using more accurate topography will also affect the predicted flood extent.

No account of the impact of climate change on the magnitude or frequency of occurrence of flood events has been considered. It is widely accepted in the scientific community that changing climate could affect rainfall and runoff in Australia, including in the project area. Accordingly the probability of occurrence for predictions given in this study could change in the future.

2. The existing physical environment

2.1 Introduction

This section presents a summary of the existing environmental conditions for the mine site and local catchment. The site location and catchment is shown in Figure 1. The description is focused on variables that influence surface water hydrology at the mine site.

This section informs the assessment of potential impacts of the mine development on surface water hydrology (see Section 3).

2.2 Climate

The site is located in an arid area with low annual rainfall and high evaporation. Climate of the area is classified by the modified Köppen system (BoM 2018a) as Desert, hot (persistently dry).

Rainfall at the site occurs generally as a result of regional rain-bearing depressions in winter, or in summer from thunderstorms and as a result of tropical cyclones that track far enough inland.

A summary of rainfall statistics derived for the site is given in Figure 2. A summary of major historical events and cyclones, based on daily rainfall data, is given in Table 1.

Table 1 Summary of major historical rainfall events

Date	Event Rain (mm)	Event duration (d)	Rain in previous 10 d (mm)	Peak AEP (1 in Y)	Comment
Mar 1939	132	2	1	<50	Two day event, largest on record.
Jul 1970	1	2	3	<1	Cyclone Ingrid.
Mar 1971	16	2	15	<1	Cyclone Mavis.
Jan 1980	28	2	0	<1	Cyclone Amy.
Mar 1984	107	1	14	2	Largest one day event on record.
May 1986	0.0	3	0	<1	Cyclone Billy-Lila.
Jan 1987	79	3	0	<20	Cyclone Connie.
Apr 1989	24	2	5	<1	Cyclone Orson.
Feb 1995	73	4	5	<20	Cyclone Bobby.
Mar 1999	64	2	3	<5	Cyclone Vance.
Mar 2000	66	2	15	<5	Cyclone Steve.
Mar 2006	115	2	10	20	Cyclone Emma.

Analysis is based on daily SILO daily data (Queensland Government 2018) and Bureau of Meteorology cyclone records (BOM 2018b). AEP is approximate, inferred from 2016 BOM data (BOM 2018c).

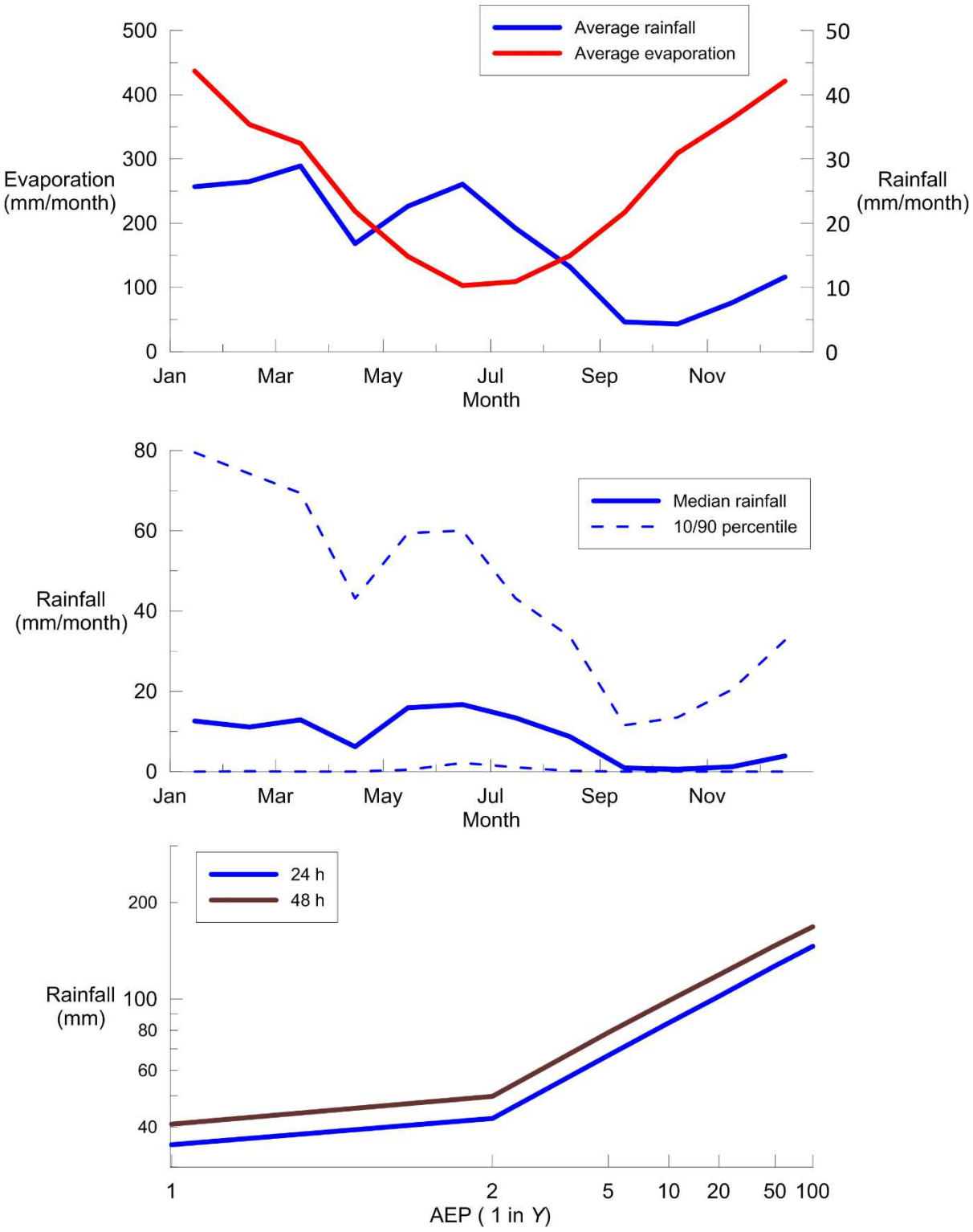


Figure 2 Rainfall and evaporation for the site

Average annual rainfall at the site is 231 mm. Rain can fall all year round, but larger events tend to occur between December and April. Annual rainfall can vary by ±50% (between the 10 and 90 percentiles).

Average annual evaporation is 3,154 mm, much higher than average rainfall. Evaporation exceeds rainfall in all months of the year. This means that after rainfall the catchment dries

quickly and is generally dry when larger, short-duration rainfall events occur. This can be seen in the generally low rainfall in the previous 10 days for events tabulated in Table 1.

The site is on the inland edge of the area influenced by tropical cyclones. Cyclones pass close to the area every 5-10 years but don't always lead to large rainfall events. Historical cyclones have produced rainfall totals varying from almost none to in excess of 130 mm (more than a 1 in 50 AEP). Event duration tends to be relatively long (2-3 days).

A selection of design rainfall intensity-frequency-duration data is plotted in Figure 2. Rainfall for the 1 in 100 AEP 24 h event is 146 mm.

2.3 Land systems and soils

There are limited land system and soil mapping data available for the area. Surface geology (GA 2012) is available for the site and the wider catchment and is mapped in Figure 3. A description of land resources and rangeland condition for the Murchison River catchment is given in Hennig *et al.* (1994). The extent of this assessment covers the north pit and surrounds, not the larger catchment nor the southern site. However, the land resource descriptions and rangeland condition is likely to be generally relevant to the project area.

Most of the catchment valley for the north and south sites has surface geology mapped as colluvium and residual deposits (GA 2012). Larger drainage lines are mapped as channel and flood plan alluvium. Fringing the catchment in places there are felsic intrusive rock outcrops and breakaways.

In the land resource mapping (Henning *et al.*, 1994), the valleys are characterised as wash plains on hardpan with mulga shrublands. The larger drainage lines are calcreted river plains with grassy shrublands. The area of the north pit, and probably the south is mapped as rough hills with acacia shrublands grading down to low laterised hills and plains with mulga and sand plains with grassy shrublands.

Generally, the elevated areas around the pits have gravelly, heavily armoured soils and rock outcrops on moderate to steep slopes. Landscape and soils at the two pit locations are shown in Photo's 1 and 2. These areas have low infiltration capacity and generate high runoff rates during rainfall events. Flow generally occurs as shallow overland flow. Shallow defined streams develop in places, defined mainly by topographic valleys. These streamlines tend to form on the hills around the centre of the pits and dissipate on wash plains downstream.

The landscape in the main catchment valley north of the site is shown in Photo 3. This area has broad flat wash plains with low infiltration and shallow overland flow during runoff events. Small drainage lines tend to form where flow concentrates. Defined streams don't tend to persist through the catchment, rather forming then dissipating depending on local land grade and flow concentration.

The landscape through the smaller catchments east of the north and south sites is similar.

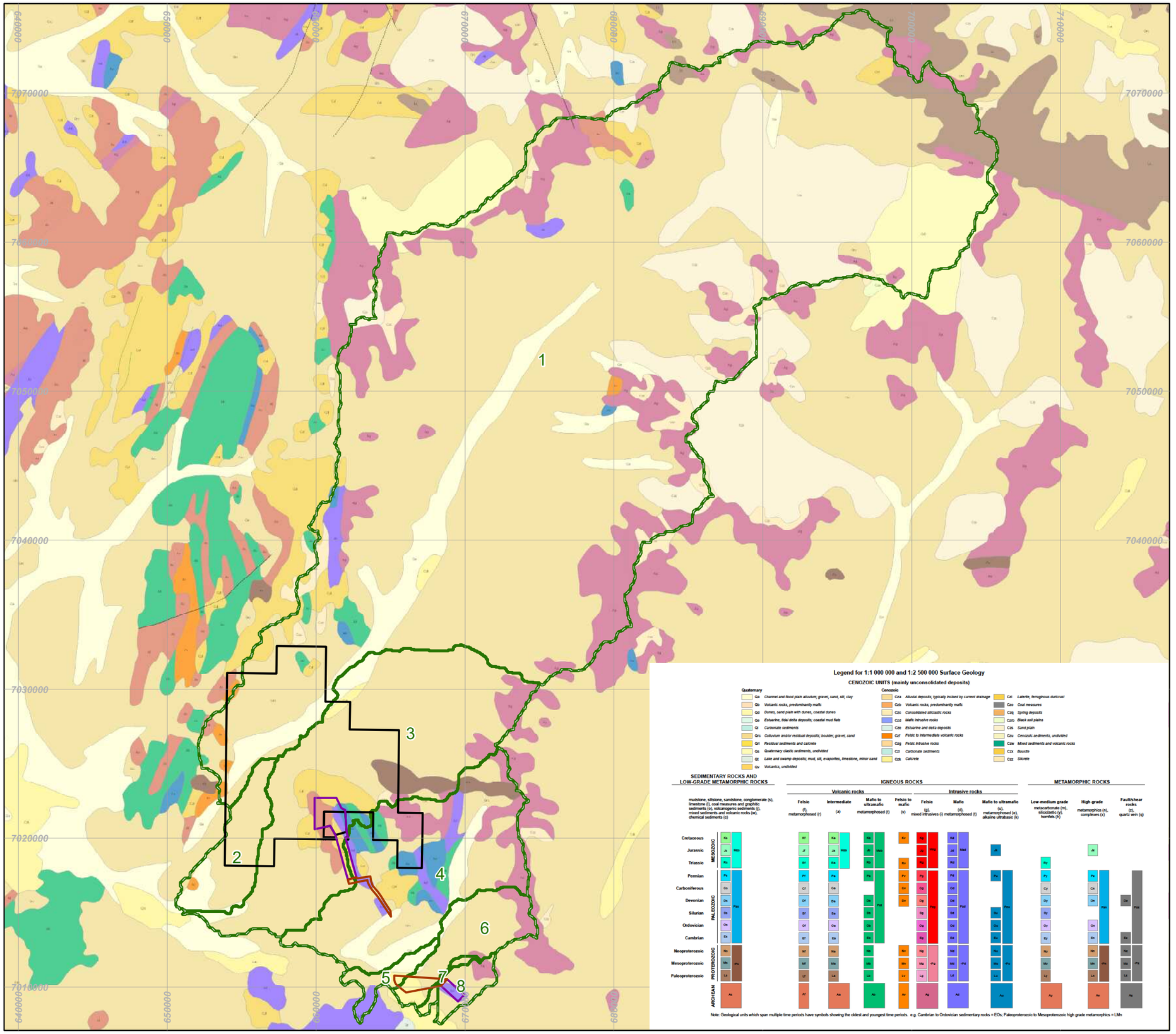
Artificial concentration of flows, such as along tracks or at the outfall of drains, can lead to scour. Photo 4 shows scour developing along a track near the south pit.

Photo 1 Landscape at the north site pit area

Photo 2 Landscape and soils at the south pit area

Photo 3 Landscape in the catchment valley north of the site

Photo 4 Scour resulting from flow concentration along a track near the south site



Legend

- Possible access areas
- Mining Licence Applications
- Tenements
- Model domain
- Catchments

Data Sources:
Catchments, model domain - Hydrologia
Tenements - Technology Metals Australia
Surface geology - Geoscience Australia

Location

1:100 000 Map Sheet Location

Tieraco 2545	Glengarry 2645	Mooloogool 2745
Meekatharra 2544	Gabanintha 2644	Yanganoo 2744
Reedy 2543	Nowthanna 2643	Youno Downs 2743

N

SCALE 1:260,000

0 1,875 3,750 7,500 11,250 15,000 m

GDA 1994 MGA Zone 50

TECHNOLOGY METALS AUSTRALIA LIMITED

Hydrologia

Project: Gabanintha surface water study
Job no: 0100048

Figure 3
Surface geology

Additional Information

COMPILED: Gaia Resources	DATE: 22/06/2018	LOCN: PERTH	A3	SCALE 1:260,000
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DOCUMENT NAME: GR604-02_Gabanintha_Fig3_new.mxd				

2.4 Vegetation and land use

Most of the area is vegetated with grasses and mulga (*Acacia aneura*) shrubland of variable pastoral value (Hennig *et al.*, 1994). The flatter plains and broad drainage lines support more grass than the hilly areas and breakaways.

Grasses tend to be reliant on overland flow from up slope areas. Shadowing and catchment reduction, as can occur along roads that modify overland flow paths, can affect pasture communities. Conversely, ponding, can increase pasture growth.

Photo 5 shows effects of modified flow paths on pasture growth along the Meekatharra-Sandstone Road between the north and south sites. The road formation in this area is raised which tends to increase ponding upstream of the road. Road-side drains can have a similar effect (Photo 6). The pasture stand is less vigorous immediately downstream of the road or drain where overland flow is reduced.

Photo 5 Effect of modified overland flow path at a road on pasture growth

Photo 6 Effect of a road-side drain on pasture growth

Land use in the area is generally low-intensity grazing with cattle, sheep and goats.

There are a number of mapped lakes throughout the study area. Photo 7 shows a lake downslope of the South site, near the Meekatharra-Sandstone Road. Water in the lake is turbid and appears to be fresh. This lake and others like it are likely to have a high pastoral value, for stock watering, and are probably used recreationally by local residents and travellers (where accessible).

Photo 7 Playa lake downstream of the south site

There are a number of mines throughout the area.

The Goldfields Highway, Murchison Downs Road and Meekatharra-Sandstone Road traverse the catchment.

2.5 Drainage and topography

Larger catchments through the project area are detailed in Table 2. Catchments and the project's tenements are shown on Figure 1.

Table 2 Catchment characteristics

Catchment name	Area (km^2)	Description
1	1,151	Large catchment that contributes to a broad drainage line through the northern half of tenement E 51/1818.
3	183	Drains the southern half of tenement E 51/1818 and the western slopes of P 51/2942 and P 51/2943.
4	121	Drains the eastern slopes of P 51/2942 and P 51/2943 and covers the northern haul road area.
6	30	Crosses most of the southern access area.
8	10	Drains the southern tenement (M51/884 pending) and surrounding catchment.

Drainage throughout the catchment contributing to both the north and south sites is generally from the northeast toward the southwest. Discrete drainage lines tend to form in hiller areas but then dissipate in the downslope wash plains and alluvial valleys.

Lake Annean lies to the west of the project area and an unnamed lake is to the south. There are a number of smaller, mapped lakes in the area of the north and south sites. These lakes

are likely to hold significant amounts of water only after periods of heavy rain. The quality of water in these lakes could vary from fresh (when full) to saline when low.

A drainage line appears to exit the unnamed southern lake and drain toward Lake Annean. In some publications this drainage line is named the Hope River. The Hope River is more generally mapped, though, as forming at the overflow from Lake Annean and discharging to the Yalgar River.

Drainage for the site area is ultimately toward Lake Annean, though stormwater from the site may only reach the lake in larger rainfall events. The unnamed lake to the south of the site appears up gradient of the site. It is possible, though, that in very large floods these two lakes and the connecting drainage line could flood and effectively join up.

A large catchment covers the northern part of tenement E 51/1818 (Catchment 1 in Table 2). This catchment extends to the northeast as far north as the Goldfields Highway. The catchment is characterised by a broad central valley with small, disconnected stream channels and fringing low hills and breakaways.

Drainage in the valley throughout Catchment 1 and past the site is diffuse, consisting of variably defined small eroded streams and overland flow. Stream channels tend to form in response to flow accumulation or local changes and land grade then dissipate. This pattern of drainage continues downstream of the site. Runoff from the catchment ultimately discharges to the drainage line toward Lake Annean.

There are a series of smaller catchments that drain the remainder of the project area. These also ultimately discharge into the Lake Annean system.

Details of drainage for the north site are shown in Figures 4 and 5. These figures show an indicative flood extent and drainage lines for a 1 in 100 AEP event, derived using the regional SRTM topography. As this topography is relatively coarse, the flood extents, drainage lines and smaller catchment boundaries should be considered to be indicative. More detailed contours (derived from 1 m contour data supplied by Technology Metals Australia) and catchments derived from these contours are shown on Figure 5.

The extent and pattern of flooding through the E 51/1818 tenement area is relatively diffuse but substantial. Floodwater in these areas are likely to be relatively shallow and slow-moving.

In the active mining area (pending tenement M51/883) of the north site, the topography is defined by a north-south trending ridge with slopes that flatten rapidly to the surrounding landscape. Drainage from the ridge will be more rapid than in the flatter areas. Small, rocky streams tend to arise in the hill area and dissipate on the surrounding plains. Drainage to the east of the ridge turns to the south, discharging toward the drainage line between Lake Annean and the unnamed lake. Drainage to the west of the ridge discharges toward the drainage lines from the wider catchment to the north, which is toward the Lake Annean system.

Figure 6 shows detailed contours and catchments for the south site. Note that the catchment boundaries to the north, east and south are truncated by the data extent.

The area of the south site is also defined by a central ridgeline. The ridge runs northwest to southeast and is not as steep as for the north site. The ridge is located in a relatively flat landscape with a general south westerly grade. Stormwater from the eastern slopes of the ridge drains as overland flow to the north and south of the mine area, joining flows from the western side of the ridge and discharging toward the playa lake upstream of the Meekatharra-Sandstone Road (Photo 7).

There are few natural, defined streams in the area. In places, erosion gullies have formed along tracks or at the outfalls of road table drains.

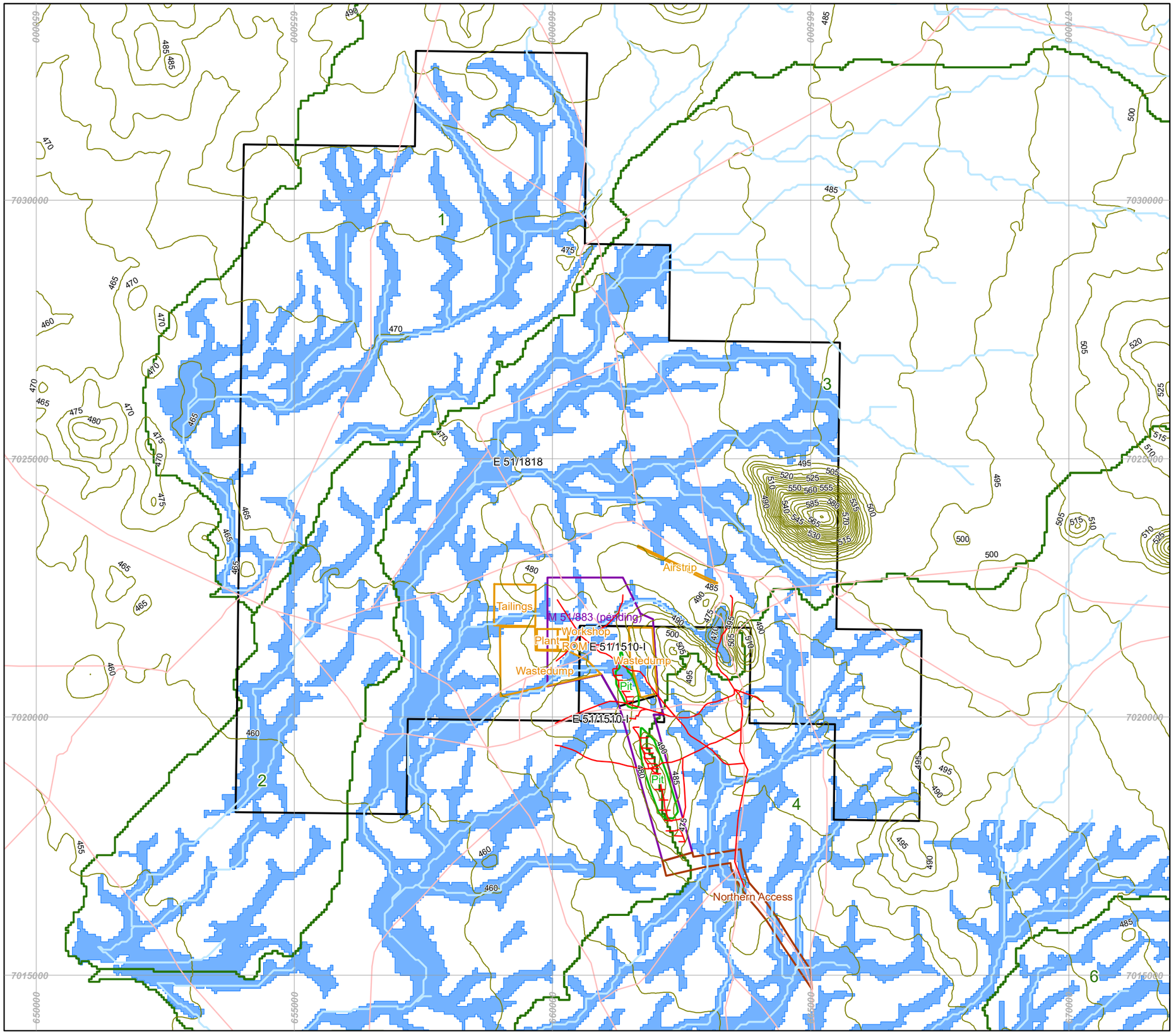
Downstream of the Meekatharra-Sandstone Road lies the large unnamed lake and drainage line toward Lake Annean.

Predicted design flow rates for the larger catchments throughout the project area are given in Table 3. These flows are for representative catchments covering the project extent and calculated using coarse topographic data (SRTM). Flows should be rederived for areas of interest, such as a road crossings or for larger drains, as part of more detailed design studies. More detailed topographic data should also be used were possible.

Table 3 Predicted peak flows

Catchment name	Area (km^2)	Peak discharge for AEP (1 in y)	
		10	**100**
1	1,151	78	207
3	183	25	66
4	121	19	50
6	30	9	23
8	10	5	12

Flows are derived using the Australian Rainfall and Runoff Regional Flood Frequency Tool (ARR 2016).



Legend

- Gabanintha access tracks
- Roads
- Drainage lines
- Contours 5m
- Infrastructure
- Pits
- Possible access areas
- Mining Licence Applications
- Tenements
- Catchments
- Indicative flood extent 1 in 100 AEP

Data Sources:
Catchments, flood extent, drainage, contours - Hydrologia
Tenements, tracks, infrastructure, pits - TMA
Roads - Geoscience Australia

Location

1:100 000 Map Sheet Location

Tieraco 2545	Glengarry 2645	Mooloogool 2745
Meekatharra 2544	Gabanintha 2644	Yanganoo 2744
Reedy 2543	Nowthanna 2643	Youno Downs 2743

N

SCALE 1:75,000

0 500 1,000 2,000 3,000 4,000 m

GDA 1994 MGA Zone 50

Hydrologia

Project: Gabanintha surface water study
Job no: 0100048

Figure 4
North site hydrology

Additional Information

COMPILED: Gaia Resources	DATE: 21/06/2018	LOCN: PERTH	A3	SCALE 1:75,000
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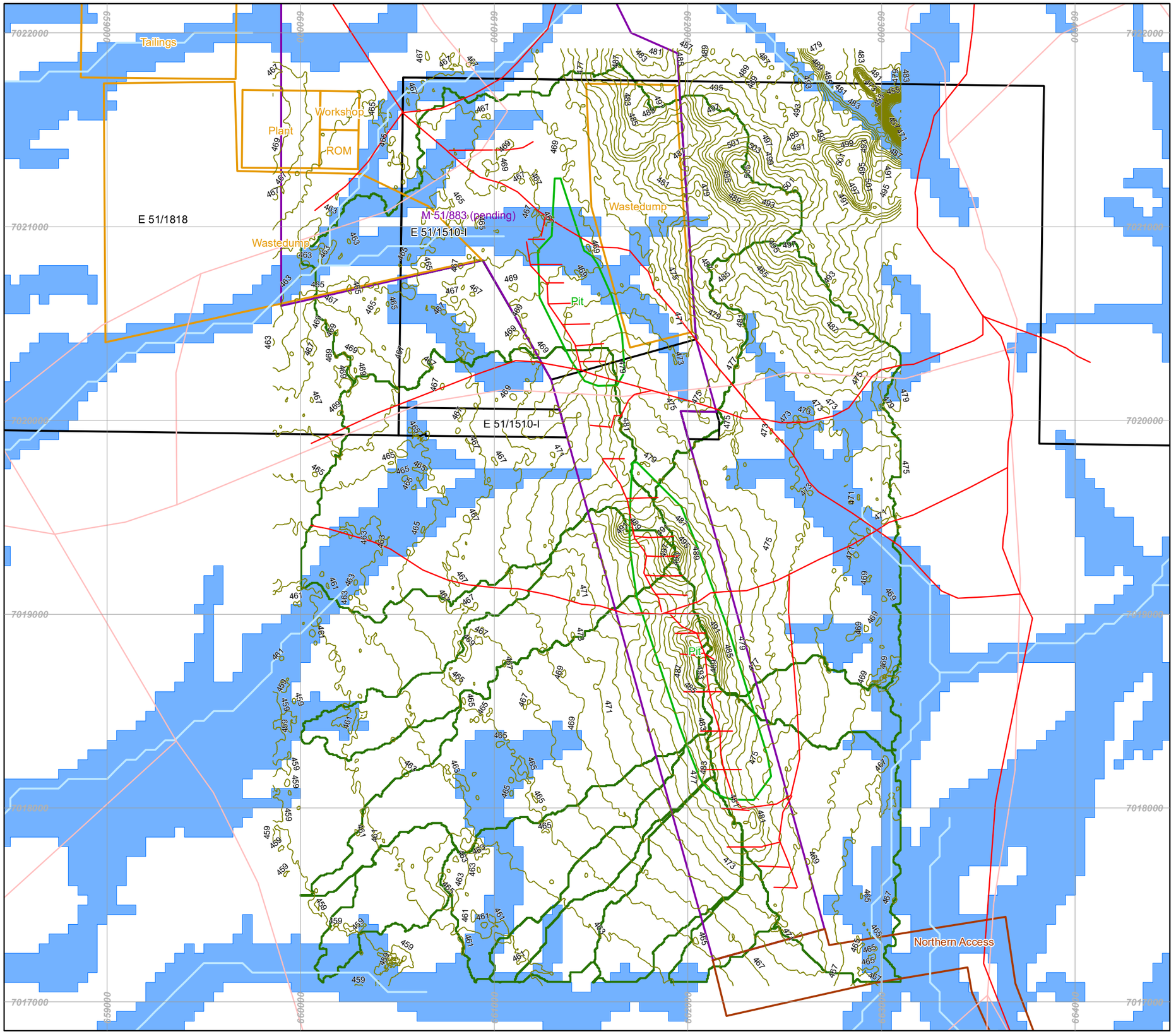

Legend

- Gabanintha access tracks
- Roads
- Drainage lines
- Contours 2m
- Infrastructure
- Pits
- Possible access areas
- Mining Licence Applications
- Tenements
- Subcatchments
- Indicative flood extent 1 in 100 AEP

Data Sources:
Catchments, flood extent, drainage - Hydrologia
Tenements, contours, tracks, infrastructure, pits - TMA
Roads - Geoscience Australia

Location

1:100 000 Map Sheet Location

Tieraco 2545	Glengarry 2645	Mooloogool 2745
Meekatharra 2544	Gabanintha 2644	Yanganoo 2744
Reedy 2543	Nowthanna 2643	Youno Downs 2743

N

SCALE 1:20,000

0 150 300 600 900 1,200 m

GDA 1994 MGA Zone 50

Hydrologia

Project: Gabanintha surface water study
Job no: 0100048

Figure 5
Detailed north site hydrology

Additional Information

COMPILED: Gaia Resources	DATE: 15/06/2018	LOCN: PERTH	A3	SCALE 1:20,000
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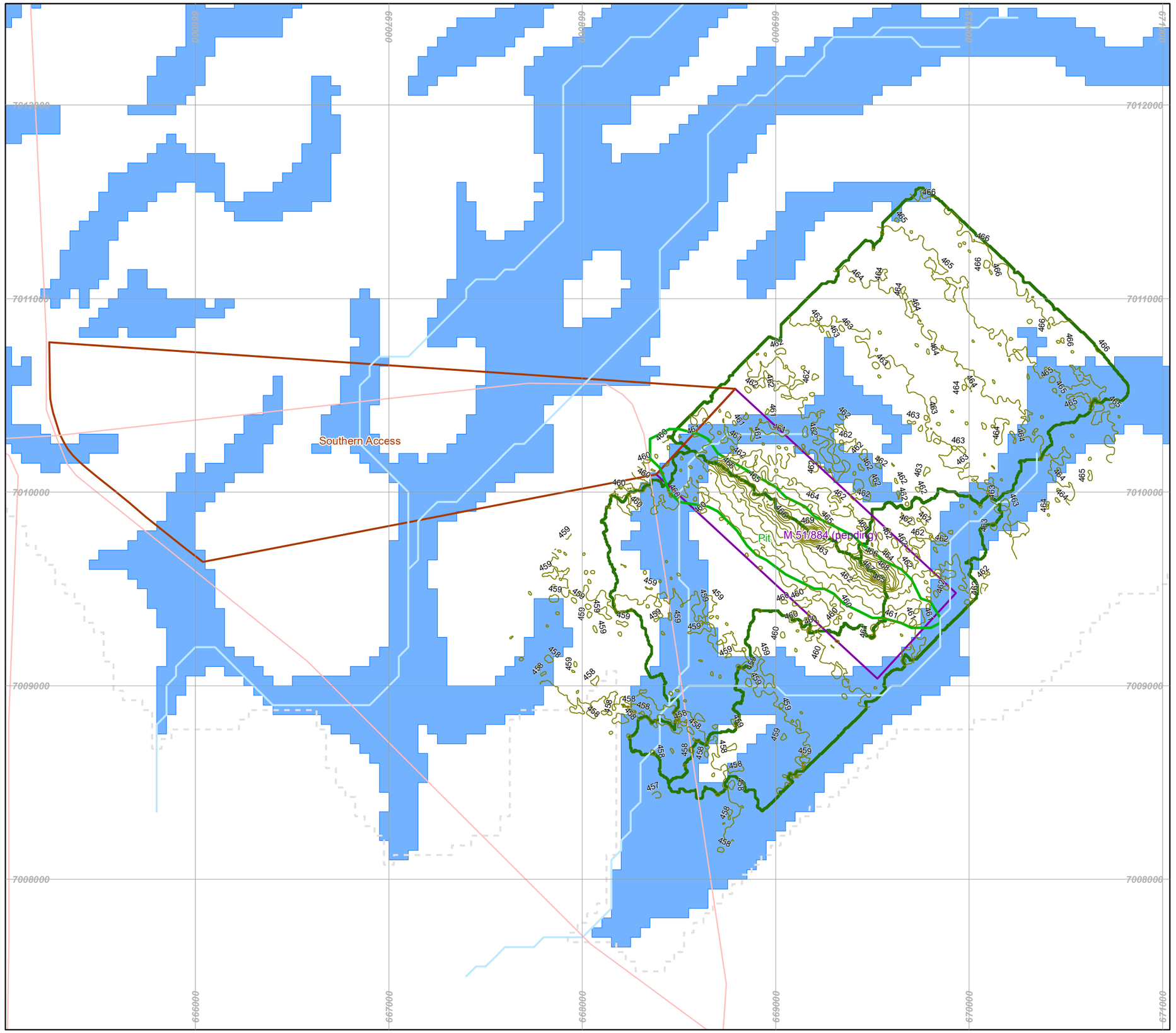
DOCUMENT NAME: GR604-02_Gabanintha_Fig5.mxd				



Legend

- Contours 1m
- Roads
- Drainage lines
- Pits
- Possible access areas
- Mining Licence Applications
- Subcatchments
- Model domain
- Indicative flood extent 1 in 100 AEP

Data Sources:
Catchments, flood extent, drainage, model domain - Hydrologia
Tenements, contours, pits - Technology Metals Australia
Roads - Geoscience Australia

Location

1:100 000 Map Sheet Location

Tieraco 2545	Glengarry 2645	Mooloogool 2745
Meekatharra 2544	Gabanintha 2644	Yanganoo 2744
Reedy 2543	Nowthanna 2643	Youno Downs 2743

N

SCALE 1:20,000

0 125 250 500 750 1,000 m

GDA 1994 MGA Zone 50

TECHNOLOGY METALS AUSTRALIA LIMITED

Hydrologia

Project: Gabanintha surface water study
Job no: 0100048

Figure 6
Detailed south site hydrology

Additional Information

COMPILED: Gaia Resources	DATE: 18/06/2018	LOCN: PERTH	A3	SCALE 1:20,000
GDA 1994 MGA Zone 50	PLAN No: GR604-02_Gabanintha_Fig6_300dpi.pdf			
DOCUMENT NAME: GR604-02_Gabanintha_Fig6.mxd				

2.6 Water quality

No publically available water quality data for surface water or stormwater for the project area could be located. The quality of surface water is inferred here from observations of land systems and weather patterns.

It is likely that the quality of stormwater flows and ponded water will be variable across the catchment. In the upper areas, stormwater flows will largely be fresh but may be turbid. Playa lakes occur in the area (Photo 7). These are likely to fill after periods of rain and be fresh, particularly when water levels are high. Lakes and drainage lines lower in the landscape, such as the drainage line to Lake Annean and Lake Annean itself, are likely to be saline, particularly when water levels are low.

3. Potential impacts of development

3.1 Introduction

This section presents a preliminary assessment of potential impacts of the proposed development on the environment and concepts for management of impacts. This assessment builds on the description of the existing environment given in Section 2

It is not intended at this time to develop mitigation measures in detail but to indicate areas where attention to mitigation of potential impacts may be required as part of the environmental approvals and infrastructure design process.

The assessment is based on the information available at this time. This information shows the likely location of the pits and indicative locations and extent of key mining infrastructure – waste dumps, tailings storage facility, airport and workshop/ROM/processing areas. The location of roads are indicated as indicative easements for connection to the Meekatharra-Sandstone Road.

The assessment is focussed on mine establishment and operation. It is expected that closure will be considered in the future. Potential impacts of the mine's activates on surface water and the environment are identified and general options for managing and mitigating these impacts are suggested.

3.2 Potential impacts

Key potential impacts relating to surface water for the project include:

- Modification of external stormwater flow paths, leading to upstream ponding, downstream shadowing or flow concentration and scour;
- Erosion of soil from disturbed areas, steep slopes and drainage infrastructure, leading to increased turbidity of stormwater discharged from site; and
- Contamination of stormwater from site activates.

Modification to flow paths

Modifications to flow paths are important at both the north and south sites. Low-lying and flood-prone drainage lines intersect the proposed tailings storage facility, western waste dump and workshop/plant/ROM area. The access road for the south site intersects several smaller flow paths.

Scour can readily occur where flow is concentrated. There are examples of this throughout the catchment (see Section 2.3). Accordingly, diversion of flow paths should only be undertaken where necessary. Diversion path ways should be properly constructed (e.g. drains with low flow velocity) and outfalls stabilised to prevent scour and designed to respread flow downstream. Roads crossing valleys should maintain distributed flow paths as much as possible.

Ponding upstream of structures, such as roads and stockpiles, should generally be avoided. Ponding can lead to changed vegetation communities, particularly pasture, upstream and downstream of the structure. This effect can be seen along the Meekatharra-Sandstone Road (see Section 2.4). Ponding of this type could affect land use (such as grazing) and change the susceptibility of the soil to scour.

It is important that infrastructure to manage stormwater during the life of the mine is appropriately designed, constructed, monitored and maintained. This will involve defining flow pathways and developing appropriate conveyance and disposal structures.

Erosion

Erosion of topsoil from disturbed areas, steep slopes, in drains and at drain outfalls could occur, particularly in steeper areas along ridgelines at the pits. This could lead to increased turbidity of stormwater discharged off-site.

Erosion is best controlled at or close to the source using soil conservation measures and appropriate design of drainage infrastructure. Stormwater generated on large flat areas, such as at the processing plant, should be managed using internal drainage infrastructure that minimises erosion and discharge of turbid stormwater.

Attention to stabilising outfalls for drains will be important, particularly if discharging to overland flow rather than an existing streamline.

Stormwater generated internally on the tailings storage facility, pits and waste dump should be contained and disposed of in the structure.

Water quality

Management of potential point pollution sources (such as fuel tanks and workshops) are usually managed using standard containment or treatment structures and spill management procedures. If roads and trafficked areas are to be watered with saline water, consideration should be given to prevention of excessive salt wash off to surrounding shrubland or pasture areas.

Any contaminated stormwater generated on structures such as the waste dumps and the tailings storage facility should be contained and disposed of on the structure.

4. Flood risk assessment

4.1 Introduction

An assessment of the risk of flooding for mine infrastructure was undertaken using the catchment assessment and modelling described in Section 2.5. The assessment is based on the available topographic and site layout information. Flood risk for a 1 in 100 AEP event is considered.

4.2 Flood risk

The main flood risk is to infrastructure located in the larger drainage lines throughout the project area. Flooding in these areas arises from flow in diffuse drainage lines or as shallow overland flow. There are a number of these flow paths that cross the northern and southern access easements. Flow at these crossings is likely to be large enough to require an engineered crossing. Flows of some size might occur every 2-3 years, but small rainfall events occurring more frequently could still interrupt traffic movement.

For infrastructure located in the area to the north (tenement E 51/1818), including the tailings storage facility, western waste dump and workshop/plant/ROM area, consideration will need to be given to management of flood risk and stormwater from the diffuse drainage lines in the area. The catchment here is larger than for the rest of the site, meaning higher flows are possible. Drainage lines and flow paths are diffuse, making location and management difficult. Infrastructure may need to be protected with levees, stream diversions and other structures (such as road crossings of drainage lines and flow paths).

The access route for the northern mine site crosses a valley with likely substantial diffuse flow. Consideration will need to be given to appropriate design of crossings and the road itself through this area. Maintenance of the road will also be important.

The access route for the south site crosses several flow paths. The catchment for this area is smaller than for the north but consideration of stream crossings and protection of the road formation will be needed.

The Meekatharra-Sandstone Road is likely to be affected by even small runoff events. This is a risk to the project if heavy vehicles from the mine cannot use the road for extended periods or have to take a longer route.

Just north of the north site a substantial length of the Meekatharra-Sandstone Road is low-lying and susceptible to damage from stormwater. Flow from the large catchment to the north east crosses the road at a number of flood ways. The Shire of Meekatharra has installed numerous drains and flow control devices along the road to help manage flooding and scour. The road surface, which is gravel, is also actively maintained by grading.

Rectification of damage to this road is also likely to be undertaken by the Shire, meaning that Technology Metals may have little control over the timing and nature of road repair or upgrades. Alternative, Technology Metals may be able to enter into an arrangement with the Shire to maintain the standard of the road at a standard to suit the mine.

The airport is located in a broad wash plan area north of the old Gabanintha Gold Mine waste dumps, at the site of the old airport. This area is likely to have substantial overland flow in larger events. There are also large drains and levees along the Meekatharra-Sandstone Road that could interact with the airport area. Consideration should be given to managing stormwater drainage and flood risk for the airport runway, service areas and connecting roads.

The pits in the north and south sites are located along ridges. Accordingly, there is little upstream catchment to present a flood risk to the pits. Stormwater draining from the ridgeline will need to be managed using minor drainage channels, road crossings and small levees.

Larger drainage lines tend to occur off the ridges, to the north and south. Infrastructure located in these areas may require more substantial works, including diversion of drainage lines and more substantial levees.

It is possible that the drainage line between the unnamed lake south of the south site and Lake Annean could flood in large events but this probably will not affect the site. The ground level in the drainage line near the unnamed southern lake is approximately 363 m AHD (from the SRTM topography) compared with 367 m AHD at the lowest point of the southern tenement. The northern tenements are some distance from Lake Annean and more than 10 m higher.

4.3 Conclusion

Infrastructure located in the larger drainage lines and overland flow paths throughout the project area will be the most susceptible to flooding. These areas occur to the north and east of the north site and north and west of the south site.

The highest flood risk is likely to be for roads crossing these drainage lines and overland flow paths. The northern access corridor and the Meekatharra-Sandstone Road are likely to be impacted during even small runoff events. The southern access crosses several smaller flow paths. Consideration will need to be given to the design, construction and maintenance of the road formation and streamline crossings.

Consideration should be given to management of stormwater drainage and flood risk for infrastructure located north of the north site, including the tailings storage facility, western waste dump, workshop/plant/ROM area and airport.

There is little flood risk for the pit from local drainage lines. The pits are located on ridgelines and well away from the local drainage lines. Stormwater control around the pits and perimeter bunding will still be required, however, to manage locally generated stormwater.

5. References

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Appendices

Appendix A

Model details

Model specification

Software:

Mike SHE release 2017, Service Pack 1.

Simulation specification:

Overland flow:

- Mike SHE, finite difference, rain on grid;
- 50 m square grid with topography derived from SRTM data;
- Design rainfall:
    - 3 h critical duration;
    - 10% AEP - pattern 10;
    - 1% AEP - pattern 10;
- Resistance: Manning's M native vegetation 50;
- Loss:
    - Initial – native vegetation 20 mm;
    - Continuing – net rainfall fraction - native vegetation 0.5;

Note: Manning's M = 1/Manning's n.

APPENDIX B-3: AQ2 – Preliminary Mine Dewatering Assessment

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Perth WA 6000
PO Box 976
South Perth 6951
Western Australia
Tel +61 8 9322 9733
www.aq2.com.au

AQ2 Pty Ltd
ABN 38 164 858 075

Memo

To	Ian Prentice	**Company**	Technology Metals Australia Ltd
From	Emma Bolton	**Job No.**	176C
Date	14/11/2018	**Doc No.**	042b
Subject	Gabanintha Vanadium Dewatering Assessment		

Ian,

We are pleased to provide our interim dewatering assessment for the Gabanintha Vanadium Project to support the Environmental Protection (EP) Act Referral.

1. INTRODUCTION

1.1 Background

Technology Metals Australia Ltd (TMAL) are currently undertaking a Feasibility Study for the Gabanintha Vanadium Project in the Murchison region of Western Australia.

The Project is located approximately 45 km southeast of Meekatharra and comprises two mining areas - the northern area (on pending M51/883) and the southern area (on pending M51/884), with additional land tenure covered by E51/1818 (refer Figure 1).

The Feasibility Study comprises the development of the northern mining area only. Two pits are proposed, the Central Pit and the North Pit, extending to depths of RL 320 and RL 330 respectively (up to ~140 m below the water table). As such, the dewatering and depressurisation of the proposed pits will be one of the key issues with respect to groundwater management for the Project, together with post-mining water level recovery and the nature of pit lake development.

AQ2 Pty Ltd (AQ2) have been engaged to provide hydrogeological inputs relating to the environmental impact assessment and Feasibility Study for the Project. This report summarises the findings to date, resulting from the compilation and review of available data and some limited hydraulic testing across the deposit. Additional field investigations are due to commence in the coming weeks.

1.2 Climate

The Murchison region is characterised by an arid climate with dry, hot summers and mild winters. Data from the Bureau of Meteorology (BOM) weather station at Meekatharra Airport (Site 007045), show mean maximum daily temperatures of between 19°C in July to 38°C in January. The long-term annual average rainfall for Meekatharra for the period 1944 to 2018 is 238.2 mm, with rainfall predominantly occurring during the summer months. Evaporation rates are high, typically over 200 mm/month. This results in a large environmental water deficit.

1.3 Topography and Drainage

The Gabanintha area is generally low lying with isolated hills. The deposit itself is located on a north-northwest - south-southeast trending ridge, with a maximum height of approximately RL 500 and approximately 30 m above the surrounding plains, whilst Yagohong Hill (4 km to the north) dominates the relief at an RL of 604 m.

Ephemeral streams drain the Project area, with the main drainage lines flowing in a generally southwesterly direction from the deposit and westwards towards Lake Annean, 25 km away in the main Lake Annean creek. One such stream, crosses through the study area to the north of the deposit.

1.4 Geological Setting

The Project is located in the granite-greenstone terrain of the Archean Yilgarn Craton. The mineralisation is hosted in a differentiated gabbro that strikes in a north-northwest to south-southeast direction for over 20 km, dipping at 60 degrees to the west, and has intruded into mafic, ultramafic, extrusive and volcaniclastic rocks of the Gabanintha Formation. The mineralisation is closely associated with a series of massive to disseminated V-Ti-Fe bands, ranging in size from a few metres up to 20 to 30 m thick. The intrusion is offset and disrupted by younger dolerite intrusions, faults and quartz porphyries, causing fragmentation of the mineralised zones.

Over the deposit area, the bedrock is oxidized to various depths:

- Complete oxidation and the development of saprolite clay occurs to between 0 m and 60 m in the northern area and 0 to 16 m in the southern area.
- Partial oxidation, forming saprock, occurs below this to depths of up to approximately 70 m in the northern area and 25 m in the southern area.
- Oxidation within individual structures (faults, fractures and veins where dissolution has occurred) is inferred in drill core to depths of up to 100 m. However, the frequency of such zones is low.
- Notwithstanding oxidation being relatively deep in some areas, review of the diamond core from the mineral exploration drilling, shows permeability due to fracturing and weathering to be limited predominantly to the top 20-30 m, with very limited zones of fracturing at greater depths.

Bedrock outcrops in the topographically higher areas, but is overlain over much of the area by relatively thin Quaternary and Tertiary deposits associated with both current and palaeo-drainages. An iron-rich duricrust is also present in some areas over the deposit, to depths of up to 20 m.

2. FIELDWORK

A site visit was undertaken in early August 2018, during which four existing mineral exploration / geotechnical drill holes across the northern deposit were subjected to micro test pumping (micro-testing), to obtain an initial, indicative understanding of the permeability of the material in and around the main orebody. Details on the bores tested are provided in Table 1 with locations shown in Figure 2.

The micro-testing involved the installation of a small, low-yielding pump into the selected drill holes, together with a pressure transducer to monitor the water level response to pumping. The holes were pumped for approximately 1 hour, with monitoring of water levels throughout the test and for 1 hour after the test (or until water levels had recovered to 90% of the initial drawdown). All pumping test results were analysed using standard curve-fitting analysis methods.

Water samples were also collected at the end of the tests and submitted to SGS Laboratory for chemical analysis.

Table 1: Details of Drill Holes Tested

BHID	East	North	Ground Elev (RL)	Dip	Type	Water Level		Micro Test	Water Sample	Date of aquifer test
						mbgl	RL			
GBDD001	661296	7020810	469.125	-58	DDH	11.12	458.01	√	√	3/08/2018
GBDD002	661355	7020599	471.919	-60	DDH	11.32	460.60	√	√	3/08/2018
GBDD005	661920	7019000	483.755	-60	DDH	28.02	455.74	√	√	3/08/2018
GBRC100	661513	7020299	475.393	-60	RC	17.4	457.99	√	√	3/08/2018

An additional site reconnaissance trip was undertaken in early September to review recent drill hole cuttings, diamond core and to liaise with the drillers and site geologists regarding groundwater intersection and yield data collected to date.

3. HYDROGEOLOGY

The results of the site reconnaissance visit and hydraulic testing described above, has been combined with data from the Department of Water and Environmental Regulation's (DWER's) database and other publicly available hydrogeological reporting, to form a hydrogeological understanding of the project area. In addition, a historical report has recently been obtained through the Freedom of Information Act, relating to previous water supply investigations in the area. The report was prepared by Groundwater Resource Consultants (GRC) and includes exploration drilling and bore installation in the vicinity of the Gabanintha northern mining area (GRC, 1987).

3.1 Groundwater Levels and Flow

Recorded water levels from DWER's database, together with NASA's SRTM data for bore elevations, have been combined with recently recorded water levels across the northern deposit, to plot groundwater level contours for the area in and around Gabanintha (Figure 3). The water table elevation is estimated to range between approximately RL 450 and RL 480 regionally and between RL 453 and RL 460 across the northern deposit. The groundwater levels are a subdued representation of the topography, with groundwater flowing from high areas to low areas and along the valleys, with the overall flow direction across the Project area to the southwest (and then west along the Lake Annean paleochannel).

The depth to groundwater is shallow in the lower lying areas (i.e. approximately 5 m below ground level (bgl)) and increases with elevation, with depths of between 10 and 41 mbgl recorded across the more elevated parts of the northern mining area.

3.2 Deposit Area Hydrostratigraphy

From the available geological data and core photos, the hydrostratigraphic units listed below have been identified across the deposit area.

- Duricrust / canga – the thin intervals of these units intercepted across the deposit are currently assumed to be unsaturated.
- Saprolite – uppermost continuous clay layer (except where bedrock outcrops) extending to depths of up to 60 m; low permeability and high storage.
- Saprock / Transition zone – weathered basement unit, with increased permeability and moderate storage, although hydraulic properties may vary laterally due to changes in bedrock composition. Yields of between 0.7 and 1.4 L/s have been recorded from GRC Bores Gb1, Gb12 and Gb14 (cased with 80 mm PVC), intersecting weathered / fractured basement to the west and northeast of the proposed North Pit (refer Figure 2).
- Fresh Bedrock – low permeability, low storage.
- Faults / Zones of Fracturing within the Bedrock – although the hydraulic characteristics of the faults are currently unknown, they could be zones of high permeability and low storage. In addition, if fracturing occurs on the margins of the dolerite intrusions, these could be potential zones of increased permeability and low storage. The hydraulic testing of drill hole GBDD005 indicates a permeability of approximately 2 m/d for an isolated (1 m thick) zone of fracturing.

Results from the hydraulic testing are shown in Table 2. Aquifer hydraulic conductivity varies between 0.06 and 0.005 m/day, with a transmissivity that varies between 8.2 and 0.3 m^2/day. These values indicate that the aquifer system associated with the ore body is "tight" and low permeability.

The aquifer parameters, along with observations from the site reconnaissance trip and assumptions based on similar deposits in the area, have been analysed to provide hydraulic information on the different hydrostratigraphic units within the ore body.

Table 2: Analysis of Micro-test Data

Bore ID	Location	Geology	Lithology [1]	Transmissivity (T) (m^2/day)			Bulk Permeability (k) (m/day)		Comment
				Drawdown (Cooper-Jacob)	Recovery (Cooper-Jacob)	Drawdown (AQTESOLV)	Drawdown (Cooper-Jacob)	Recovery (Cooper-Jacob)	
GBDD001	North Pit	Mafic	MVB 30% / FE 20% / MID 5% / MIG 10%	0.4753	0.5198	0.4769	0.0053	0.0058	High degree of fracturing in the top 26 m, 44-45 m, 64.5-65 m and 65.7-68.1 m. Notwithstanding the fracturing, the aquifer permeability is low, suggesting localized fracturing only.
GBDD002	North Pit	Mafic	MVB 15% / FE 15% / MID 70%	0.2622	1.7917	0.2424	0.0020	0.0135	Fractured/weathered material in the top 20 m only – below that, the formation is solid. Any aquifer permeability and groundwater inflow, only in the top 20 m.
GBDD005	Central Pit	Mafic	MVB 10% / FE 20% / MID 70%	2.6292	8.1505	2.416	0.0194	0.0601	Zones of fracturing in the top 26 m (above the water table), then fracturing from 49-50 m. Solid from 60 m onwards.
GBRC100	North Pit	Mafic	FE 1% / MID 99%	0.8186	1.8992	1.528	0.0082	0.0190	RC bore, so no core

[1] Lithology codes provided in the table below.

Code	Geological Description	Code	Geological Description
CANGA	Canga	MVB	Basalt
CCRETE	Calcrete	NR	Not Recorded
FE	Massive Magnetite-Hematite Ironstone	QVN	Quartz Veining
FEDURI	Iron rich duricrust	RKA	Intense Kaolointite - regolith related
FIA	Aplite	SCRETE	Silcrete
FIQ	Quartz Porphyry	SL	Siltstone
LC	Intensely clay weathered bedrock	TSG	Coarse local colluvium
MID	Dolerite	UKTC	Talc-Chlorite Schist
MIG	Gabbro	XSC	Chlorite Schist

3.3 Water Quality

Four groundwater samples were collected from the orebody aquifer during the field programme. These were analysed for cations, anions and basic water quality parameters by SGS Australia. Additionally, groundwater quality data are available for two hydrogeological exploration holes (Gb1 and Gb2) drilled to the north of the deposit, in fractured felsic volcanics, as part of previous water supply investigations for the Gabanintha Gold Mine. All available chemical analyses data are presented in Table 3 and are plotted on an Expanded Durov Diagram, in Figure 4.

The recorded groundwater quality data in the northern deposit area is brackish, with electrical conductivity (EC) values ranging between 1,100 to 3,300 µS/cm, and slightly alkaline (pH ranging between 7.6 and 8.4).

Table 3: Groundwater Chemistry Analyses

		Bore ID	GBDD001	GBDD002	GBDD005	GBRC100	Gb1	Gb2
		Sample Date	3/8/2018 10:30	3/8/2018 12:45	3/8/2018 15:30	3/8/2018 7:30	1986	1986
Analyte Name	Units	Reporting Limit	North Pit	North Pit	Central Pit	North Pit	-	-
pH	No unit	0.1	7.9	7.7	7.6	7.9	8.4	8.3
Conductivity	µS/cm	2	1,100	3,000	2,300	1,300	1,721	1,672
Total Alkalinity as CaCO3	mg/L	5	150	340	700	220	-	-
Carbonate Alkalinity as CO3	mg/L	1	<1	<1	<1	<1	10	10
Bicarbonate Alkalinity as HCO3	mg/L	5	180	420	850	270	320	290
Chloride, Cl	mg/L	1	190	760	390	220	320	310
Sulfate, SO4	mg/L	1	75	22	3	74	110	90
Calcium, Ca	mg/L	0.2	55	150	100	76	51	40
Magnesium, Mg	mg/L	0.1	46	130	120	64	60	64
Sodium, Na	mg/L	0.5	84	290	210	83	240	220
Potassium, K	mg/L	0.1	1.3	3.6	4.9	0.9	5	3

The chemical signature of the groundwater indicates three different water types. Bores Gb1 and Gb2 show a sodium and chloride dominant water-type (Type 9), indicative of an end point ("older") water. This suggests the groundwater has been subjected to mineral dissolution since recharge. Drill holes GBDD001, GBDD002 and GBRC100, located in the North Pit area, show a chloride dominant water-type (Type 8), indicative of reverse ion-exchange; whilst GBDD005, in the Central Pit area, shows a bicarbonate dominant water-type (Type 2), indicative of ion exchange.

It should be noted, however, that although the recently sampled drill holes were pumped at a low rate for an hour before a sample was collected, the bores may not have been fully purged and the results (especially where water was introduced during the diamond drilling) should be seen as indicative quality only. Additional samples will be collected during future field programmes.

4. MINE INFLOWS

4.1 Gabanintha Mine Plan

Open pit designs and mining schedules have been provided by CSA Global and adopted for the dewatering assessment. The Central Pit and the North Pit are both orientated in a north-northwest – south-southeast direction. The proposed pits are narrow and elongate in shape, with dimensions as follows:

- The final Central Pit is approximately 1,550 m long and 300 m wide at surface, extending to a maximum depth of RL 330, where it is approximately 100 m by 20 m.

- The final North Pit is approximately 900 m long and 300 m wide at surface, extending to a maximum depth of RL 320, where it is approximately 100 m by 20 m

The mining at Gabanintha is planned over a 20 year period. The mining schedule for the first 10 years has been provided by CSA Global Pty Ltd for the dewatering assessment. The schedules have been provided as tonnes per period (year) and converted to mining elevations. The adopted schedule is summarised in Table 4 and presented in Figure 5.

Table 4: Mining Schedule Used for Dewatering Predictions

Period (Years)	Mining Elevation (RL)				
	Central Pit Stage 1	Central Pit Stage 2	Central Pit Stage 3	North Pit Stage 1	North Pit Stage 2
1	**475**				
2	450			**465**	
3	440	460		395	
4		435	445	390	
5		410	425		
6		380	410		
7		365	375		
8			355		445
9			330		395
10					320

Figures denoted in bold indicate above water table mining.

Pre-mining groundwater levels of RL 458 and RL 456 have been assumed for the North Pit and Central Pit dewatering assessments (respectively).

4.2 Mine Inflow Calculations

There is a large uncertainty associated with dewatering estimates; even the best estimates derived from a comprehensive numerical model with very substantial field programmes and long-term monitoring are typically accurate to +/- 30% (Cashman and Preene 2013). Therefore, rather than predict a single dewatering rate, stochastic and analytical methods have been used to estimate the possible range in inflow to the open pits, defined as a likely inflow and plausible maximum and minimum inflow.

The approach estimates groundwater inflow based on aquifer parameters and the proposed mine plan (which is divided into a series of time-steps). It is based on the application of steady-state equations to the main flow fields around the mine (e.g. Cashman and Preene, 2012; Marinelli and Niccoli, 2000) for each time-step and the reduction of the water level to the base of the mine-workings active during that time-step. The estimated dewatering takes account of:

- removal of groundwater storage within the dewatered volume of aquifer;
- variations in hydraulic parameters between the hydrostratigraphic units;
- groundwater flow through the pit; and
- groundwater upflow through the floor of the pit.

The dewatering estimates do not currently account for any rainfall or surface water which may report to the pit during the wet season. We assume this is being assessed by those who are conducting the surface water management studies for the Project and that surface water ingress will be controlled by berms developed around the open pits.

Details of the analysis approach, assumptions and aquifer parameters used to estimate the open pit inflows are presented in Appendix A.

4.3 Mine Inflow Volumes

The range of predicted inflow rates over the first 10 years of mining are presented for each of the pits in Figures 6 and 7 and summarised in Table 5, with likely inflows (indicating the estimated dewatering requirements) presented in Figure 8 and Table 6. The results of the likely dewatering rates can be summarised as follows:

- Predicted dewatering for the Central Pit is low, with long-term rates of less than 1,000 kL/d (~12 L/s). Minimal dewatering (in the order of 100 kL/d or 1 L/s) is required during the first year of mining below the water table (Year 2 of mining) as the pit progresses through low permeability saprolite. Below this (during Years 3, 4 and 5), dewatering requirements are anticipated to increase slightly (up to approximately ~750 kL/d or 9 L/s) due to the increased inflows associated with the saprock / transition zone. Thereafter, inflows from the bedrock are anticipated to decline.
- Predicted dewatering for the North Pit is also low, with long term rates of approximately 1,000 kL/d (~12 L/s). However, initial dewatering rates (in Year 2 of mining) are predicted to be high (up to 3,300 kL/d or 38 L/s) as mining below the water table in this area commences in the saprock / transition zone (ie with the saprolite assumed to be predominantly above the water table). Additionally, this predicted dewatering rate is based on the pit progressing to approximately 63 m below the water table in this year.
- The combined dewatering requirements for the two pits is predicted to peak at 3,600 kL/d (42 L/s) in Year 2 of mining (the first year of mining below the water table), reducing to an average rate of 1,400 kL/d (16 L/s) during Years 3 to 7, thereafter progressively declining to approximately 1,100 kL/d (13 L/s). Although there is potential for the dewatering of one pit to influence inflow rates to the adjacent pit, there is believed to be a dolerite dyke which may form a flow barrier between the two pits, thus reducing any dewatering benefits from one pit to the next.
- The assessments made at this initially stage are purposely conservative. Further fieldwork may allow refinement to a shallower zone of permeability and lower aquifer hydraulic conductivity, with a possible decrease in predicted inflow rates.

5. POTENTIAL IMPACTS ASSOCIATED WITH MINING

Although work to date is only of a preliminary nature, potential impacts to the environment and other groundwater users which could result from mining are as follows:

- Due to the assumed low permeability of the ground in the deposit area, the radius of impact from dewatering of the open pit is not anticipated to be extensive. Based on the pit depths expected (~140 m below the water table) and the hydraulic conductivities provided in Table 2, the cone of depression due to the open pit dewatering, is not expected to extend much more than 1.6 kms. If faults are found to be permeable, drawdown may extend along these lineaments.
- All water resulting from dewatering will be used on site (i.e. there will be no discharge of excess water to the environment).
- It is assumed that the pit will remain open after mining has ceased, therefore the recovery of the pit aquifer system and the potential impact to the water quality (with the pit lake being exposed to evaporation) will need to be assessed. It is probable that a pit lake will develop with water level recovering to post-mining levels below current static water levels, with the lake being a groundwater sink. This has occurred at the adjacent Dominion Gabanintha Gold mine, closed in 1992.

Table 5: Range of Potential Dewatering Requirements

	Years of Mining										
	1	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Central Pit (kL/d) - Max	0	530	1,170	1,170	2,070	3,620	3,320	2,970	2,530	2,030	1,650
Central Pit (kL/d) - Min	0	40	40	40	70	100	130	130	110	60	30
North Pit (kL/d) - Max	0	0	25,350	24,500	18,200	14,830	12,830	11,480	10,480	9,700	13,260
North Pit (kL/d) - Min	0	0	1,660	520	370	350	340	320	320	310	400

Table 6: Likely Dewatering Requirements

	Years of Mining										
	1	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Central Pit (kL/d)	0	60	310	310	520	710	490	470	390	240	130
North Pit (kL/d)	0	0	3,246	1,230	890	830	800	770	750	740	960
Total (kL/d)	0	60	3,556	1,540	1,410	1,540	1,290	1,240	1,140	980	1,090

6. FURTHER WORK

Further work is required to better assess the hydraulic characteristics of the northern deposit area, not only with respect to the dewatering and mine closure assessments, but also to assess the water supply potential in the immediate area of the proposed pits to satisfy short-term construction water requirements.

The following activities are currently scheduled to take place:

- Installation of monitoring bores in the northern deposit area to provide a baseline monitoring network;
- Exploration drilling targeting potential zones of increased permeability;
- Hydraulic testing of additional existing mineral / geotechnical exploration holes across the deposit area, existing production bores in the vicinity of Gb12 and 14 (as no data is available for the production bores) and each of the installed monitoring bores; and
- Groundwater modelling to assess the groundwater level drawdown (during mining) and recovery (post-mining) for an environmental impact assessment.

We trust that this report meets your current requirements to support the EP Act Referral. Should you require any further information, please do not hesitate to contact the undersigned.

Regards

Emma

Emma Bolton
Consulting Hydrogeologist

Jeff

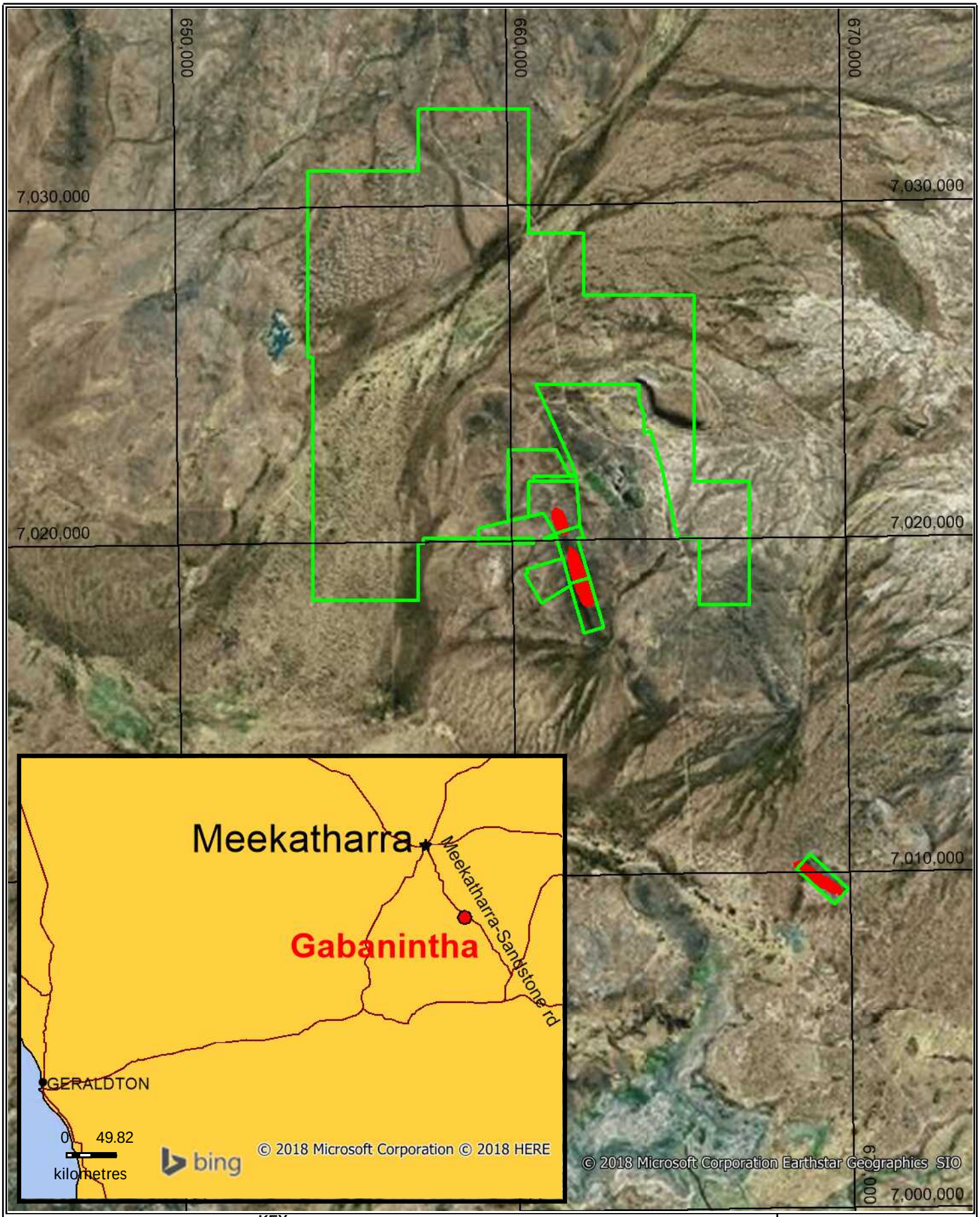
Jeff Jolly
Consulting Hydrogeologist

Author: EJB (12/11/18)
Checked: JLJ (12/11/18)
Reviewed: JLJ (12/11//18)

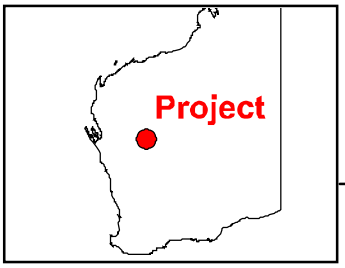
References

Groundwater Resource Consultants (GRC), 1987. Report on Groundwater Exploration and Development at Gabanintha for Dominion Gold Mines N.L. Unpublished report.

FIGURES



LOCATION MAP



Location: F:\176\4.GIS\Workspaces

KEY

Tenement Boundary

Pit Locations

0 5,000

metres

Scale 1:150,000

AQ2

FIGURE 1

Location Map Showing Project Tenements

AUTHOR: EB

DRAWN: LDS

DATE: 04/05/2018

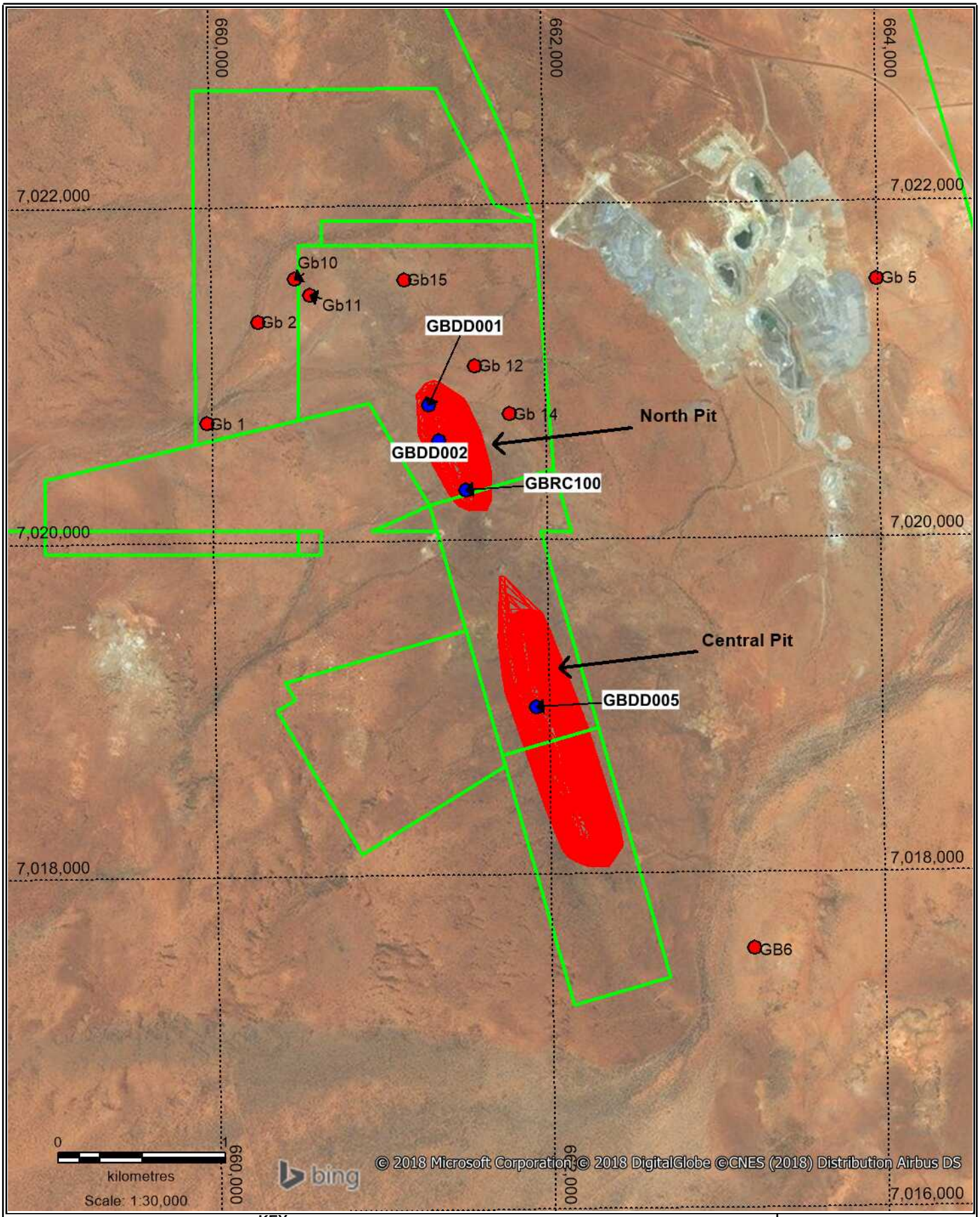
REPORT NO: 042

REVISION: a

JOB NO: 176C

NOTES & DATA SOURCES:

Aerial image from Bing 2018, Microsoft Corporation.
Tenement boundaries from Technology Metals Australia Ltd



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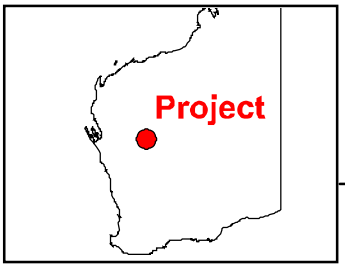


Location: F:\176\4.GIS\Workspaces

KEY

- Exploration Lease Boundary
- Tenement Boundary
- Pit Locations
- GRC Bores
- Tested Drill Holes

AUTHOR: EB
DRAWN: LDS
DATE:23/10/2018

REPORT NO: 042
REVISION: a
JOB NO: 176C

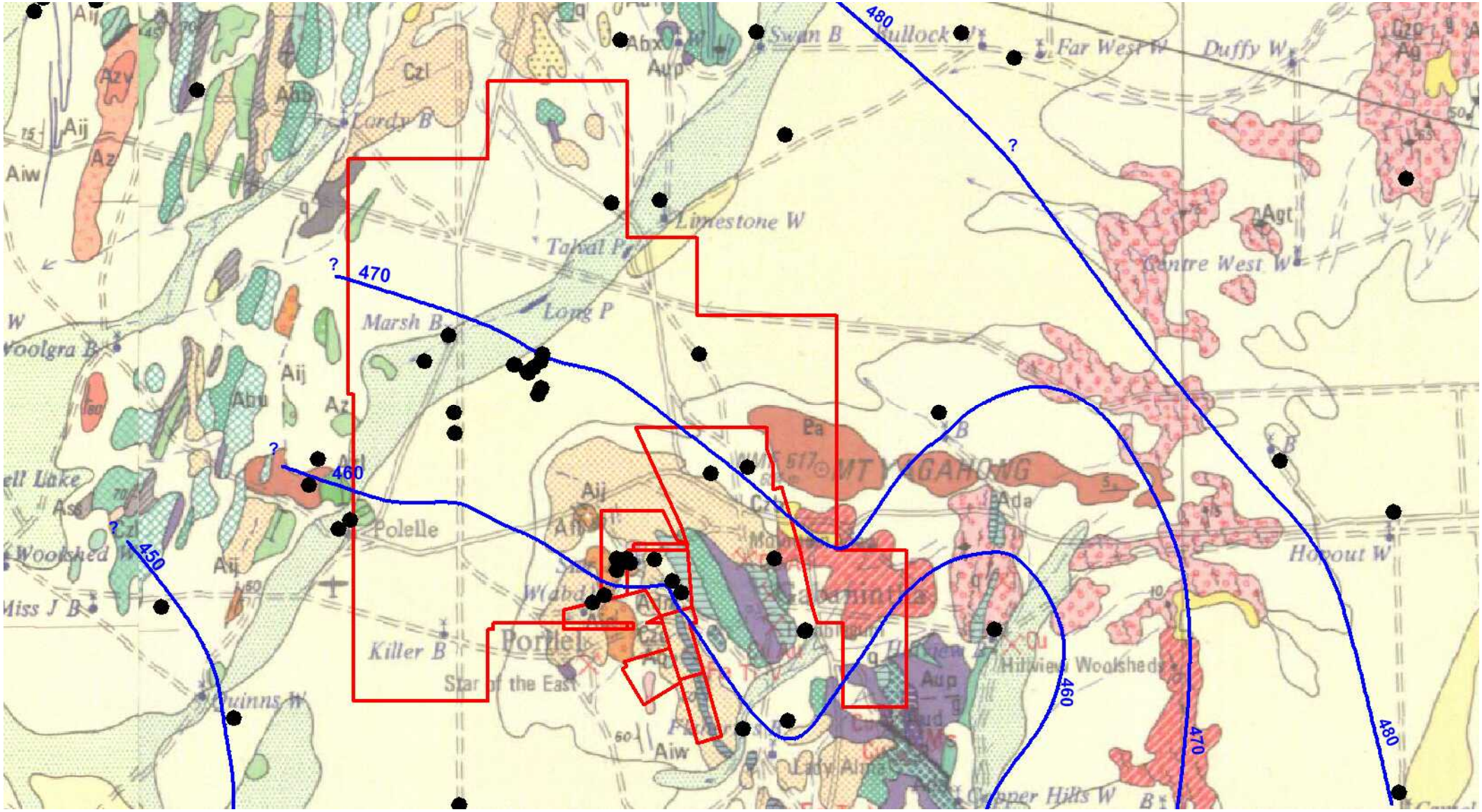
NOTES & DATA SOURCES:

Aerial image from Bing 2018, Microsoft Corporation.
Tenement boundaries from Technology Metals Australia Ltd

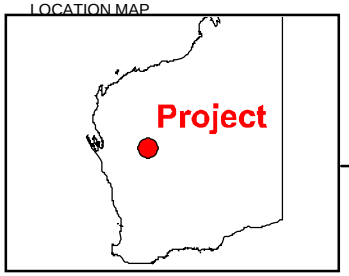
AQ2

FIGURE 2

Northern Deposit Location Map



LOCATION MAP



Location: F:\176\4.GIS\Workspaces

KEY

- Groundwater Contours (mRL)
- DWER Dababase Bores
- Tenement Boundary

0 5,000

metres

Scale 1:125,000

DRAWN: LDS
AUTHOR: EB
DATE: 07/06/2018

REPORT NO: 042
REVISION: a
JOB NO: 176C

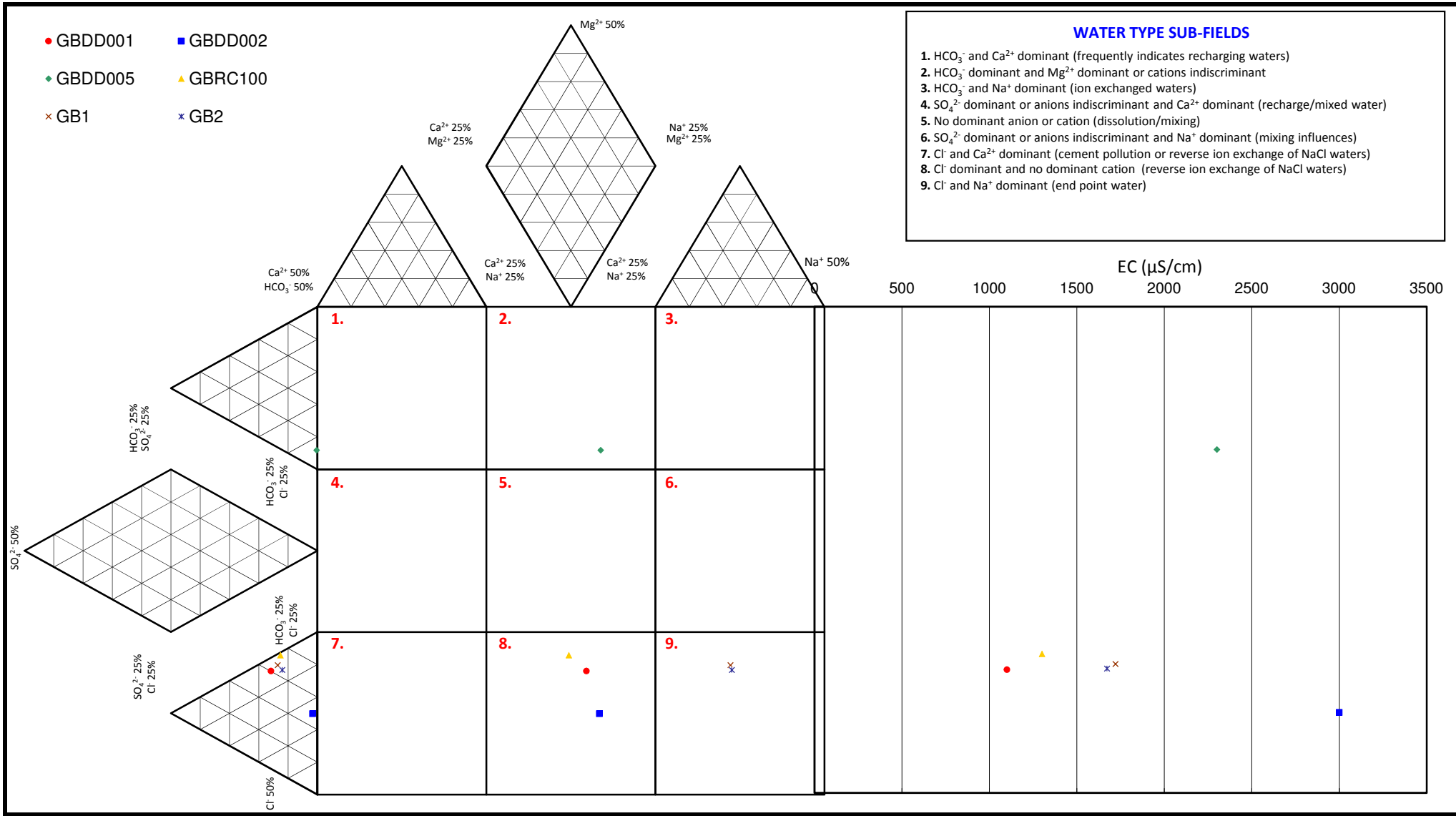
NOTES & DATA SOURCES:

Tenement boundaries from Technology Metals Australia Ltd

AQ2

FIGURE 3

Geology Map showing Water Level Contours



WATER TYPE SUB-FIELDS

1. HCO_3^- and Ca^{2+} dominant (frequently indicates recharging waters)
2. HCO_3^- dominant and Mg^{2+} dominant or cations indiscriminant
3. HCO_3^- and Na^+ dominant (ion exchanged waters)
4. SO_4^{2-} dominant or anions indiscriminant and Ca^{2+} dominant (recharge/mixed water)
5. No dominant anion or cation (dissolution/mixing)
6. SO_4^{2-} dominant or anions indiscriminant and Na^+ dominant (mixing influences)
7. Cl^- and Ca^{2+} dominant (cement pollution or reverse ion exchange of NaCl waters)
8. Cl^- dominant and no dominant cation (reverse ion exchange of NaCl waters)
9. Cl^- and Na^+ dominant (end point water)

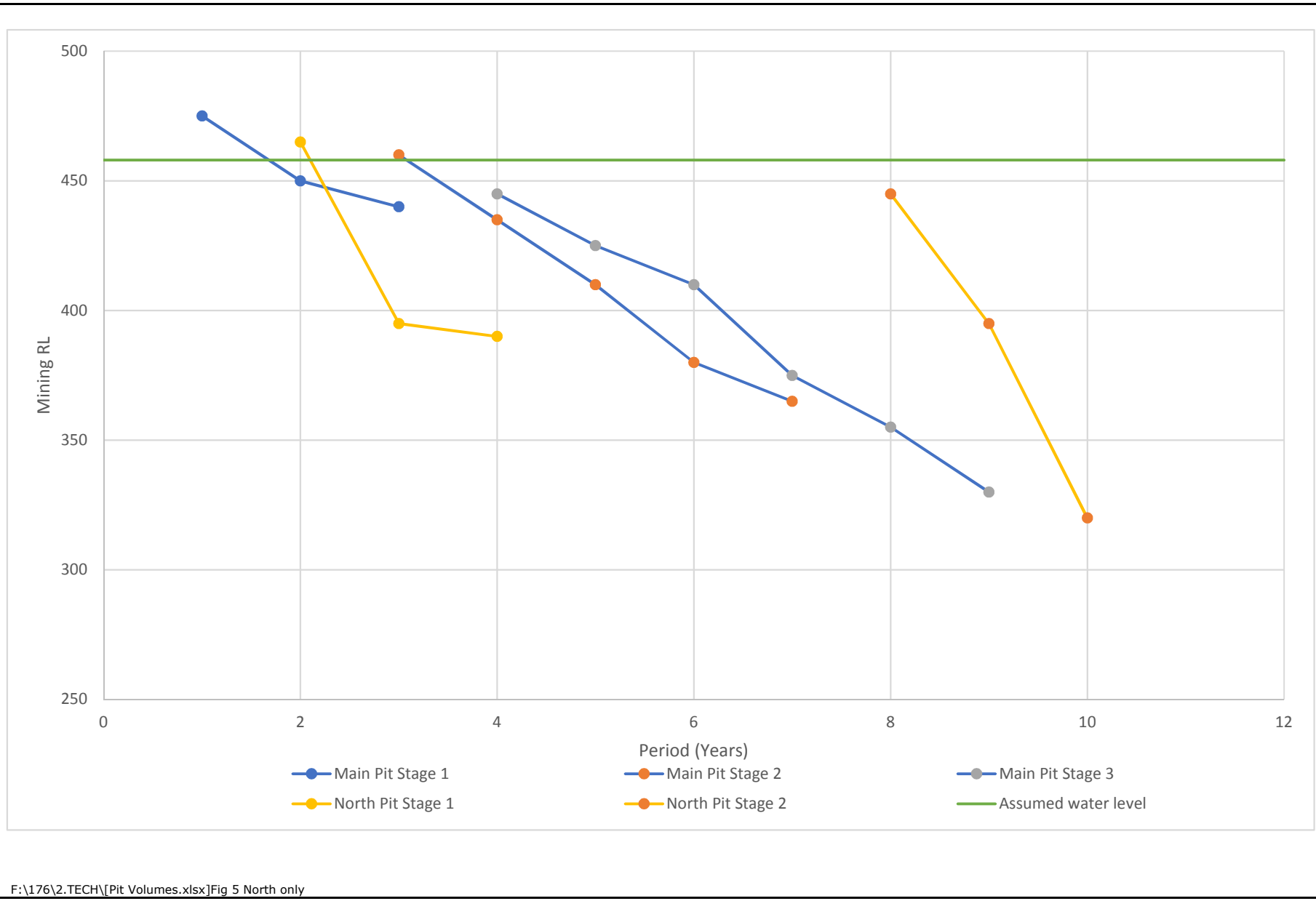
Expanded Durov Diagram

Figure 4

Date: 22/10/18

F:\176\2.TECH\[Gab_HYDROCHEM_North Deposit.xlsm]EXPANDED DUROV (1)

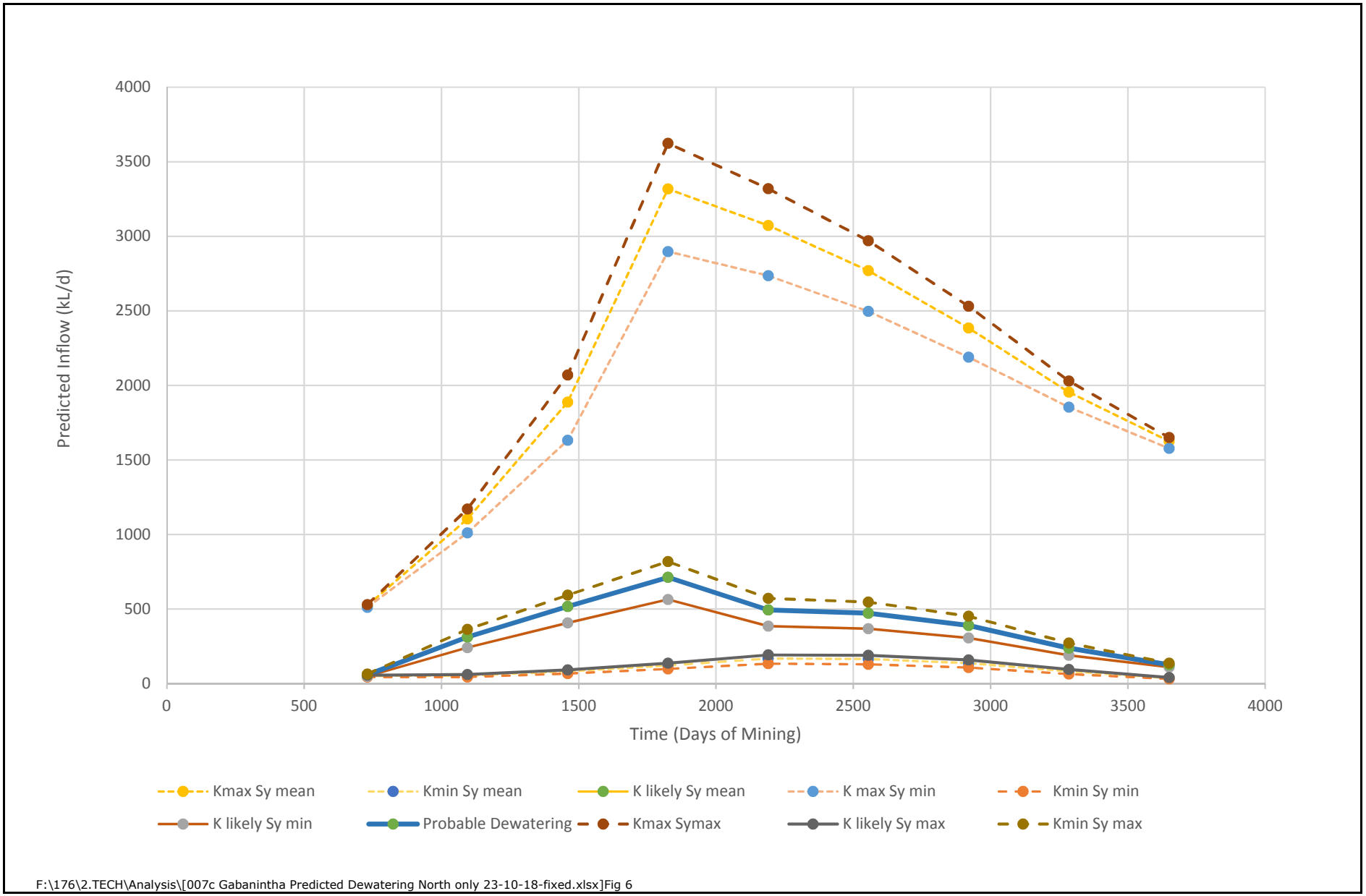
Project: Gabanintha Vanadium
Project No: 176C
Description: Northern Deposit
Client: Technologhy Metals Australia Ltd



F:\176\2.TECH\[Pit Volumes.xlsx]Fig 5 North only

AQ2

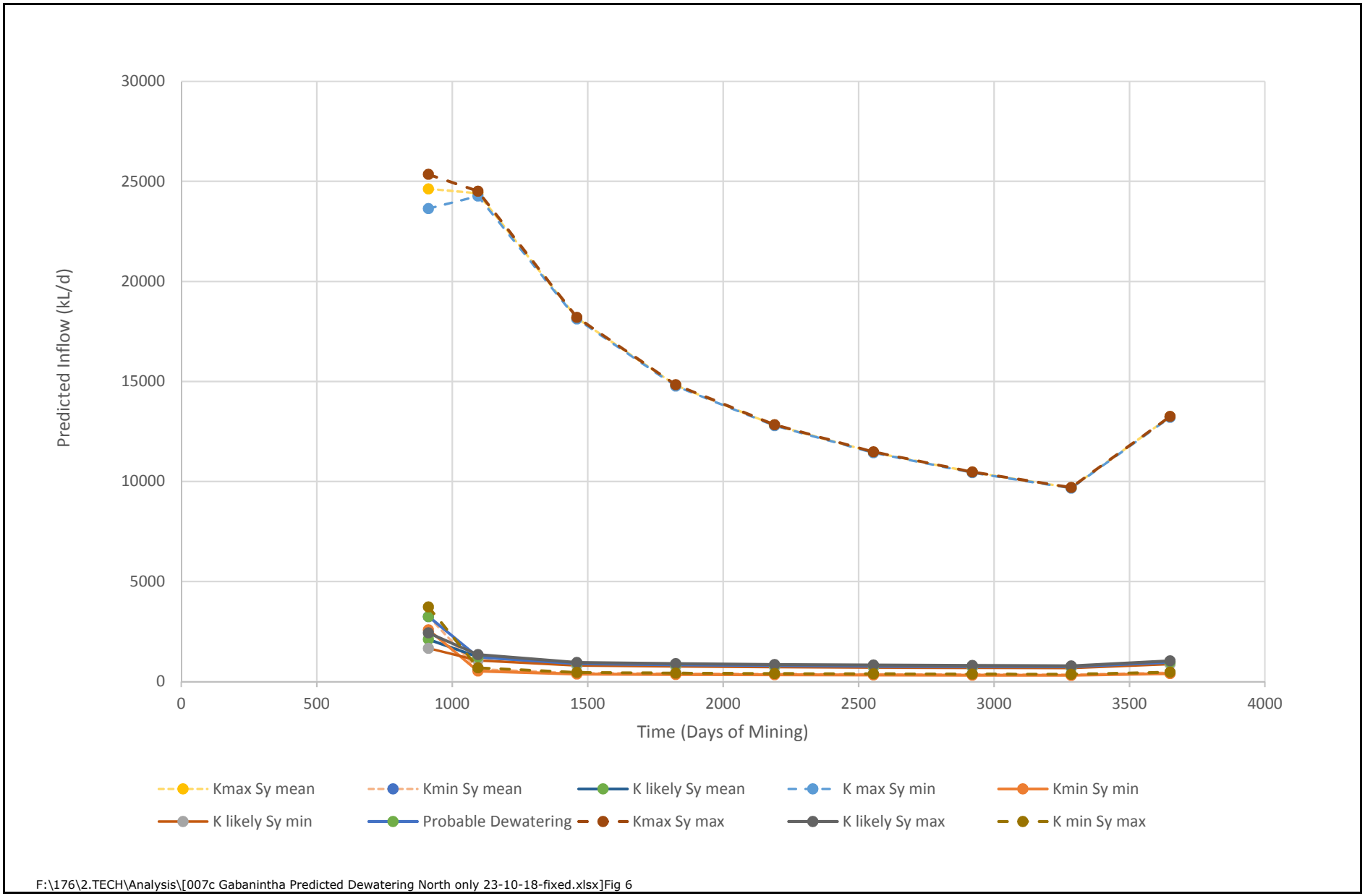
Adopted Mine Schedule FIGURE 5



F:\176\2.TECH\Analysis\[007c Gabanintha Predicted Dewatering North only 23-10-18-fixed.xlsx]Fig 6

AQ2

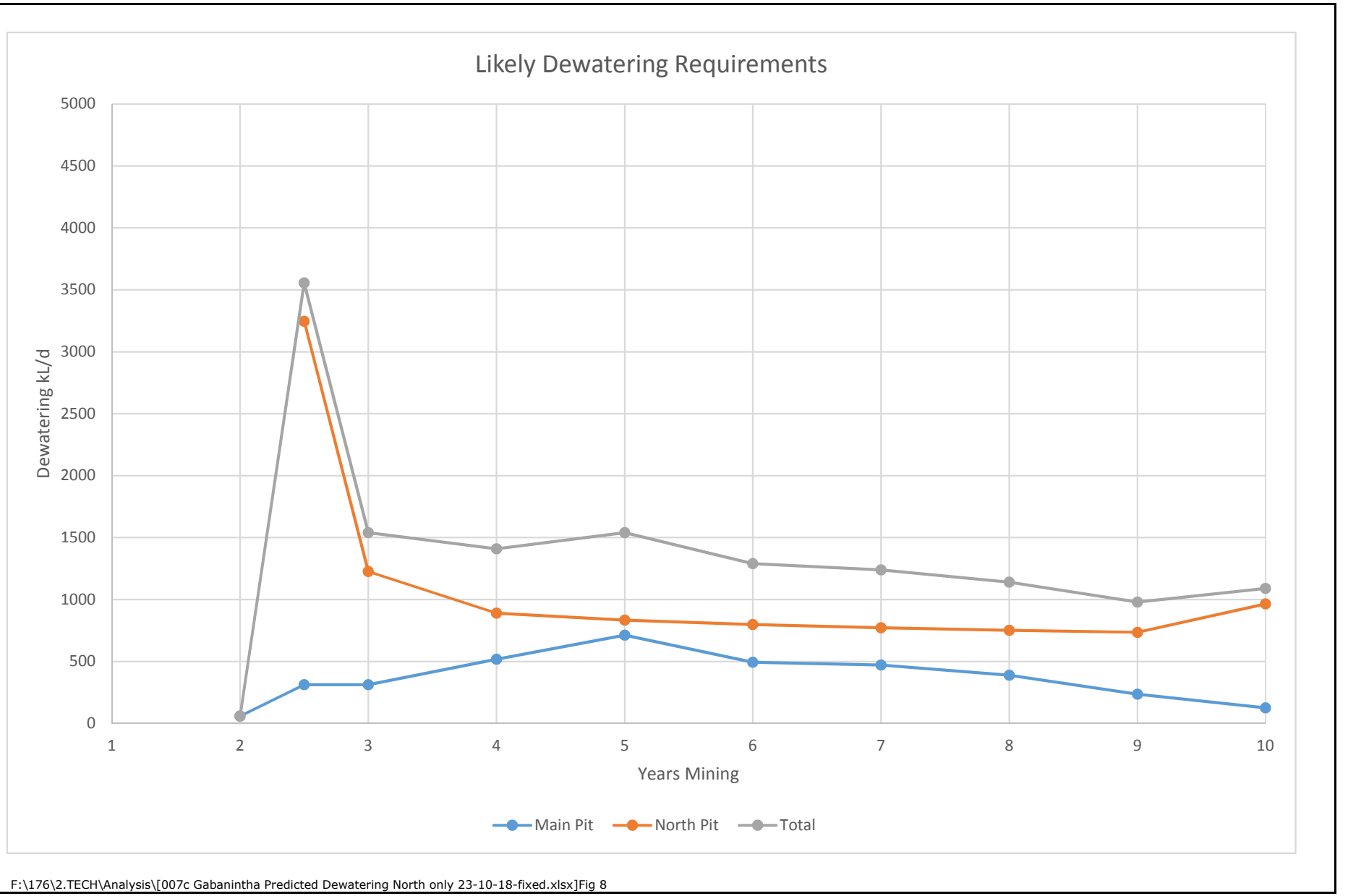
Predicted Main Pit Groundwater Dewatering FIGURE 6



F:\176\2.TECH\Analysis\[007c Gabanintha Predicted Dewatering North only 23-10-18-fixed.xlsx]Fig 6

AQ2

Predicted North Pit Groundwater Dewatering FIGURE 7



F:\176\2.TECH\Analysis\[007c Gabanintha Predicted Dewatering North only 23-10-18-fixed.xlsx]Fig 8

AQ2

Likely Dewatering Requirements FIGURE 8

APPENDIX A

Details of Dewatering Analysis

Appendix A - Dewatering Analysis

Details of the analysis approach, assumptions and aquifer parameters used to estimate the open pit inflows are summarised below:

- The dewatering estimates allow for the mine area to be characterised by single continuous blocks of material (representing each of the hydrostratigraphic units) with uniform aquifer properties.
- As estimates of groundwater inflows are inherently imprecise, dewatering estimates are calculated for the harmonic, geometric and arithmetic mean of effective permeability. This range in values for effective permeability have been derived (refer text below) from the bulk aquifer conductivities summarised in Table A1.
- The aquifer parameter values applied (Table A1) are consistent with the ranges determined for the same hydrostratigraphic units for other projects. The range in parameters have been chosen to provide a range of estimates of the potential pit inflows (i.e. a minimum, likely (median) and maximum inflow).
- Dewatering estimates assume aquifer thicknesses of 131 m and 143 m for the Cetnral and North Pits respectively. These thicknesses are based on the aquifer extending to 5 m below the final mining depths, assuming an initial water level of RL 458 for the North Pit and RL 456 for the Central Pit.
- The impact on dewatering rates of permeable structures (ie faults) has been simulated in assuming that two of these permeable features intersect the Central and North Pits. The permeable features are assigned the following properties:
    - A saturated thickness (ie vertical extent of the structure) equivalent to the main aquifer.
    - A range in hydraulic conductivity of between 0.01 m/d (minimum) and 10 m/d (maximum).
    - A specific yield of 0.1%.
    - Each feature is assumed to have a width (intersecting the pit) of 0.25 m.

Table A1: Summary of Dewatering Analysis Parameters

Hydrostratigraphic Unit	Hydraulic Conductivity (m/d)			Specific Yield		
	Min	Mean	Max	Min	Mean	Max
Saprolite	0.0001	0.001	0.05	1%	2%	2%
Saprock / Transition	0.001	0.1	0.5	2%	4%	6%
Bedrock	0.0001	0.005	0.05	0.01%	0.05%	0.1%

Effective permeability

The following method has been adopted to determine the effective permeability for each unit:

- The permeability for each hydrostratigraphic unit is assumed to follow a log-normal distribution, the mean and standard deviation of which have been estimated from the field results (corroborated against other published information where relevant e.g. USGS, 1989 and 2002).
- A Monte Carlo-approach has then been applied to this distribution to generate 10,000 random estimates of permeability, based on the distribution's key parameters, from which the harmonic mean and geometric mean of permeability can also be estimated.

  The harmonic mean, geometric mean and arithmetic mean (for the log-permeability distribution) represent the likely minimum, median and maximum effective permeability values that may be observed at an upscaled level (Scheiber et al, 1998). These three estimates of effective permeability have been used to determine the minimum, median and maximum likely dewatering inflows.

APPENDIX B-4: AQ2 – Preliminary Water Supply Assessment

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AQ2 Pty Ltd
ABN 38 164 858 075

Memo

To	Ian Prentice	**Company**	Technology Metals Australia Ltd
From	Emma Bolton	**Job No.**	176D
Date	16/11/2018	**Doc No.**	041b
Subject	Gabanintha Vanadium Groundwater Supply Assessment		

Ian,

We are pleased to provide our interim water supply assessment for the Gabanintha Vanadium Project, to support the Environmental Protection (EP) Act Referral.

1. INTRODUCTION

Technology Metals Australia Ltd (TMT) are currently undertaking a Feasibility Study for the Gabanintha Vanadium Project in the Murchison region of Western Australia.

The Project is located approximately 45 km southeast of Meekatharra and comprises two mining areas, the northern area (on pending M51/883) and the southern area (on pending M51/884), with additional land tenure covered by E51/1818 (refer Figure 1).

Water will be required for construction, dust-suppression, processing and potable supply. The current estimate for the Project water demand (as provided by Wave International, email dated 4th October 2018) is 3.3 GL/yr (i.e. ~9,000 kL/day or 104 L/s), although we understand this estimate takes no account of the gains from recycling.

AQ2 Pty Ltd (AQ2) have been engaged to provide hydrogeological inputs relating to the environmental impact assessment and Feasibility Study for the Project. During the scoping study, the Tertiary aquifer system to the north of proposed mine site (on tenement E51/1818) was identified as the most prospective water supply option on the current tenements and is the focus for further investigation.

This report summarises the findings to date, resulting from a geophysical survey and the compilation and review of available data for the Tertiary aquifer within E51/1818 (hereafter referred to as the study area). Available data includes two historical reports (recently obtained through the Freedom of Information Act) for the Gabanintha Gold Project borefield (now decommissioned). Hydrogeological drilling investigations are due to commence in the coming weeks.

2. CLIMATE

The Murchison region is characterised by an arid climate with dry, hot summers and mild winters. Data from the Bureau of Meteorology (BOM) weather station at Meekatharra Airport (Site 007045), show mean maximum daily temperatures of between 19°C in July to 38°C in January. The long-term annual average rainfall for Meekatharra for the period 1944 to 2018 is 238.2 mm, with rainfall predominantly occurring during the summer months. Evaporation rates are high, typically over 200 mm/month (~7 mm/d, ~2,400 mm/yr).

3. TOPOGRAPHY AND DRAINAGE

The Gabanintha area is generally low lying with isolated hills. The deposit itself is located on a north-northwest - south-southeast trending ridge, with a maximum height of approximately RL 500 and approximately 30 m above the surrounding plains, whilst Yagohong Hill (4 km to the north) dominates the relief at RL 604.

Ephemeral streams drain the Project area, with the main drainage lines flowing in a generally southwesterly direction from the deposit and westwards towards Lake Annean, 25 km away in the main Lake Annean creek. One such stream, crosses through the study area to the north of the deposit.

4. GEOLOGICAL SETTING

The Gabanintha Project is located in the granite-greenstone terrain of the Archean Yilgarn Craton. The mineralisation is hosted in a differentiated gabbro that strikes in a north-northwest to south-southeast direction for over 20 km and has intruded into mafic, ultramafic, extrusive and volcaniclastic rocks of the Gabanintha Formation. The intrusion is offset and disrupted by younger dolerite intrusions, faults and quartz porphyries, causing fragmentation of the mineralised zones.

Bedrock outcrops in the topographically higher areas, but is overlain over much of the area by relatively thin Quaternary and Tertiary deposits, associated with both current and palaeo-drainages. Calcrete is exposed in many of the drainage channels.

The published Geoscience Australia and Department of Water and Environmental Regulation (DWER) palaeochannel mapping (Bell et al, 2012; Davis & Macaulay et al, 2016), has a palaeochannel tributary mapped across the study area to the north of the deposit, feeding into the larger palaeo-drainage to the south (refer Figure 2).

5. REGIONAL AQUIFERS

In the extended area around the proposed mine site, there are anticipated to be two potential aquifer types, each of which are summarised below.

5.1 Palaeochannel Aquifers

As referenced in Section 4, palaeochannels have been mapped coincident with the current drainage lines in the vicinity of the Gabanintha Project. In many areas, palaeochannels are targeted for water supplies, as the basal unit of the Tertiary-aged palaeochannel often comprises a sand / gravel aquifer. Additionally, calcrete outcrops are mapped along current drainage lines to the north/west, east and south of the Gabanintha deposits, forming an upper aquifer within the Tertiary palaeochannels.

The palaeochannel aquifer located on current Project tenure (i.e. within E51/1818) has been the focus of investigations to date and is described in detail in Section 6 of this report.

Although no lithological or yield data is available for the pastoralist bores located along the drainage channel to the east of the proposed mine site, hydrogeological investigations for the Barrambie Project have been conducted on a calcrete aquifer within the drainage line to the south the Gabanintha area (approximately 30 km upgradient along the main creek line feeding into Lake Annean). These investigations identified calcrete thicknesses ranging from 3 and 18 m, with an adopted hydraulic conductivity of 100 m/d and a specific yield of 20% (Aquaterra, 2012). Furthermore, numerical groundwater modelling has indicated that the aquifer is capable of sustaining the proposed Barrambie water demand of 2.5 GL/a (6,850 kL/d). The Barrambie investigations also referred to a deep palaeochannel aquifer, however this was not fully investigated, as the calcrete aquifer was sufficient to satisfy the project water demand. Only two deep holes were drilled to investigate the paleochannel sediments at Barrambie. However, the sand intersected has been interpreted as weathered basement and no deep palaeochannel aquifer has been identified to date.

5.2 Fractured Rock Aquifer

Increased (secondary) permeability can result from fracturing and faulting, providing local aquifers. There is always some uncertainty related to the extent of fracturing in fractured rock aquifers, resulting in uncertainty in the sustainability of the derived water resource.

Recorded yields from 80 mm cased bores (ie Gb1, Gb12 and Gb14) intersecting weathered / fractured bedrock in the vicinity of the Gabanintha northern area, range between 0.7 L/s and 1.4 L/s. Production bores have been installed adjacent to Gb12 and Gb14 as part of the historic water supply investigations, although no bore completion details or test pumping data are available. The recent hydraulic testing of drill hole GBDD005 indicates a permeability of approximately 2 m/d for an isolated (1 m thick) zone of fracturing.

6. HYDROGEOLOGY OF THE WATER SUPPLY STUDY AREA

The Department of Water and Environmental Regulation's (DWER's) database and other publicly available hydrogeological reporting has been reviewed, to form a hydrogeological understanding of the project area. In addition, two historical reports have recently been obtained through the Freedom of Information Act. These two reports relate to previous water supply investigations in the area (GRC, 1987) and the performance of the Gabanintha Gold Project borefield (now decommissioned) (GRC, 1988).

6.1 Groundwater Levels and Flow

Recorded water levels obtained from DWER's database, together with NASA's SRTM data for bore elevations, have been combined with recently recorded water levels, to plot groundwater level contours for the area in and around Gabanintha (Figure 3).

The groundwater level across the water supply study area is estimated to range between approximately RL 455 and RL 473, with groundwater flowing from the northeast to the southwest (and then west along the Lake Annean paleochannel). The depth to groundwater in the water supply study area ranges between approximately 1.8 and 2.6 m below ground level (bgl).

6.2 Aquifers

Historic water supply investigations for the Gabanintha Gold Mine identified a shallow palaeochannel in the study area, infilled with Tertiary-aged calcrete, silcrete, clay, sand, silt and ironstone gravel to depths of up to 50 mbgl (GRC, 1987).

The Tertiary paleochannel sediment sequence has been described (GRC, 1987) as comprising:

- an upper calcrete (and calcareous clay) aquifer unit approximately 12 m thick;
- a layer of clay and, in places, silcrete which separates the upper and lower aquifer units, ranging in thickness from 2 to 8 m;
- a lower aquifer unit comprising 6 to 12 m of slightly clayey ironstone gravel and sand overlying a clayey quartz sand ranging between 3 and 10 m thick.

Four test production bores (PB1 to PB4), cased with 150 mm ND PVC, were initially installed to intersect and test this paleochannel aquifer system. The bores were subsequently replaced with four 200 mm ND steel production bores (PB1R to PB4R) and the borefield was commissioned in October 1987 (referred to here as the Gabanintha Gold Borefield). The locations of these bores are shown on Figure 4, with borelogs presented in Appendix A. Additionally, two production bores further down-gradient (Well 1 and Well 4) are anticipated to also intersect calcrete / Tertiary sediments and were installed by the Water Corporation as part of the Meekatharra town water supply investigations (refer Figure 4).

Hydraulic testing of bore PB1, 2 and 3 resulted in aquifer transmissivity values of between 65 and 200 m^2/d, with a value of 20 m^2/d derived for bore (PB4). Calculated storativity ranged from $2.4x10^{-4}$ to $1.3x10^{-3}$.

TMT recently engaged Southern Geoscience Consultants (SGC) to conduct a transient electromagnetic (TEM) survey along three transects in the palaeochannel study area, including one transect (Transect 2) through the Gabanintha Gold Borefield. The profile plots of the TEM data, together with cross-sections of the conductivity depth inversion (CDI) models are presented in Appendix B. The results define channel-type features on each transect, inferred to be the paleochannel identified by the GRC drilling. It should be noted, however, that the modelled depths have not been correlated to the drilling data.

The locations of the TEM survey lines and the interpreted location of the palaeochannel, derived from the survey results, are shown in Figure 5. Bore PB2 is located near to the centre of the paleochannel, whilst the other production bores (PB4, PB3 and PB1) are closer to the edge of the channel. Additionally, the TEM data suggests the depth of the channel in the vicinity of PB2 should be significantly deeper than at the other production bores, with the greater depth potentially associated with a fault zone. Although Bore PB2 terminated in clay, it is unknown whether it is Tertiary clay - with the potential for additional palaeochannel sediments at depth - or weathered bedrock (saprolite), suggesting a deep weathered profile.

6.3 Water Quality

The recorded groundwater quality data in the water supply study area ranges from fresh to brackish, with concentrations of total dissolved solids (TDS) generally ranging between 920 and 3,000 mg/L, although concentrations of up to 10,000 mg/L have been recorded more regionally / at depth. The fresher groundwater occurs in or near areas of rainfall recharge or potentially in shallow, perched aquifers, whilst the deeper groundwater is more saline. It should be noted that the majority of the water quality data available, is from shallow bores intersecting calcrete and Tertiary sediments. Any groundwater abstracted from bedrock and/or deeper palaeochannel sediments (ie deep basal sands), should they exist in the area, may be much more saline.

Groundwater chemistry data for the two Water Corporation bores (Wells 1 and 4) and the Gabanintha Gold Borefield (PB1 to PB4) are presented in Table 1 and have been plotted on an Expanded Durov Plot (Figure 6). The plot shows the groundwater from both areas to be sodium and chloride dominant, indicative of an end point ("older") water. This suggests the groundwater has been subjected to evapotranspiration and / or mineral dissolution since it was recharged.

Table 1: Groundwater Chemistry Analyses

	Bore ID	PB1	PB2	PB3	PB4	Gb7	Well 1	Well 4
	Sample Date	1986	1986	1986	1986	1986	17/6/85	13/10/83
Analyte Name	Units							
pH	No unit	7.7	7.5	7.6	7.6	8.3	8.4	7.8
Conductivity	µS/cm	2230	2180	2450	2270	2230	1410	1450
Carbonate Alkalinity as CO3	mg/L	-	-	-	-	10	3	-
Bicarbonate Alkalinity as HCO3	mg/L	210	210	230	220	180	180	205
Chloride, Cl	mg/L	480	460	530	480	490	299	263
Sulfate, SO4	mg/L	160	160	180	170	200	125	112
Calcium, Ca	mg/L	81	78	89	85	82	36	47
Magnesium, Mg	mg/L	53	48	56	53	54	29	34
Sodium, Na	mg/L	270	270	308	276	302	229	184
Potassium, K	mg/L	23	23	28	24	22	17	17

7. PRELIMARY WATER SUPPLY ASSESSMENT

A preliminary assessment of the identified palaeochannel aquifer has been conducted to estimate the potential long-term sustainability of a water supply borefield for the proposed Gabanintha Project. This assessment is based on the aquifer parameters derived from the hydraulic testing of bores PB1 to PB4 as well as the observed drawdowns reported in the preliminary borefield performance review

(GRC, 1988). Total drawdown in the immediate borefield area after 5 months of historical abstraction (at an average rate of ~2,100 kL/d) was approximately 2 m, with a drawdown of between 0.2 and 0.5 m recorded 2 km down-gradient.

The water supply assessment was based on the following assumptions:

- The palaeochannel aquifer ranges between 1.4 and 2.7 km wide (based on the recent geophysical survey) and 30 m deep, with a strike length crossing the Gabanintha Exploration tenement (E51/1818) of approximately 12 km.
- The hydraulic gradient across the proposed borefield area is $1.5x10^{-3}$.
- Adopted aquifer parameters range between 5 and 10 m/d permeability and 5 to 10% specific yield.
- Aquifer recharge to the borefield is based on 0.1% of annual average rainfall across the whole catchment upstream of the borefield area. This is approximately equal to 600 kL/d.
- The conceptual borefield consists of twelve production bores, located along the strike length of the paleochannel (within the tenement boundaries and south of the vermin-proof fence), at a spacing of approximately 1 km, with a combined yield of 9,000 kL/d (i.e. individual bore yields of 500 to 1,000 kL/d). Refer to Figure 7 for the nominal borefield configuration that has been adopted.
- Maximum drawdown across the borefield has been limited to 20 m (i.e. two-thirds of the total aquifer thickness), to allow some remaining stygofauna habitat.

Based on the above, it is estimated that the proposed borefield would be able to supply the assumed water demand of 9,000 kL/d for a duration of between 6 and 10 years. However, it should be noted that this is a very preliminary estimate, based on data over an assumed aquifer extent which is still to be proven. Additionally, it has been assumed that the borefield abstraction must satisfy the full water demand, whilst in reality groundwater abstracted for dewatering purposes will also contribute towards the required water supply. Even with some supply from dewatering, it is still anticipated that aquifer(s) outside of the current Project tenure will be required to meet the current water demand, based on a 20 year mine life.

8. FURTHER WORK

Further work is required to better assess the water supply potential of the identified palaeochannel aquifer and to determine the actual location and configuration of the proposed borefield. As such, the maximum depth of the paleochannel aquifer needs to be confirmed and the potential variability in aquifer parameters needs to be assessed.

The following activities are currently scheduled to take place:

- drilling, targeting the deepest parts of the paleochannel (identified from the TEM survey), to confirm maximum aquifer depths;
- additional drilling bore installation and hydraulic testing to confirm the extent, continuity and hydraulic characteristics of the palaeochannel aquifer and to provide a network of baseline monitoring bores;
- groundwater modelling to determine the optimal borefield configuration, to assess the maximum sustainable abstraction rates and duration, and to predict groundwater level drawdowns for an environmental impact assessment.
- hydrogeological investigations of additional water supply sources outside of the current Project tenements; for example, the main palaeochannel to the south of the Gabanintha Project (coincident with the main creek line which feeds into Lake Annean) – refer Figure 2.

We trust that this report meets your current requirements to support the EP Act Referral. Should you require any further information, please do not hesitate to contact the undersigned.

Regards

Emma

Emma Bolton
Consulting Hydrogeologist

Jeff

Jeff Jolly
Consulting Hydrogeologist

Author: EJB (13/11/18)
Checked: JLJ (15/11/18)
Reviewed: JLJ (15/11/18)

References

Aquaterra, 2009. Barrambie Water Supply Investigations. Appendix C of the Public Environmental Review for the Barrambie Vanadium Project, Reed Resources Ltd. Doc Ref: 767/B12/233b.

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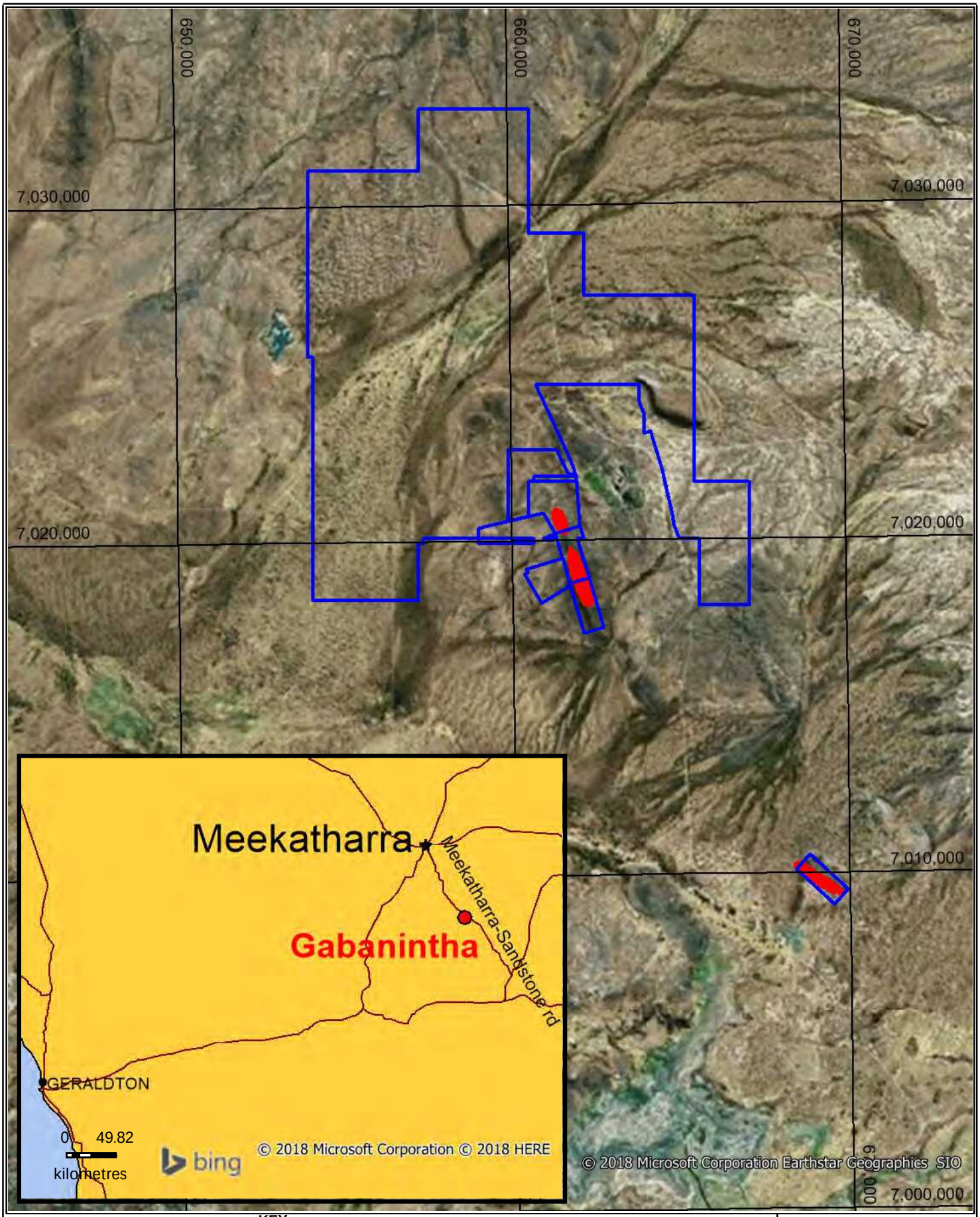
Southern Geoscience Consultants (SGC), 2018. TEM Surveys for Mapping Paleo-channel Structures at the Gabanintha Vanadium Project. Unpublished Memorandum (Report No SGC3413).

AQ2

FIGURES



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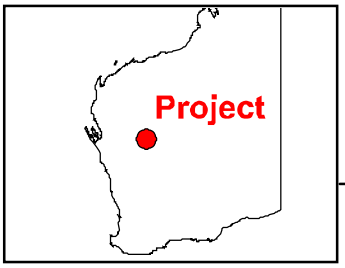


Location: F:\176\4.GIS\Workspaces

KEY

Tenement Boundary

Pit Locations

0 5,000

metres

Scale 1:150,000

AQ2

FIGURE 1

Location Map Showing Project Tenements

AUTHOR: EB

DRAWN: LDS

DATE: 04/05/2018

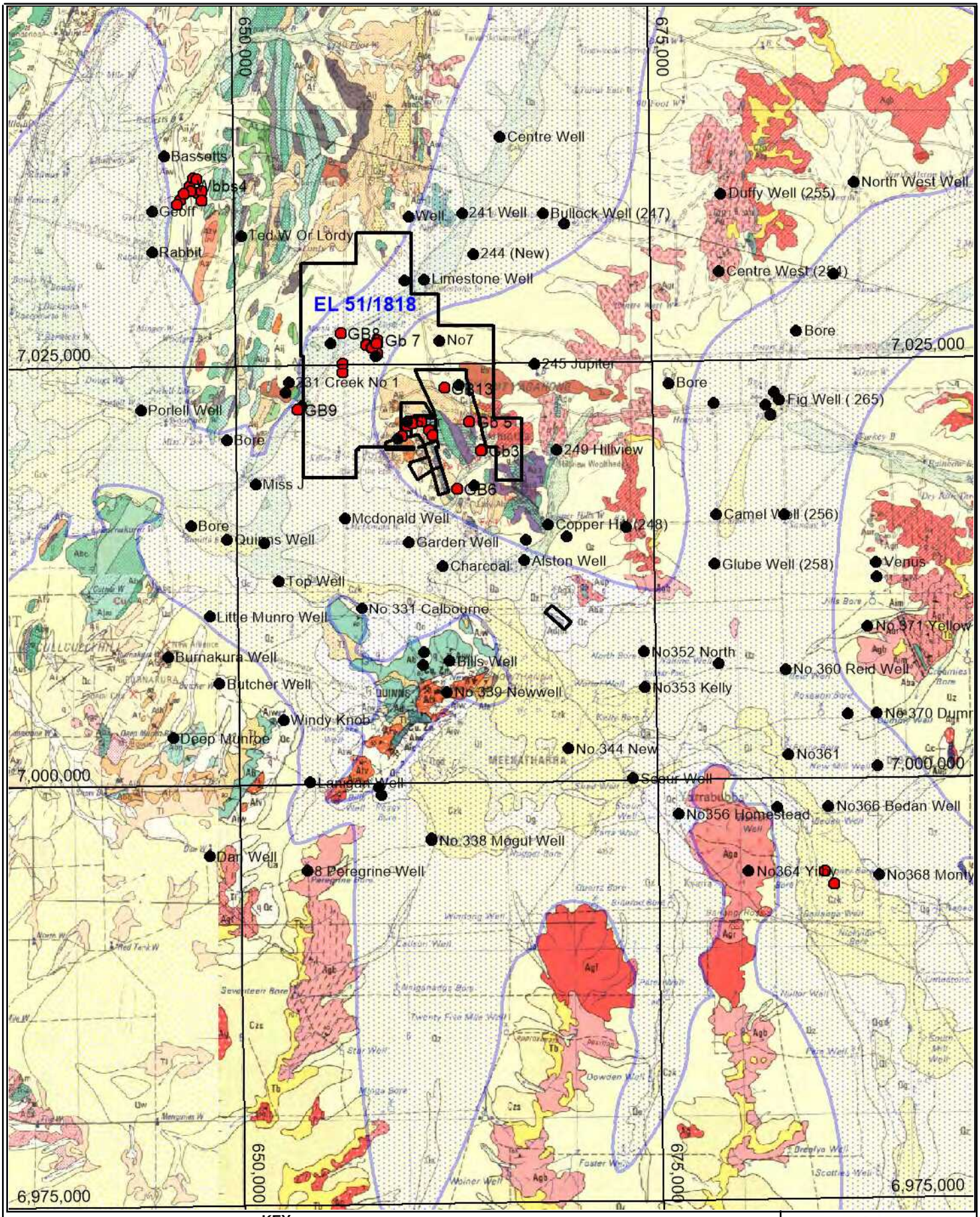
REPORT NO: 041

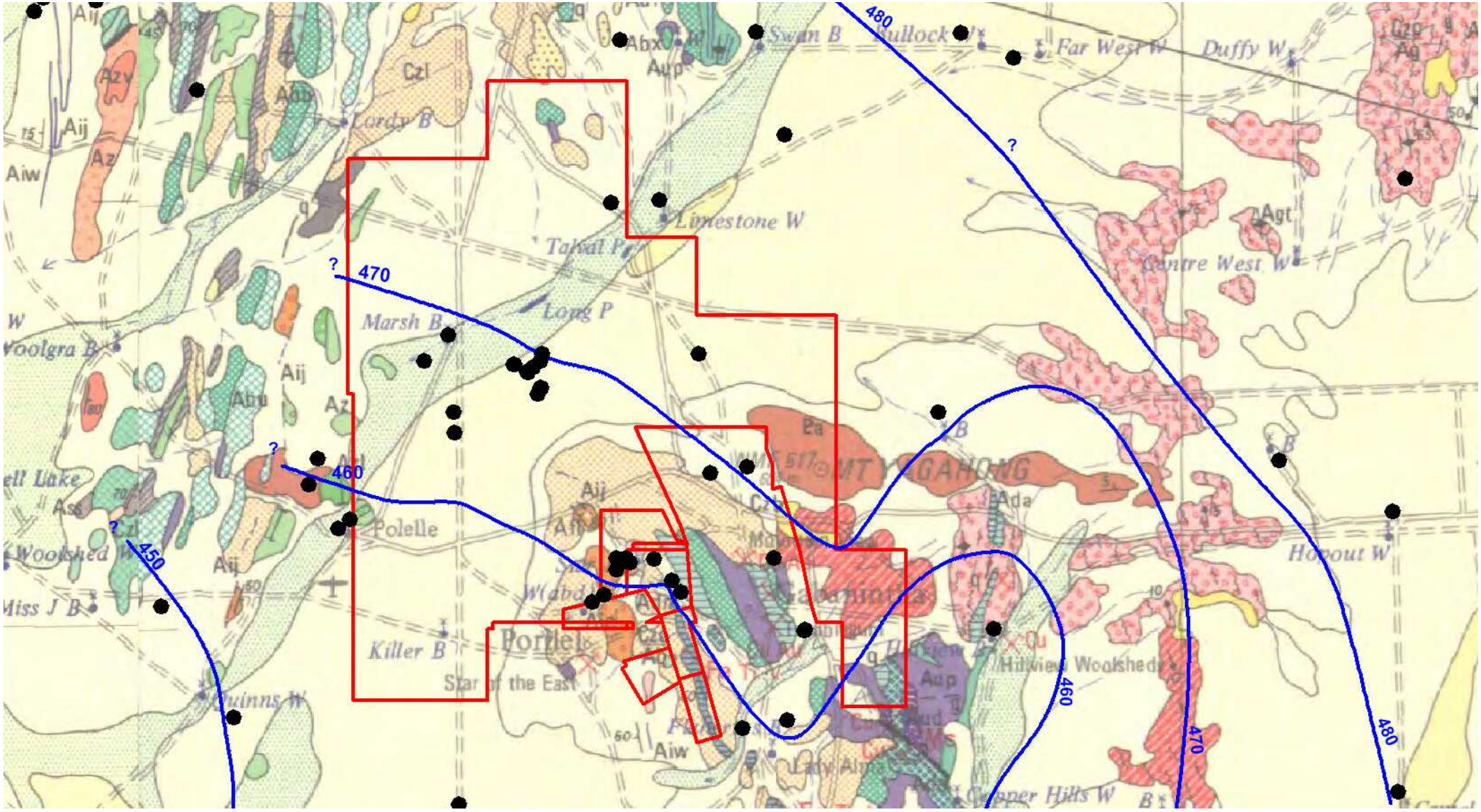
REVISION: a

JOB NO: 176D

NOTES & DATA SOURCES:

Aerial image from Bing 2018, Microsoft Corporation.
Tenement boundaries from Technology Metals Australia Ltd


650,000
675,000
7,025,000
7,000,000
6,975,000
Centre Well
Bassetts
Wbbs4
Geoff
Well
241 Well
Bullock Well (247)
Duffy Well (255)
North West Well
Ted W Or Lordy
Rabbit
244 (New)
Centre West (264)
Limestone Well
EL 51/1818
GB8
Gb 7
No7
Bore
245 Jupiter
731 Creek No 1
GB13
Bore
Fig Well (265)
Porlell Well
GB9
Gb 5
Bore
Gb3
249 Hillview
Miss J
GB6
Mcdonald Well
Camel Well (256)
Bore
Quins Well
Garden Well
Copper Hill (248)
Charcoal
Alston Well
Glube Well (258)
Venus
Top Well
Little Munro Well
No 331 Calbourne
No 371 Yellow
Burnakura Well
Bills Well
No352 North
No 360 Reid Well
Butcher Well
No 339 Newwell
No353 Kelly
No 370 Dumr
Windy Knob
Deep Munroe
No 344 New
No361
Langdat Well
Scour Well
No356 Homestead
No368 Bedan Well
No 338 Mogul Well
Dar Well
8 Peregrine Well
No364 Yilby
No368 Monty
LOCATION MAP
Project
KEY
DWER Database Bores
GRC Bores
Mapped Palaeodrainage (Bell, 2012)
Tenement EL51/1818
0
10,000
metres
Scale 1:300,000
AQ2
FIGURE 2
Geology Map showing DWER Database Bores
AUTHOR: EB
DRAWN: LDS
DATE: 23/10/2018
REPORT NO: 041
REVISION: a
JOB NO: 176D
NOTES & DATA SOURCES:
Tenement boundaries from Technology Metals Australia Ltd
Location: F:\176\4.GIS\Workspaces



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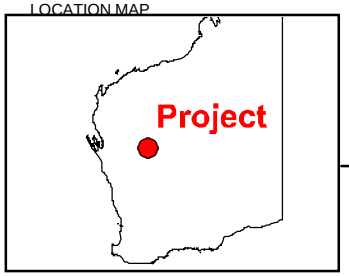


Location: F:\176\4.GIS\Workspaces

KEY

- Groundwater Contours (mRL)
- DWER Dababase Bores
- Tenement Boundary

0 5,000

metres

Scale 1:125,000

DRAWN: LDS
AUTHOR: EB
DATE: 07/06/2018

REPORT NO: 041
REVISION: a
JOB NO: 176D

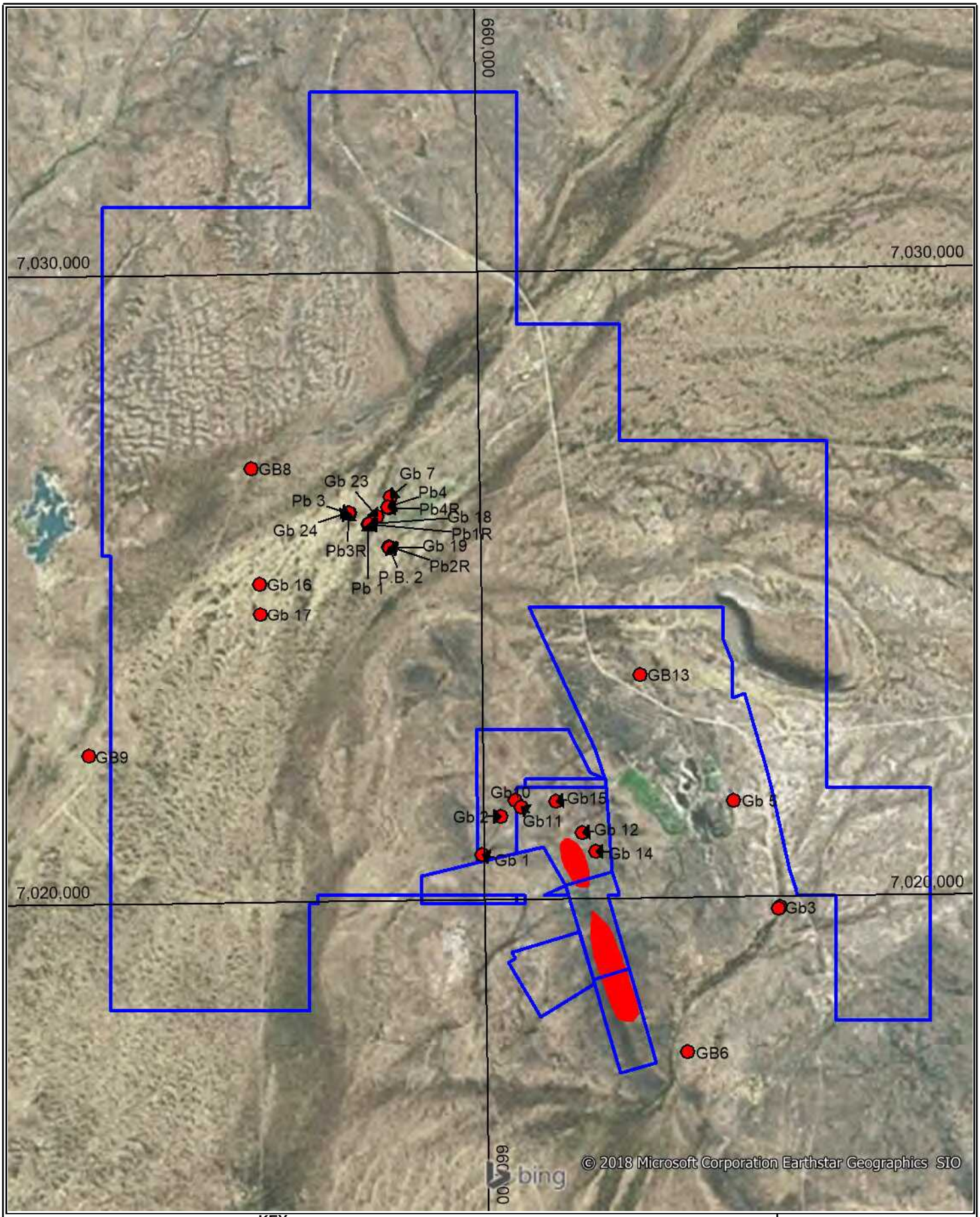
NOTES & DATA SOURCES:

Tenement boundaries from Technology Metals Australia Ltd

AQ2

FIGURE 3

Geology Map showing Water Level Contours



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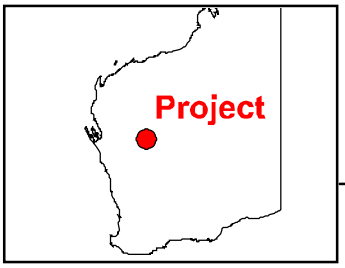


Location: F:\176\4.GIS\Workspaces

KEY

- Tenement Boundary
- Pit Locations
- GRC Bores

0 2,500

metres

Scale 1:80,000

AQ2

FIGURE 4

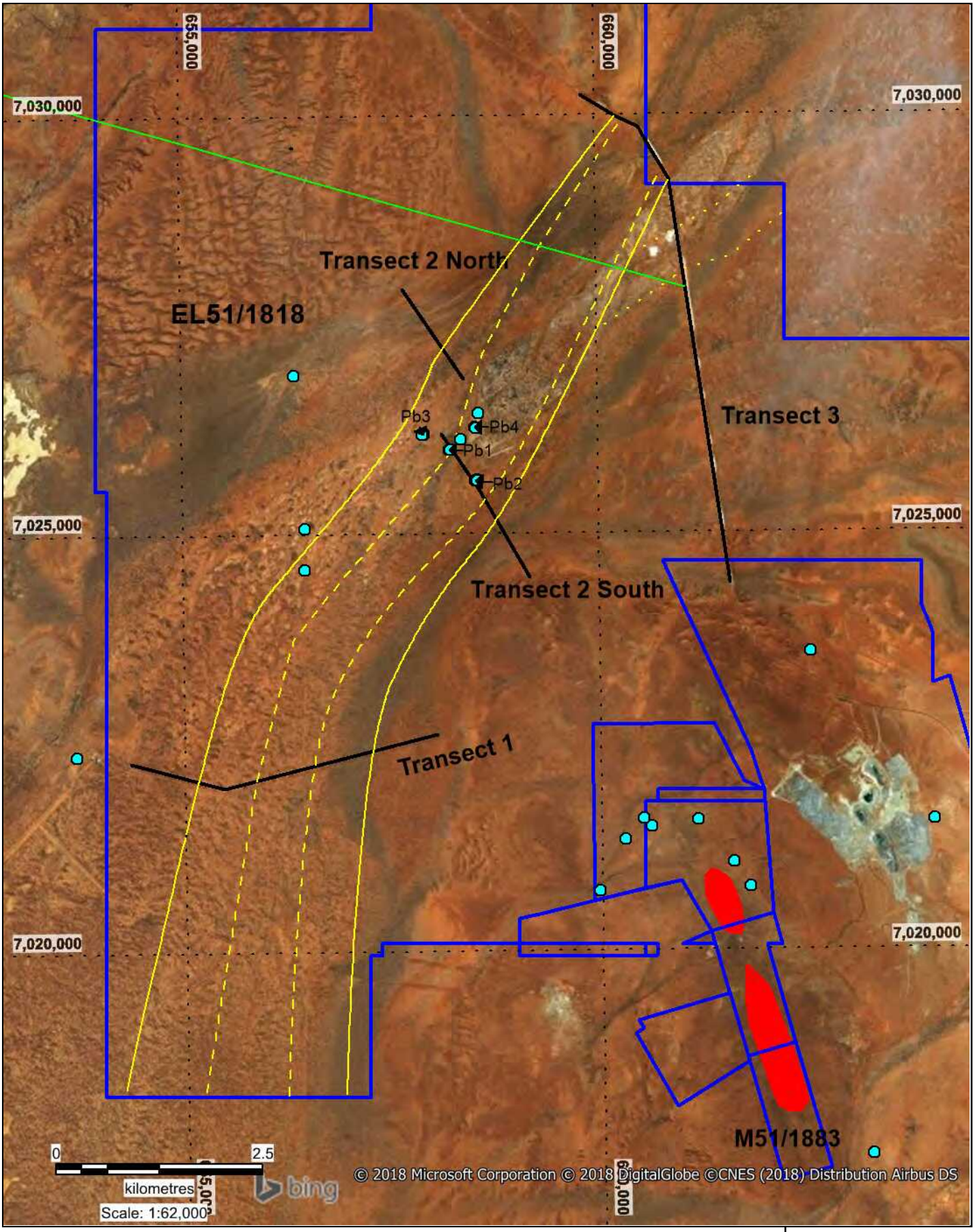
Water Supply Study Area

AUTHOR: EB
DRAWN: LDS
DATE: 23/10/2018

REPORT NO: 041
REVISION: a
JOB NO: 176D

NOTES & DATA SOURCES:

Aerial image from Bing 2018, Microsoft Corporation.
Tenement boundaries from Technology Metals Australia Ltd



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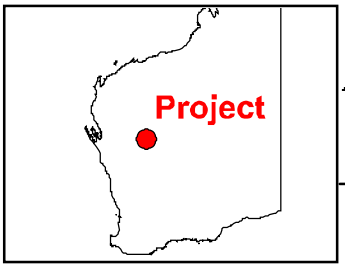


Location: F:\176\4.GIS\Workspaces

KEY

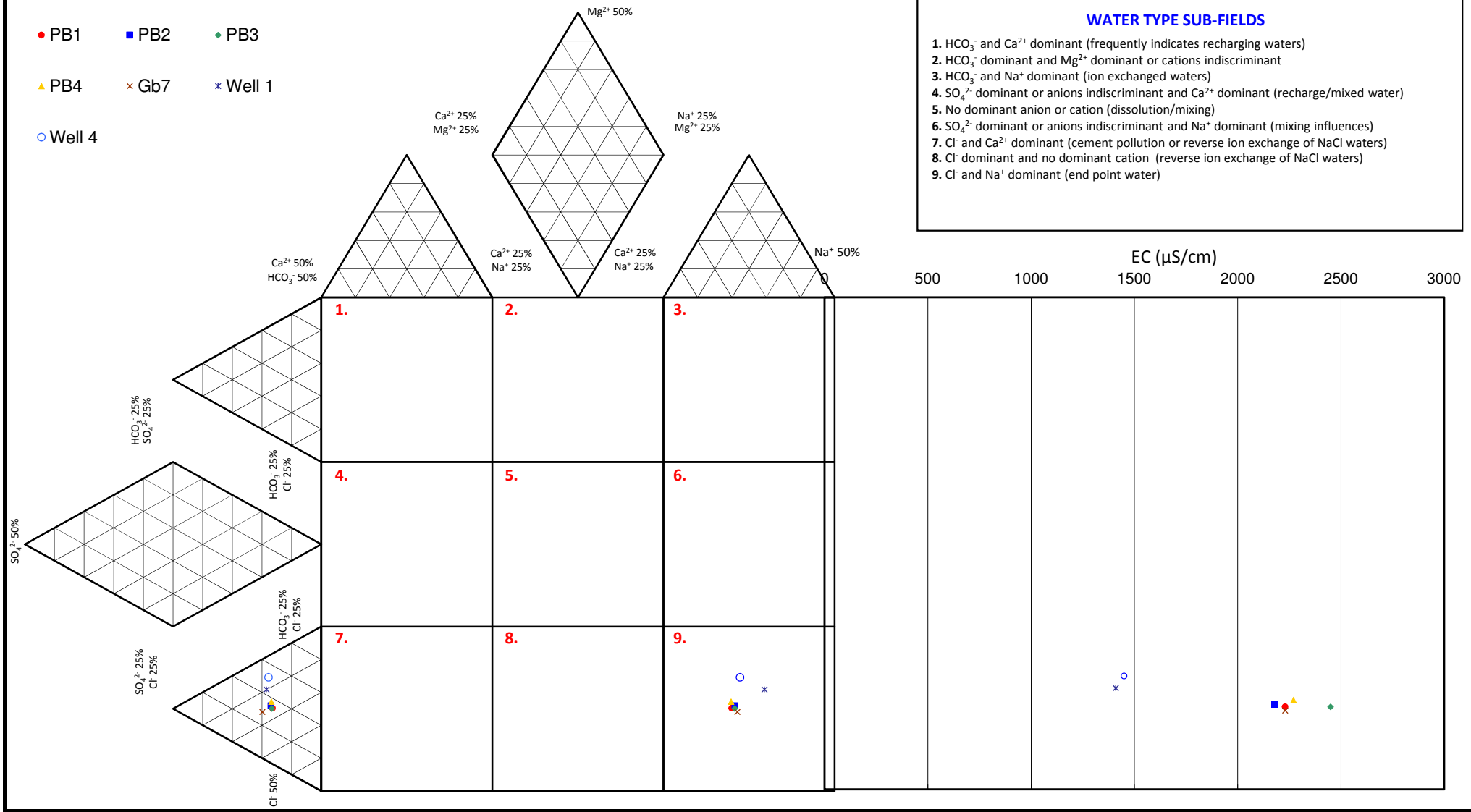
- TMT Tenements
- TEM transect
- Pit outline
- GRC bores
- Deepest part of main palaeochannel
- Boundary of main palaeochannel
- Boundary of tributary palaeochannel
- Vermin Proof Fence

AUTHOR: EB	REPORT NO: 041	**NOTES & DATA SOURCES:** Aerial image from Bing 2018, Microsoft Corporation. Tenement boundaries from Technology Metals Australia Ltd
DRAWN: LDS	REVISION: a	
DATE: 13/11/2018	JOB NO: 176D	

AQ2

FIGURE 5

PALAEOCHANNEL LOCATION FROM TEM SURVEY



WATER TYPE SUB-FIELDS

1. HCO_3^- and Ca^{2+} dominant (frequently indicates recharging waters)
2. HCO_3^- dominant and Mg^{2+} dominant or cations indiscriminant
3. HCO_3^- and Na^+ dominant (ion exchanged waters)
4. SO_4^{2-} dominant or anions indiscriminant and Ca^{2+} dominant (recharge/mixed water)
5. No dominant anion or cation (dissolution/mixing)
6. SO_4^{2-} dominant or anions indiscriminant and Na^+ dominant (mixing influences)
7. Cl^- and Ca^{2+} dominant (cement pollution or reverse ion exchange of NaCl waters)
8. Cl^- dominant and no dominant cation (reverse ion exchange of NaCl waters)
9. Cl^- and Na^+ dominant (end point water)

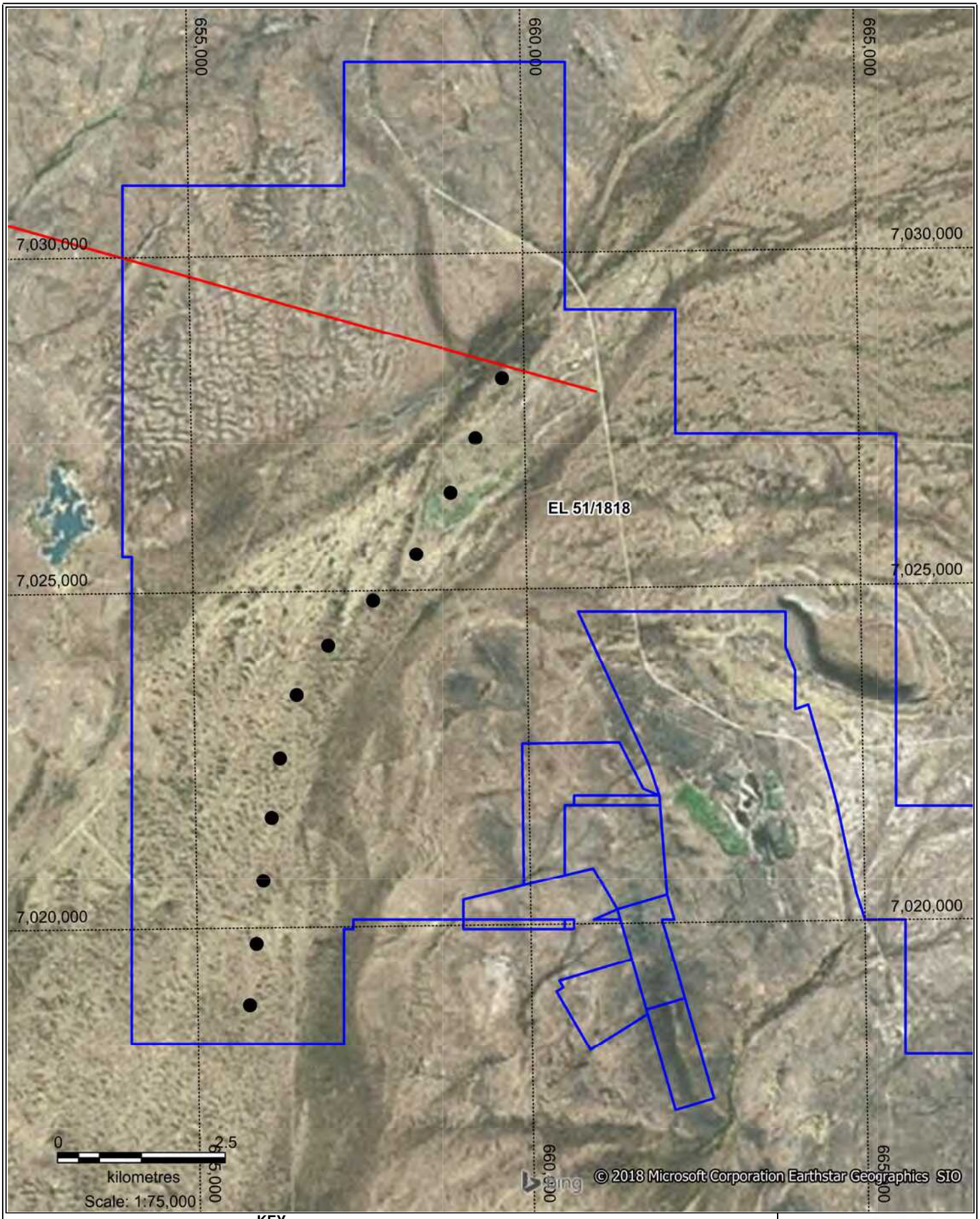
Expanded Durov Diagram

Figure 6

Date: 22/10/18

F:\176\2.TECH\[Gab_HYDROCHEM_Historical Bores.xlsm]EXPANDED DUROV (1)

Project: Gabanintha Vanadium
Project No: 176D
Description: Water Supply Study Area
Client: Technologhy Metals Australia Ltd



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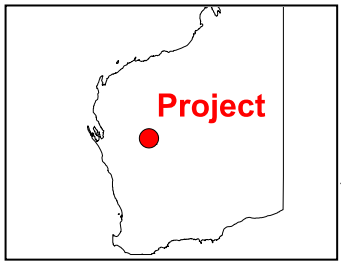


Location: F:\176\4.GIS\Workspaces

KEY

Tenement Boundary

Vermin Proof Fence

Nominal Bore Location

AUTHOR: EB
DRAWN: LDS
DATE: 19/10/2018

REPORT NO: 041
REVISION: a
JOB NO: 176D

NOTES & DATA SOURCES:

Aerial image from Bing 2018, Microsoft Corporation.
Tenement boundaries from Technology Metals Australia Ltd

AQ2

FIGURE 7

Nominal Borefield Configuration

APPENDIX A

Bore Completion Logs for the Gabanintha Gold Borefield (from GRC, 1986 & 1987)

DOWNUNDER GOLD GABANINTHA

BORE COMPLETION REPORT

BORE Nº : PB1R

STATUS : PRODUCTION

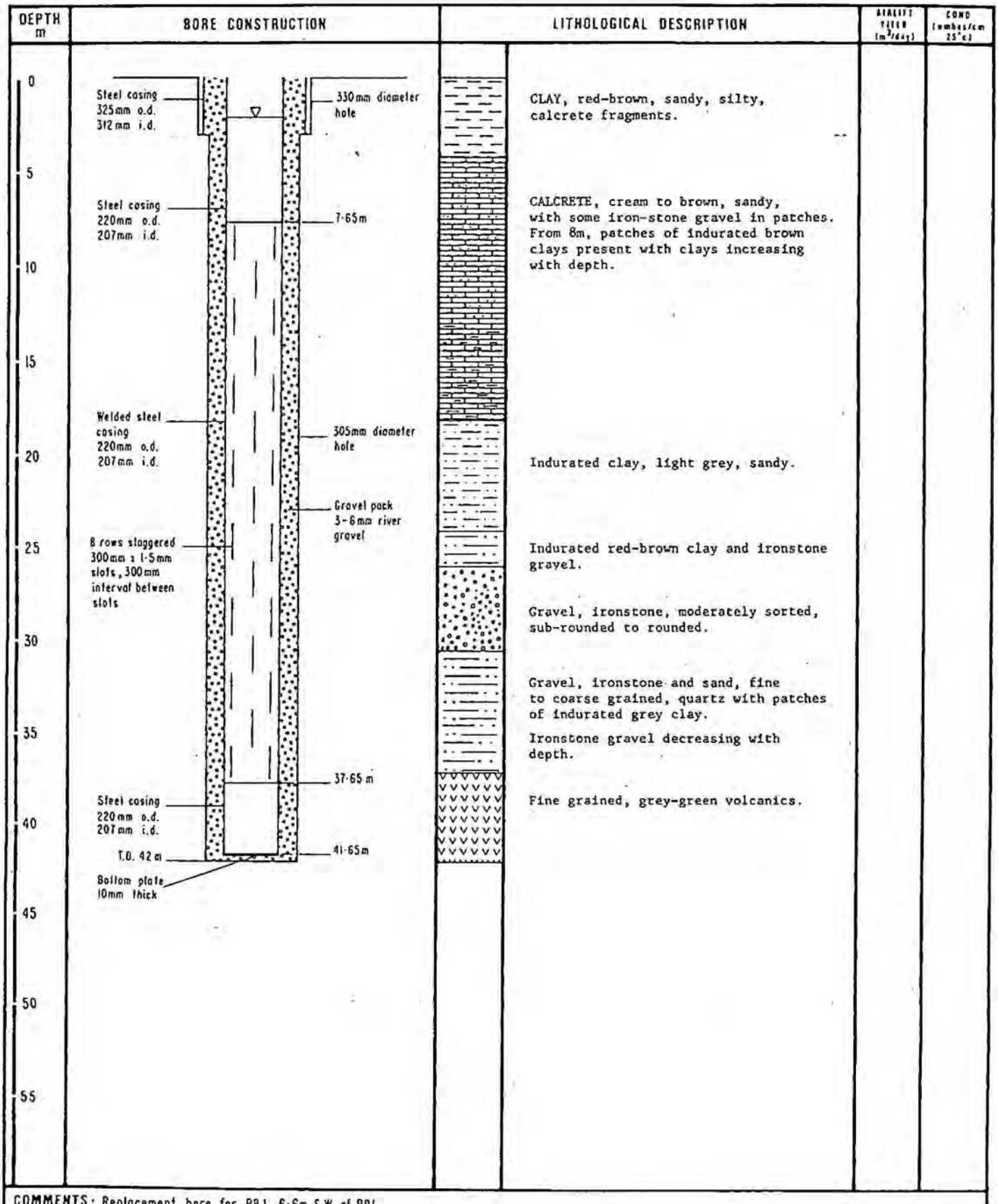
TOTAL DEPTH : 42m

ELEVATION :

OPEN INTERVAL : 7·65 - 37·65 m

DRILLED : DOWNHOLE HAMMER 30/8/87

WATER LEVEL : 2·15 m



COMMENTS : Replacement bore for PB1, 6·6m S.W. of PB1

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD - GABANINTHA

BORE COMPLETION REPORT

BORE NO : PB 2B

STATUS : PRODUCTION

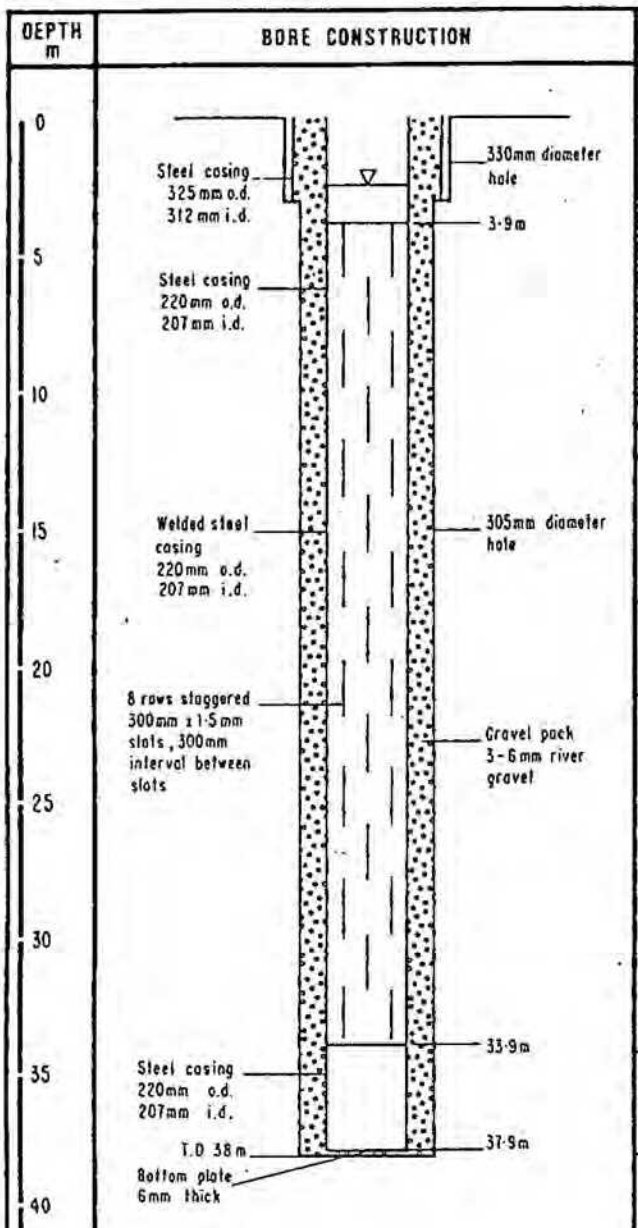
TOTAL DEPTH : 38 m

ELEVATION :

OPEN INTERVAL : 3·9 - 33·9 m

DRILLED : DOWNHOLE HAMMER 28/8/87

WATER LEVEL : 2·4 m



COMMENTS : Replacement bore for PB 2, 3·9m South of PB 2

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD - GABANINTHA

BORE COMPLETION REPORT

BORE Nº : PB3R

STATUS : PRODUCTION

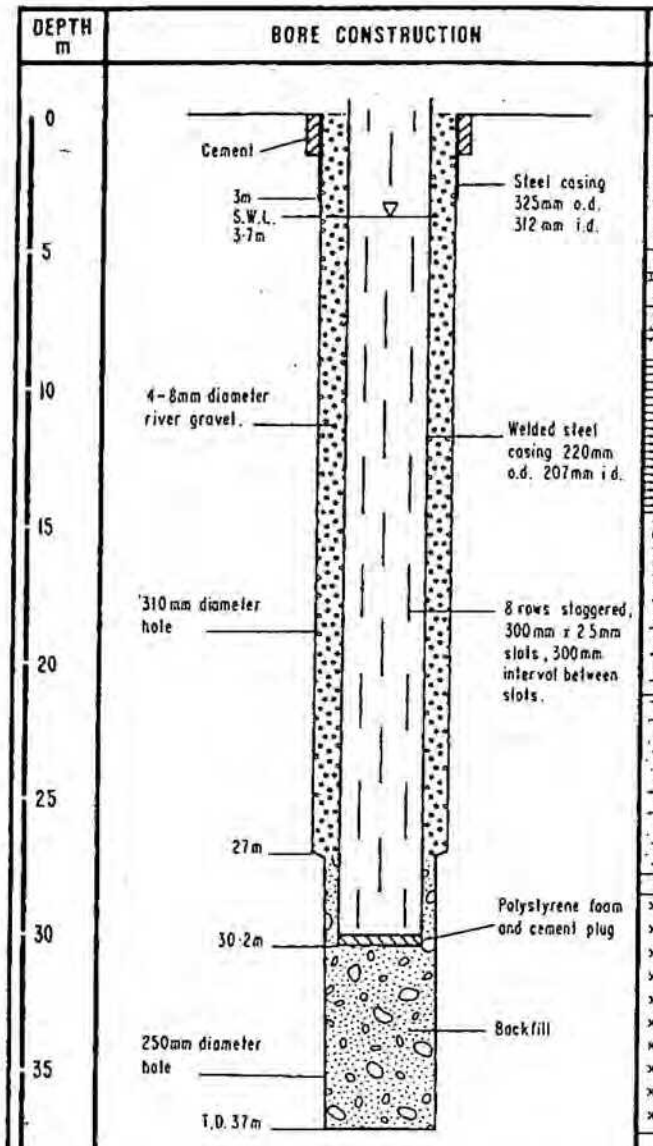
TOTAL DEPTH : 37m

ELEVATION :

OPEN INTERVAL : 0·2 – 30·2 m

DRILLED : 10/12 – 14/12/87

WATER LEVEL : 3·7 m



COMMENTS : Replacement production bore, 11·7 m S.E. of PB 3

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD GABANINTHA

BORE COMPLETION REPORT

BORE Nº : PB 4R

STATUS : PRODUCTION

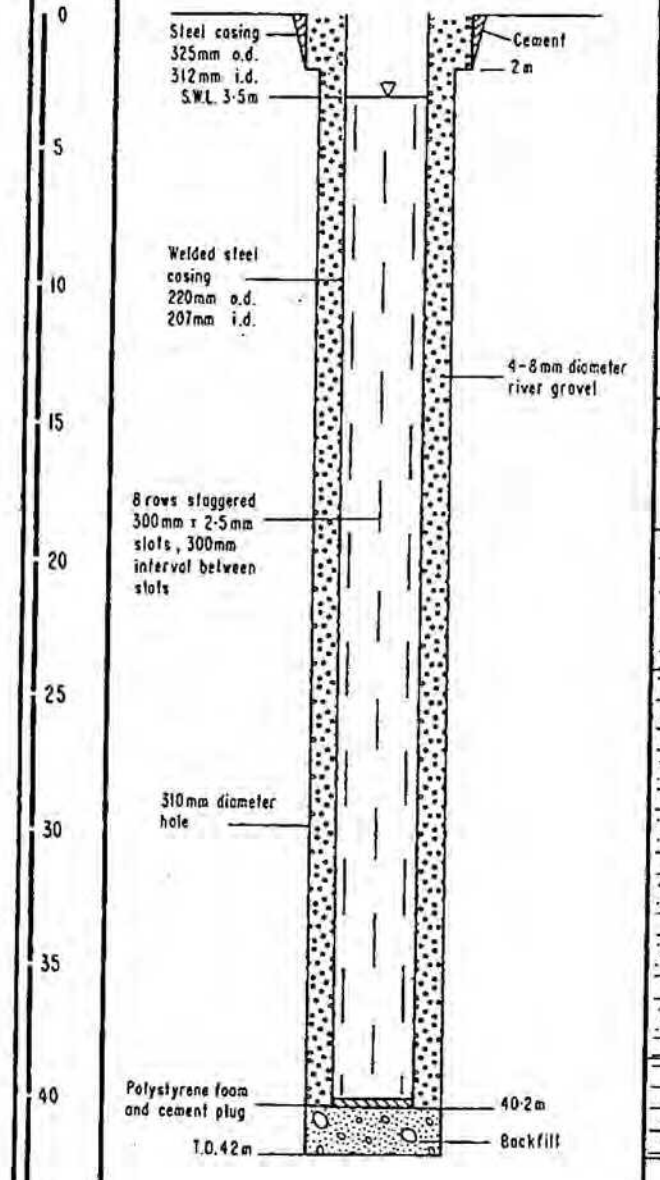
TOTAL DEPTH : 42 m

ELEVATION :

OPEN INTERVAL : 4·2 – 40·2 m

DRILLED : 14/12 – 16/12/87

WATER LEVEL : 3·5 m



LITHOLOGICAL DESCRIPTION

CALCAREOUS INDURATED ALLUVIUM

CALCRETE, CLAYEY: hard calcareous silty clay with carbonate veins.

CALCRETE, hard, pink and buff, water at 5m.

VERY CLAYEY SAND, buff, fine to coarse, poorly sorted, subrounded to rounded, quartz and ironstone.

Water increasing from 13m.

CLAY, pink, a little grey silcrete.

SILCRETE, grey and buff, quartz in hard siliceous matrix. Increase in water.

CLAY, pink and SILCRETE, grey, interbedded.

CLAY, red, with SAND INTERBEDS

Sand, quartz and ironstone, mainly fine-medium subrounded to rounded.

CLAY, hard, dense, pale green and yellow-brown.

AIRLIFT YIELD (m³/day)

COND (mmhos/cm 25°c)

COMMENTS: Replacement production bore, 11·8m S.W. of PB 4

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD MINES N.L.

BORE COMPLETION REPORT

GABANINTHA BORE Nº: PB 1

STATUS: PRODUCTION

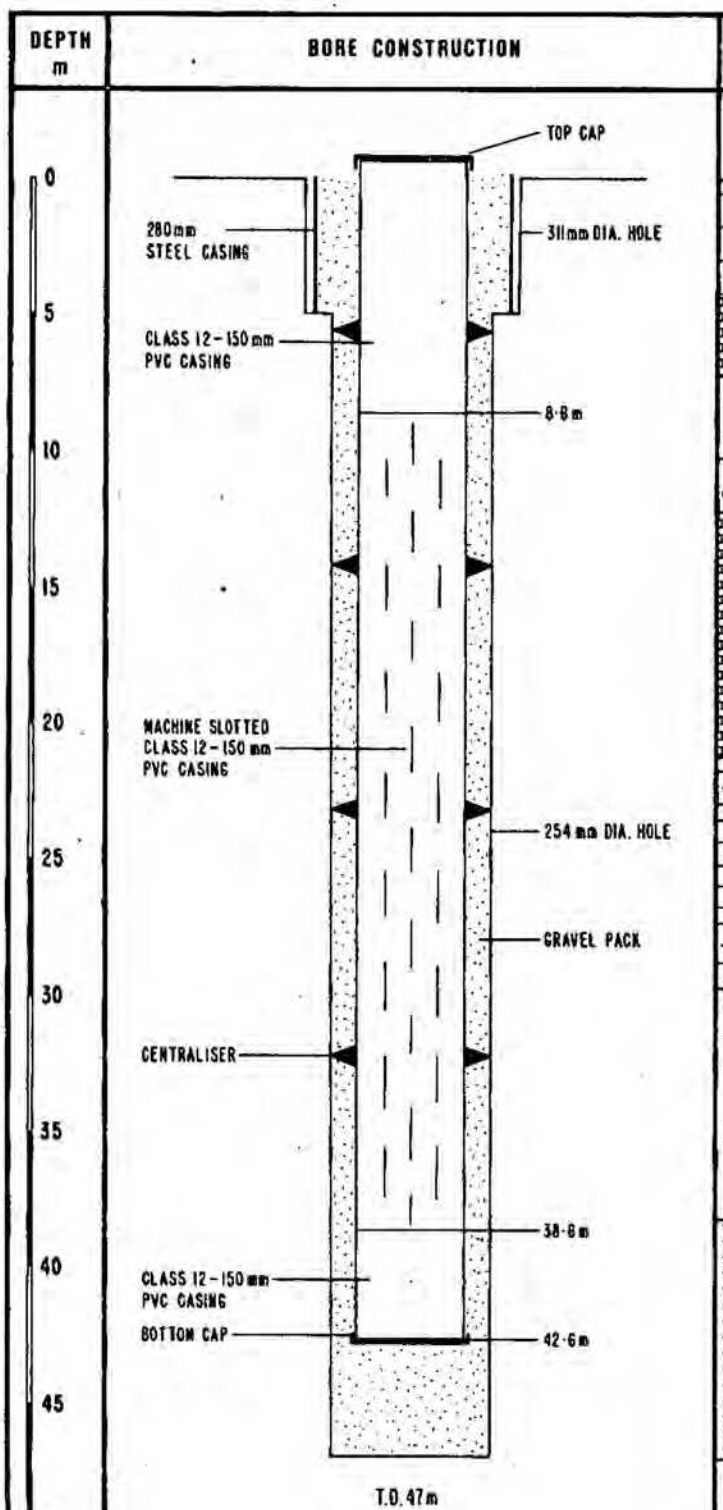
TOTAL DEPTH: 47m

ELEVATION: 465·90 m

OPEN INTERVAL: 8·6 – 38·6 m

DRILLED: DOWNHOLE HAMMER 7/11/86

WATER LEVEL: 1·81 m b.g.l. (26/11/86)



LITHOLOGICAL DESCRIPTION	AIRLIFT YIELD (m³/day)	COND. (µmhos/cm 25°C)
Clay, red-brown, calcareous, silty, sandy		
Calcrete. Sand, brown, silty in calcareous cement matrix.		
Ironstone gravel and sand, quartz sub-rounded.		
Gravel and sand, clayey		
Calcrete and sand, sl. clayey. Sand and calcrete as above	26	2320
Silcrete, grey and clay, brown, interbedded	595	2200
Clay, red-brown and grey slightly sandy	920	2230
Sand, ironstone, medium - coarse grained. Clayey, minor quartz sand	960	2200
Sand, quartz, slightly clayey Fine to coarse-grained Minor ironstone gravel	1060	2200
Grey-green very fine grained volcanics. Hard	1060	2210

REMARKS:

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD MINES N.L.

BORE COMPLETION REPORT

GABANINTHA BORE Nº: PB 2

STATUS: PRODUCTION

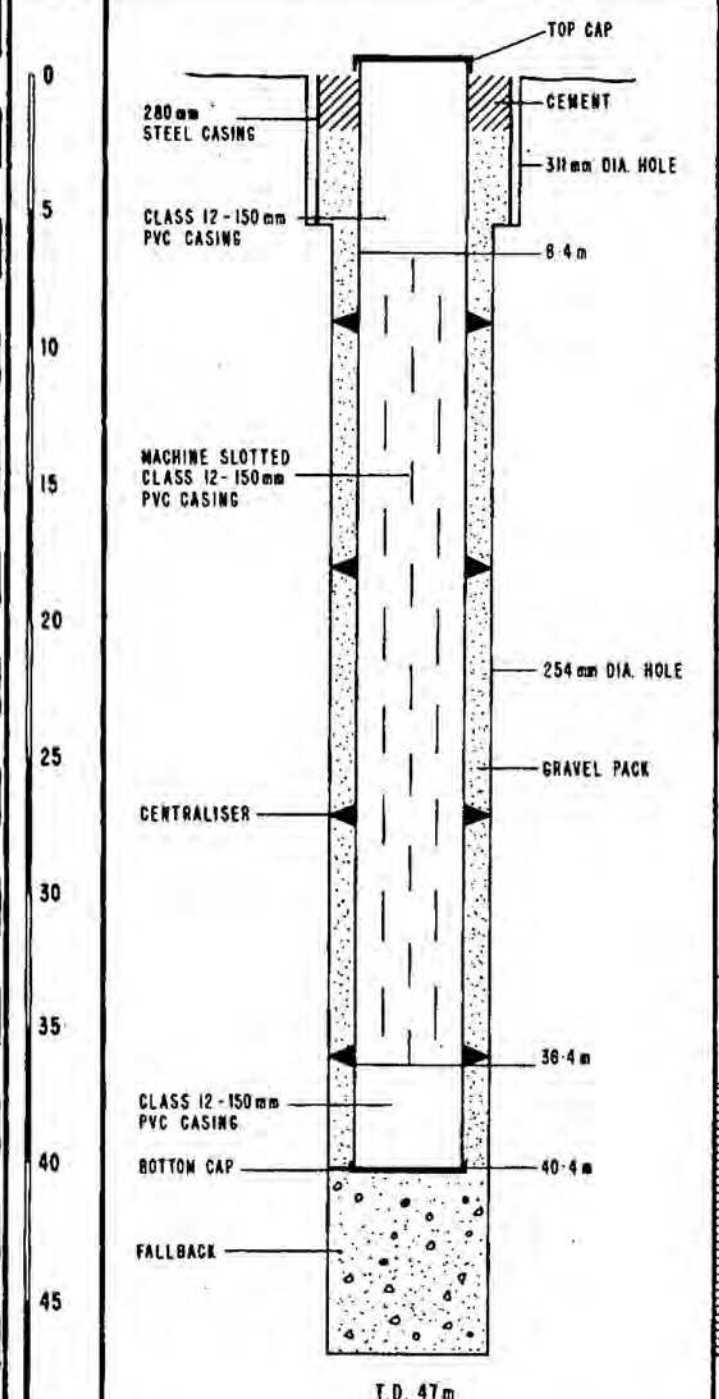
TOTAL DEPTH: 47 m

ELEVATION: 466·11m

OPEN INTERVAL: 6·4 - 36·4m

DRILLED: DOWNHOLE HAMMER 9/11/86

WATER LEVEL: 2·06 m b.g.l. (26/11/86)



LITHOLOGICAL DESCRIPTION	AIRLIFT YIELD (m^3/day)	COND. (µmhos/cm 25°C)
Clay, red, sandy, silty		
As above plus calcrete, (sand in calcareous matrix)		
Calcrete and ironstone gravel and sand, quartz, clayey.		
Ironstone gravel and sand, quartz, clayey. Clay red-brown	210	2200
Clay, red, sandy		
Ironstone, gravel, sandy, clayey sub-angular to rounded, poorly sorted.	920	2200
	855	2200
Ironstone gravel and clay, brown, Minor sand, quartz	855	2200
Clay mottled red/light brown, soft	855	2200
	855	2220

REMARKS:

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD MINES N.L.

BORE COMPLETION REPORT

GABANINTHA BORE Nº: PB 3

STATUS: PRODUCTION

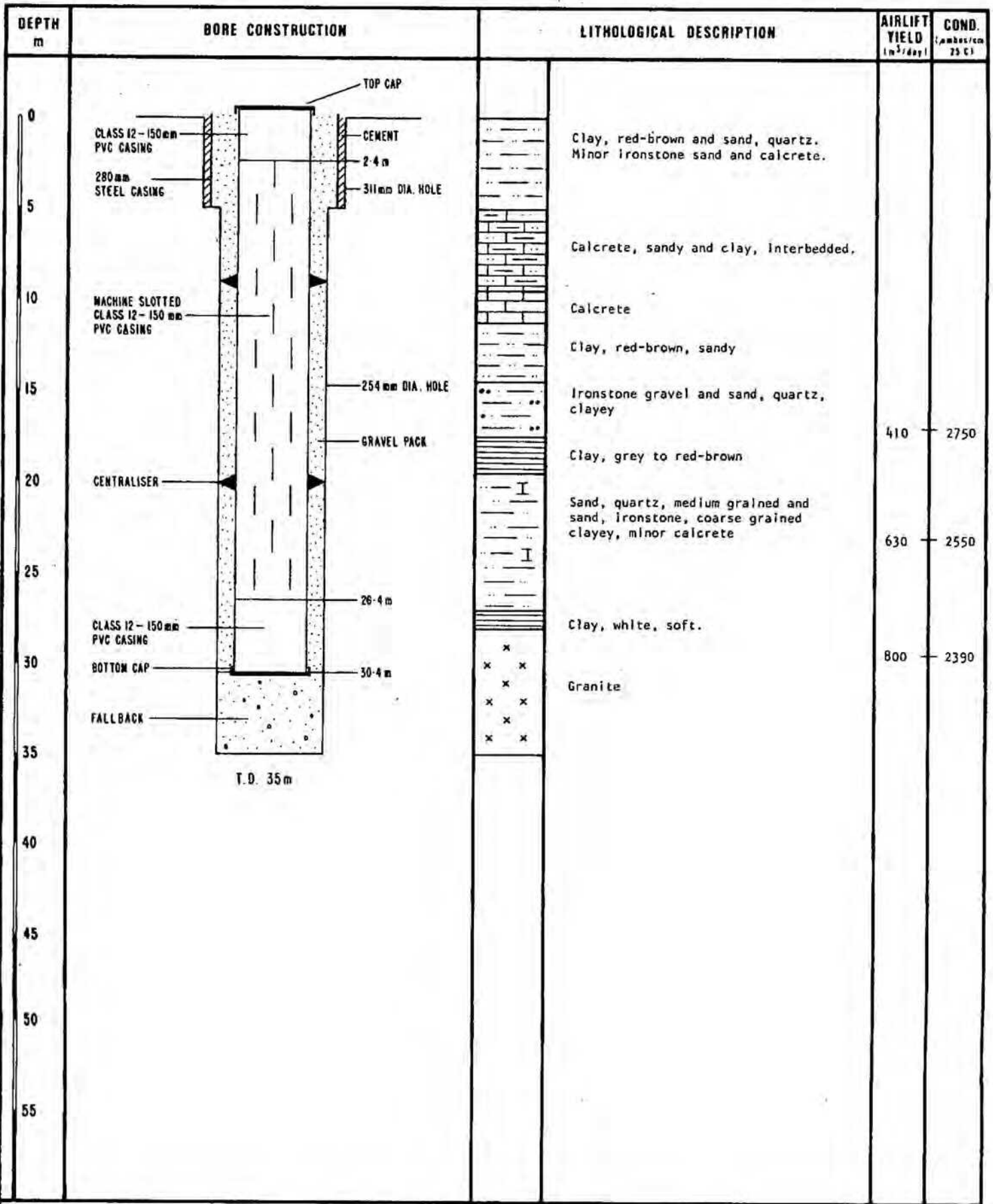
TOTAL DEPTH: 35 m

ELEVATION: 466·07 m

OPEN INTERVAL: 2·4 - 26·4 m

DRILLED: DOWNHOLE HAMMER 13/11/86

WATER LEVEL: 2·36 m b.g.l. (26/11/86)



REMARKS:

GROUNDWATER RESOURCE CONSULTANTS

DOMINION GOLD MINES N.L.

BORE COMPLETION REPORT

GABANINTHA BORE Nº: PB 4

STATUS: PRODUCTION

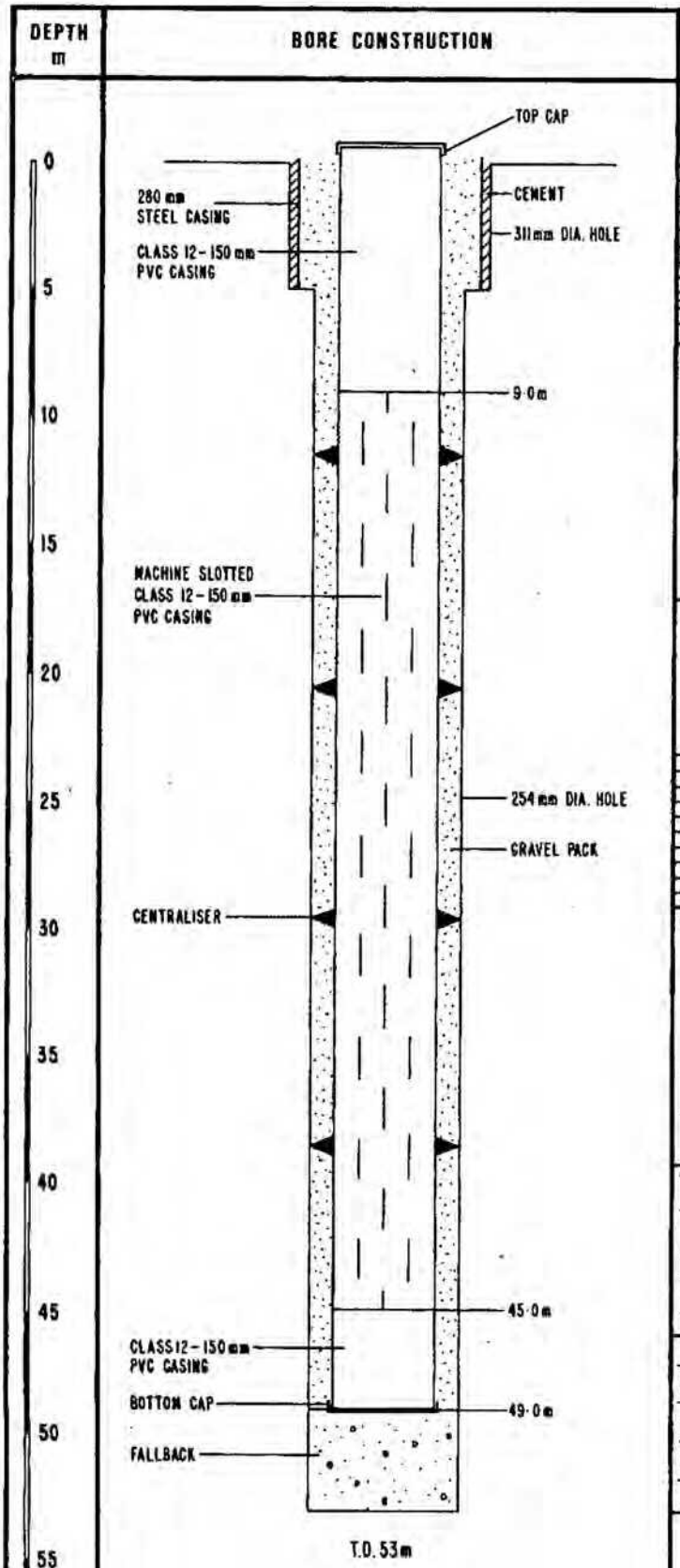
TOTAL DEPTH: 53m

ELEVATION: 466·79m

OPEN INTERVAL: 9-45m

DRILLED: DOWNHOLE HAMMER 14/11/86

WATER LEVEL: 1·85m b.g.l. (26/11/86)



LITHOLOGICAL DESCRIPTION	AIRLIFT YIELD (m³/day)	COND. (µmhos/cm 25°C)
Calcrete, powder and sandy, quartz		
Clay, sandy and calcrete interbedded.		
Clay, light brown, sandy with minor calcrete.		
Clay, light brown, slightly sandy	60	3380
Silcrete, grey and clay, red-brown interbedded.	190	2750
Sand, quartz, clayey, minor-coarse grained. Sub-rounded to sub-angular and ironstone gravel, clayey.	370	2340
	445	2550
Sand, quartz, medium coarse-grained and minor ironstone gravel.	490	2350
Clay, brown, sandy	530	2350
	530	

REMARKS:

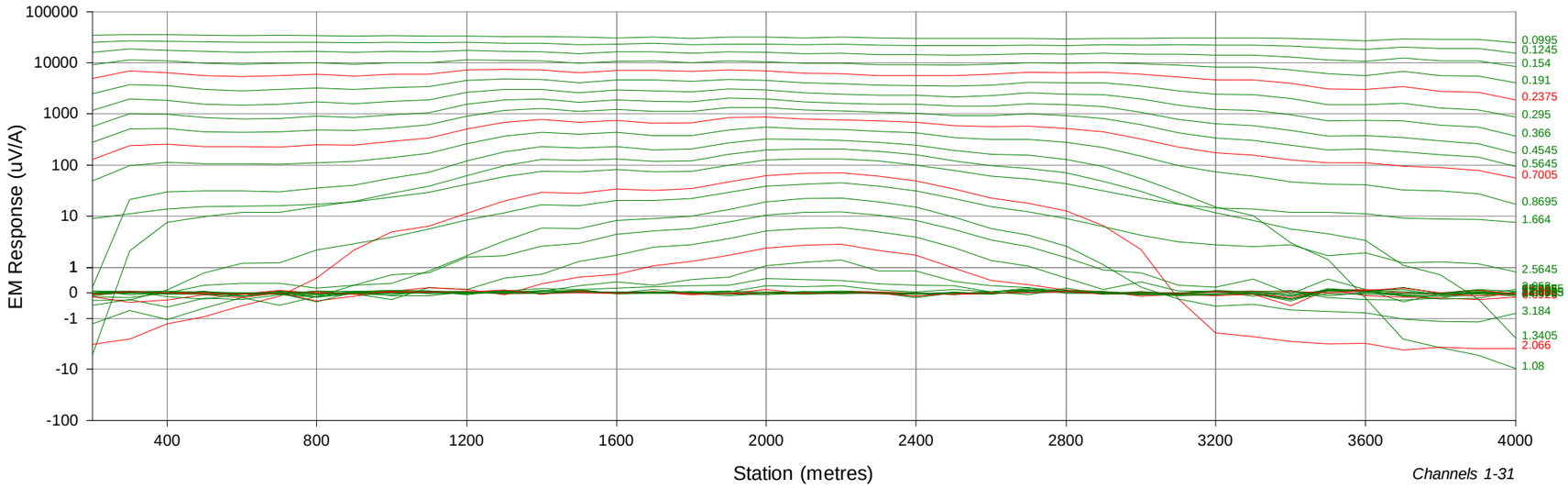
GROUNDWATER RESOURCE CONSULTANTS

AQ2

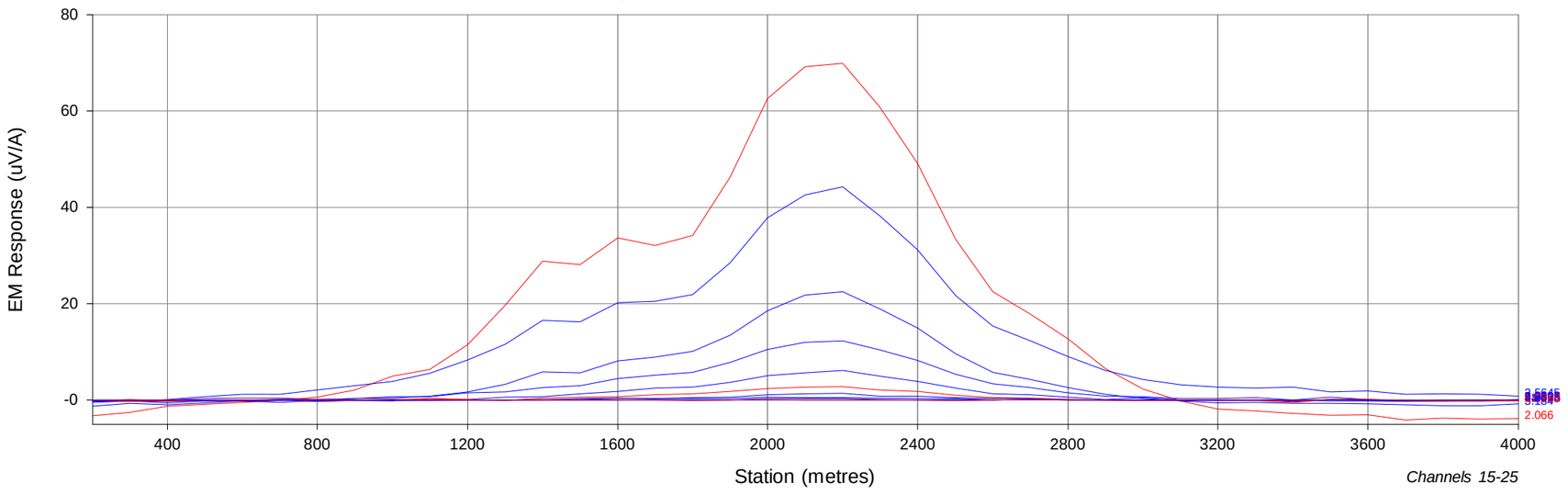
APPENDIX B

TEM Profiles & CDI Sections (SGC, 2018)

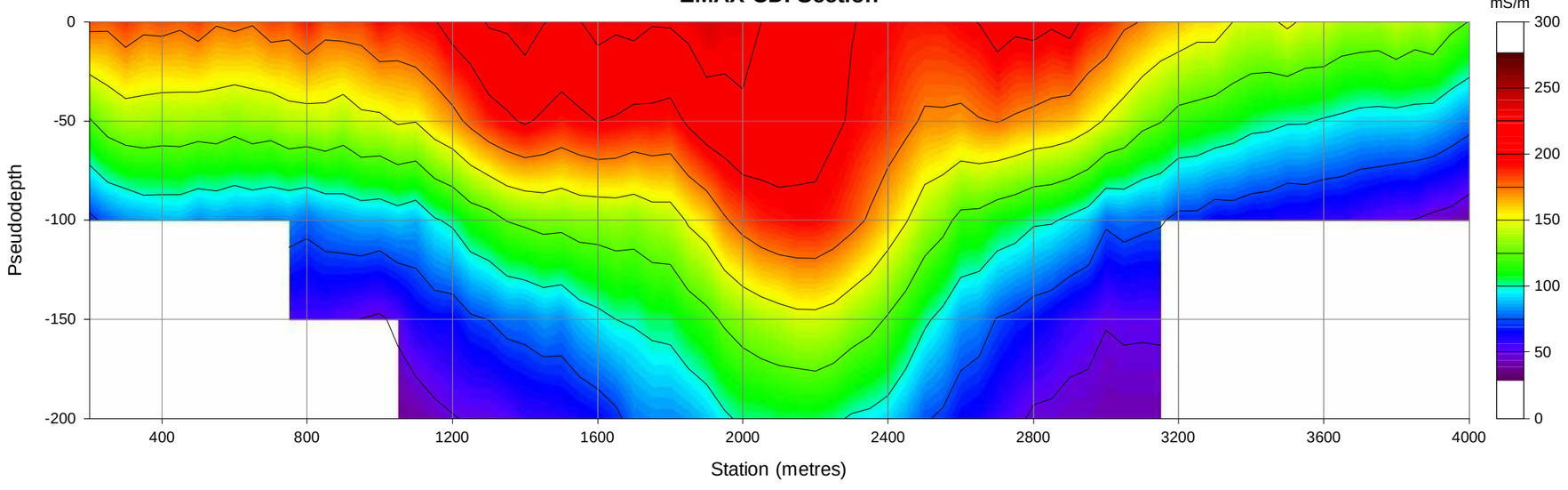
Z Component Log Scale - Channels 1 to 31



Z Component Linear Scale - Channels 15 to 25



EMAX CDI Section



WINDOW TIMES (ms): Centre
From the end of the TX ramp

1	: 0.0995	17	: 3.184
2	: 0.1245	18	: 3.953
3	: 0.1540	19	: 4.908
4	: 0.1910	20	: 6.093
5	: 0.2375	21	: 7.564
6	: 0.2950	22	: 9.390
7	: 0.3660	23	: 11.66
8	: 0.4545	24	: 14.47
9	: 0.5645	25	: 17.97
10	: 0.7005	26	: 22.31
11	: 0.8695	27	: 27.69
12	: 1.080	28	: 34.38
13	: 1.341	29	: 42.68
14	: 1.664	30	: 52.99
15	: 2.066	31	: 65.79
16	: 2.565		

SURVEY PARAMETERS

Configuration	: In-Loop
Station Spacing	: 100 m

RECEIVER

Receiver	: SMARTem24
Frequency	: 3.125
Component	: Z
Rx Coil	: TRC-3 coil
Rx Area	: 1000 turn-m

TRANSMITTER

Transmitter	: Zonge NT-20
Tx Loop Side	: 100 m
Tx Current	: 6.0-6.3 A
Turn Off	: 0.16 ms

-100 0 100 200 300 400 500

Scale 1:15000

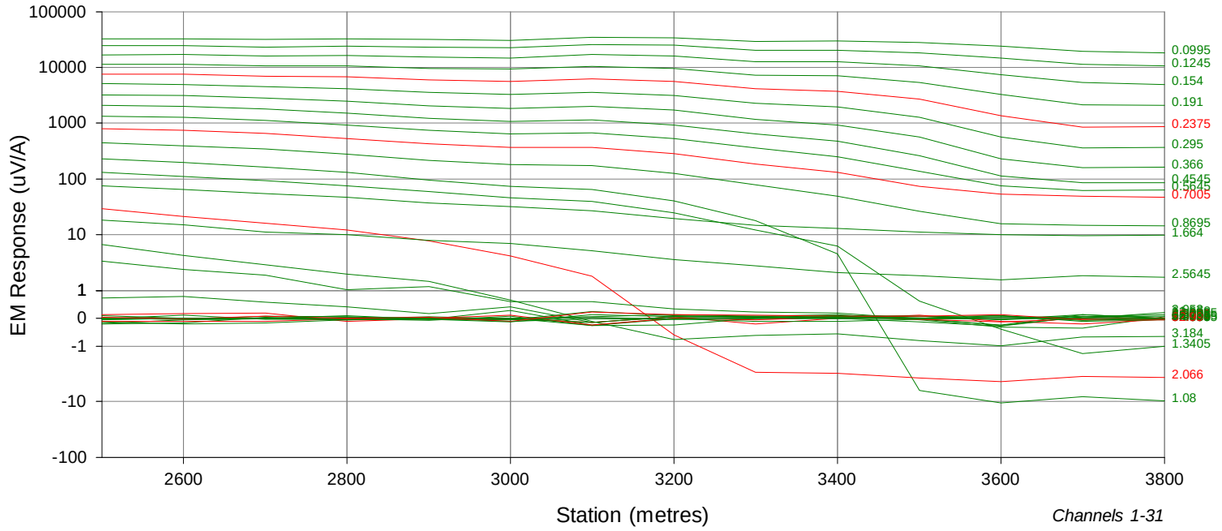
Datum: GDA 94
Grid: MGA Zone 50

Southern Geoscience Consultants Pty Ltd
ACN 067 552 461

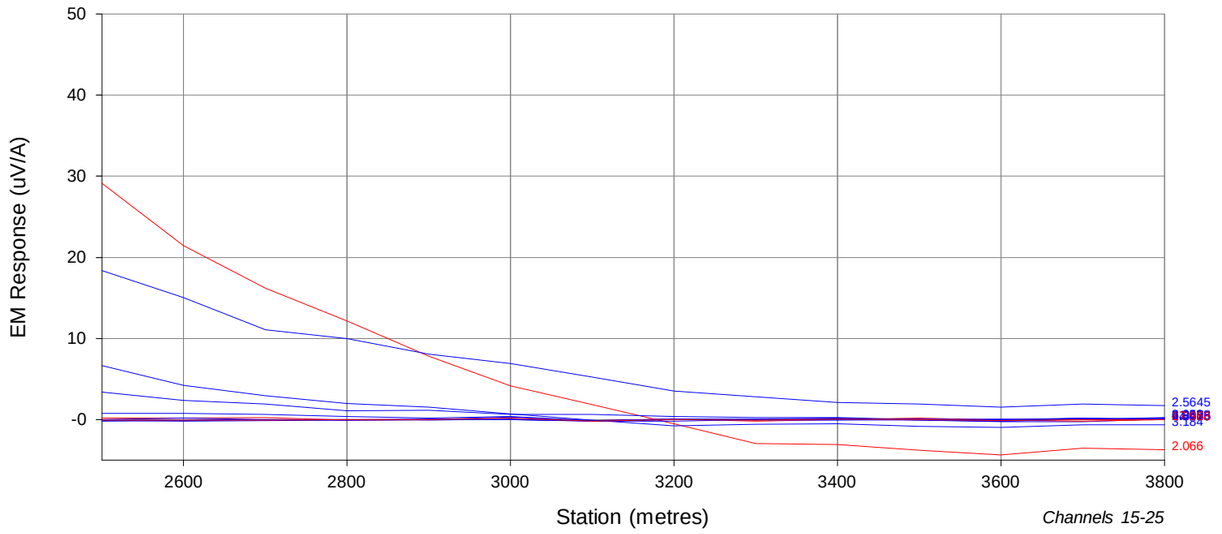
GABANINTHA PROJECT
In-Loop EM Survey
TEM PROFILES
CDI SECTION
Line 1000

Drawn: G.Maude	Date: Nov-2018
Scale: 1:15,000	Figure:

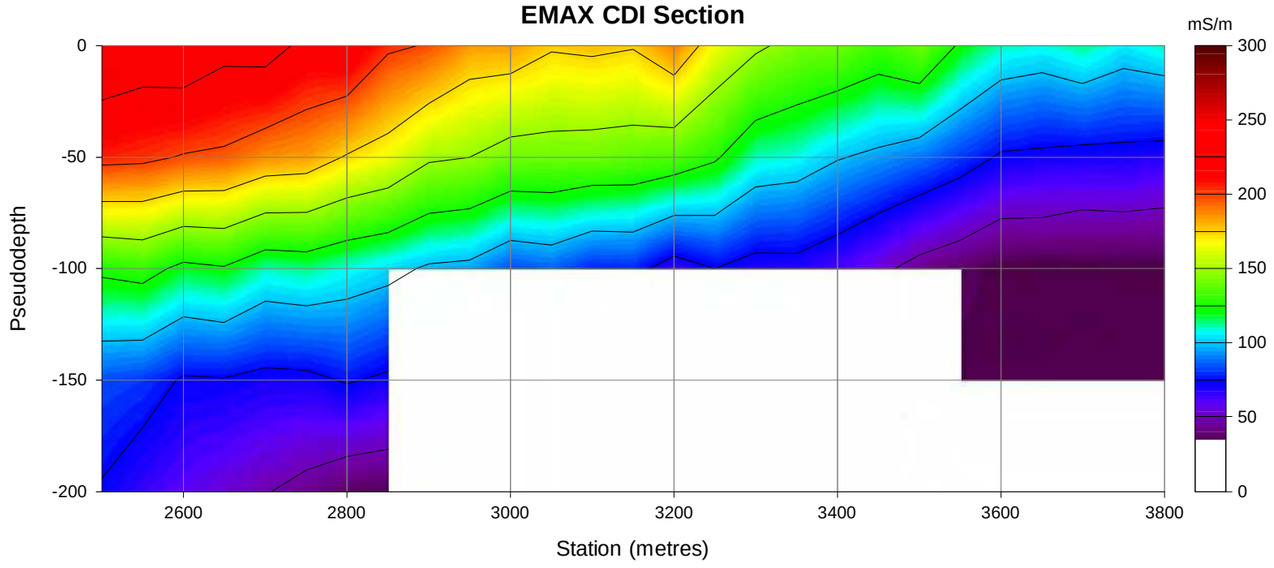
Z Component Log Scale - Channels 1 to 31



Z Component Linear Scale - Channels 15 to 25



EMAX CDI Section



WINDOW TIMES (ms): Centre
From the end of the TX ramp

1	: 0.0995	17	: 3.184
2	: 0.1245	18	: 3.953
3	: 0.1540	19	: 4.908
4	: 0.1910	20	: 6.093
5	: 0.2375	21	: 7.564
6	: 0.2950	22	: 9.390
7	: 0.3660	23	: 11.66
8	: 0.4545	24	: 14.47
9	: 0.5645	25	: 17.97
10	: 0.7005	26	: 22.31
11	: 0.8695	27	: 27.69
12	: 1.080	28	: 34.38
13	: 1.341	29	: 42.68
14	: 1.664	30	: 52.99
15	: 2.066	31	: 65.79
16	: 2.565		

SURVEY PARAMETERS

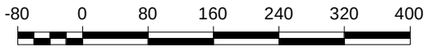
Configuration	: In-Loop
Station Spacing	: 100 m

RECEIVER

Receiver	: SMARTem24
Frequency	: 3.125
Component	: Z
Rx Coil	: TRC-3 coil
Rx Area	: 1000 turn-m

TRANSMITTER

Transmitter	: Zonge NT-20
Tx Loop Side	: 100 m
Tx Current	: 5.9 A
Turn Off	: 0.16 ms



Scale 1:7500

Datum: GDA 94
Grid: MGA Zone 50

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GABANINTHA PROJECT

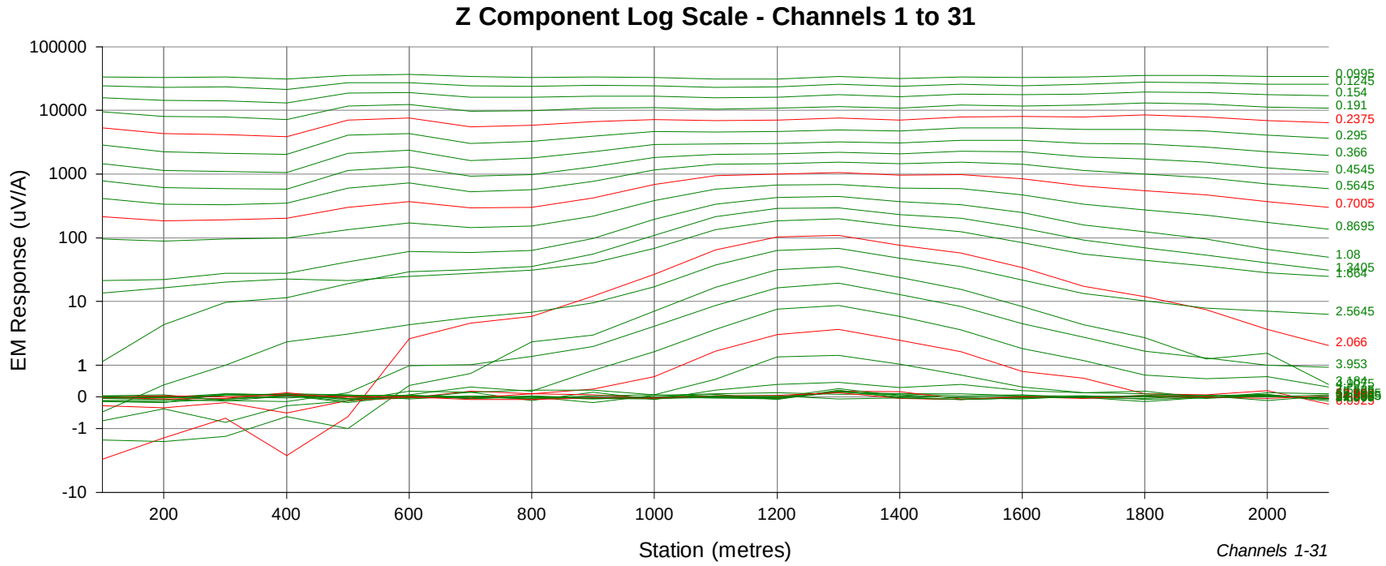
In-Loop EM Survey

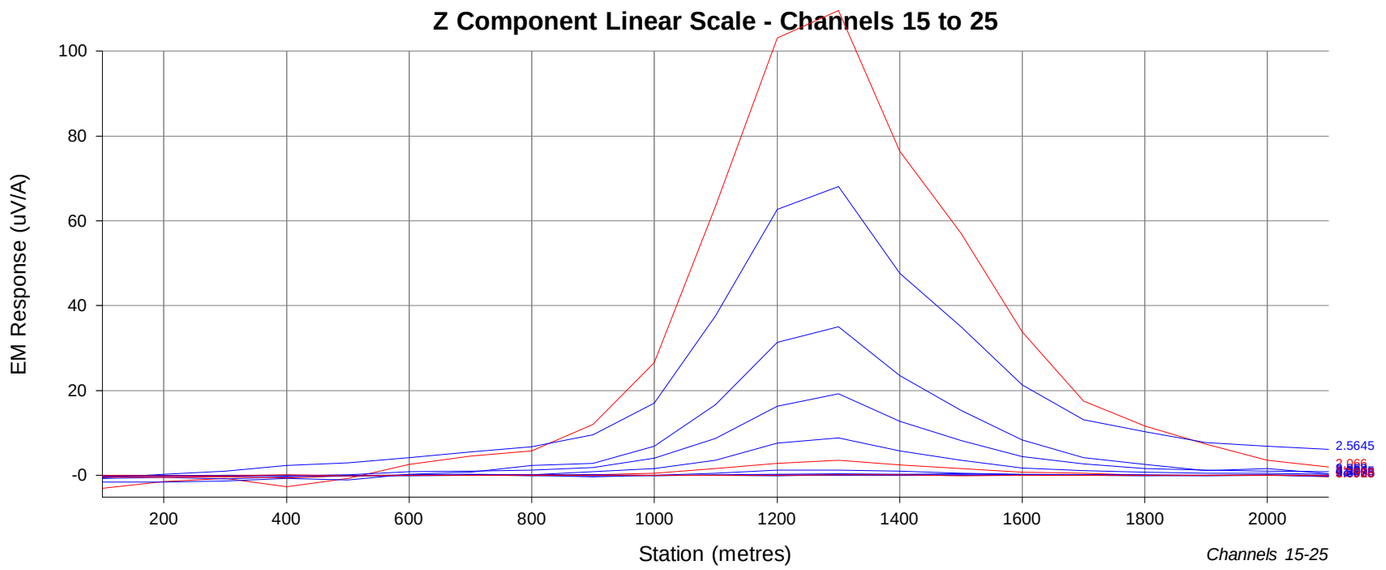
TEM PROFILES

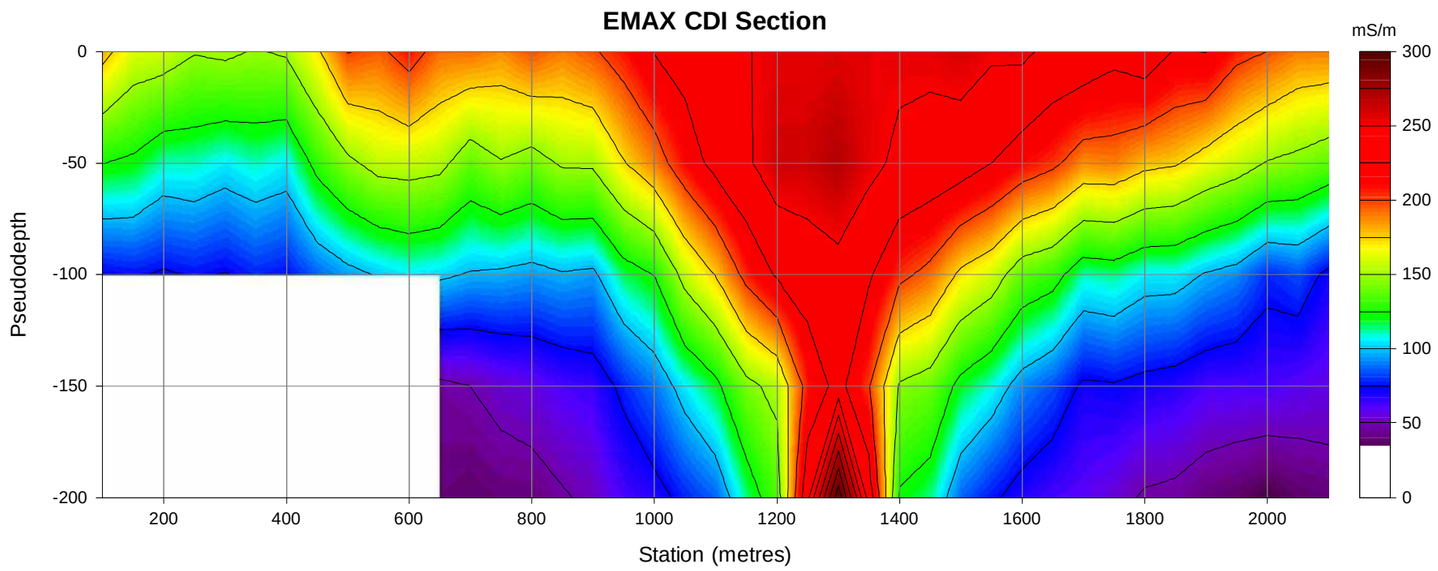
CDI SECTION

Line 2000_north

Drawn: G.Maude	Date: Nov-2018
Scale: 1:7,500	Figure:







WINDOW TIMES (ms): Centre
From the end of the TX ramp

1	: 0.0995	17	: 3.184
2	: 0.1245	18	: 3.953
3	: 0.1540	19	: 4.908
4	: 0.1910	20	: 6.093
5	: 0.2375	21	: 7.564
6	: 0.2950	22	: 9.390
7	: 0.3660	23	: 11.66
8	: 0.4545	24	: 14.47
9	: 0.5645	25	: 17.97
10	: 0.7005	26	: 22.31
11	: 0.8695	27	: 27.69
12	: 1.080	28	: 34.38
13	: 1.341	29	: 42.68
14	: 1.664	30	: 52.99
15	: 2.066	31	: 65.79
16	: 2.565		

SURVEY PARAMETERS

Configuration	: In-Loop
Station Spacing	: 100 m

RECEIVER

Receiver	: SMARTem24
Frequency	: 3.125
Component	: Z
Rx Coil	: TRC-3 coil
Rx Area	: 1000 turn-m

TRANSMITTER

Transmitter	: Zonge NT-20
Tx Loop Side	: 100 m
Tx Current	: 5.9-6.3 A
Turn Off	: 0.16 ms

-100 0 100 200 300 400 500

Scale 1:10000

Datum: GDA 94
Grid: MGA Zone 50

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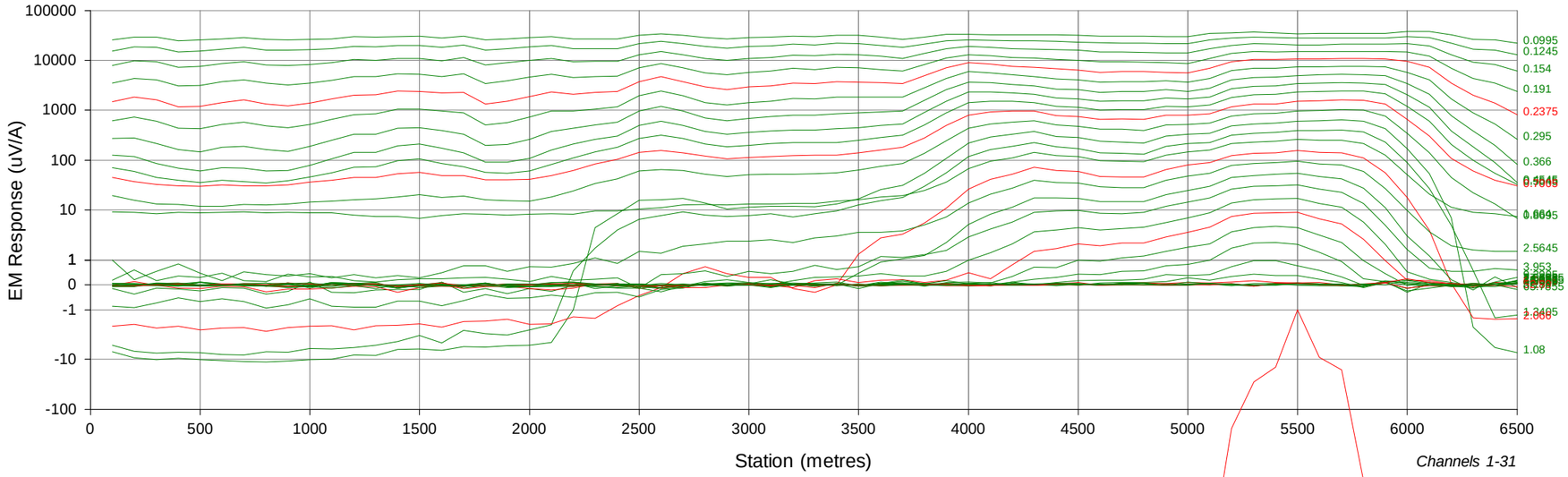
GABANINTHA PROJECT

In-Loop EM Survey

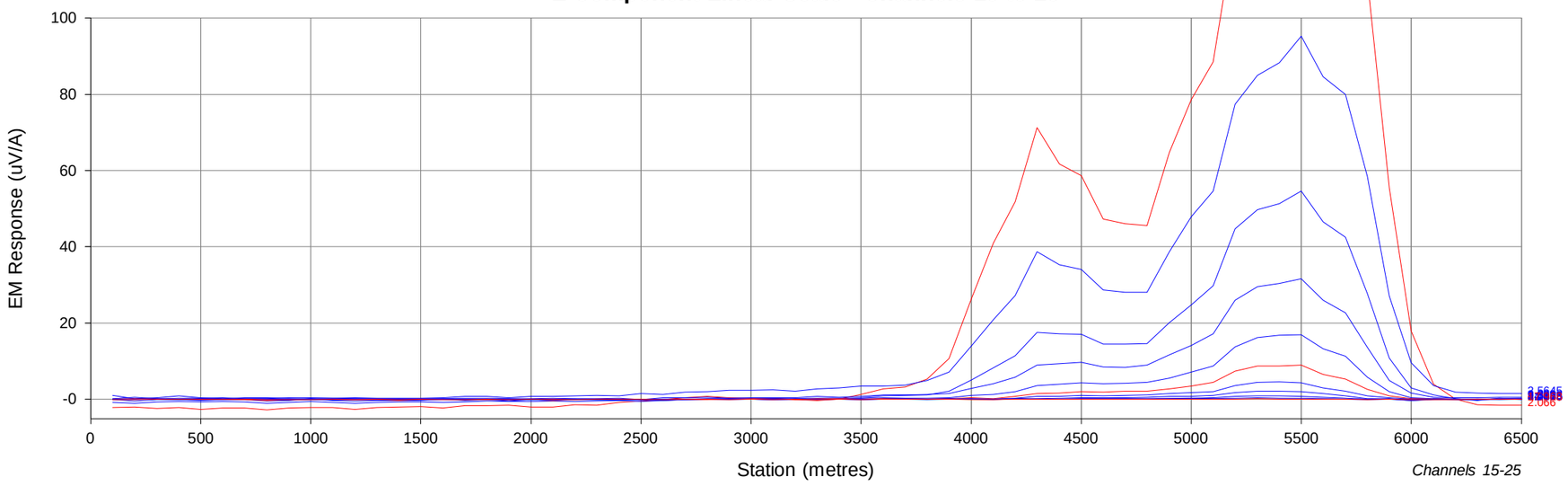
TEM PROFILES
CDI SECTION
Line 2000_south

Drawn: G.Maude	Date: Nov-2018
Scale: 1:10,000	Figure:

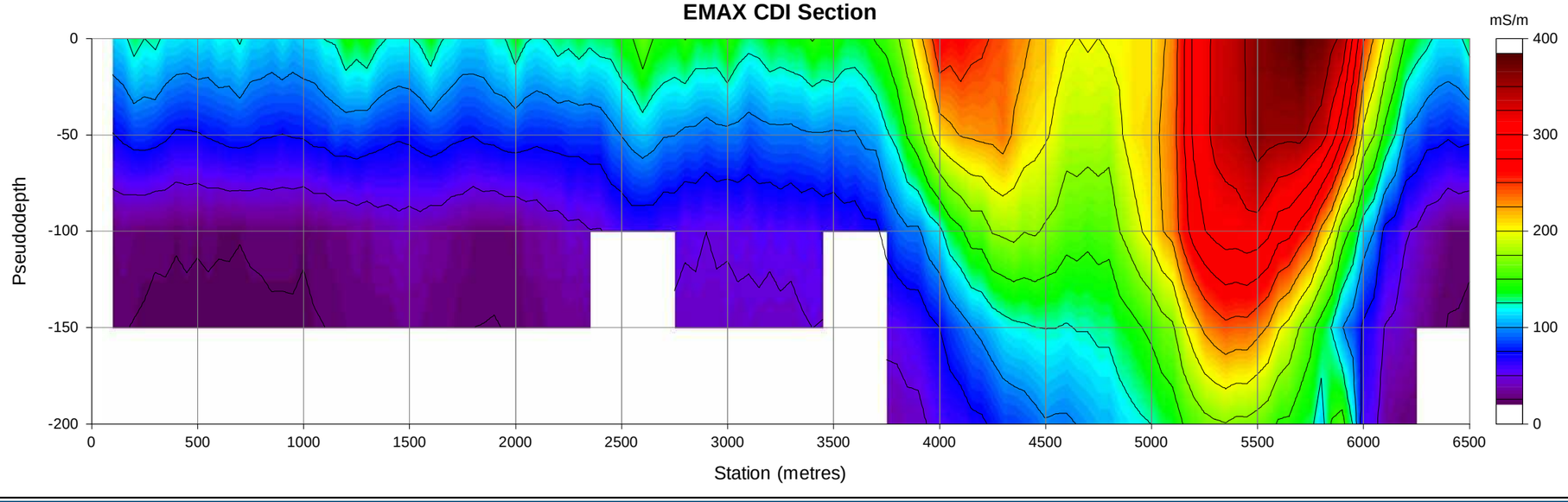
Z Component Log Scale - Channels 1 to 31



Z Component Linear Scale - Channels 15 to 25



EMAX CDI Section



WINDOW TIMES (ms): Centre
From the end of the TX ramp

1	: 0.0995	17	: 3.184
2	: 0.1245	18	: 3.953
3	: 0.1540	19	: 4.908
4	: 0.1910	20	: 6.093
5	: 0.2375	21	: 7.564
6	: 0.2950	22	: 9.390
7	: 0.3660	23	: 11.66
8	: 0.4545	24	: 14.47
9	: 0.5645	25	: 17.97
10	: 0.7005	26	: 22.31
11	: 0.8695	27	: 27.69
12	: 1.080	28	: 34.38
13	: 1.341	29	: 42.68
14	: 1.664	30	: 52.99
15	: 2.066	31	: 65.79
16	: 2.565		

SURVEY PARAMETERS

Configuration	: In-Loop
Station Spacing	: 100 m

RECEIVER

Receiver	: SMARTem24
Frequency	: 3.125
Component	: Z
Rx Coil	: TRC-3 coil
Rx Area	: 1000 turn-m

TRANSMITTER

Transmitter	: Zonge NT-20
Tx Loop Side	: 100 m
Tx Current	: 6.0-6.4 A
Turn Off	: 0.16 ms

-200 0 200 400 600 800 1000

Scale 1:25000

Datum: GDA 94
Grid: MGA Zone 50

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GABANINTHA PROJECT

In-Loop EM Survey

TEM PROFILES
CDI SECTION
Line 3000

Drawn: G.Maude	Date: Nov-2018
Scale: 1:25,000	Figure:

APPENDIX B-5: Biologic Environmental Survey – Reconnaissance Flora and Vegetation Survey

Gabanintha Vanadium Project Reconnaissance Flora and Vegetation Survey

Biologic Environmental Survey Pty Ltd

Technology Metals Australia Limited.

November 2018

GABANINTHA RECONNAISSANCE FLORA AND VEGETATION SURVEY

DOCUMENT STATUS				
Rev. No.	**Author**	**Review / Approved for Issue**	**Approved for Issue to**	
			Name	**Date**
1	C. van den Bergh	M. O'Connell	Belinda Bastow	29/06/2018
2	C. van den Bergh	M. O'Connell	Belinda Bastow	14/09/2018
Final	C. van den Bergh	M. O'Connell	Belinda Bastow	22/11/2018

Contents

Tables

Figures

Appendices

Executive Summary

Technology Metals Australia Limited (TMAL) proposes to develop the Gabanintha Vanadium Project. TMAL is currently completing a pre-feasibility study into the Project and plan on progressing the Project further to obtain the necessary environmental approvals. To assist in the development of environmental impact assessment (EIA) documents, Integrate Sustainability Pty Ltd (ISPL), on behalf of TMAL, commissioned Biologic Environmental Survey Pty Ltd (Biologic) to complete a flora and vegetation assessment of the Project.

The overarching objective of the flora and vegetation assessment (hereafter referred to as the Survey) was to identify the environmental values of the Study Area and to determine if there are any conservation significant and regional values that need to be considered during the design and future approvals of the Project. The overarching objective was achieved through a desktop assessment and a Reconnaissance Survey, with the aid of relevé sampling. The field survey was completed over one field trip from the 7th to the 12th of May 2018.

The current assessment of the Study Area recorded a total of 153 vascular flora taxa, from 33 families and 73 genera. Five flora taxa that are considered to be priority, as determined by the Department of Biodiversity, Conservation and Attractions – Parks and Wildlife Division (Parks and Wildlife), were recorded from the Study Area; *Acacia speckii* (Priority 4), *Dodonaea amplisemina* (Priority 4), *Hibiscus krichauffianus* (Priority 3), *Ptilotus luteolus* (Priority 3) and *Tribulus adelacanthus* (Priority 3). Two introduced flora taxa, **Cucumis myriocarpus* (Prickly Paddy Melon) and **Citrullus colocynthis* (Colocynth), were recorded from the Study Area during the current assessment.

A total of 15 vegetation units were described and delineated from the Study Area, with one additional vegetation unit mapped outside of the Study Area. The 15 vegetation types can be broadly categorised into Mulga woodlands/ shrublands and chenopod shrublands. *Acacia aneura* (Mulga) and its close relatives were the dominant feature across the Study Area. The mid and understorey mainly consisted of members from the *Eremophila* genus, the Amaranthaceae family (*Ptilotus* spp.) and the Chenopodiaceae family (*Maireana* spp. and *Sclerolaena* spp.).

Four of the 15 vegetation types recorded from the Study Area are considered locally significant as they support Priority listed flora taxa, or were mapped in association with minor ephemeral drainage lines. None of the vegetation types recorded are considered regionally significant as they where not classified as threatened or priority ecological communities.

The condition of the vegetation in the Study Area ranged from Completely Degraded to Excellent, with the majority in a good or very good condition. It was noted that some areas demonstrate signs of impact by mining exploration and pastoralism, the majority of the vegetation was in a very good condition with evidence of historical and ongoing trampling and grazing from cattle.

1 Introduction

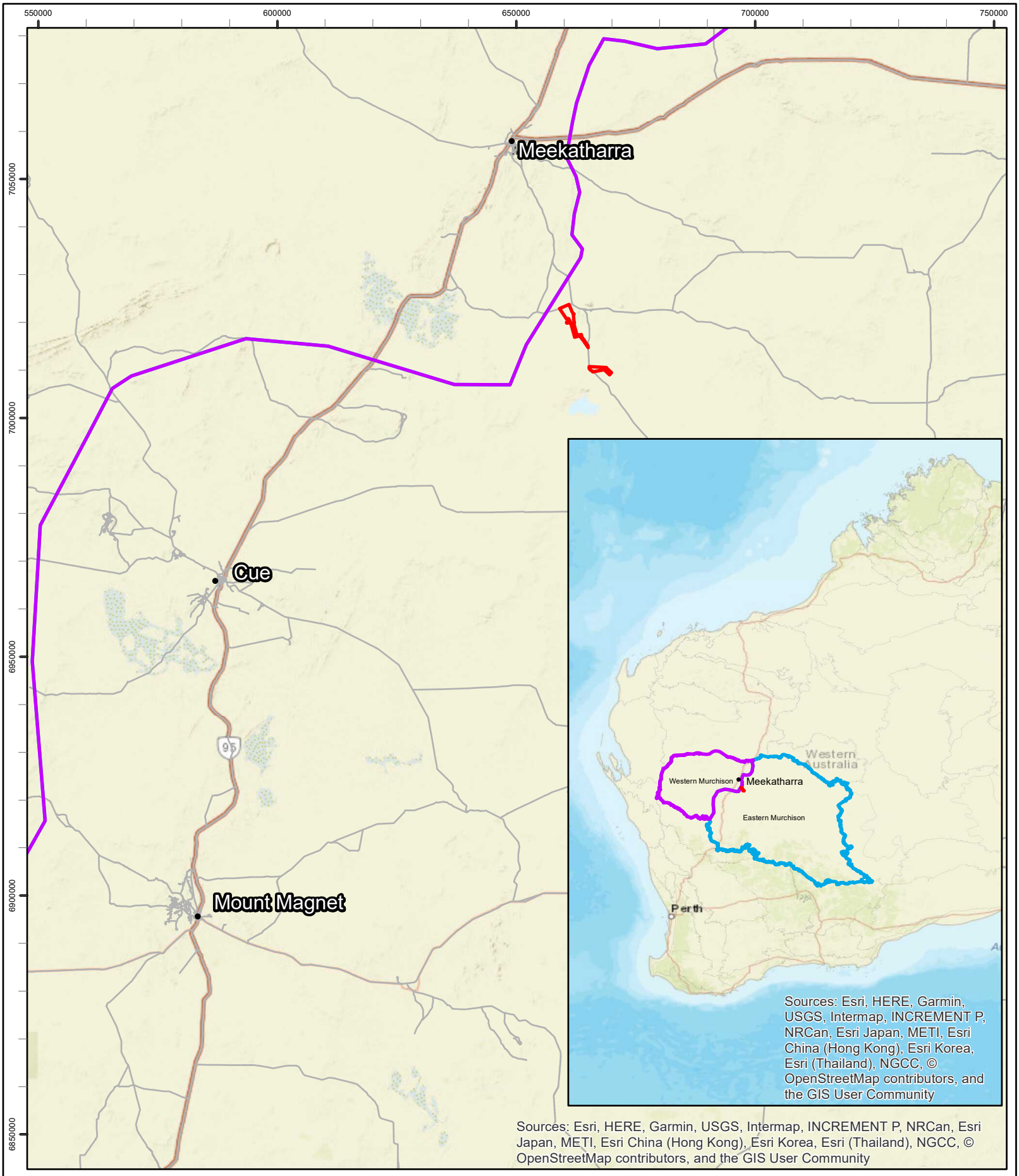
1.1 Background

Technology Metals Australia Limited (TMAL) primary purpose is to identify exploration projects in Australia (and overseas) with the aim of discovering commercially significant mineral deposits. TMAL's primary focus is on the Gabanintha Vanadium Project (the Project), with the aim to develop this Project to supply high-quality vanadium oxide (V_20_5) flake product to both the steel market and the emerging vanadium redox battery (VRB) market. TMAL is currently completing a pre-feasibility study into the Project and plan on progressing the Project further to obtain the necessary environmental approvals.

To assist in the development of environmental impact assessment (EIA) documents, Integrate Sustainability Pty Ltd, on behalf of TMAL, commissioned Biologic Environmental Survey Pty Ltd (Biologic) to complete a flora and vegetation assessment of the Project. The Project is located approximately 36 kilometres (km) south-southeast of the town of Meekatharra, within the Murchison bioregion (according to the Interim Biogeographical Regionalisation of Australia (IBRA); Thackway & Cresswell, 1995) (Figure 1.1). The Project includes two regions and associated access corridors (Figure 1.2, collectively hereafter referred to as the Study Area) and is 1,233.2 hectares (ha) in size:

- Northern Region (M51/883- pending) – 789.2 hectares (ha);
- Northern Access – 95.2 ha;
- Southern Region (M51/884 – pending) – 93.9 ha; and
- Southern Access – 254.9 ha.

The Study Area occurs across numerous tenements, not all held by TMAL. The Study Area occurs in part or wholly within tenements E51/1510-I, P51/2944, P51/2943, P51/2942 and E51/1818. The Northern and Southern Regions partially or wholly occur within mining tenement M51/883 (pending) and M51/884 (pending) (Figure 1.2). The Study Area was surveyed over six days from the 7th to the 12th of May 2018.



Legend

- Study Area
- Major Towns
- Roads

IBRA Subregions

- Eastern Murchison
- Western Murchison

biologic Environmental Survey

N

1:1,000,000

0 10 20 40 km

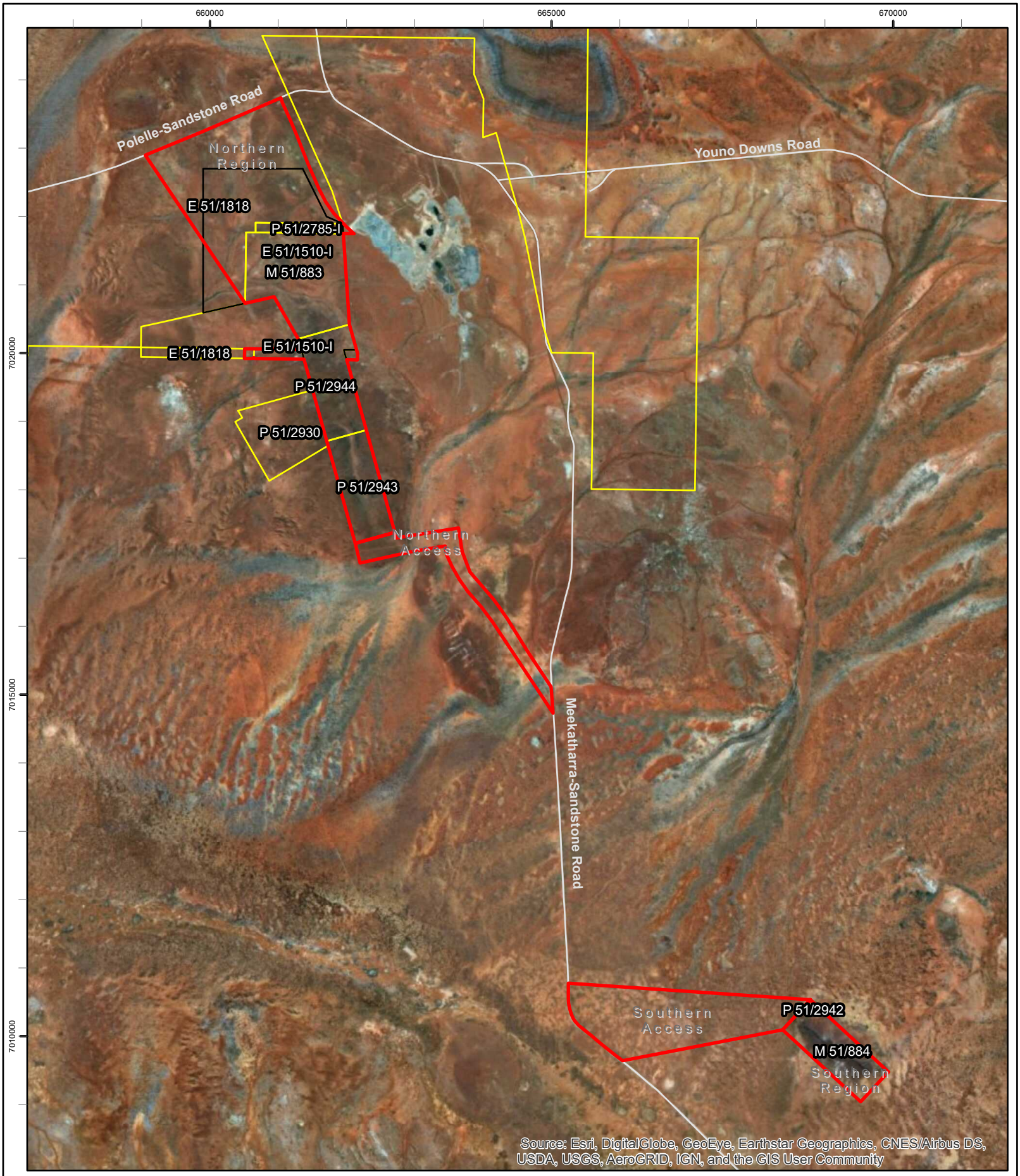
Technology Metals Australian Limited

Gabanintha Vanadium Project

Figure 1.1: Regional location and IBRA subregion

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 05/09/2018



Legend

- StudyArea
- Roads

TMAL Tenure

- Live
- Pending

biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

Technology Metals Australian Limited

Gabanintha Vanadium Project

Figure 1.2: Gabanintha Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 20/11/2018

1.2 Objective and Scope of Work

The overarching objective of the flora and vegetation assessment (hereafter referred to as the Survey) was to identify the environmental values of the Study Area and to determine if there are any conservation significant values that need to be considered during the design and future approval of the Project. The overarching objective was achieved via the following scope of works:

- The completion of a desktop assessment, including the review of previous biological surveys and government and non-government databases;
- The completion of a Reconnaissance Flora and Vegetation Survey (formerly referred to as a Level 1 flora and vegetation survey) across the Study Area and relevant regional context;
- A review of the results of the flora and vegetation assessment to determine if there are any significant environmental values within the Study Area;
- A discussion of the significant environmental values (and remaining environmental values) from a regional and local context; and
- The provision of advice and guidance related to the environmental approval process, with respect to any significant flora and vegetation values identified from the Study Area.

1.3 Background to Protection of Flora and Vegetation

Within Western Australia, all native flora is protected under the *Wildlife Conservation Act 1950* (WC Act) and any action that has the potential to impact on native flora needs to be approved by relevant State and/ or Federal departments as dictated by the Western Australian *Environmental Protection Act 1986* (EP Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Current listings for conservation significant flora were checked against the latest (January 2018) Western Australian Government Gazette (Western Australian Government, 2018) and the *EPBC Act* list of threatened species (available online at http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl).

Some species of flora that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called conservation significant species. A summary of applicable legislation and status codes is provided in Table 1.1. Additional information on conservation status codes is provided in Appendix A.

The *EPBC Act* identifies Threatened Ecological Communities (TECs) as ecological communities at risk of extinction. Currently, there are no statutory processes to list threatened ecological communities in Western Australia. The Minister for the Environment may list an ecological community as being threatened through a non-statutory process if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) will provide for the statutory listing of TECs by the Minister

when the relevant Parts of the Act are proclaimed following the preparation of enabling Regulations.

For some species and ecological communities there is insufficient information to determine their status. These species are generally considered by the Environmental Protection Authority (EPA) / Department of Biodiversity, Conservation and Attractions (DBCA) as 'conservation significant' for all development related approvals, and are listed on a 'Priority List', which is regularly reviewed and maintained by DBCA. Possible TECs that do not meet the criteria for non-statutory listing by the Minister for the Environment are added to DBCA's 'Priority Ecological Communities' (PECs) lists under Priorities 1, 2, 3, 4 (near threatened) or 5 (conservation dependent).

The determination of local significance for vegetation units is based on whether the vegetation units support conservation significant taxa or ecological communities, and are in association with drainage lines or support unique or unusual flora assemblages, to name a few differentiators (Table 1.1).

Table 1.1: Conservation significance assessment guidelines

Agreement, Act or List	Status Codes
FEDERAL	
Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*) DoEE lists threatened flora, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes'). Threatened Ecological Communities (TECs) are those that are at risk of extinction.	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD) Critically Endangered Endangered Vulnerable
STATE[#]	
Wildlife Conservation Act 1950 (*WC Act*) At a state level, native flora are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable. **DBCA Priority list (DBCA)** DBCA produces a list of Priority species and ecological communities (*e.g.* Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs)) that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 5.	• Schedule 1 (Critically Endangered) (S1 or CR) • Schedule 2 (Endangered) (S2 or EN) • Schedule 3 (Vulnerable) (S3 or VU) • Schedule 4 (Extinct) (S4 or EX) • Priority 1 (P1) • Priority 2 (P2) • Priority 3 (P3) • Priority 4 (P4) • Priority 5 (P5)

Agreement, Act or List	Status Codes
LOCALLY SIGNIFICANT VEGETATION UNITS	
Supports threatened flora taxa/ threatened ecological community or supports a unique or regionally significant population of Priority 1 or Priority 2 taxa/ ecological communities or occurs in association with a regionally significant river or creek	• High
Supports a population of Priority 1 or Priority 2 taxa/ ecological community or occurs in association with a major river or creek or supports a unique/ unusual floral assemblage not recognised by Parks and Wildlife as a PEC	• Moderate
Supports a population of Priority 3 or Priority 4 taxa/ ecological community or occurs in association with a minor ephemeral river or creek or supports a unique/ unusual floral assemblage	• Low
Supports a population of Priority 3 or Priority 4 taxa/ ecological community along an ecotone between vegetation units or the population occurs in degraded/ altered habitats or is associated with man-made environments (i.e. rehabilitation)	• Negligible

- The *Biodiversity Conservation Act 2016* was enacted in 2016, however only several parts of the new Act were proclaimed by the State Governor in the *Government Gazette*. Provisions that replace those existing under the WC Act (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations cannot be brought into effect until the necessary *Biodiversity Conservation Regulations* have been made.

2 Existing Environment and Background Context

2.1 Climate

The Study Area is located within the Eastern Murchison subregion of the Murchison bioregion (following Thackway & Cresswell, 1995) (Figure 1.1). The region features an arid climate, with rainfall occurring predominantly in winter of 200 millimetres (mm) per annum (Cowan *et al.*, 2001).

Long-term climatic data is not available for the Study Area itself; however, long-term climatic data (BoM, 2018) is available from the Bureau of Meteorology weather station at Meekatharra Airport (Station 7045), 35.24 km north of the Study Area, which provides an indication of climatic conditions experienced at the Study Area (Figure 2.1).

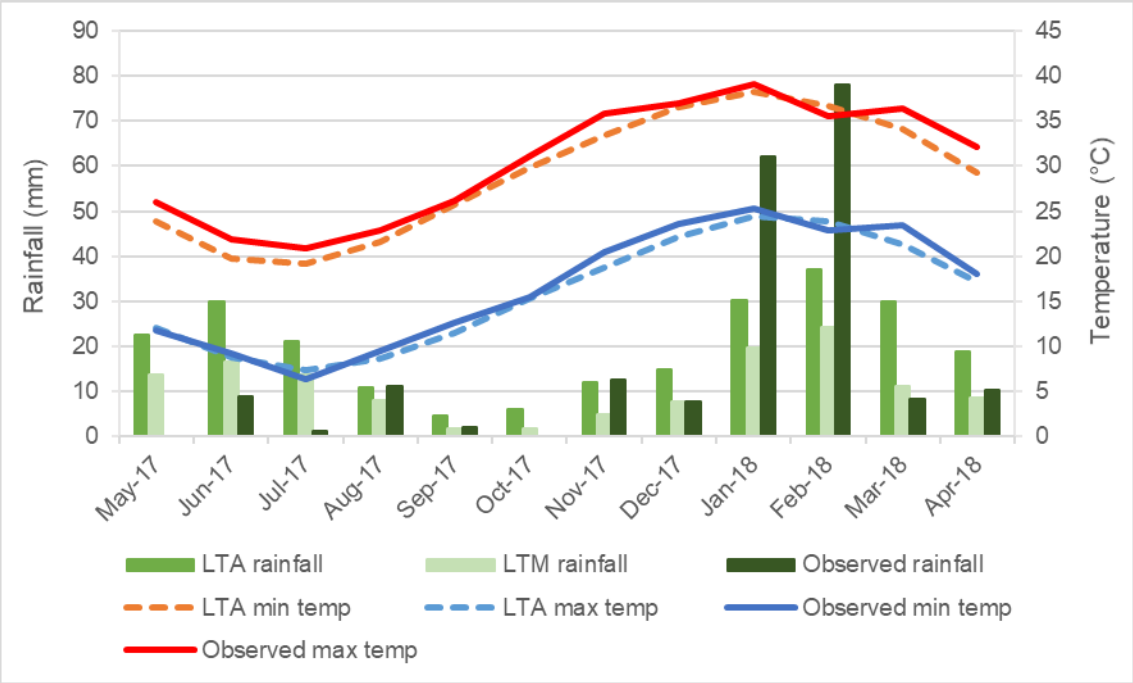


Figure 2.1: Climate data for Meekatharra Airport (BoM, 2018), comparing long-term average (LTA) monthly rainfall (mm) and temperatures (°C), Long-term median (LTM) rainfall (mm), observed average monthly rainfall (mm) and temperatures (°C).

2.2 Existing Land Use

The Study Area is located within the Murchison bioregion (see Section 2.3), which is predominantly used for pastoralism (85%) (Cowan *et al.*, 2001). Additional land uses within the Murchison bioregion include vacant crown land (11%) and mining exploration, while only a small proportion of the bioregion is located within conservation estates (1%).

The Study Area is located on three operating pastoral stations, Polelle, Hillview and Yarrabubba, and adjacent to the now abandoned, Gabanintha townsite. Gold has formerly been mined from the closed “Star of the East” mine (on the western side) and Gabanintha gold mine (located on the eastern side of the Project tenure).

The Northern Region of the Study Area is located partly within the Polelle station, while the remaining southern portion is located within unallocated crown land (UCL). The Northern Access of the Study Area is located almost wholly within the UCL, while the southern end is located just within the Hillview station boundary. The Southern Region and Southern Access of the Study Area are wholly located within the Yarrabubba station.

2.3 Biogeographical Regionalisation of Australia

The IBRA is a key tool for planning nature conservation in Australia and is used by all levels of government. IBRA regions are defined and mapped by the Department of the Environment and Energy (DoEE) and updated periodically. IBRA regions are defined based on commonalities in climate, vegetation, soils, geology and fauna.

The Study Area lies within the Murchison IBRA bioregion and the Eastern Murchison (MUR01) subregion, close to the boundary with the Western Murchison (MUR02) subregion. The Eastern Murchison subregion represents the northern parts of the Yilgarn craton and is geologically characterised by internal drainage, areas of elevated red desert sandplains, salt lakes with paleo-drainages and plains of red-brown soils with breakaways (Cowan *et al.*, 2001). Vegetation in this broad subregion, of nearly 7.9 million hectares, is dominated by Mulga (*Acacia aneura* and close relatives) woodlands, hummock (spinifex) grasslands (*Triodia* spp.), saltbush (*Atriplex* spp.) shrublands and Samphire (*Tecticornia* spp.) shrublands. The climate is arid with mostly winter rainfall of around 200 mm per annum (Cowan *et al.*, 2001).

2.4 Soils and Landforms

The Study Area is located within the Murchison Province and occurs in association with three soils zones; 272 Upper Murchison Zone, 273 Yalgoo Plains Zone, and Salinaland Plains Zone (Tille, 2006).

The Atlas of Australian Soils (Northcote *et al.*, 1960-1968) was compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the 1960's to provide a consistent national description of Australia's soils. It comprises of a series of ten maps and associated explanatory notes and is published at a scale of 1:2,000,000 (with its original compilation at scales from 1:250,000 to 1:500,000). The landscape soil mapping across the Study Area indicates that two units occur, units BE2 and Mz23. The Southern Region and Southern Access occur within unit Mz23, while the Northern Region and the majority of the Northern Access occur within unit BE2. The remaining portion of the Northern Access occurs within unit Mz23.

Table 2.1: Soil landscape units mapped within the Study Area

Code	Description	Extent	
		Ha	%
BE2	Generally undulating terrain on granites with rocky granitic hills, bosses, and tors, some breakaways, and a surface stone mantle: chief soils seem to be shallow earthy loams (Um5.3) underlain by a red-brown hardpan. Associated are shallow (Uc5.21, Uc5.22) soils both underlain by a red-brown hardpan; some (Gn2.1) soils underlain by a red-brown hardpan; and shallow (Uc1.43) and (Um5.41) soils on the hills (no hardpan). The red-brown hardpan is often exposed in eroded sites, and elsewhere is present between 8 and 40 in.	873	71
Mz23	Extensive flat and gently sloping plains with a scatter of surface gravels, similar in topography to unit My5O: chief soils are shallow acid red earths (Gn2.11) and shallow earthy loams (Um5.3) often occurring in intimate micro-associations. Red-brown hardpan occasionally outcrops and is normally present within a depth of 1 m. As mapped, soils of units Oc47 and My5O may be included	360	29
Total		**1,233**	**100**

2.5 Geology

The Murchison Province occupies the north-western part of the Yilgarn Craton and is divided into six major crustal components; two greenstone sequences, the Luke Creek and the overlying Mount Farmer Groups (together forming the Murchison super group), and four granitoid suites (Watkins & Hickman, 1990).

The Study Area is located over units of the Meekatharra-Wydgee Greenstone Belt within the Archaean Yilgarn Craton. More specifically, it is located over the Archaean Gabanintha Gabbro (part of the Lady Anna Igneous Complex), one of several mafic / ultramafic intrusive complexes in the region (IIR, 2018).

The Study Area consists of two rocky ridges, located in the Northern and Southern Regions. The two ridges are located on the eastern limb of the synclinal Meekatharra Greenstone Belt, which consists of interlayered mafic and felsic-volcanoclastic units. The ridges represent cumulate magnetite bands within a layered gabbro sill, dipping steeply to the west, which contains layers of anorthosite as well as magnetite. The magnetite bands are coarsely crystalline and contain titanium and vanadium (John Barnett pers com, 1 September 2018).

2.6 Land Systems

Work undertaken by a joint team from the (former) Department of Agriculture (now Department of Primary Industries and Regional Development) and the (former) Department of Lands Administration (now Department of Planning, Lands and Heritage) attempted to classify the pastoral areas of Western Australia (Curry *et al.*, 1994). The purpose of the surveys were to provide a comprehensive description and mapping of the biophysical resources of the pastoral areas, together with an evaluation of the pastoral potential and the condition of the soils and vegetation (Curry *et al.*, 1994).

The Study Area occurs close to the boundary of three rangeland surveys, Curry *et al.* (1994), Payne *et al.* (1998) and Mabbutt *et al.* (2010). Pollele Station occurs within Curry *et al.* (1994), Yarrabubba Station occurs within Payne *et al.* (1998) and Hillview Station occurs predominantly within Mabbutt *et al.* (2010).

The Study Area is located across eight land systems, as mapped by Curry *et al.* (1994) and Payne *et al.* (1998) (Figure 2.2; Table 2.2). The dominant land system is the Wiluna Land System, which covers 61% of the Study Area, while the Carnegie Land System covers 15% of the Study Area. The remaining six land systems represent less than 10% of the Study Area, with the Koonmarra Land System representing 2% of the Study Area as the smallest extent.

Table 2.2: Land Systems mapped within the Study Area and their extent

Land System	Description	Extent within the Study Area	
		ha	%
Carnegie	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	186	15
Gabanintha	Greenstone ridges, hills and footslopes supporting sparse acacia and other mainly non-halophytic shrublands.	70	6
Koonmarra	Quartz-strewn stony plains and low rises with outcropping granite, gneiss and schist, supporting scattered mulga shrublands and other mainly non-saline shrubs.	22	2
Nallex	Gently undulating stony plains supporting acacia tall shrublands and chenopod low shrublands.	36	3
Naluthanna	Rough hills, tor fields and slopes of gabbro above lower stony plains with gilgaied drainage floors supporting mixed acacia shrublands with sparse halophytes.	53	4

Land System	Description	Extent within the Study Area	
		ha	%
Violet	Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supporting groved mulga and bowgada shrublands and occasionally chenopod shrublands.	39	3
Wiluna	Low greenstone hills with occasional lateritic breakaways and broad stony slopes, lower saline stony plains and broad drainage tracts; supporting sparse mulga and other acacia shrublands with patches of halophytic shrubs.	750	61
Yanganoo	Almost flat hardpan wash plains, with or without small wanderrie banks and weak groving; supporting mulga shrublands and wanderrie grasses on banks.	78	6
Total		**1,233**	**100**

NB: values have been rounded to the nearest whole number

2.7 Vegetation Associations

The Study Area is located in the Austin Botanical District, which is a part of the Eremaean Province. It is predominantly mulga low woodlands (*Acacia aneura)* on plains, reduced to scrub on hills, tree steppe of *Eucalyptus* spp. and *Triodia basedowii* occur on sand plains within the area (Beard, 1990). The vegetation associations of the Study area were mapped by Beard (1976), in which he classified the following five vegetation associations (Figure 2.3):

- 18: Low woodland; mulga (*Acacia aneura*)
- 29: Sparse low woodland; mulga, discontinuous in scattered groups
- 39: Shrublands; mulga scrub
- 204: Succulent steppe with open scrub; scattered mulga & *Acacia sclerosperma* over saltbush & bluebush
- 389: Succulent steppe with open low woodland; mulga over saltbush

Shepherd *et al.* (2002) attempted to reinterpret and update the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). The update also accounts for extensive clearing since Beard (1976) mapping. Some of Beard's vegetation associations have been separated to remove mosaic vegetation associations; however, some mosaics still occur. The majority of the Study Area is located within the Wiluna Vegetation System, while a small portion is in the Upper Murchison System, as reinterpreted by Shepherd *et al.* (2002) (Table 2.3).

The current extent remaining of the vegetation system associations exceeds 98% across the four regional scales: State, bioregion (Murchison), subregion (Eastern Murchison) and Local Government Authority (Shire of Meekatharra) (Government of Western Australia, 2018) (Table

2.3). Reservation of the vegetation system associations is low, with only the Wiluna 18 vegetation system association having some part of its extent located within the State Reserve System (Government of Western Australia, 2018) (approximately 1%, Table 2.3).

Table 2.3: Regional and local extent of vegetation system associations within the Study Area

Code	Extent within Study Area (ha / %)	Scale	Pre-European extent (ha)	Current extent remaining (ha / %)	Current extent remaining within reserves (ha / %)
Wiluna 18	373 / 30	State	4,308,336	4,290,594 / 99.59	45,238 / 1.05
		Bioregion	4,307,946	4,290,204 / 99.59	45,030 / 1.05
		Subregion	4,273,510	4,256,038 / 99.59	45,030 / 1.05
		LGA	793,159	793,066 / 99.99	0 / 0
Wiluna 29.1	163 / 13	State	779,382	779,188 / 99.98	0 / 0
		Bioregion	776,651	776,457 / 99.97	0 / 0
		Subregion	772,808	772,614 / 99.97	0 / 0
		LGA	292,478	292,478 / 100.00	0 / 0
Wiluna 39.2	678 / 55	State	426,536	421,471 / 98.81	0 / 0
		Bioregion	426,436	421,370 / 98.81	0 / 0
		Subregion	411,278	406,212 / 98.77	0 / 0
		LGA	63,776	63,521 / 99.60	0 / 0
Upper Murchison 204.1	2 / <1	State	115,310	115,306 / 100.00	0 / 0
		Bioregion	115,310	115,306 / 100.00	0 / 0
		Subregion	4,751	4,751 / 100.00	0 / 0
		LGA	40,009	40,006 / 100.00	0 / 0
Wiluna 389.1	17 / 1	State	57,514	57,496 / 99.97	0 / 0
		Bioregion	57,514	57,496 / 99.97	0 / 0
		Subregion	57,514	57,496 / 99.97	0 / 0
		LGA	18,873	18,873 / 100.00	0 / 0

NB: Bioregion: Murchison; Subregion: Eastern Murchison; Local Government Authority (LGA): Shire of Meekatharra
Reserves – International Union of Nature Conservation (IUCN) Class I-IV reserves (i.e. National Parks, Strict Nature Reserves)
Source: Government of Western Australia (2018)

Legend

- StudyArea
- **Land System**
- Belele System
- Carnegie System
- Challenge System
- Cunyu System
- Ero System
- Gabanintha System
- Jundee System
- Koonmarra System
- Millrose System
- Nallex System
- Naluthanna System
- Sherwood System
- Violet System
- Wiluna System
- Yagahong System
- Yanganoo System

biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

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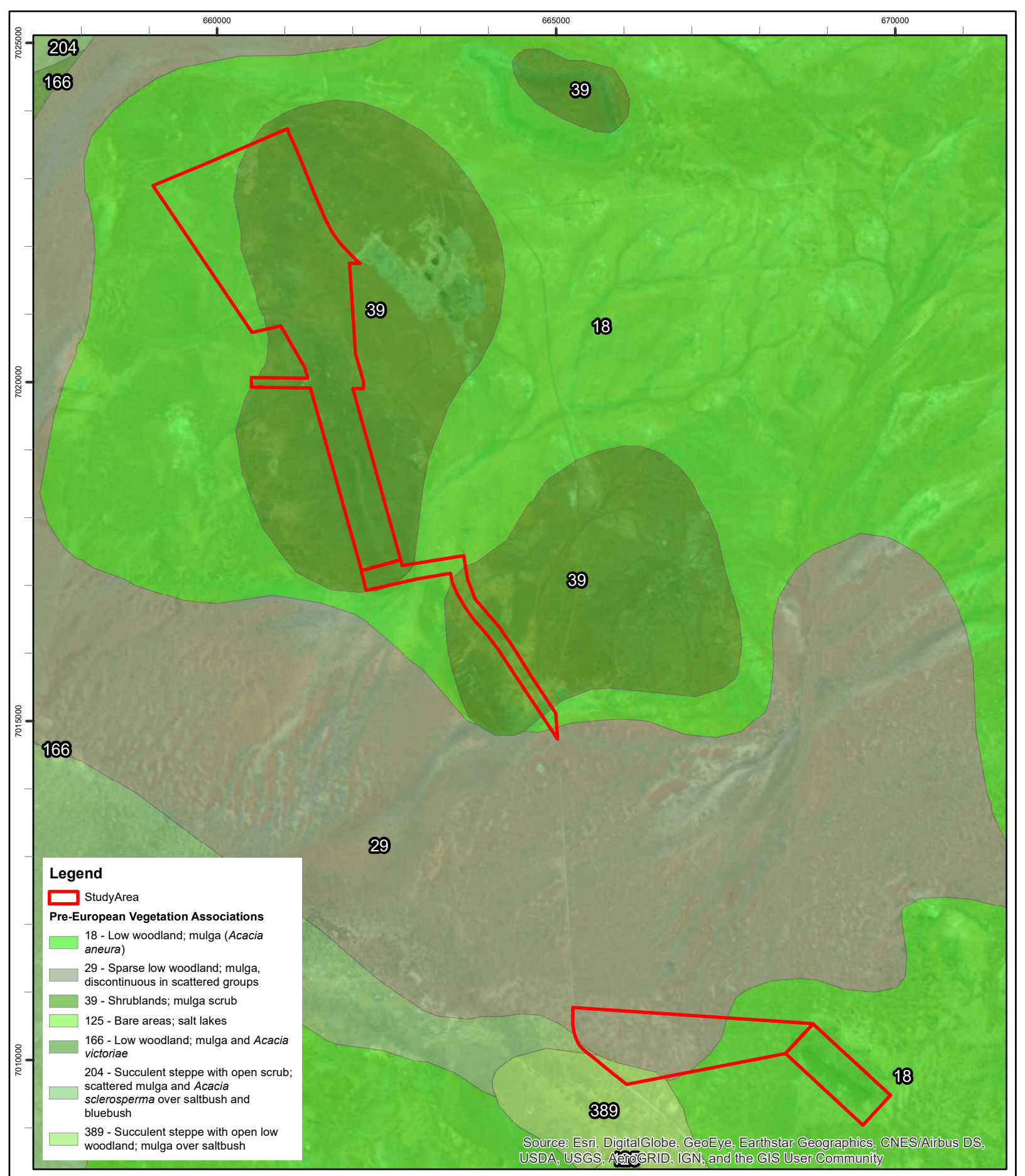
Gabanintha Vanadium Project

Figure 2.2: Land System mapping across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018



biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

Technology Metals Australian Limited

Gabanintha Vanadium Project

Figure 2.3: Vegetation Associations mapped across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018

3 Desktop Assessment

3.1 Literature Review

Background information on the Study Area and surrounds was compiled prior to, during and after the field survey. Historic vegetation mapping conducted by Beard (1976) and Shepherd *et al.* (2002), land systems mapping (Curry *et al.*, 1994; Mabbutt *et al.*, 2010; Payne *et al.*, 1998), and the IBRA classification system (Cowan *et al.*, 2001) were consulted to provide broad contextual knowledge of the vegetation types likely to be encountered within the Study Area. The literature review also considered eight previous field surveys of relevance to the Study Area (Table 3.1). The eight previous field surveys that were considered are publicly available, recently conducted and in close proximity to the Study Area. A summary of the key points and results for each flora and vegetation survey reviewed is detailed in Table 3.2.

Table 3.1: Previous flora and vegetation surveys of relevance to the Study Area

Reference	Title	Distance to Study Area
Biologic (2015)*	Yellow Rock Resources Gabanintha Level 1 flora report	Overlaps
ecologia Environment (2010)	Oakagee Port and Rail OPR rail development vegetation and flora assessment	~70 km to the West
GHD (2011)	Report for Goldfields Highway, SLK 737-748, Biological Survey	~55 km to the north-northeast
Markey and Dillon (2009)	Flora and vegetation of the banded iron formations of the Yilgarn Craton: Herbert Lukin Ridge (Wiluna)	~135 km to the southeast
Mattiske Consulting (2009)	Flora and vegetation of Barrambie survey area, bore fields and water pipeline corridors	~35 km to the south-southeast
Meissner and Caruso (2008)	Flora and vegetation of banded iron formations of the Yilgarn Craton: Jack Hills	~160 km to the west-northwest
Onshore Environmental (2017)*	Australian Vanadium Limited Detailed flora and vegetation survey Gabanintha tenements	Overlaps
Western Botanical (2011)	Yeelirrie Project, Flora and Vegetation Survey Baseline Report	~110 km to the east

* - Only data recorded by Biologic (2015) and Onshore Environmental (2017) within TMAL tenure was utilised in this current assessment.

Table 3.2: Key findings from the literature review

Study details	Methods	Results	Significant findings	Limitations
Biologic (2015) **Client**: Yellow Rock Resources **Type**: Level 1[1] flora and vegetation survey. **Location**: Overlaps partially with Study Area. Only data recorded within TMAL tenure was utilised in this current assessment. **Timing**: Jan 2015	• Desktop assessment • Reconnaissance survey (i.e. site walkover)	• Vegetation types and condition were broadly described	• N/A	• N/A
ecologia Environment (2010) **Client**: Oakagee Port and Rail Pty Ltd **Type**: Two phase Level 2[2] flora and vegetation survey **Location**: Geraldton to Jack Hills **Timing**: Apr, Jun, Aug, Sep, Oct 2009 & Mar 2010	• Desktop assessment • Phase 1 field survey (quadrat sampling) • Phase 2 field survey (transects and targeted searches)	• 1,016 flora species • 62 introduced taxa • 72 vegetation communities • Condition ranged from Pristine to Degraded	• One threatened taxon (*Caladenia hoffmanii*) • 57 priority listed taxa recorded • Four PECs recorded • 68 vegetation associations of local significance	• Completeness was a moderate constraint • Access was a moderate constraint

[1] Level 1 flora and vegetation surveys are now referred to as “Reconnaissance Surveys”

[2] Level 2 flora and vegetation surveys are now referred to as “Detailed Surveys”

Study details	Methods	Results	Significant findings	Limitations
GHD (2011) **Client**: Main Roads WA **Type**: modified Level 2 flora and vegetation survey **Location**: Goldfields Hwy between Meekatharra and Wiluna **Timing**: Nov 2010	• Desktop assessment • Transect sampling (approx. 1 km apart) • Targeted searches	• 98 flora taxa • Two introduced taxa • Eight vegetation associations • Condition ranged from Very Good to Completely Degraded	• No significance findings	• No significant limitations
Markey and Dillon (2009) **Client**: Government of WA **Type**: Level 2 flora and vegetation survey **Location**: near Wiluna **Timing**: Aug 2006	• Quadrat sampling	• 191 flora taxa • One introduced taxon • Six floristic communities	• Nine taxa of conservation significance • Vegetation types are endemic to the Herbert Lukin Ridge	• No significant limitations
Mattiske Consulting (2009) **Client**: Reed Resources Ltd **Type**: Level 2 flora and vegetation survey **Location**: 75 km north of Sandstone **Timing**: Oct 2007, Jul 2008, Apr & Sep 2009	• Desktop assessment • Quadrat sampling • Targeted searches	• 192 flora taxa • Five introduced taxa • 24 vegetation communities • Condition ranged from good to degraded	• No significant findings	• No significant limitations

Study details	Methods	Results	Significant findings	Limitations
Meissner and Caruso (2008) **Client**: Government of WA **Type**: Level 2 flora and vegetation survey **Location**: 140 km WNW of Meekatharra **Timing**: Aug 2006	• Quadrat sampling	• 209 flora taxa • Six floristic communities	• Five taxa of conservation significance • Restricted vegetation communities	• No significant limitations
Onshore Environmental (2017) **Client**: Australian Vanadium Ltd **Type**: Detailed flora and vegetation survey **Location**: Gabanintha – partially overlaps Study Area. Only data recorded within TMAL tenure was utilised in this current assessment. **Timing**: Mar, Apr and Sep 2017	• Desktop assessment • Quadrat sampling • Targeted searches	• 47 flora taxa within TMAL tenure • Several vegetation associations mapped within TMAL tenure	• No significant flora or vegetation recorded from within TMAL tenure	• No significant limitations with data in TMAL tenure
Western Botanical (2011) **Client**: URS Australia Pty Ltd **Type**: Level 2 flora and vegetation survey **Location**: 80 km south of Wiluna **Timing**: Between Dec 2008 and Dec 2010	• Desktop assessment • Quadrat sampling • Targeted searches	• 577 flora taxa • Ten introduced taxa • 52 vegetation communities • Condition ranged from Excellent to completely Degraded	• One threatened taxon (*Atriplex yeelirrie*) • Ten Priority listed flora	• No significant limitations

3.2 Database Searches

Database searches were undertaken to generate a list of vascular flora taxa previously recorded within, and near, the Study Area, including introduced species and taxa of conservation significance. The database searches also identified ecological communities / vegetation types of conservation significance that occur, or may occur, within, and near, the Study Area. Conservation codes for flora and vegetation of conservation significance are provided in Appendix A. Six database searches were conducted around a central coordinate (50J 663775 mE; 7016444 mN), with varying buffers as deemed appropriate (Table 3 3).

Table 3.3: Databases interrogated during the desktop assessment

Database	Reference	Buffer (km)
Threatened and Priority Ecological Communities	DBCA (2018b)	40
Threatened and Priority Flora	DBCA (2018c)	40
NatureMap	DBCA (2018a)	40
Protected Matters	DoEE (2018)	40
Atlas of Living Australia	ALA (2018)	10
Declared Plants Database (Western Australian Organism List; WAOL)	DPIRD (2018)	#

- search was completed for the Shire of Meekatharra and filtered to only include declared plant pests listed under Section 22 of the *Biosecurity and Agriculture Management Act* 2007 (BAM Act).

3.3 Flora of Conservation Significance

A total of 19 conservation significant flora taxa (those listed under the EPBC Act, WC Act, or the Department of Biodiversity, Conservation and Attractions - Parks and Wildlife Division (Parks and Wildlife) Priority List) were identified from the database searches (Appendix B). None of the 19 taxa are listed as Threatened under the EPBC Act or the WC Act. There are four threatened flora taxa, *Atriplex yeelirrie, Ricinocarpos brevis, Acacia rhamphophylla* and *Eremophila rostrata* subsp. *rostrata*, known to occur within the Murchison bioregion (WAH, 1998-). Each of the four taxa are restricted in distribution, with none known to occur within the Shire of Meekatharra local government area.

Of the 19 priority listed taxa, three are listed as Priority 1, thirteen are listed as Priority 3, while the remaining three taxa are listed as Priority 4. Flora taxa of conservation significance identified by the desktop assessment were assessed and ranked on the likelihood of occurring within the Study Area. The rankings were assigned using the following definitions:

1. **Confirmed**: the presence of the species in the Study Area has been recorded unambiguously during the last 15 years.

2. **Highly Likely**: the Study Area lies within the known distribution of the species, the species has been recorded from within 10 km and within the last 15 years.
3. **Likely**: the Study Area lies within the known distribution of the species and the species has been recorded within 20 km in the last 20 years; however, either:
    a. the Study Area is likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or
    b. the species is generally rare and patchily distributed in suitable habitat.
4. **Possible**: there is an outside chance of occurrence, because:
    a. the Study Area is just outside the known distribution of the species, but is likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
    b. the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
    c. the Study Area lies on the edge of, or within, the known distribution and is likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years.
5. **Unlikely**: the Study Area lies outside the known distribution of the species, the Study Area is unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.
6. **Highly Unlikely**: the Study Area lies a significant distance outside of the known distribution, for example, greater than 150 km to the nearest record, and has never been recorded from the area.

No threatened or priority listed taxa have previously been recorded from the Study Area (Figure 3.1) following the desktop assessment. Prior to the field survey, two priority taxa were considered highly likely to occur, two were considered likely to occur and five were considered to possibly occur within the Study Area (Table 3.4).

Three priority taxa, *Eremophila fasciata* (P3), *Ptilotus lazaridis* (P3) and *Drummondita miniata* (P3), have previously been recorded from within 10 km of the Study Area. The three priority listed taxa are highly likely, likely or possible to occur within the Study Area, respectively (Table 3.4). An additional species is considered highly likely to occur, an additional species is considered likely to occur and an additional four species are considered possible to occur based on known records and habitat present within the Study Area (Table 3.4). The remaining ten taxa were considered unlikely and highly unlikely to occur within the Study Area (Appendix C).

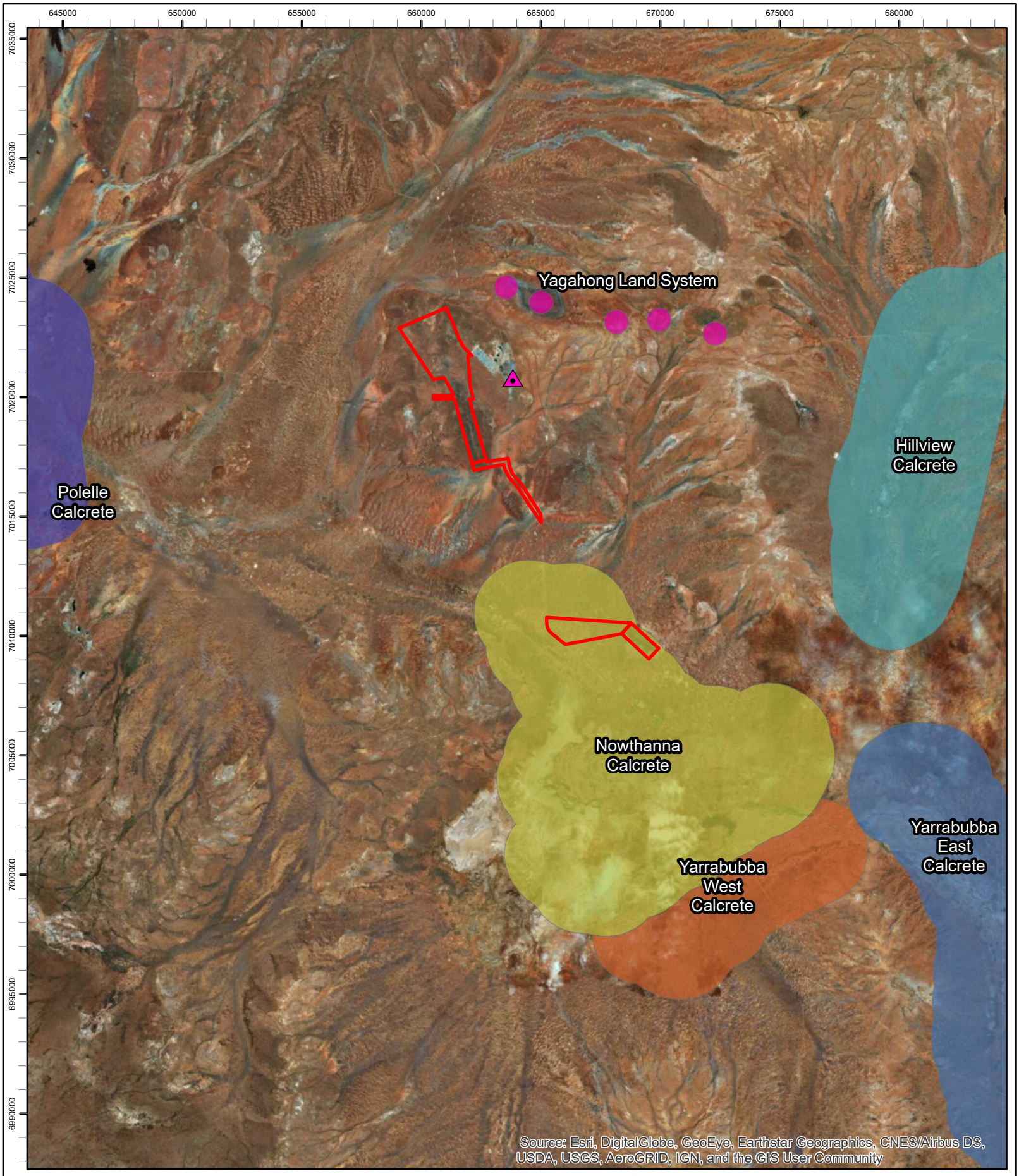
Table 3.4: Conservation significant flora taxa known to occur near the Study Area based on the desktop assessment.

Taxon	Description (WAH, 1998-)	Location
Highly Likely		
Eremophila fasciata (P3)	Erect shrub, 0.6-0.9 m high. Fl. blue-violet, Aug.	1.8 km east of the Northern Region
Acacia speckii (P4)	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	20 km east of the Northern Region

Taxon	Description (WAH, 1998-)	Location
Likely		
Ptilotus lazaridis (P3)	Herb or shrub, to 0.6 m high. Fl. pink/red, Jul or Oct. Clay loam. Floodplains.	10 km south-west of the Southern Access
Ptilotus luteolus (P3)	Compact, perennial shrub (with a yellow indumentum). Fl. yellow & red/purple, Mar to May or Jul to Oct. Rocky slopes, screes, and ridges	25 km east of the Northern Region
Possible		
Eremophila retropila (P1)	Spreading shrub, 0.7-1.7 m high, to 4.2 m wide. Fl. purple-red-white, Aug to Sep. Gravelly loam. Stony flats	36 km north-west of the Northern Region
Calytrix verruculosa (P3)	Shrub, 0.4-0.75 m high. Fl. pink/white, Aug or Oct. Sandy clay.	33 km west of the Southern Access
Grevillea inconspicua (P4)	Intricately branched, spreading shrub, 0.6-2 m high. Fl. white/pink-white, Jun to Aug. Loam, gravel. Along drainage lines on rocky outcrops, creeklines	26 km south of the Southern Region
Drummondita miniata (P3)	Divaricately branched shrub, 0.5-2 m high. Fl. orange-red, Jul to Aug or Nov. Laterite. Breakaways.	9.5 km east of the Southern Region
Acacia sclerosperma subsp. *glaucescens* (P3)	Spreading shrub, 1-3 m high, branchlets puberulous, sometimes glabrous. Fl. yellow, Jul to Aug. Sand, sandy loam, stony soils.	31 km west of the Northern Region

3.4 Vegetation of Conservation Significance

One Threatened Ecological Community (TEC), Depot Springs stygofauna community, was recognised in the Murchison region of Western Australia, which is located over 150 km to the south-east. This TEC was not identified within the 40 km database search buffer around the Study Area. The Parks and Wildlife TEC and Priority Ecological Community (PEC) database search (DBCA, 2018b) identified nine PECs within the 40 km database search buffer (Figure 3.1; Table 3.5). Of the nine PECs identified from the database, one overlaps the Southern Region and Southern Access sites of the Study Area (Figure 3.1). Of the nine PECs identified, six of them, including the PEC that overlaps the Study Area, relate to groundwater assemblages on the Murchison palaeodrainage. The remaining three relate to mapped Land System units that do not occur within the Study Area (Figure 3.1; see Section 2.6).



Legend

- StudyArea
- **Flora of Conservation Significance**
  - *Eremophila fasciata* (Priority 3)
- **Priority Ecological Communities**
  - Hillview Calcrete (Priority 1)
  - Nowthanna Calcrete (Priority 1)
  - Polelle Calcrete (Priority 1)
  - Yagahong Land System (Priority 3)
  - Yarrabubba East Calcrete (Priority 1)
  - Yarrabubba West Calcrete (Priority 1)

biologic Environmental Survey

N

1:200,000

0 1.75 3.5 7 km

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Figure 3.1: Threatened and Priority Flora and Ecological Communities database search results

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018

Table 3.5: Priority Ecological Communities known to occur within, and surrounding, the Study Area

Community ID	Community Name and Description	Location
Austin LS Priority 3	**Austin Land System** Saline stony plains with low rises and drainage foci supporting low halophytic shrublands with scattered mulga; occurs mainly adjacent to lakes Austin and Annean below greenstone hill systems.	27 km west of the Northern Region
Trillbar LS Priority 3	**Trillbar Land System** Gently sloping stony plains with low rises of metamorphic rocks and gilgaied drainage foci; supports more or less saline shrublands of snakewood, mulga, bluebush and samphire with patches of tussock grassland	20 km north of the Northern Region
Yagahong LS Priority 3	**Yagahong Land System** Rough greenstone ridges, hills and cobble-strewn footslopes supporting mulga shrublands	2.1 km east of the Northern Region
Hillview Calcrete Priority 1	**Hillview calcrete groundwater assemblage type on Murchison palaeodrainage on Hillview Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes.	7.7 km east of the Southern Region
Murchison Calcrete Priority 1	**Murchison Downs calcrete groundwater assemblage type on Murchison palaeodrainage on Murchison Downs Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes.	26 km east of the Northern Region
Nowthanna Calcrete Priority 1	**Nowthanna Hill calcrete groundwater assemblage type on Murchison palaeodrainage on Yarrabubba Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes.	Overlaps the Southern Region and Southern Access
Polelle Calcrete Priority 1	**Polelle calcrete groundwater assemblage type on Murchison palaeodrainage on Polelle Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes.	13 km west of the Northern Access
Yarrabubba East Calcrete Priority 1	**Yarrabubba east calcrete groundwater assemblage types on Murchison palaeodrainage on Yarrabubba Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes.	9.4 km south-east of the Southern Region
Yarrabubba West Calcrete Priority 1	**Yarrabubba west calcrete groundwater assemblage types on Murchison palaeodrainage on Yarrabubba Station** Unique assemblages of invertebrates have been identified in the groundwater calcretes	6.1 km south of the Southern Region

3.5 Introduced Taxa

The NatureMap (DBCA, 2018a), Protected Matters (DoEE, 2018), ALA (ALA, 2018) and WAOL (DPIRD, 2018) database searches identified a list of 37 introduced taxa that may potentially occur within the Study Area. The list of introduced taxa known to occur or potentially occur within the Study Area (Appendix C) was reviewed to identify Weeds of National Significance (WoNS) and Declared Plant Pests (DPP).

3.5.1 Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 Weeds of National Significance (WoNS) based on an assessment process that prioritises these weeds according to their invasiveness, potential to spread and environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities.

Of the list of introduced taxa identified during the desktop assessment as occurring in or near the Study Area, 13 are listed as WoNS (Appendix C). The 13 WoNS were identified from the WAOL database search for the entire Shire of Meekatharra. No other database search or literature review identified any WoNS.

3.5.2 Declared Plant Pests

To protect Western Australian agriculture the Department of Primary Industries and Regional Development (DPIRD) (formerly the Department of Agriculture and Food Western Australia, DAFWA) regulates harmful plants under the BAM Act. Plants that are prevented entry into the state, or have control or keeping requirements within the state, are known as declared pests. The main purposes of the BAM Act and its regulations related to Declared Plant Pests (DPP), are to prevent new plant pests (weeds) from entering Western Australia, manage the impact and spread of those pests already present in the state, and to safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

- C1 (Exclusion) — Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State;

- C2 (Eradication) — Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still feasible; and
- C3 (Management) — Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

The desktop assessment identified 31 DPPs (including numerous cacti species that are all listed as DPPs, Appendix C), previously recorded or potentially located within the Shire of Meekatharra. The desktop assessment did not identify any DPPs as occurring within, or immediately adjacent to, the Study Area.

The Environmental Weed Strategy of Western Australia (CALM, 1999) provided a ranking of weed species on a state-wide basis against three criteria; invasiveness, distribution and environmental impacts. The state-wide ratings from the Strategy are deemed too broad to be of use from an on-ground operational perspective, and are now out of date. In addition to these factors, the strategy was meant to have developed an integrated approach to environmental weed management that included site and resource led control (CALM, 1999). However, due to funding constraints, it did not carry out an assessment and ranking of weed species against the biodiversity assets they threaten, nor did it consider feasibility of control.

To address these issues and implement an integrated approach to weed management on Parks and Wildlife-managed lands in WA, the Weed Prioritisation Process for Parks and Wildlife was developed in 2008. It was updated in 2013 and further revised in 2016. Parks and Wildlife prioritised weeds in each region, based on their:

- Invasiveness;
- Ecological impact;
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed species that are already widespread may not be ranked as a high priority. The weed prioritisation for Parks and Wildlifes Midwest district (which includes the Murchison bioregion and the Study Area) has recently been revised by Parks and Wildlife. The key priorities are now centred on ‘Priority Alert’ weeds and weeds that receive a rating for ‘Ecological Impact” and “Invasiveness’.

Seven introduced taxa have been identified by Parks and Wildlife as ‘Priority Alerts’ for the Midwest district, including **Chrysanthemoides monilifera* subsp. *monilifera*, **Eichhornia crassipes*, **Lantana camara*, **Parkinsonia aculeata*, **Rubus anglocandicans*, **Salvinia molesta* and **Zantedeschia aethiopica*. None of these introduced ‘Priority Alerts’ taxa are expected to occur in the Study Area.

4 Methods and Approach

4.1 Survey Timing and Weather

The flora and vegetation survey was undertaken by Biologic over one field trip from the 7th to the 12th of May 2018, inclusive of travel days. A total of 47 personnel hours was spent traversing and sampling the flora and vegetation within the Study Area. The daytime climatic conditions during the field survey were adequate to complete the survey with minimal constraints and limitations (Table 4.1).

Table 4.1: Climatic conditions during the field survey

Date	Min. temp (°C)	Max. temp (°C)	Rainfall (mm)	RH at 9 am (%)	RH at 3 pm (%)
7/05/2018	17.2	29.0	0.0	67	32
8/05/2018	16.6	31.8	0.0	28	16
9/05/2018	14.7	32.1	0.0	42	15
10/05/2018	18.7	32.3	0.0	38	16
11/05/2018	16.4	30.0	0.0	34	18
12/05/2018	16.3	30.1	0.0	30	16

The field survey was undertaken following a summer and autumn season of large fluctuations. The months of January and February 2018 received well above average rainfall (62 mm and 78 mm, respectively; Figure 2.1). The months of March and April received below average rainfall, while the day time maximum temperatures were over 2°C higher, on average (Figure 2.1). As a result of the low March and April rainfall, the high maximum temperatures and perceived high evaporation rates, the soil and surrounds were noted as being dry over the majority of the Study Area. This was further emphasised by the low diversity of annual and ephemeral taxa present.

Although the survey was undertaken during a time considered to be optimal, the climatic conditions prevailing the survey were not ideal for the germination and proliferation of annual and ephemeral taxa. In addition, flowering and fruiting of perennial taxa was low, which has hindered the confidence and identification of some taxa. The survey type (Reconnaissance Survey) is not considered to be as constrained by climate and seasonal conditions (compared to a Detailed Survey) (EPA, 2016). Therefore, the seasonal and prevailing climatic conditions are not considered to be a constraint to the survey.

4.2 Survey Team and Licencing

The field survey was led by Mr Clinton van den Bergh, an experienced botanist with over 11 years of experience. Clinton was assisted by senior zoologist Mr Brad Maryan during the field

survey. Clinton meets the minimum requirements (5+ years of experience in the bioregion) to lead and manage a flora survey in Murchison bioregion, as prescribed by the EPA (EPA, 2016). The collection of flora specimens was taken under a flora collecting permit (SL012369) pursuant to the WC Act Section 23C and 23F.

4.3 Flora and Vegetation Survey Design

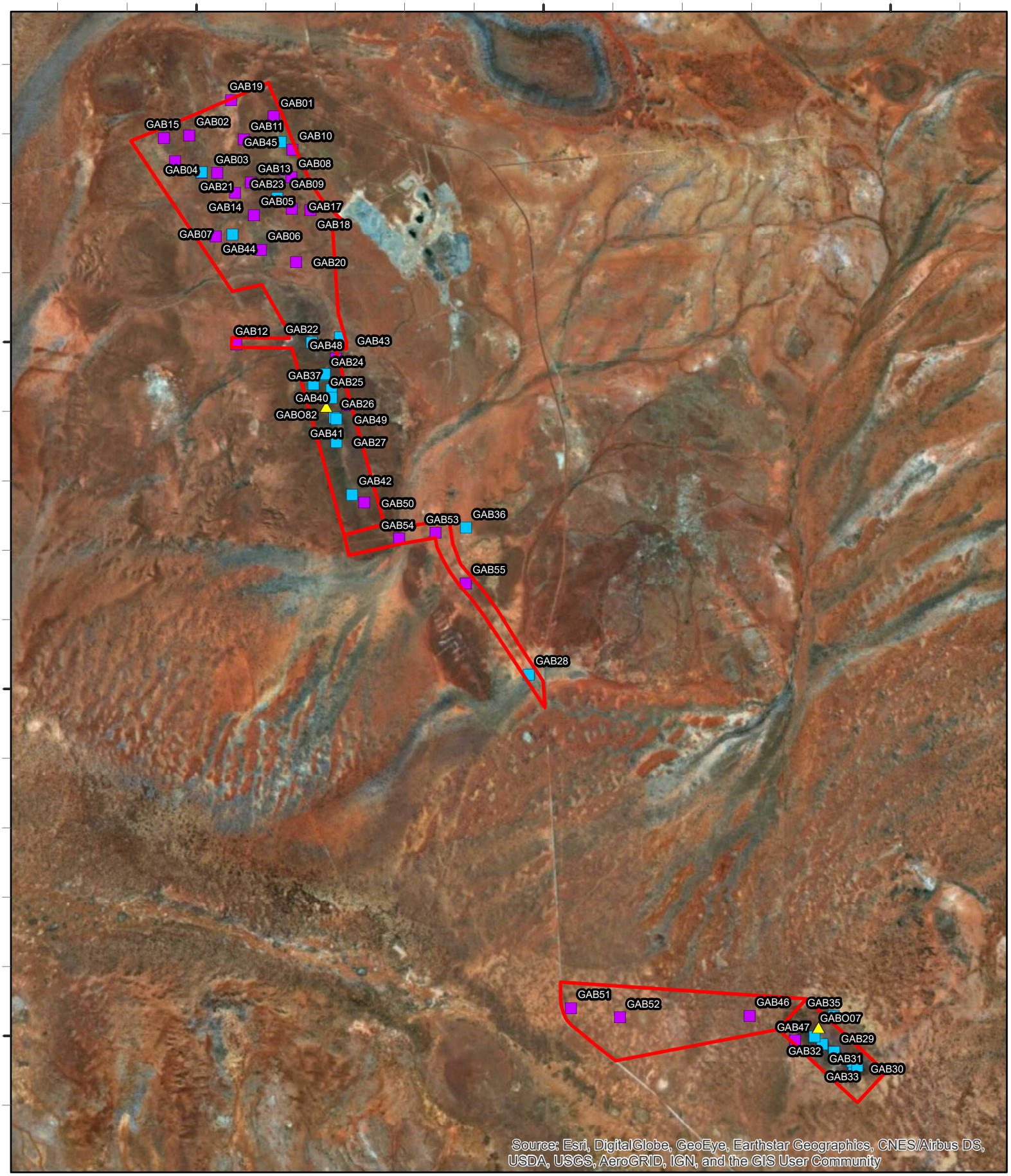
Aerial photography (Scale 1:30,000) of the Study Area and Google Earth Pro©, were used with previous vegetation mapping (Beard, 1976; Biologic, 2015; Onshore Environmental, 2017; Shepherd *et al.*, 2002)[3], land systems mapping (Curry *et al.*, 1994; Mabbutt *et al.*, 2010; Payne *et al.*, 1998) and soil landscape mapping (Northcote *et al.*, 1960-1968), to determine broad preliminary vegetation unit boundaries prior to the field survey. Reconnaissance surveys are traditionally sampled at a low intensity via relevés (unmarked area within which data is collected, EPA, 2016) and mapping points (unmarked area within which the vegetation unit and condition is broadly described). Relevés and mapping points were sampled within the Study Area. Where practical, at least one sampling site (relevé or mapping point) was established in each of the preliminary vegetation unit areas, to ensure that each vegetation unit occurring within the Study Area was captured by the survey and described appropriately and in accordance with EPA (2016).

A total of 55 relevés and mapping points were sampled across the Study Area during the current assessment (Figure 4.1; Appendix E). The mapping notes were sampled to assist in the vegetation unit and condition mapping.

A substantial portion of the Study Area overlaps a previous flora and vegetation survey completed by Onshore Environmental (2017) for Biologic, on behalf of Australian Vanadium Ltd. An agreement exists, where data captured by Onshore Environmental within TMAL tenure can be utilised within this current assessment. The remaining data captured outside of TMAL tenure has not be utilised within this current assessment. Two quadrats were established and sampled within TMAL tenure in the Study Area (Figure 4.1), with these data points used to further supplement the current assessment.

The total number of flora sampling sites located within (and directly adjacent to) the Study Area is 57. This includes two quadrats (sampled by Onshore Environmental, 2017), 30 relevés and 25 mapping points.

[3] Only the portions of the vegetation mapping completed by Onshore Environmental (2017) and Biologic (2015) within TMAL tenure was reviewed and considered for the current assessment.



Legend

- StudyArea

Sampling Sites

- Mapping Note
- Relevé
- Quadrat (Onshore 2017)

biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

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Figure 4.1: Sampling Intensity

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 20/11/2018

The dominant vascular flora taxa located within each relevé sampling area were recorded, with their corresponding height. Flora taxa that had not yet been recorded from previous relevés or during the site traverses, were also recorded to document a comprehensive species list for the Study Area. A brief summary of the vegetation assemblage at each site was also recorded to aid in producing vegetation unit descriptions (ESCAVI, 2003) (Appendix F). In addition, the following information was recorded at each flora sampling sites:

- relevé number;
- date of survey;
- personnel;
- a central GPS coordinate (GDA 94) was taken;
- site photograph – generally taken facing south-east;
- soil characteristics (texture and colour);
- geology (type, size and nature of any rocks, stones, gravel, or outcropping);
- topography (landform type and aspect);
- vegetation condition (based on Trudgen, 1988) (Appendix G);
- disturbance (if present); and
- approximate time since last fire.

Any flora taxa observed opportunistically near relevés, or while traversing the Study Area, were also recorded. For any observed populations of flora taxa known to be conservation significant or introduced, a GPS location and a count of the individuals present, or percentage foliar cover for a given area, were recorded.

Prior to the survey, a list of conservation significant flora with the likelihood or potential to occur within the Study Area was compiled. The field personnel familiarised themselves with photographs, reference samples and descriptions of the priority taxa identified during the desktop assessment before conducting the survey. Once on the ground, the field personnel actively searched the Study Area within suitable habitat to identify priority listed flora taxa, if present.

4.4 Targeted Searching

Targeted searching was undertaken for flora of conservation significance, as identified during the desktop assessment. Taxa that were confirmed, very likely, likely or possible to occur within the Study Area were targeted. Given that the Project has not defined impact footprints, targeted searching was centred on known occurrences, and the immediate surrounds and habitat considered likely to support conservation significant flora (i.e. ironstone ridgeline, drainage lines).

In addition to targeted searching for specific Priority Listed flora taxa in particular habitats, personnel actively searched for all Priority Listed flora taxa and opportunistic flora taxa while completing relevés and traversing the Study Area. Personnel also identified suitable habitat for targeted searches while travelling within the Study Area.

When a conservation significant taxon was identified, a GPS coordinate of the individual was taken when occurring in isolation, or a central GPS coordinate was taken for a small population (central coordinate with an approximate 20 m radius). Information collected at each location included:

- Number of individuals, for a small population;
- Condition and reproductive status of the plants in each population;
- Photographs of vegetation habitat; and
- Broad information on vegetation type and condition.

Rare Flora Report Forms will be provided to the Parks and Wildlife Service of DBCA, as required under the flora collecting permits.

4.5 Identification of Flora Specimens

Plant taxa that could not be easily identifiable during the field survey were collected and pressed for subsequent identification at the Western Australian Herbarium (WAH). Identifications were carried out by Mr Clinton van den Bergh, with assistance from WAH employees (Mr Rob Davis, *Ptilotus* species). All taxa were checked against Florabase© (version 2.9.29; WAH, 1998-) to ensure their currency and validity. Any conservation significant flora taxa, including potential threatened and priority species, range extensions and potential new taxa have been verified and vouchered (if appropriate) at the WAH.

4.6 Vegetation Unit Mapping

Broad vegetation mapping was conducted in the field, with vegetation boundaries delineated over aerial photography. Following the completion of the relevé sampling and taxonomic identifications, the broad vegetation units were refined based on the review of the floristic data collected from the relevés, and the results of the flora and vegetation surveys that partially overlap the Study Area. The vegetation type mapping was then digitised using geographic information systems (GIS) software.

Vegetation types were delineated and described from aerial imagery utilising the flora sampling site data. The vegetation structure information collected from the relevés and mapping points was reviewed to describe the vegetation units based on the dominant taxa, foliar cover and height of the three traditional strata (upper, mid and lower/ground). This method of vegetation type determination is consistent with EPA (2016). As the survey did not involve the systematic sampling of vegetation units via quadrats, statistical analysis was not undertaken on the dataset.

The vegetation types have been described to Level V (Vegetation Association) in the NVIS hierarchical structure (ESCAVI, 2003) and have been coded (for example AiAt) in accordance with standard practice. The mapping reliability is high, excluding those areas that have been subjected to substantial alterations from mining, exploration and pastoral activities. The mapping reliability of these areas is moderate (Section 4.8).

4.7 Vegetation Condition Mapping

Vegetation condition was defined within the Study Area using the Trudgen (1988) Vegetation Condition Scale as detailed in EPA (2016) (Appendix G) based on the level of disturbance observed in an area. Condition was recorded at each relevé and additional notes were taken while traversing the Study Area, and used to broadly map vegetation condition boundaries. The vegetation condition mapping was then digitised using GIS software.

4.8 Potential Limitations and Constraints

There are a number of possible limitations and constraints that can impinge on the adequacy of vegetation and flora surveys (EPA, 2016). The limitations of the current assessment are presented in accordance with the Technical Guidance (EPA, 2016) (Table 4.2).

Table 4.2: Botanical survey limitations and constraints

Limitation	Constraint	Comment
Availability of contextual information at a regional and local scale	No	Sufficient contextual information was available for the Study Area, including broad information on land systems and vegetation associations. A survey overlapping the Study Area was undertaken in 2017, with the information overlapping TMAL tenure reviewed to provide local contextual information.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	No	The survey was led by an experienced botanist with over 11 years of experience. The lead botanist met the minimum requirements to manage a flora and vegetation field survey in the Murchison bioregion (EPA, 2016)
Proportion of flora recorded and/or collected, any identification issues	Yes Minor	The survey intensity (Reconnaissance) is not designed to capture all flora within the Study Area. In addition, the seasonal conditions prior to the survey was not considered ideal to capture all flora within the Study Area. The flora recorded from the current assessment were supplemented by the work completed within TMAL tenure by Onshore Environmental (2017).
Was the appropriate area fully surveyed (effort and extent)	No	The Study Area was traversed and surveyed either on foot or via vehicle, with all major vegetation units visited.
Access restrictions within the survey area	No	The entire Study Area was easily accessible via active pastoral tracks and mining/exploration tracks. The Study Area was accessed via the public road, Meekatharra-Sandstone Road, which adjoins both survey extents.

Limitation	Constraint	Comment
Survey timing, rainfall, season of survey	Yes Minor	The survey was undertaken during a period which would be considered optimal (March to June for the Eremaean region; EPA, 2016). Rainfall in the two preceding months was below average. This followed two months (January and February 2018) of above average rainfall. The Study Area was noted as being dry with very minimal evidence of annual and ephemeral germination and growth, suggesting that the seasonality was sub-optimal. Although the survey was undertaken during dry conditions, the intensity and scope of the survey (Reconnaissance Survey) is not hampered by seasons and can occur at any time during the year (EPA, 2016). As a result, the survey was constrained by the survey timing, but it is only considered to be a minor constraint and is not significant with respect to the Project.
Disturbance that may have affected the results of survey such as fire, flood or clearing	No	The Study Area is located within active pastoral leases, historic mine sites and current mining exploration tenements. The vegetation was noted as being altered, however not to a point that limited the results of the flora and vegetation survey.

5 Results

5.1 Flora Composition

The current assessment of the Study Area recorded a total of 153 vascular flora taxa, from 33 families and 73 genera (Appendix H). The vascular flora taxa recorded from the Study Area included 151 native species and two introduced taxa. The dominant families were Fabaceae (27 taxa), Poaceae (21 taxa) and Chenopodiaceae (18 taxa), which equates to 43% of the total vascular taxa recorded. The most represented genera were *Acacia* (17 taxa), Eremophila (15 taxa) and Ptilotus (nine taxa), which equates to 27% of the total vascular taxa recorded.

Including all sampling within TMAL tenure (Biologic, 2015; Onshore Environmental, 2017), the total vascular flora taxa recorded within the Study Area (and immediate surrounds) increased to 160, from 34 families and 74 genera (Appendix H). Of the 160 vascular flora taxa recorded, 158 are native taxa, while the remaining two vascular flora were introduced taxa.

5.2 Survey Adequacy

The Study Area was sampled by a combination of relevés, mapping points and quadrats (two quadrats sampled within TMAL tenure, Onshore Environmental, 2017), with 57 sampling sites located within, or adjacent to, the Study Area. The sampling intensity is adequate for the purposes of meeting the objective of the survey. In addition to the sampling of sites, the Study Area was traversed on foot and by vehicle to record the dominant flora taxa present.

The number of the flora taxa recorded from the Study Area is consistent with surveys reviewed during the desktop assessment (Table 3.2). The flora diversity (153) is moderate and reflective of the survey intensity (Reconnaissance) and seasonal conditions. It is anticipated that additional flora taxa would be recorded following a more systematic sampling survey, during optimal survey conditions, and across several phases (or seasons).

5.3 Flora of Conservation Significance

5.3.1 Federal and State Listing

The desktop assessment did not identify any federal or state listed threatened flora species as occurring in, or near, the Study Area. The field survey confirmed that there were no threatened flora occurring, or likely to occur within the Study Area. The vegetation and habitats present within the Study Area and the known locations of threatened flora confirm that it is unlikely that any threatened flora would occur within the Study Area.

The desktop assessment identified 19 priority listed taxa as potentially occurring within the Study Area (Section 3.3). Of these 19 priority listed taxa, two were considered ‘Highly Likely’ to occur, two were considered ‘Likely’ to occur and five were considered ‘Possible’ to occur within the Study Area (Table 3.4). Five flora taxa that are priority listed, as determined by Parks and Wildlife, were recorded from the Study Area (Table 5.1). The five priority listed taxa include one

taxon that was considered 'Highly Likely' to occur and three that were not identified from the desktop assessment:

- *Hibiscus krichauffianus* – Priority 3;
- *Ptilotus luteolus* – Priority 3;
- *Tribulus adelacanthus* – Priority 3;
- *Acacia speckii* – Priority 4; and
- *Dodonaea amplisemina* – Priority 4.

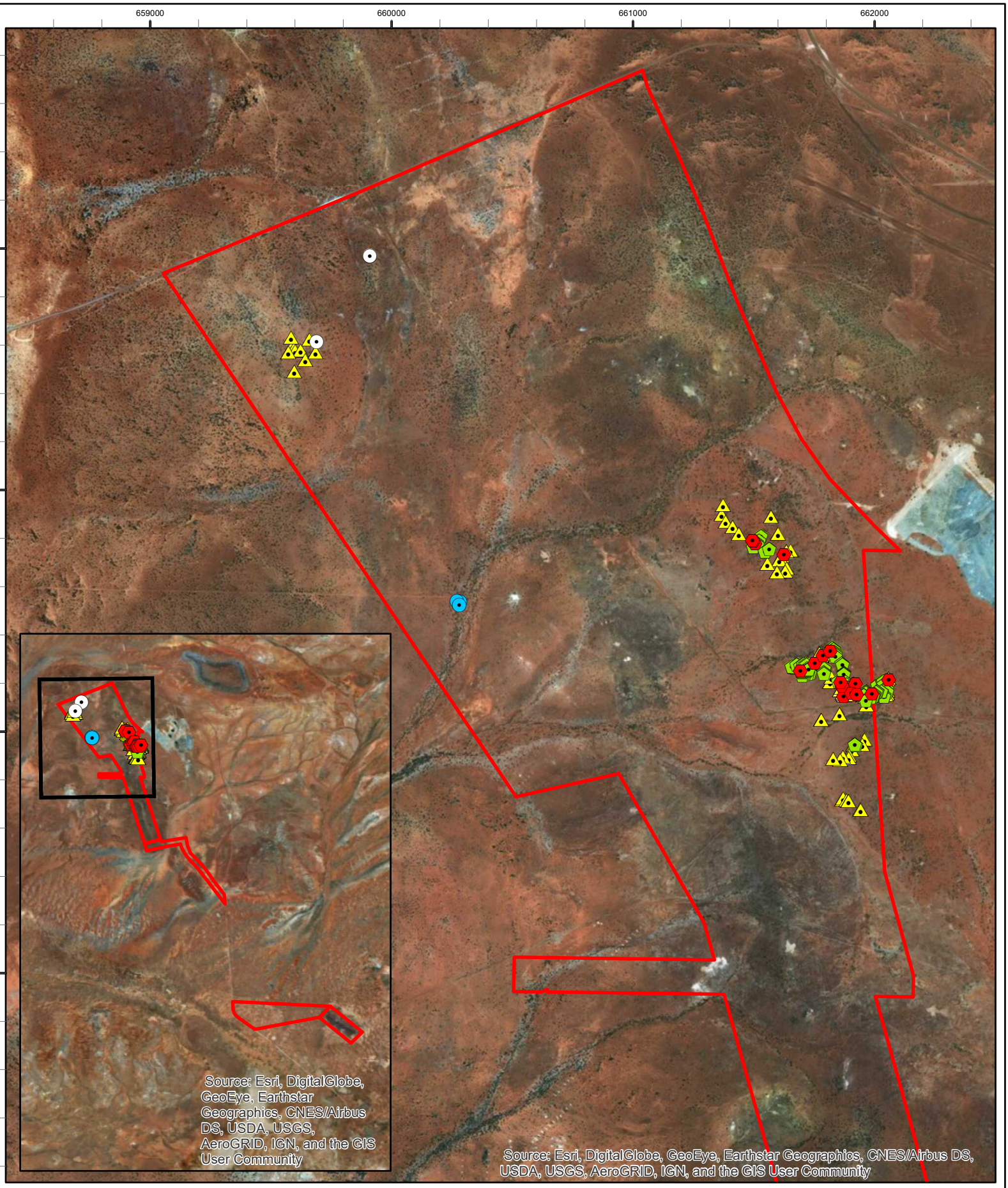
Hibiscus krichauffianus occurs across the majority of mainland Australia, with a large number of records in central Australia (South Australia and Northern Territory) (ALA, 2018). It is described as a low or ascending shrub growing to a height of 0.7 m with purple-pink flowers that have been recorded from March and October (WAH, 1998-), however it is likely that it flowers following favourable rains. *Hibiscus krichauffianus* commonly occurs on red sandy soils and has previously been recorded on flat plains and drainage lines (personal observations).

A total of 11 individuals from one population were recorded from a minor drainage line in the west of the Study Area (Figure 5.1). The individuals were recorded from the base of *Acacia* shrubs on the banks of the drainage line within vegetation unit AiAt. Young buds, fruits and old flowers were observed from the population.

Ptilotus luteolus was originally considered to be a variety of *Ptilotus astrolasius* (*Ptilotus astrolasius* var. *luteolus*), however recent work has warranted the rank of species (Davis, 2009). *Ptilotus luteolus* is a compact, perennial shrub preferring red sandy soils on rocky slopes, screes, and ridges (WAH, 1998-). The type locality was collected 13 km south of Meekatharra on Gabanintha Road (Davis, 2009).

Ptilotus luteolus was recorded in association with *Acacia speckii* and *Dodonaea amplisemina* on basalt hills in the east of the Study Area within vegetation unit AiAca (Figure 5.1). A total of 22 individuals were recorded from one population, however this is considered to be an underestimation of the total population size. *Ptilotus luteolus* is difficult to identify without flowers, while the population was noted as being in varying levels of flowering and bud maturity. The distinctive yellow indumentum on the flower spikes (Davis, 2009) was less evident on the individuals present in the Study Area.

Tribulus adelacanthus is a small, prostrate herb with villous hairs and leaflets with three to six pairs (WAH, 1998-). *Tribulus adelacanthus* has similarities to *Tribulus hirsutus*, however, the size of the fruits and the style and stigma vary (fruit 10-14 mm compared to 20-32 mm, and style and stigma 1.8-2.3 mm compared to 3.5 mm, respectively) (Barker, 1998). *Tribulus adelacanthus* appears to have a hardened structure within the fruit, similar to a spine, when the specimen has dried (Barker, 1998). *Tribulus hirsutus* does not have this hardened structure.



Legend

- StudyArea

Name

- *Acacia speckii* (Priority 4)
- *Dodonaea amplisemina* (Priority 4)
- *Hibiscus krichauffianus* (Priority 3)
- *Ptilotus luteolus* (Priority 3)
- *Tribulus adelacanthus* (Priority 3)

biologic Environmental Survey

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1:20,000

0 0.175 0.35 0.7 km

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Figure 5.1: Location of Priority Flora in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018

Ten individuals were recorded from two sample sites (GAB02 and GAB16), approximately 400 m apart (Figure 5.1) within vegetation unit ApAiAca. As the priority taxon was not identified in the field (identified at WAH from a specimen collected from the field), exact counts and population extents were not completed during the field survey. It is conceivable that the exact extent is more substantial than what has been recorded.

Tribulus adelacanthus has a scattered occurrence in the Murchison and Gascoyne bioregions, with the type locality from 35 km south of the Wongawol Station Homestead, located greater than 340 km to the east-northeast of the Study Area. WAH has 14 specimens lodged within its research collection (WAH, 1998-) (Table 5.1), suggesting that the taxon is not commonly encountered or vouchered.

Acacia speckii is a bushy shrub or small tree growing to a height of approximately 3 m. The priority taxon has distinctive upright, terete, pungent phyllodes with eight strongly raised nerves. The type locality was from approximately 25 km southwest of Nannine, an abandoned town near Lake Annean (25 km to the west of the Study Area). *Acacia speckii* is known from the Meekatharra, Cue and Yalgoo regions and has historically been collected from mulga (*Acacia aneura* and close relatives) scrub on low hills underlain by basalt, granite or dolerite.

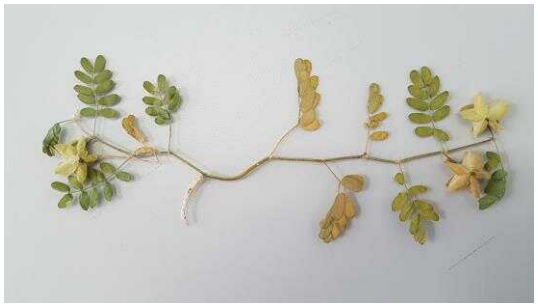
The field survey identified 92 individuals from 88 point locations (Figure 5.1). The individuals were recorded from two populations, separated by distances greater than 500 m (Stack, 2017), with 13 individuals recorded from one population (north-western population), and 79 individuals from the second population (eastern population) (Figure 5.1). The individuals were recorded from basalt hills within vegetation units AiAca and ApAiAca. All individuals observed were sterile at the time of the survey, while mature and younger individuals were observed, suggesting a healthy, sustainable population exists.

Dodonaea amplisemina is described as a dioecious, multi-stemmed shrub growing to a height of 1 m (Shepherd *et al.*, 2007; WAH, 1998-). It is commonly recorded from rocky hills of red-brown sandy clay underlain with basalt, gabbro, banded ironstone, dolerite or quartzite (Shepherd *et al.*, 2007). The type locality is from Ninghan Station, east southeast of Paynes Find (Shepherd *et al.*, 2007).

A total of 205 individuals from 99 point locations were recorded from the Study Area (Figure 5.1). The individuals were recorded from one population along the eastern boundary of the Study Area, in association with *Acacia speckii* (and *Ptilotus luteolus*). The individuals were recorded from basalt hills within vegetation unit AiAca. Several individuals were noted as having fruits at varying ages of maturity, with some dehisced fruits evident. This suggests that the population can reproduce and is self-sustaining.

Table 5.1: Regional and Local extent of priority listed flora recorded from the Study Area

Taxon	Priority listing	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens records
		Point locations	Individuals			
Hibiscus krichauffianus 	P3	3	11	• Great Victoria Desert • Murchison • Nullarbor	• Central • Central band • Nullarbor Plain • Eastern Murchison • Western Murchison	5
Ptilotus luteolus[1] 	P3	17	22	• Carnarvon, • Gascoyne, • Murchison	• Augustus • Eastern Murchison • Western Murchison • Wooramel	16

Taxon	Priority listing	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens records
		Point locations	Individuals			
Tribulus adelacanthus[2] 	P3	2	~10	• Gascoyne • Murchison	• Augustus • Eastern Murchison • Western Murchison	14
Acacia speckii 	P4	88	92	• Gascoyne • Murchison • Yalgoo	• Augustus • Eastern Murchison • Tallering • Western Murchison	31

Taxon	Priority listing	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens records
		Point locations	Individuals			
Dodonaea amplisemina 	P4	99	205	• Avon Wheatbelt • Gascoyne • Murchison • Yalgoo	• Augustus • Avon Wheatbelt P1 • Eastern Murchison • Tallering • Western Murchison	34

1 - due to the difficulty in positively identifying *Ptilotus luteolus* when not flowering in the field, the extent within the Study Area is an under estimate of the true extent.

2 – The population size and extent was not completed during the field survey as it was not confirmed as a priority until the specimen identification process.

5.3.2 Flora of "Other" Significance

The EPA (2004) advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism and anomalous features.

Based on these features, no taxa recorded from the Study Area during the current assessment were considered to be flora of "other" significance.

5.4 Unknown Flora Taxa

Eight (8) flora specimens collected from, and taxa left *in situ*, within the Study Area could not be confidently identified to family, genera or species level (Appendix H), due to a lack of reproductive material and/or poor flora specimen availability at the time of the survey. The taxa that were left *in situ* did not have sufficient vegetative and/or flowering material present at the time of the field survey, or were of poor quality that would hinder a positive identification beyond family, genera or species level. As a result, the taxa were not collected and were identified in the field to the highest taxonomic level possible.

The unknown flora taxa represent approximately 5% of the total taxa recorded from the Study Area. Of the eight specimens, one could not be identified to family level, two could only be identified to family level, while four could not be confidently identified to species level, while the remaining four were tentatively identified to species level (Appendix H). None of the unknown flora taxa collected are analogous to Parks and Wildlife listed Threatened or Priority flora taxa, nor are they likely to represent flora of other significance.

5.5 Introduced Flora Taxa

Two introduced flora taxa, **Cucumis myriocarpus* (Prickly Paddy Melon) and **Citrullus colocynthis* (Colocynth), were recorded from the Study Area during the current assessment (Appendix H). Onshore Environmental (2017) did not identify any introduced taxa within their sampling of TMAL tenure.

The introduced flora taxa recorded from the Study Area were noted as being in isolated occurrences, mainly associated with previously disturbed areas, or minor drainage lines. The introduced flora taxa recorded are commonly encountered in the Murchison bioregion and are not considered to be of concern. The ecological impact of the two introduced flora taxa is low or unknown, while their invasiveness is rapid.

The introduced flora taxa identified from the Study Area during the current assessment are not considered to be significant environmental weeds. No Weeds of National Significance or Declared Plant Pests listed under Section 22 of the BAM Act were recorded.

5.6 Vegetation Units

A total of 15 vegetation units were described (Table 5.2) and delineated (Figure 5.2) from the Study Area following the sampling completed during the current assessment. The vegetation unit mapping completed by Onshore Environmental (2017) within TMAL tenure was reviewed, as it covered a portion of the Study Area, and is a more intensive survey (Detailed) completed across two seasons, following above average rainfall (Onshore Environmental, 2017).

The 15 vegetation units can be broadly categorised into Mulga woodlands/ shrublands and chenopod shrublands. *Acacia aneura* (Mulga) and its close relatives were the dominant feature across the Study Area. The mid and understorey mainly consisted of members from the *Eremophila* genus, the Amaranthaceae family (*Ptilotus* spp.) and the Chenopodiaceae family (*Maireana* spp. and *Sclerolaena* spp.).

The chenopod shrublands occurred in higher proportions within the Southern Region and Southern Access areas. This is due to the area being lower in the landscape and in close proximity to Quinns Lake (located approximately 2 km south of the Southern Access area). On stony quartz hills, *Hakea preissii* and *Acacia synchronicia* were the dominant tall shrubs over chenopod shrubs.

An additional vegetation unit (AtHpAptAs) was described during the current assessment, however it is located outside of the Study Area. The additional vegetation unit was described while completing the vertebrate fauna assessment and deploying a motion camera and an SM4 acoustic recording unit. The vegetation unit has similarities to vegetation unit AiAsHp.

Table 5.2: Vegetation units described and delineated from the Study Area

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AapAaAfAcAca *Acacia aptaneura, Acacia aneura, Acacia fuscaneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia craspedocarpa, Acacia craspedocarpa* (hybrid), and *Acacia tetragonophylla* tall open shrubland over *Eremophila galeata, Sida ectogama* and *Rhagodia drummondii* mid sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Paspalidium clementii* open tussock grassland	GAB28, GAB53	None	26.5 / 2	Very Good; Good; Degraded; and Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AfAiAp *Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	GAB29, GAB30, GAB31, GAB32, GAB33, GAB34	None	6.9 / 1	Good	
AiAcaAp *Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland with *Acacia pruinocarpa* isolated clumps of mid trees over *Eremophila galeata, Acacia tetragonophylla* and *Acacia spathulata* mid sparse shrubland over *Ptilotus obovatus, Ptilotus rotundifolius* and *Sclerolaena cuneata* low sparse shrubland over *Aristida contorta* low isolated tussock grasses	GAB04, GAB11, GAB13, GAB21	None	160.2 / 13	Very Good; Good; and Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AiAapAfAcr *Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	GAB12, GAB22, GAB24, GAB37, GAB38, GAB54	None	31.8 / 3	Very Good; Good; Poor; Degraded; and Completely Degraded	
AiAca *Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low sparse woodland over *Eremophila spathulata* and *Senna glutinosa* subsp. *chatelainiana* mid to low sparse shrubland over isolated chenopod shrubs and tussock grasses	GAB17, GAB18	• *Acacia speckii* (P4) • *Dodonaea amplisemina* (P4) • *Ptilotus luteolus* (P3)	76.3 / 6	Very Good; Good; and Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AiAfAq *Acacia incurvaneura, Acacia fuscaneura* and *Acacia quadrimarginea* tall open shrubland over *Eremophila latrobei* subsp. *latrobei, Eremophila forrestii* subsp. *forrestii* and *Eremophila galeata* mid sparse shrubland over *Ptilotus schwartzii* and *Solanum lasiophyllum* low isolated shrubs	GAB50	None	32.5 / 3	Very Good; and Completely Degraded	
AiApAca *Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	GAB25, GAB27, GAB39, GAB40, GAB42, GABO82	None	52.9 / 4	Very Good	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AiApApt *Acacia incurvaneura, Acacia pruinocarpa* and *Acacia pteraneura* low open woodland over *Eremophila spathulata* mid sparse shrubland over *Ptilotus schwartzii, Solanum lasiophyllum* and *Ptilotus obovatus* low isolated shrubs	GAB14, GAB44, GAB49	None	176.7 / 14	Very Good; Good; Poor; and Completely Degraded	
AiAsHp *Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	GAB06, GAB08, GAB09, GAB19, GAB20, GAB55, GABO07	None	272.4 / 22	Very Good; Good; Poor; Degraded; and Completely Degraded	

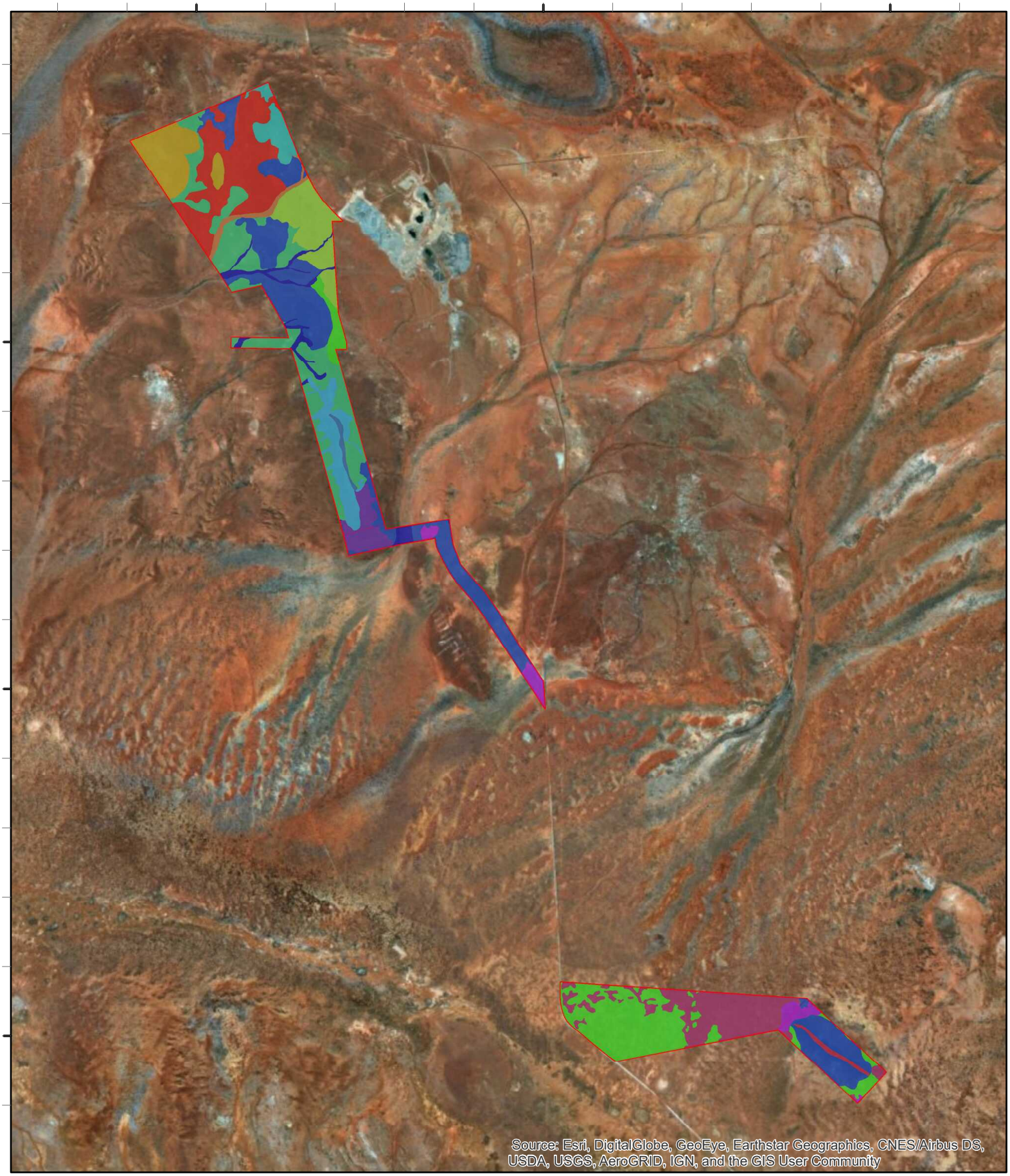
Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AiAt *Acacia incurvaneura* and *Acacia tetragonophylla* low open woodland with *Grevillea striata* isolated clumps of mid trees over *Eremophila exilifolia, Eremophila galeata* and *Senna artemisioides* subsp. x *sturtii* mid sparse (to isolated) shrubland over *Aristida contorta, Digitaria brownii* and *Eragrostis leptocarpa* mid to low isolated tussock grasses	GAB05, GAB07, GAB23	• *Hibiscus krichauffianus* (P3)	14.2 / 1	Very Good; Good; Poor; and Completely Degraded	
ApAi *Acacia pruinocarpa* low isolated trees over *Acacia incurvaneura* low open woodland over *Senna artemisioides* subsp. *artemisioides* and *Thryptomene decussata* mid to tall isolated shrubs over mid isolated tussock grasses dominated by *Eragrostis eriopoda* and *Aristida contorta*	GAB01, GAB10, GAB45	None	29.0 / 2	Very Good; and Good	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
ApAiAca *Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	GAB02, GAB03, GAB15, GAB16	• *Acacia speckii* (P4) • *Tribulus adelacanthus* (P3)	69.0 / 6	Very Good; and Completely Degraded	
AptAcAca *Acacia pteraneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland over *Acacia tetragonophylla* tall sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Eriachne pulchella* subsp. *pulchella, Tripogon loliiformis* and *Aristida contorta* low sparse tussock grassland	GAB46, GAB51	None	115.7 / 9	Good; and Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AqAiAp *Acacia quadrimarginea, Acacia incurvaneura* and *Acacia pruinocarpa* tall sparse shrubland over *Eremophila latrobei* subsp. *latrobei*, *Ptilotus obovatus* and *Maireana georgei* low isolated shrubs	GAB26, GAB41	None	6.1 / <1	Excellent	
MpCsPo *Maireana pyramidata, Cratystylis subspinescens* and *Ptilotus obovatus* low open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Tripogon loliiformis* low open tussock grassland with *Hakea preissii*, *Acacia pteraneura* and *Acacia tetragonophylla* tall isolated shrubs	GAB43, GAB47, GAB48, GAB52	None	165.7 / 13	Very Good; Good; and Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AtHpAptAs[4] *Acacia tetragonophylla, Hakea preissii, Acacia pteraneura* and *Acacia synchronicia* tall sparse shrubland over *Eremophila galeata* mid sparse shrubland over *Ptilotus obovatus* and *Solanum lasiophyllum* low sparse shrubland	GAB35, GAB36	None	Not mapped	Good; and Completely Degraded	

[4] Vegetation unit occurs outside of Study Area, but was sampled and described while completing fauna habitat assessments associated with SM2 and motion camera units



Legend

- StudyArea
- **Vegetation Unit**
- AapAaAfAcAca
- AfAiAp
- AiAapAfAcr
- AiAca
- AiAcaAp
- AiAfAq
- AiApAca
- AiApApt
- AiAsHp
- AiAt
- ApAi
- ApAiAca
- AptAcAca
- AqAiAp
- MpCsPo

biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

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Figure 5.2: Vegetation unit mapping in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018

5.7 Vegetation of Conservation Significance

5.7.1 Federal and State Listing

The desktop assessment did not identify any known TECs as potentially occurring within the Study Area. In addition, there is only one TEC known from the Murchison bioregion, Depot Springs Stygofauna Community, located over 150 km to the south-west. The vegetation units described from the Study Area are not considered to be analogous to the known TEC, while the TEC does not represent terrestrial (above-ground) vegetation.

The desktop assessment identified nine PECs as occurring within 40 km of the Study Area, with one PEC (Nowthanna Calcrete) occurring in association with the Study Area. The PEC supports a groundwater assemblage of invertebrate fauna on the Murchison palaeodrainage on Yarrabubba Station. As with the Depot Springs Stygofauna TEC, the Nowthanna Calcrete PEC was not listed due to a unique assemblage of terrestrial vegetation. As such, the vegetation in association with this PEC is not considered to be significant due to the presence of the PEC.

The remaining eight PECs are known to occur outside of the Study Area. The remaining PECs are also associated with unique land systems (i.e. Austin, Trillbar and Yagahong) or subterranean fauna assemblages that are not connected to the land systems and terrestrial vegetation within the Study Area. The vegetation units are not considered to be analogous to any other PECs known in the Murchison bioregion.

5.7.2 Vegetation of "Other" Significance

The EPA (2004) advises that vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, novel combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level.

The vegetation units described from the Study Area are not considered to be of regional significance, as they are not analogous with any known TECs or PECs, do not support unique floristic assemblages and do not support any known threatened flora species. Although some vegetation types may be unique from a local perspective, they are not considered to be unique from a regional perspective.

Several of the vegetation units recorded from the Study Area are locally significant as they support Priority listed flora taxa or were mapped in association with a minor ephemeral drainage line (Table 5.3). The vegetation units are considered to be of low local significance as the priority flora they support are generally widespread in the Murchison bioregion and adjoining bioregions. In addition, the priority flora are P3 and P4, which are considered to be poorly known, but with some populations within conservation estates.

Table 5.3: Locally significant vegetation units mapped within the Study Area

Code and description	Area (ha / %)	Significance	Comment
AiAca *Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low sparse woodland over *Eremophila spathulata* and *Senna glutinosa* subsp. *chatelainiana* mid to low sparse shrubland over isolated chenopod shrubs and tussock grasses	76.3 / 6	Low	Supports a population of *Acacia speckii* (P4), *Dodonaea amplisemina* (P4) and *Ptilotus luteolus* (P3).
AiAt *Acacia incurvaneura* and *Acacia tetragonophylla* low open woodland with *Grevillea striata* isolated clumps of mid trees over *Eremophila exilifolia, Eremophila galeata* and *Senna*	14.2 / 1	Low	Associated with a minor ephemeral drainage line and supports a population of *Hibiscus krichauffianus* (P3).
ApAiAca *Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	69.0 / 6	Low	Supports populations of *Acacia speckii* (P4) and *Tribulus adelacanthus* (P3).
AiAapAfAcr *Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	31.8 / 3	Low	Vegetation associated with a minor ephemeral drainage line.

5.7.3 Bioregional Significance

Under the Convention of Biological Diversity, Australia has worked towards a target of 17% of the continent to be protected as part of the National Reserve System (NRS). In building the NRS, priority is given to under-represented bioregions that have less than 10% of their remaining area protected in reserves (NRSTG, 2009). The Murchison bioregion is an

underrepresented bioregion, with less than 10% of its total area protected in reserves. The Eastern Murchison (and Western Murchison) subregion is also underrepresented, with less than 10% of the subregional area protected in reserves.

Although the Murchison bioregion, and the Eastern Murchison subregion, are underrepresented within the NRS, greater than 99% of the bioregional and subregional area remains intact (Government of Western Australia, 2018). Thus it has been determined that vegetation clearing associated with the Project will not substantially impact the biological values of the bioregion (and subregion) as the region will remain intact, and therefore the State retains the ability to adequately reserve vegetation within the Murchison bioregion (and the Eastern Murchison subregion).

5.8 Vegetation Condition

The condition of the vegetation in the Study Area ranged from Completely Degraded to Excellent, with the majority in a good to very good condition (Table 5.4; Figure 5.3). Portions of the Study Area were mapped as Completely Degraded, with these areas coinciding with exploration and pastoral tracks and pastoral infrastructure. The Degraded and Poor condition vegetation occurred in areas of mining exploration and areas that have been heavily grazed by cattle (i.e. watering dams).

Although there was evidence of mining exploration and pastoralism, the majority of the vegetation was in a very good condition with only minor evidence of trampling and grazing from cattle. The areas of excellent condition vegetation occurred along the rocky ironstone ridges, which are difficult for vehicles and cattle to navigate across. As a result, the vegetation has been subjected to less disturbances and grazing pressures.

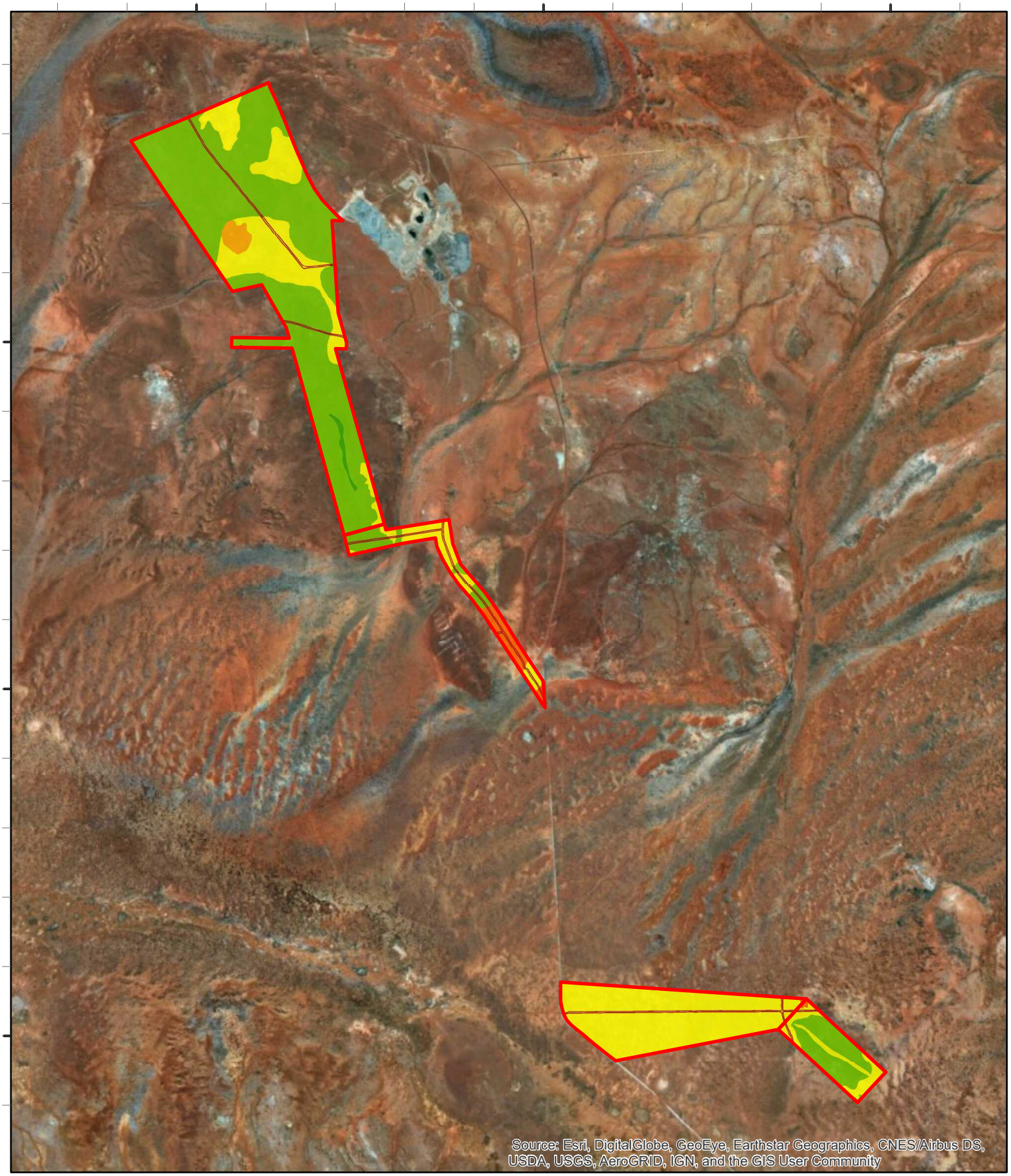
The presence of introduced flora taxa within the Study Area has not drastically altered or disturbed the native flora assemblages of the vegetation units. The occurrence of introduced flora taxa are isolated and minor. Where larger extents of introduced flora taxa are present, they are located within vegetation that has been impacted by additional pressures (i.e. grazing and pastoralism), resulting in the proliferation of introduced taxa.

Table 5.4: Vegetation condition extent in the Study Area

Condition Rating	Extent (ha / %)	Comment
Excellent	6.1 / <1	Minimal evidence of anthropogenic disturbances and disturbances associated with introduced herbivores and introduced flora taxa.
Very Good	676.6 / 55	Evidence of grazing and impacts associated with introduced herbivores and cattle. Pastoral tracks and exploration drill lines present.

Condition Rating	Extent (ha / %)	Comment
Good	502.6 / 41	Vegetation structure impacted by pastoralism and exploration mining. Reduction in species diversity
Poor	15.4 / 1	Vegetation structure visibly altered by pastoralism and exploration mining. Presence of weeds and impacts associated with heavy grazing from introduced herbivores
Degraded	24.1 / 2	Vegetation structure severely altered with disturbance associated with heavy grazing and trampling from introduced herbivores. Minimal recovery in vegetation structure and presence of weeds.
Completely Degraded	8.1 / 1	Associated with previously cleared areas, for example, pastoral tracks and infrastructure and mining related infrastructure.
Total	1,233 / 100	

NB: values have been rounded to the nearest whole number



Legend

- StudyArea
- **Vegetation Condition**
  - Excellent
  - Very Good
  - Good
  - Poor
  - Degraded
  - Completely Degraded

biologic Environmental Survey

N

1:70,000

0 0.5 1 2 km

Technology Metals Australian Limited

Gabanintha Vanadium Project

Figure 5.3: Vegetation condition mapping in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A4. Created 25/06/2018

6 Discussion

6.1 Flora

The floristic diversity recorded within the Study Area was moderate, in consideration of the location of the Study Area, the range of landforms and the survey intensity. It is anticipated that the floristic diversity would increase following; surveys across several seasons (or phases), optimal survey conditions, and with the aid of systematic sampling (i.e. quadrats). The reconnaissance survey was undertaken following sub-optimal seasonal conditions (two months with well below average rainfall and higher than average maximum temperatures, Section 4.1), so the annual and ephemeral diversity recorded from the Study Area was lower than expected.

The Southern Access area occurs in association with vegetation that is lower in the landscape and supports some clay-based soil. A small ephemeral claypan is present within the Southern Access area which would support tussock grasses and ephemeral herbs when soil moisture is present. The claypan was dry at the time of the survey with identification of annual and ephemeral taxa difficult due to a lack of flowering and fruiting material. There is potential that the claypan may support a population of the Priority 4 taxon *Goodenia berringbinensis*.

The current assessment identified five priority listed taxa as occurring within the Study Area, *Hibiscus krichauffianus* (P3)*, Ptilotus luteolus* (P3), *Tribulus adelacanthus* (P3), *Acacia speckii* (P4) and *Dodonaea amplisemina* (P4). The priority taxa were ranked Priority 3 or Priority 4 and are known to occur in the Murchison bioregion and adjacent bioregions (i.e. Gascoyne, Yalgoo). Apart from *Tribulus adelacanthus* and *Hibiscus krichauffianus*, the priority taxa are widespread in the Murchison bioregion. As a result, the location of *Ptilotus luteolus* (P3), *Acacia speckii* (P4) and *Dodonaea amplisemina* (P4) within the Study Area represents negligible regional significance.

Acacia speckii, Dodonaea amplisemina and *Ptilotus luteolus* were recorded occurring in association with each other along a basalt hill along the eastern boundary of the Northern Region area. This basalt hill extends to the south-east where further individuals of *Acacia speckii, Dodonaea amplisemina* and *Ptilotus luteolus* were observed when traversing through and around the Study Area. The exact number of individuals was not recorded, however a preliminary glance across the area suggests that the number of individuals would be equal to what was recorded within the Study Area. The basalt hill occurs adjacent to the historical Gabanintha mine. Due to the extent of individuals occurring outside of the Study Area, the location of *Acacia speckii, Dodonaea amplisemina* and *Ptilotus luteolus* within the Study Area is deemed to be of low local significance.

Tribulus adelacanthus and *Hibiscus krichauffianus* are less widespread in the Murchison bioregion, which may be a result of poor collections and vouchering of specimens. *Hibiscus krichauffianus* occurs across mainland Australia, with a large concentration in central Australia. The distribution and understanding of *Hibiscus krichauffianus* in Western Australia is limited and the current knowledge suggests that it has not previously been recorded east of the Great

Northern Highway in the Murchison bioregion. The presence of *Hibiscus krichauffianus* is deemed to be of low regional significance and moderate local significance. Although *Hibiscus krichauffianus* is poorly collected in Western Australia, it is listed as Priority 3 suggesting that that it does not appear to be under imminent threat. The record of *Hibiscus krichauffianus* in the Study Area represents moderate local significance as it has not previously been recorded from east of the Great Northern Highway, extending it current known easterly extent in Western Australia. However, this may be a result of poor collections and vouchering.

The presence of *Tribulus adelacanthus* in the Study Area represents low regional significance. The new locality does not extend the current known distribution, while the Priority 3 listing suggests it is not under imminent threat and some populations occurring in lands managed for conservation. The new locality fills in a 'gap' between known occurrences. The records of *Tribulus adelacanthus* in the Study Area is deemed to be of moderate local significance. The extent of the priority taxon in the Study Area is poorly understood and there are no known records from within close proximity to the Study Area. A population is known to occur north-east of Cue, approximately 50 to 60 km southwest of the Study Area. However, there are no voucher specimens for this record.

At the time of the survey, no disturbance footprints had been identified, as a result the targeted traverses for conservation significant flora concentrated on known locations and habitat considered to support conservation significant flora. The impact of the Project on the local and regional extent of the priority flora populations identified from the Study Area cannot be determined.

6.2 Vegetation

The vegetation units identified from the Study Area represent variations of Mulga woodlands/ shrublands and chenopod shrublands that occur extensively in the Murchison bioregion. The vegetation was not analogous with any TECs or PECs identified from the desktop assessment or known from the Murchison bioregion. The vegetation is not regionally significant due to the extensive occurrence of Mulga woodlands in the Murchison bioregion. The Murchison bioregion has not been extensively cleared maintaining ecological linkages across the bioregion.

Several of the vegetation units described and delineated from the Study Area were deemed to be of local significance. The vegetation units are locally significant as they support priority flora populations and/or are associated with ephemeral drainage lines. The local significance of the vegetation units is low as the vegetation supports Priority 3 and Priority 4 taxa that are not restricted to the Study Area or the Murchison bioregion. The vegetation units and associated priority flora do not occur on unique or unusual landforms suggesting that available habitat is not limited.

The ephemeral drainage lines that occur within the Study Area are only minor and would only have moving surface water during substantial rainfall events (following the passage of ex-tropical cyclones or large winter storms). Ephemeral drainage lines are common throughout the

Murchison bioregion and are not unique to the Study Area. The remaining vegetation units described and delineated from the Study Area are not locally significant and are widespread from a local and regional extent.

Of the 15 vegetation units described and delineated from the Study Area, 11 of them represented less than 10% of the total area (Table 5.2). Although these vegetation units were restricted within the Study Area, review of aerial imagery suggests they extend beyond into the local region. In addition, vegetation units did not support unique floral assemblages that may be considered unique to certain landforms (i.e. the cumulate magnetite ridges).

The flora and vegetation described and delineated from the Study Area has been subjected to anthropogenic disturbances associated with historical mining (and recent exploration drilling) and ongoing pastoralism. The anthropogenic disturbances have resulted in altered vegetation structures and floristic assemblages across the Study Area (and the general area). Although the Study Area has been subjected to historical and ongoing disturbances, the vegetation units mapped within the Study Area were mostly considered to be in good or very good condition. In addition, portions of the Study Area were also considered to be in excellent condition. Conversely, there were also portions of the Study Area considered to be in poor, degraded and completely degraded condition.

The main disturbances were associated with cattle grazing, and the portion of the Study Area considered to be in excellent condition occurred in association with the cumulate magnetite ridge. Cattle rarely, if ever, venture across the rocky cumulate magnetite ridge so the vegetation structure was not severely impacted. Man-made dams and watering points were present in the Study Area. Due to the presence of a permanent water source the vegetation was severely impacted by grazing and trampling from cattle, resulting in a vegetation condition rating of degraded. The less palatable vegetation (i.e. *Acacia* shrubs and trees with fibrous foliage) was mostly undisturbed, while the palatable grasses and annual herbs were more severely impacted from grazing.

The minor ephemeral drainage lines showed signs of grazing and trampling from cattle due to the shade that the dense vegetation provides, and the higher proportion of palatable vegetation. Similar to the cumulate magnetite ridge, the stony rises and hills showed minimal signs of grazing pressures due to the lower diversity and density of palatable vegetation.

6.3 Summary

The floral diversity, assemblages and vegetation units described from the Study Area do not represent regionally significant features. Of the 15 vegetation units mapped, four were demmed to be of low local significance for supporting priority flora and occurring in association with an ephemeral drainage line. The presence of *Hibiscus krichauffianus* (P3) and *Tribulus adelacanthus* (P3) in the Study Area is deemed to be of low regional significance and moderate local significance, while the three remaining priority taxa *Acacia speckii* (P4), *Dodonaea*

amplisemina (P4) and *Ptilotus luteolus* (P3) were deemed to be of negligible regional significance and low local significance.

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8 Appendices

Appendix A: Conservation listings

Fauna and flora may be accorded legislative protection by being listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) and/or the *Wildlife Conservation Act 1950* (State) (WC Act), or by being listed on the WA Department of Biodiversity, Conservation and Attractions: Parks and Wildlife Services' Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Status	Code	Description
Categories used under the EPBC Act		
Critically Endangered	Cr	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	En	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	Vu	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	Mi	Fauna that migrate to, over and within Australia and its external territories.
Schedules used under the WC Act		
Critically Endangered	Schedule 1	Taxa that is rare or likely to become extinct, as critically endangered fauna
Endangered	Schedule 2	Taxa that is rare or likely to become extinct, as endangered fauna
Vulnerable	Schedule 3	Taxa that is rare or likely to become extinct, as vulnerable fauna
Presumed Extinct	Schedule 4	Taxa that is presumed to be extinct
Migratory	Schedule 5	Birds that are subject to international agreements relating to the protection of migratory birds
Parks and Wildlife Services Priority flora and fauna lists		
Priority 1	P1	Taxa with few, poorly known populations on threatened lands. These are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Status	Code	Description
Priority 2	P2	Taxa with few, poorly known populations on conservation lands. These are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands. These are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4	P4	Taxa in need of monitoring. These are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring. These are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years.

Status	Code	Description
Threatened Ecological Communities: TECs are indirectly protected under the Western Australian Environmental Protection Act 1986 and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.		
Presumed Totally Destroyed	PD	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): a) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or b) All occurrences recorded within the last 50 years have since been destroyed.

Status	Code	Description
Critically Endangered	Cr	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (a, b or c): a. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely Vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely Vulnerable to known threatening processes. c. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Status	Code	Description
Endangered	En	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b, or c): a. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very Vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very Vulnerable to known threatening processes. c. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Status	Code	Description
Vulnerable	Vu	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b or c): a. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. b. The ecological community may already be modified and would be Vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. c. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority One	P1	Poorly-known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally =5 occurrences or a total area of = 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	P2	Poorly-known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally =10 occurrences or a total area of =200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Status	Code	Description
Priority Three	P3	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority Four	P4	Rare or Near Threatened Ecological Communities or Ecological communities that have been removed from the list of threatened communities during the past five years. These communities require regular monitoring. **Rare:** Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. **Near Threatened:** Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
Priority Five	P5	Conservation dependant ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix B: Database Search Results

Parks and Wildlife Service (DBCA, 2018c)

EPBC Act Protected Matters Search (DoEE, 2018)

NatureMap (DBCA, 2018a)

Atlas of Living Australia (ALA, 2018)

Western Australian Organism List (DPIRD, 2018)

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
Acanthaceae	*Harnieria kempeana* subsp. *muelleri*			•						
Acarosporaceae	*Acarospora citrina*			•						
Aizoaceae	*Gunniopsis rodwayi*			•						
	Tetragonia moorei			•						
	Trianthema glossostigmum			•						
Alismataceae	*Sagittaria platyphylla*					•				•
Amaranthaceae	*Ptilotus chamaecladus*			•						
	Ptilotus chippendalei			•						
	Ptilotus crosslandii	•							3	
	Ptilotus divaricatus			•						
	Ptilotus gaudichaudii			•						
	Ptilotus helipteroides			•						
	Ptilotus lazaridis	•		•					3	
	Ptilotus luteolus	•		•					3	
	Ptilotus obovatus			•						
	Ptilotus roei			•						
	Ptilotus rotundifolius			•	•					
	Ptilotus schwartzii			•						
Apocynaceae	*Calotropis procera*					•				•
	Cryptostegia madagascariensis					•				•
	Marsdenia graniticola			•						
Araceae	*Pistia stratiotes*					•				•

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Zantedeschia aethiopica					•				•
Araliaceae	*Hydrocotyle ranunculoides*					•				•
	Neosciadium glochidiatum			•						
Asparagaceae	*Asparagus asparagoides*					•				•
Asphodelaceae	*Asphodelus fistulosus*			•						•
Asteraceae	*Angianthus milnei*			•						
	Angianthus tomentosus			•						
	Asteridea chaetopoda			•						
	Brachyscome ciliaris			•						
	Brachyscome simulans			•						
	Calocephalus multiflorus			•						
	Calotis multicaulis			•						
	Cephalipterum drummondii			•						
	Chondrilla juncea					•				•
	Chrysocephalum gilesii			•						
	Cratystylis subspinescens			•						
	Dielitzia tysonii			•						
	Erymophyllum compactum			•	•					
	Erymophyllum ramosum			•						
	Gilruthia osbornii			•						
	Gnephosis angianthoides			•						
	Gnephosis tenuissima			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Helipterum craspedioides			•						
	Isoetopsis graminifolia			•						
	Kippistia suaedifolia			•						
	Lemooria burkittii			•						
	Millotia incurva			•						
	Millotia perpusilla			•						
	Minuria gardneri			•						
	Myriocephalus pygmaeus			•						
	Olearia pimeleoides			•						
	Onopordum acaulon					•				•
	Pluchea rubelliflora			•						
	Podolepis capillaris			•						
	Podotheca pritzelii	•							3	
	Podotheca wilsonii			•						
	Rhodanthe charsleyae			•						
	Rhodanthe chlorocephala subsp. *splendida*			•						
	Rhodanthe floribunda			•	•					
	Rhodanthe humboldtiana			•						
	Rhodanthe maryonii			•	•					
	Rhodanthe propinqua			•						
	Rhodanthe sphaerocephala	•							1	

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Rhodanthe sterilescens			•						
	Schoenia cassiniana			•						
	Schoenia filifolia subsp. *filifolia*			•						
	Senecio gregorii			•						
	Senecio lacustrinus			•						
	Silybum marianum					•				•
	Streptoglossa liatroides			•						
	Waitzia acuminata var. *acuminata*			•						
	Xanthium spinosum					•				•
	Xanthium strumarium					•				•
Boraginaceae	*Echium plantagineum*					•				•
	Halgania cyanea var. Allambi Stn (B.W. Strong 676)			•						
	Heliotropium ammophilum			•						
	Heliotropium curassavicum			•						
	Heliotropium inexplicitum			•	•					
	Heliotropium mitchellii			•	•					
	Heliotropium ovalifolium			•	•					
	Plagiobothrys plurisepalus			•						
Brassicaceae	*Carrichtera annua*									•
	Lepidium oxytrichum			•						
	Lepidium platypetalum			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Menkea draboides	•							3	
	Stenopetalum anfractum			•						
	Stenopetalum pedicellare			•						
Cactaceae	*Austrocylindropuntia cylindrica*					•				•
	Austrocylindropuntia subulata					•				•
	Cylindropuntia fulgida					•				•
	Cylindropuntia imbricata					•				•
	Cylindropuntia kleiniae					•				•
	Cylindropuntia pallida					•				•
	Cylindropuntia tunicata					•				•
	Opuntia elata					•				•
	Opuntia elatior					•				•
	Opuntia engelmannii					•				•
	Opuntia ficus-indica					•				•
	Opuntia microdasys					•				•
	Opuntia monacantha					•				•
	Opuntia polyacantha					•				•
	Opuntia puberula					•				•
	Opuntia stricta					•				•
	Opuntia tomentosa					•				•
Campanulaceae	*Isotoma petraea*			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
Celastraceae	*Stackhousia* sp. Mt Keith (G. Cockerton & G. O'Keefe 11017)			•						
Chenopodiaceae	*Atriplex amnicola*			•						
	Atriplex bunburyana			•						
	Atriplex codonocarpa			•						
	Atriplex hymenotheca			•						
	Atriplex nana			•						
	Atriplex semilunaris			•						
	Atriplex spongiosa			•						
	Atriplex vesicaria			•						
	Chenopodium gaudichaudianum			•						
	Didymanthus roei			•						
	Dissocarpus paradoxus			•						
	Dysphania kalpari			•						
	Dysphania plantaginella			•						
	Dysphania simulans			•						
	Eriochiton sclerolaenoides			•						
	Maireana amoena			•						
	Maireana atkinsiana			•	•					
	Maireana brevifolia			•						
	Maireana carnosa			•						
	Maireana convexa			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Maireana georgei			•						
	Maireana melanocoma			•						
	Maireana pentatropis			•						
	Maireana planifolia			•						
	Maireana prosthecochaeta	•							3	
	Maireana pyramidata			•						
	Maireana thesioides			•						
	Maireana triptera			•						
	Maireana villosa			•						
	Salsola australis			•						
	Sclerolaena burbidgeae			•						
	Sclerolaena clelandii			•						
	Sclerolaena cuneata			•						
	Sclerolaena densiflora			•						
	Sclerolaena diacantha			•						
	Sclerolaena eriacantha			•						
	Sclerolaena eurotioides			•						
	Sclerolaena fimbriolata			•						
	Sclerolaena lanicuspis			•						
	Sclerolaena obliquicuspis			•						
	Sclerolaena patenticuspis			•						
	Sclerolaena recurvicuspis			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Tecticornia cymbiformis	•		•					3	
	Tecticornia disarticulata			•						
	Tecticornia halocnemoides			•						
	Tecticornia halocnemoides subsp. *catenulata*			•						
	Tecticornia indica subsp. *bidens*			•						
	Tecticornia indica subsp. *leiostachya*			•						
	Tecticornia peltata			•						
	Tecticornia pterygosperma subsp. *denticulata*			•						
	Tecticornia sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)			•						
Convolvulaceae	*Cuscuta epithymum*				•					•
	Cuscuta planiflora			•	•					•
	Duperreya commixta			•						
Cyperaceae	*Eleocharis pallens*			•						
	Isolepis congrua			•						
Droseraceae	*Drosera macrantha* subsp. *macrantha*			•						
Euphorbiaceae	*Jatropha gossypiifolia*					•				•
Fabaceae	*Acacia aneura*			•	•					
	Acacia aptaneura			•						
	Acacia burkittii			•						
	Acacia caesaneura			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Acacia craspedocarpa			•	•					
	Acacia cuthbertsonii subsp. *linearis*			•						
	Acacia fuscaneura			•						
	Acacia grasbyi			•	•					
	Acacia incurvaneura			•						
	Acacia murrayana			•						
	Acacia oswaldii			•						
	Acacia pruinocarpa			•						
	Acacia pteraneura			•						
	Acacia quadrimarginea			•						
	Acacia ramulosa var. *linophylla*			•						
	Acacia ramulosa var. *ramulosa*			•						
	Acacia sclerosperma subsp. *glaucescens*			•					3	
	Acacia sclerosperma subsp. *sclerosperma*			•						
	Acacia sibilans			•						
	Acacia speckii	•		•					4	
	Acacia synchronicia			•						
	Acacia tetragonophylla			•						
	Acacia tysonii			•						
	Acacia umbraculiformis			•						
	Acacia victoriae			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Acacia victoriae subsp. *victoriae*			•						
	Acacia xanthocarpa			•						
	Aeschynomene indica			•						
	Alhagi maurorum					•				•
	Glycine canescens			•						
	Indigofera chamaeclada subsp. *chamaeclada*			•						
	Indigofera georgei			•						
	Indigofera gilesii	•							3	
	Indigofera monophylla			•						
	Parkinsonia aculeata					•				•
	Prosopis glandulosa x Prosopis velutina					•				•
	Senna alata					•				•
	Senna artemisioides			•						
	Senna artemisioides subsp. *helmsii*			•						
	Senna glutinosa subsp. *chatelainiana*			•						
	Senna obtusifolia					•				•
	Senna sp. Austin (A. Strid 20210)			•						
	Senna sp. Meekatharra (E. Bailey 1-26)			•						
	Swainsona incei			•						
	Swainsona oroboides			•						
	Swainsona paradoxa			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Swainsona paucifoliolata			•						
	Swainsona pterostylis			•						
	Swainsona purpurea			•						
	Ulex europaeus					•				•
Frankeniaceae	*Frankenia cinerea*			•						
	Frankenia fecunda			•						
	Frankenia laxiflora			•						
	Frankenia setosa			•						
Goodeniaceae	*Goodenia maideniana*			•						
	Goodenia mimuloides			•						
	Goodenia tenuiloba			•						
	Scaevola collaris			•						
	Scaevola tomentosa			•						
	Velleia glabrata			•						
	Velleia hispida			•						
Gyrostemonaceae	*Codonocarpus cotinifolius*			•						
Iridaceae	*Moraea flaccida*					•				•
	Moraea miniata					•				•
Juncaginaceae	*Triglochin hexagona*			•						
Lamiaceae	*Prostanthera wilkieana*			•						
	Teucrium teucriiflorum			•						
Loranthaceae	*Amyema microphylla*			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Amyema nestor			•						
Malvaceae	*Abutilon otocarpum*			•						
	Androcalva luteiflora			•						
	Lawrencia densiflora			•						
	Lawrencia helmsii			•						
	Sida ammophila			•						
Montiaceae	*Calandrinia* sp. Bungalbin (G.J. Keighery & N. Gibson 1656)			•						
Myrtaceae	*Calytrix amethystina*			•						
	Calytrix brevifolia				•					
	Calytrix desolata			•						
	Calytrix erosipetala			•						
	Calytrix flavescens				•					
	Calytrix strigosa				•					
	Calytrix verruculosa	•							3	
	Chamelaucium drummondii				•					
	Enekbatus eremaeus			•						
	Eucalyptus camaldulensis subsp. *obtusa*			•						
	Eucalyptus kingsmillii				•					
	Eucalyptus striaticalyx			•						
	Melaleuca stereophloia			•						
	Melaleuca xerophila			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Micromyrtus sulphurea			•						
	Thryptomene decussata			•						
Nyctaginaceae	*Boerhavia repleta*			•						
Parmeliaceae	*Xanthoparmelia praegnans*			•						
	Xanthoparmelia versicolor			•						
Pedaliaceae	*Josephinia eugeniae*			•						
Peltulaceae	*Peltula patellata*			•						
Phrymaceae	*Peplidium* sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)			•						
Pittosporaceae	*Pittosporum angustifolium*			•						
Plumbaginaceae	*Muellerolimon salicorniaceum*			•						
Poaceae	*Aristida contorta*			•						
	Aristida holathera var. *holathera*			•						
	Austrostipa nitida			•						
	Brachyachne prostrata				•					
	Cenchrus ciliaris									•
	Cymbopogon ambiguus			•						
	Dichanthium sericeum subsp. *humilius*			•						
	Digitaria brownii			•						
	Enneapogon caerulescens			•	•					
	Eragrostis dielsii			•						
	Eragrostis eriopoda			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Eragrostis falcata			•						
	Eragrostis leptocarpa			•						
	Eragrostis setifolia			•						
	Eragrostis sp. Erect spikelets (P.K. Latz 2122)			•						
	Eragrostis xerophila			•						
	Eriachne flaccida			•						
	Eulalia aurea			•						
	Monachather paradoxus			•						
	Rostraria pumila			•						•
	Sporobolus actinocladus			•	•					
	Triodia melvillei			•						
Polygonaceae	*Rumex vesicarius*			•						•
Pottiaceae	*Crossidium geheebii*			•						
	Didymodon torquatus			•						
Proteaceae	*Grevillea deflexa*			•						
	Grevillea inconspicua	•		•					4	
	Grevillea juncifolia subsp. *temulenta*			•						
	Grevillea nematophylla subsp. *supraplana*			•						
	Hakea francisiana			•						
	Hakea preissii			•	•					
Psoraceae	*Psora decipiens*			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
Ramalinaceae	*Toninia sedifolia*			•						
Rhamnaceae	*Cryptandra connata*			•						
	Ziziphus mauritiana					•				•
Rosaceae	*Rubus ulmifolius*					•				•
Rubiaceae	*Psydrax latifolia*			•						
	Psydrax rigidula			•						
Rutaceae	*Drummondita miniata*			•					3	
Santalaceae	*Exocarpos aphyllus*			•						
Sapindaceae	*Dodonaea microzyga*				•					
	Dodonaea microzyga var. *acrolobata*			•						
	Dodonaea petiolaris			•						
	Dodonaea viscosa subsp. *angustissima*			•						
Scrophulariaceae	*Eremophila alternifolia*			•						
	Eremophila arachnoides subsp. *arachnoides*	•		•					3	
	Eremophila compacta subsp. *fecunda*			•						
	Eremophila deserti			•						
	Eremophila exilifolia			•						
	Eremophila fasciata	•		•	•				3	
	Eremophila forrestii			•						
	Eremophila forrestii subsp. *forrestii*			•						
	Eremophila forrestii subsp. *hastieana*			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Eremophila gilesii subsp. *variabilis*			•						
	Eremophila glabra subsp. *glabra*			•						
	Eremophila glabra subsp. *tomentosa*			•						
	Eremophila glutinosa			•	•					
	Eremophila granitica			•	•					
	Eremophila ionantha			•						
	Eremophila jucunda subsp. *jucunda*			•						
	Eremophila lachnocalyx			•	•					
	Eremophila latrobei subsp. *latrobei*			•						
	Eremophila linearis			•	•					
	Eremophila longifolia			•						
	Eremophila macmillaniana			•	•					
	Eremophila maculata subsp. *brevifolia*			•						
	Eremophila malacoides			•						
	Eremophila oppositifolia subsp. *angustifolia*			•						
	Eremophila phyllopoda				•					
	Eremophila phyllopoda subsp. *phyllopoda*			•						
	Eremophila platycalyx			•	•					
	Eremophila platycalyx subsp. *platycalyx*			•						
	Eremophila pterocarpa subsp. *pterocarpa*			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
	Eremophila pungens	•							4	
	Eremophila retropila	•		•					1	
	Eremophila serrulata			•						
	Eremophila sp.			•						
	Eremophila sp. Meekatharra (D.J. Edinger 4430)	•							1	
	Eremophila spathulata			•						
	Eremophila youngii subsp. *youngii*			•						
Solanaceae	*Lycium australe*			•						
	Nicotiana cavicola			•						
	Nicotiana simulans			•						
	Solanum austropiceum			•						
	Solanum elaeagnifolium					•				•
	Solanum lasiophyllum			•						
	Solanum linnaeanum					•				•
Stylidiaceae	*Stylidium longibracteatum*			•						
Tamaricaceae	*Tamarix aphylla*					•				•
Thymelaeaceae	*Pimelea forrestiana*			•						
	Pimelea holroydii			•						
	Pimelea microcephala				•					
	Pimelea microcephala subsp. *microcephala*			•						
	Pimelea trichostachya			•						

Family	Taxon	Parks and Wildlife	EPBC Act	NatureMap	Atlas of Living Australia	Western Australian Organism List	Conservation Rating			Introduced
							EPBC Act	WC Act	Parks and Wildlife	
Verbenaceae	*Lantana camara*					•				•
Verrucariaceae	*Placidium squamulosum*			•						
Violaceae	*Hybanthus floribundus*			•						
Zygophyllaceae	*Zygophyllum aurantiacum*			•						
	Zygophyllum compressum			•						
	Zygophyllum kochii			•						
	Zygophyllum ovatum			•						
	Zygophyllum tetrapterum			•						

Appendix C: Assessment of Conservation Significant Flora Likelihood of Occurrence Based on the Desktop Assessment

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	Parks and Wildlife							
Acacia sclerosperma subsp. *glaucescens*			P3	D	Spreading shrub, 1-3 m high, branchlets puberulous, sometimes glabrous. Fl. yellow, Jul to Aug. Sand, sandy loam, stony soils.	Yes	No	31 km	No	Possible
Acacia speckii	-	-	P4	A; D	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Yes	Yes	20 km	No	Highly Likely
Calytrix verruculosa			P3	A, D	Shrub, 0.4-0.75 m high. Fl. Pink/white, Aug or Oct. Sandy clay.	Yes	Yes	33 km	No	Possible
Drummondita miniata			P3	D	Divaricately branched shrub, 0.5-2 m high. Fl. orange-red, Jul to Aug or Nov. Laterite. Breakaways.	Potential	Yes	10 km	No	Possible
Eremophila arachnoides subsp. *arachnoides*			P3	A, D	Broom-like shrub, to 3 m high, branches with circular, discrete tubercles. Fl. White/blue-purple, Sep. Shallow loam over limestone.	No	Yes	32 km	No	Unlikely
Eremophila fasciata			P3	B, D, E	Erect shrub, 0.6-0.9 m high. Fl. Blue-violet, Aug.	Potential	Yes	2 km	No	Highly Likely
Eremophila pungens			P4	A	Erect, viscid shrub, 0.5-1.5 m high. Fl. Purple-violet, Jun to Aug. Sandy loam, clayey sand over laterite. Plains, ridges, breakaways	No	No	90 km	No	Unlikely
Eremophila retropila			P1	A, D	Spreading shrub, 0.7-1.7 m high, to 4.2 m wide. Fl. Purple-red-white, Aug to Sep. Gravelly loam. Stony flats	Yes	Yes	36 km	No	Possible
Eremophila sp. Meekatharra (D.J. Edinger 4430)			P1	A	Erect, spindly and sparsely branched shrub. Outcropping laterite and rocky slopes along mesas.	No	No	110 km	No	Unlikely
Grevillea inconspicua			P4	A, D	Intricately branched, spreading shrub, 0.6-2 m high. Fl. White/pink-white, Jun to Aug. Loam, gravel. Along drainage lines on rocky outcrops, creeklines	Yes	Yes	38 km	No	Possible
Indigofera gilesii			P3	A	Shrub, to 1.5 m high. Fl. Purple-pink, May or Aug. Pebbly loam. Amongst boulders & outcrops, hills.	No	No	93 km	No	Unlikely
Maireana prosthecochaeta			P3	A	Open, densely-leaved shrub, 0.3-0.6 m high. Laterite. Hills, salty places.	Potential	Yes	95 km	No	Unlikely
Menkea draboides			P3	A	Prostrate, spreading annual, herb, to 0.6 m wide. Fl. White/cream, Aug to Sep. Red sand or clay, granite.	Potential	No	50 km	No	Unlikely
Podotheca pritzelii			P3	A	Ascending to erect, succulent annual, herb, 0.05-0.25 m high. Fl. Yellow-orange, Sep to Oct. Sand. Sand ridges in salt flats.	No	No	>350 km	No	Highly Unlikely
Ptilotus crosslandii			P3	A	Prostrate herb. Fl. White, Sep to Oct. Sandy soils. Colluvial plains.	No	No	117 km	No	Unlikely
Ptilotus lazaridis			P3	A; D	Herb or shrub, to 0.6 m high. Fl. Pink/red, Jul or Oct. Clay loam. Floodplains.	Yes	Yes	10 km	No	Likely

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	Parks and Wildlife							
Ptilotus luteolus			P3	A; D	Compact, perennial shrub (with a yellow indumentum). Fl. Yellow & red/purple, Mar to May or Jul to Oct. Rocky slopes, screes, and ridges	Yes	Yes	25 km	No	Likely
Rhodanthe sphaerocephala			P1	A	Erect annual, herb, to 0.25 m high, with ascending branches. Fl. Oct. Clayey loam. On flats.	Potential	No	85 km	No	Unlikely
Tecticornia cymbiformis			P3	A, D	Erect, perennial shrub, 0.3-0.5 m high. Saline soils. Along the edge of creeklines.	No	No	25 km	No	Unlikely

1 – A: Threatened and Priority Flora Database (DBCA, 2018c); B: WA Herbarium Specimen Database (DBCA, 2018c); C: PMST (DoEE, 2018); D: NatureMap (DBCA, 2018a), E: Atlas of Living Australia (ALA, 2018).

2 – WAH (1998-)

Appendix D: Introduced taxa identified from the desktop assessment

Family	Taxon	Common Name	WoNS	DPP	Source
Alismataceae	*Sagittaria platyphylla*	Sagittaria	Yes	Yes	A
Apocynaceae	*Calotropis procera*	Rubber bush	No	Yes	A
Apocynaceae	*Cryptostegia madagascariensis*	Rubbervine	No	Yes	A
Araceae	*Pistia stratiotes*	Water lettuce	No	Yes	A
Araceae	*Zantedeschia aethiopica*	Arum lily	No	Yes	A
Araliaceae	*Hydrocotyle ranunculoides*	Hydrocotyle	No	Yes	A
Asparagaceae	*Asparagus asparagoides*	Bridal creeper	Yes	Yes	A
Asphodelaceae	*Asphodelus fistulosus*	Onion weed	No	No	C
Asteraceae	*Chondrilla juncea*	Skeleton weed	No	Yes	A
Asteraceae	*Onopordum acaulon*	Stemless thistle	No	Yes	A
Asteraceae	*Silybum marianum*	Variegated thistle	No	Yes	A
Asteraceae	*Xanthium spinosum*	Bathurst burr	No	Yes	A
Asteraceae	*Xanthium strumarium*	Bathurst burr	No	Yes	A
Boraginaceae	*Echium plantagineum*	Paterson's curse	No	Yes	A
Brassicaceae	*Carrichtera annua*	Ward's weed	No	No	B
Cactaceae	*Austrocylindropuntia* spp.	Cactus	Yes	Yes	A
Cactaceae	*Cylindropuntia* spp.	Cactus	Yes	Yes	A
Cactaceae	*Opuntia* spp.	Cactus	Yes	Yes	A
Convolvulaceae	*Cuscuta planiflora*	Dodder	No	No	C
Euphorbiaceae	*Jatropha gossypiifolia*	Bellyache bush	Yes	Yes	A
Fabaceae	*Alhagi maurorum*	Camelthorn	No	Yes	A

Family	Taxon	Common Name	WoNS	DPP	Source
Fabaceae	*Parkinsonia aculeata*	Parkinsonia	Yes	Yes	A
Fabaceae	*Prosopis* spp.	Mesquite	Yes	Yes	A
Fabaceae	*Senna alata*	Candlestick senna	No	Yes	A
Fabaceae	*Senna obtusifolia*	Sicklepod senna	No	Yes	A
Fabaceae	*Ulex europaeus*	Gorse	Yes	Yes	A
Iridaceae	*Moraea flaccida*	One-leaf cape tulip	No	Yes	A
Iridaceae	*Moraea miniata*	Two-leaf cape tulip	No	Yes	A
Poaceae	*Cenchrus ciliaris*	Buffel grass	No	No	B
Poaceae	*Rostraria pumila*	Tiny bristle-grass	No	No	C
Polygonaceae	*Rumex vesicaria*	Ruby dock	No	No	C
Rhamnaceae	*Ziziphus mauritiana*	Chinese apple	No	Yes	A
Rosaceae	*Rubus ulmifolius*	Blackberry	Yes	Yes	A
Solanaceae	*Solanum elaeagnifolium*	White horsenettle	Yes	Yes	A
Solanaceae	*Solanum linnaeanum*	Apple of Sodom	No	Yes	A
Tamaricaceae	*Tamarix aphylla*	Tamarisk	Yes	Yes	A
Verbenaceae	*Lantana camara*	Common lantana	Yes	Yes	A

A: WAOL (DPIRD, 2018); B: PMST (DoEE, 2018); C: NatureMap (DBCA, 2018a);

Appendix E: Flora relevé data

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB01	8/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Ironstone, Laterite	*Acacia pruinocarpa* low isolated trees over *Acacia incurvaneura* low open woodland over *Senna artemisioides* subsp. *artemisioides* and *Thryptomene decussata* mid to tall isolated shrubs over mid isolated tussock grasses dominated by *Eragrostis eriopoda* and *Aristida contorta*	Very Good
1733 TMT Gabanintha Flora	GAB02	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Dolerite, Ironstone	*Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	Very Good
1733 TMT Gabanintha Flora	GAB03	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Greenstone, Ironstone	*Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	Very Good
1733 TMT Gabanintha Flora	GAB04	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Greenstone, Ironstone	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland with *Acacia pruinocarpa* isolated clumps of mid trees over *Eremophila galeata, Acacia tetragonophylla* and *Acacia spathulata* mid sparse shrubland over *Ptilotus obovatus, Ptilotus rotundifolius* and *Sclerolaena cuneata* low sparse shrubland over *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB05	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Greenstone, Ironstone, Riverstone	*Acacia incurvaneura* and *Acacia tetragonophylla* low open woodland with *Grevillea striata* isolated clumps of mid trees over *Eremophila exilifolia, Eremophila galeata* and *Senna artemisioides* subsp. x *sturtii* mid sparse (to isolated) shrubland over *Aristida contorta, Digitaria brownii* and *Eragrostis leptocarpa* mid to low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB06	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Ironstone	*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB07	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Ironstone	*Acacia incurvaneura* and *Acacia tetragonophylla* low open woodland with *Grevillea striata* isolated clumps of mid trees over *Eremophila exilifolia, Eremophila galeata* and *Senna artemisioides* subsp. x *sturtii* mid sparse (to isolated) shrubland over *Aristida contorta, Digitaria brownii* and *Eragrostis leptocarpa* mid to low isolated tussock grasses	Good
1733 TMT Gabanintha Flora	GAB08	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Greenstone, Ironstone	*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Poor
1733 TMT Gabanintha Flora	GAB09	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Greenstone, Ironstone	*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB10	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Dolerite, Greenstone, Ironstone	*Acacia pruinocarpa* low isolated trees over *Acacia incurvaneura* low open woodland over *Senna artemisioides* subsp. *artemisioides* and *Thryptomene decussata* mid to tall isolated shrubs over mid isolated tussock grasses dominated by *Eragrostis eriopoda* and *Aristida contorta*	Very Good
1733 TMT Gabanintha Flora	GAB11	9/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Ironstone	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland with *Acacia pruinocarpa* isolated clumps of mid trees over *Eremophila galeata, Acacia tetragonophylla* and *Acacia spathulata* mid sparse shrubland over *Ptilotus obovatus, Ptilotus rotundifolius* and *Sclerolaena cuneata* low sparse shrubland over *Aristida contorta* low isolated tussock grasses	Good
1733 TMT Gabanintha Flora	GAB12	10/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Granite, Ironstone	*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB13	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Granite, Ironstone, Quartzite	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland with *Acacia pruinocarpa* isolated clumps of mid trees over *Eremophila galeata, Acacia tetragonophylla* and *Acacia spathulata* mid sparse shrubland over *Ptilotus obovatus, Ptilotus rotundifolius* and *Sclerolaena cuneata* low sparse shrubland over *Aristida contorta* low isolated tussock grasses.	Good
1733 TMT Gabanintha Flora	GAB14	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Basalt, Quartzite	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia pteraneura* low open woodland over *Eremophila spathulata* mid sparse shrubland over *Ptilotus schwartzii, Solanum lasiophyllum* and *Ptilotus obovatus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB15	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Granite, Ironstone	*Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	Very Good
1733 TMT Gabanintha Flora	GAB16	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Basalt	*Acacia pruinocarpa* mid isolated trees over *Acacia incurvaneura, Acacia caesaneura* (narrow phyllode variant) and *Acacia grasbyi* low open woodland over *Ptilotus rotundifolius, Eremophila spathulata, Eremophila linearis* and *Ptilotus obovatus* mid to low sparse shrubland	Very Good
1733 TMT Gabanintha Flora	GAB17	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Loam	Basalt	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low sparse woodland over *Eremophila spathulata* and *Senna glutinosa* subsp. *chatelainiana* mid to low sparse shrubland over isolated chenopod shrubs and tussock grasses	Good
1733 TMT Gabanintha Flora	GAB18	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Basalt	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low sparse woodland over *Eremophila spathulata* and *Senna glutinosa* subsp. *chatelainiana* mid to low sparse shrubland over isolated chenopod shrubs and tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB19	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Clay loam	Ironstone	*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB20	11/05/2018	CvdB	Average	Relevé	Unbounded	No	Northern Region	Sandy loam	Basalt, Quartz	*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Good
1733 TMT Gabanintha Flora	GAB21	9/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loam	None Discernible	*Acacia incurvaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland with *Acacia pruinocarpa* isolated clumps of mid trees over *Eremophila galeata, Acacia tetragonophylla* and *Acacia spathulata* mid sparse shrubland over *Ptilotus obovatus, Ptilotus rotundifolius* and *Sclerolaena cuneata* low sparse shrubland over *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB22	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Magnetite	*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB23	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Clay Loam	None Discernible	*Acacia incurvaneura* and *Acacia tetragonophylla* low open woodland with *Grevillea striata* isolated clumps of mid trees over *Eremophila exilifolia, Eremophila galeata* and *Senna artemisioides* subsp. x *sturtii* mid sparse (to isolated) shrubland over *Aristida contorta, Digitaria brownii* and *Eragrostis leptocarpa* mid to low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB24	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Sandy Loam	Magnetite	*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB25	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Conglomerate	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB26	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Sandy Loam	Detritals	*Acacia quadrimarginea, Acacia incurvaneura* and *Acacia pruinocarpa* tall sparse shrubland over *Eremophila latrobei* subsp. *latrobei*, *Ptilotus obovatus* and *Maireana georgei* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB27	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	None Discernible	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB28	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Access	Clay Loam	None Discernible	*Acacia aptaneura, Acacia aneura, Acacia fuscaneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia craspedocarpa, Acacia craspedocarpa* (hybrid), and *Acacia tetragonophylla* tall open shrubland over *Eremophila galeata, Sida ectogama* and *Rhagodia drummondii* mid sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Paspalidium clementii* open tussock grassland	Very Good
1733 TMT Gabanintha Flora	GAB29	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Sandy Loam	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB30	10/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Sandy Loam	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB31	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Loamy Sand	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB32	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Loamy Sand	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB33	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Loamy Sand	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB34	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Loamy Sand	Magnetite	*Acacia fuscaneura, Acacia incurvaneura* and *Acacia pruinocarpa* tall open shrubland over *Eremophila glutinosa* and *Senna glaucifolia* mid sparse shrubland over *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei* and *Tribulus suberosus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB35	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Southern Region	Sandy Clay Loam		*Acacia tetragonophylla, Hakea preissii, Acacia pteraneura* and *Acacia synchronicia* tall sparse shrubland over *Eremophila galeata* mid sparse shrubland over *Ptilotus obovatus* and *Solanum lasiophyllum* low sparse shrubland	Very Good
1733 TMT Gabanintha Flora	GAB36	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Access	Sandy Clay Loam		*Acacia tetragonophylla, Hakea preissii, Acacia pteraneura* and *Acacia synchronicia* tall sparse shrubland over *Eremophila galeata* mid sparse shrubland over *Ptilotus obovatus* and *Solanum lasiophyllum* low sparse shrubland	Good
1733 TMT Gabanintha Flora	GAB37	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Magnetite	*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB38	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Magnetite	*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB39	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Magnetite	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB40	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Magnetite	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB41	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Sandy Loam	Granite	*Acacia quadrimarginea, Acacia incurvaneura* and *Acacia pruinocarpa* tall sparse shrubland over *Eremophila latrobei* subsp. *latrobei*, *Ptilotus obovatus* and *Maireana georgei* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB42	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Loamy Sand	Laterite, Ironstone	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Good
1733 TMT Gabanintha Flora	GAB43	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Clayey Sand	None Discernible	*Maireana pyramidata, Cratystylis subspinescens* and *Ptilotus obovatus* low open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Tripogon loliiformis* low open tussock grassland with *Hakea preissii*, *Acacia pteraneura* and *Acacia tetragonophylla* tall isolated shrubs	Degraded
1733 TMT Gabanintha Flora	GAB44	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Clayey Sand	Ironstone	*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia pteraneura* low open woodland over *Eremophila spathulata* mid sparse shrubland over *Ptilotus schwartzii, Solanum lasiophyllum* and *Ptilotus obovatus* low isolated shrubs	Degraded
1733 TMT Gabanintha Flora	GAB45	8/05/2018	CvdB	Average	Mapping Note	Unbounded	No	Northern Region	Clay Loam	Laterite, Ironstone	*Acacia pruinocarpa* low isolated trees over *Acacia incurvaneura* low open woodland over *Senna artemisioides* subsp. *artemisioides* and *Thryptomene decussata* mid to tall isolated shrubs over mid isolated tussock grasses dominated by *Eragrostis eriopoda* and *Aristida contorta*	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB46	10/05/2018	CvdB	Very Good	Releve	Unbounded	No	Southern Region	Silty Loam		*Acacia pteraneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland over *Acacia tetragonophylla* tall sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Eriachne pulchella* subsp. *pulchella, Tripogon loliiformis* and *Aristida contorta* low sparse tussock grassland	Good
1733 TMT Gabanintha Flora	GAB47	10/05/2018	CvdB	Very Good	Releve	Unbounded	No	Southern Region	Sandy Loam		*Maireana pyramidata, Cratystylis subspinescens* and *Ptilotus obovatus* low open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Tripogon loliiformis* low open tussock grassland with *Hakea preissii*, *Acacia pteraneura* and *Acacia tetragonophylla* tall isolated shrubs	Good
1733 TMT Gabanintha Flora	GAB48	8/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Region	Sandy Clay Loam		*Maireana pyramidata, Cratystylis subspinescens* and *Ptilotus obovatus* low open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Tripogon loliiformis* low open tussock grassland with *Hakea preissii*, *Acacia pteraneura* and *Acacia tetragonophylla* tall isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB49	8/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Region	Sandy Loam		*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia pteraneura* low open woodland over *Eremophila spathulata* mid sparse shrubland over *Ptilotus schwartzii, Solanum lasiophyllum* and *Ptilotus obovatus* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB50	8/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Access	Sandy Loam		*Acacia incurvaneura, Acacia fuscaneura* and *Acacia quadrimarginea* tall open shrubland over *Eremophila latrobei* subsp. *latrobei, Eremophila forrestii* subsp. *forrestii* and *Eremophila galeata* mid sparse shrubland over *Ptilotus schwartzii* and *Solanum lasiophyllum* low isolated shrubs	Very Good
1733 TMT Gabanintha Flora	GAB51	11/05/2018	CvdB	Very Good	Releve	Unbounded	No	Southern Access	Sandy Clay Loam		*Acacia pteraneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low open woodland over *Acacia tetragonophylla* tall sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Eriachne pulchella* subsp. *pulchella, Tripogon loliiformis* and *Aristida contorta* low sparse tussock grassland	Good
1733 TMT Gabanintha Flora	GAB52	11/05/2018	CvdB	Very Good	Releve	Unbounded	No	Southern Access	Sandy Loam		*Maireana pyramidata, Cratystylis subspinescens* and *Ptilotus obovatus* low open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Tripogon loliiformis* low open tussock grassland with *Hakea preissii*, *Acacia pteraneura* and *Acacia tetragonophylla* tall isolated shrubs	Very Good

Project	Site	Date	Describer	Seasonal Condition	Site Type	Dimensions	Permanent?	Location	Soil	Rock Type	Vegetation	Vegetation Condition
1733 TMT Gabanintha Flora	GAB53	10/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Access	Clay Loam		*Acacia aptaneura, Acacia aneura, Acacia fuscaneura, Acacia caesaneura* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia craspedocarpa, Acacia craspedocarpa* (hybrid), and *Acacia tetragonophylla* tall open shrubland over *Eremophila galeata, Sida ectogama* and *Rhagodia drummondii* mid sparse shrubland over *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila forrestii* subsp. *forrestii* low sparse shrubland over *Aristida contorta, Eriachne pulchella* subsp. *pulchella* and *Paspalidium clementii* open tussock grassland	Good
1733 TMT Gabanintha Flora	GAB54	10/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Access	Loamy Sand		*Acacia incurvaneura, Acacia aptaneura, Acacia fuscaneura* and *Acacia craspedocarpa* (hybrid) low open forest to low woodland over *Eremophila galeata, Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid sparse shrubland over *Iseilema membranaceum, Dactyloctenium radulans* and *Aristida contorta* low isolated tussock grasses	Very Good
1733 TMT Gabanintha Flora	GAB55	10/05/2018	CvdB	Very Good	Releve	Unbounded	No	Northern Access	Sandy Clay Loam		*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Good
1733 TMT Gabanintha Flora	GABO07	Apr-17 & Sep-17	Onshore	Very Good	Quadrat	50m x 50m	Yes	Southern Region	Silty Loam		*Acacia incurvaneura* low isolated woodland over *Acacia synchronicia* and *Hakea preissii* tall sparse shrubland over *Senna artemisioides* subsp. x *sturtii, Eremophila linearis* and Senna *artemisioides* subsp. *helmsii* mid sparse (to isolated) shrubland over *Sclerolaena cuneata* and *Aristida contorta* mixed isolated herbs and tussock grasses	Very Good
1733 TMT Gabanintha Flora	GABO82	Apr-17 & Sep-17	Onshore	Very Good	Quadrat	50m x 50m	Yes	Northern Region	Sandy Loam		*Acacia incurvaneura, Acacia pruinocarpa* and *Acacia caesaneura* (narrow phyllode variant) low woodland over *Acacia tetragonophylla* and *Acacia quadrimarginea* tall sparse shrubland over *Sida ectogama* and *Eremophila spathulata* mid sparse shrubland over *Ptilotus obovatus* and *Maireana villosa* low isolated shrubs	Excellent

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB01	>10	No evidence	Flat	Flat (0-3 degrees)	Red	90	0-2	Dry	Mining, Pastoral	Cattle, Rabbit's	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB02	>10	No evidence	Flat	Flat (0-3 degrees)	Red	90	0-2	Dry	Grazing, Pastoral	Cattle, Goats, Rabbit's	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB03	>10	No evidence	Hill	Gentle (3-10 degrees)	Red	90	0-2	Dry	Pastoral	Cattle, Goats, Rabbit's	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB04	>10	No evidence	Slope	Gentle (3-10 degrees)	Red	85	0-2	Dry	Pastoral, Roads/tracks	Cattle, Rabbit's	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB05	>10	No evidence	Drainage Line	Flat (0-3 degrees)	Red	25	0-2	Intermittently inundated	Grazing, Pastoral	Cattle, Rabbit's	None evident	40	15	20
1733 TMT Gabanintha Flora	GAB06	>10	No evidence	Hill	Gentle (3-10 degrees)	Red	80	0-2	Dry	Grazing, Pastoral	Cattle	None evident	0	5	10
1733 TMT Gabanintha Flora	GAB07	>10	No evidence	Drainage Line	Flat (0-3 degrees)	Red	50	0-2	Intermittently inundated	Grazing, Hydrology, Pastoral, Roads/tracks	Cattle	None evident	25	5	15
1733 TMT Gabanintha Flora	GAB08	>10	No evidence	Slope	Gentle (3-10 degrees)	Red	80	0-2	Dry	Clearing, Fire, Pastoral	Cattle	None evident	5	5	5
1733 TMT Gabanintha Flora	GAB09	>10	No evidence	Slope	Gentle (3-10 degrees)	Red	80	0-2	Dry	Grazing, Pastoral	Cattle	None evident	5	5	5

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB10	>10	No evidence	Crest	Gentle (3-10 degrees)	Red	85	2-10	Dry	Grazing, Pastoral	Cattle	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB11	>10	No evidence	Flat	Flat (0-3 degrees)	Red	80	0-2	Dry	Grazing, Pastoral	Cattle	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB12	>10	No evidence	Flat	Flat (0-3 degrees)	Red	75	0-2	Dry	Pastoral, Roads/tracks	Cattle	None evident	5	5	10
1733 TMT Gabanintha Flora	GAB13	>10	No evidence	Flat	Flat (0-3 degrees)	Red	85	0-2	Dry	Grazing, Pastoral	Cattle	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB14	>10	No evidence	Flat	Flat (0-3 degrees)	Red	80	2-10	Dry	Grazing, Pastoral	Cattle	None evident	0	5	10
1733 TMT Gabanintha Flora	GAB15	>10	No evidence	Hill	Gentle (3-10 degrees)	Red	80	0-2	Dry	Grazing, Pastoral	Cattle	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB16	>10	No evidence	Outcrop	Moderate (10-25 degrees)	Red	75	20-50	Dry	Grazing, Pastoral	Cattle	None evident	0	15	5
1733 TMT Gabanintha Flora	GAB17	>10	No evidence	Slope	Gentle (3-10 degrees)	Red	85	0-2	Dry	Grazing, Pastoral	Cattle	None evident	0	5	5
1733 TMT Gabanintha Flora	GAB18	>10	No evidence	Hill	Gentle (3-10 degrees)	Red	90	2-10	Dry	Grazing, Pastoral	Cattle	None evident	0	3	3

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB19	>10	No evidence	Floodplain	Flat (0-3 degrees)	Red	50	0-2	Intermittently waterlogged	Grazing, Pastoral	Cattle	None evident	0	15	25
1733 TMT Gabanintha Flora	GAB20	>10	No evidence	Flat	Flat (0-3 degrees)	Red	75	0-2	Dry	Grazing, Pastoral, Roads/tracks	Cattle	None evident	0	10	5
1733 TMT Gabanintha Flora	GAB21	Old (6+ yr)	No evidence	Stony Plain	Low	Red			Dry	Cattle Grazing	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB22	Old (6+ yr)	No evidence	Boulders/ Rockpiles	Low	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB23	Old (6+ yr)	No evidence	Medium Drainage Line	Flat	Red			Dry	Cattle Grazing	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB24	Old (6+ yr)	No evidence	Boulders/ Rockpiles	Steep	Red			Dry	Cattle Grazing, Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB25	Old (6+ yr)	No evidence	Hillcrest/ Upper Hillslope	Moderate	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB26	Old (6+ yr)	No evidence	Breakaway	Low	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB27	Old (6+ yr)	No evidence	Hillslope	Low	Red			Dry	Cattle Grazing	Cattle	None evident			

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB28	Old (6+ yr)	No evidence	Drainage Area/ Floodplain	Flat	Red			Dry	Cattle Grazing	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB29	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB30	Old (6+ yr)	No evidence	Ironstone Outcrops	Low	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB31	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry		Cattle	None evident			
1733 TMT Gabanintha Flora	GAB32	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Cattle Grazing, Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB33	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry		Cattle	None evident			
1733 TMT Gabanintha Flora	GAB34	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB35	Old (6+ yr)	No evidence	Stony Plain	Flat	Red			Dry	Cattle Grazing, Mining Exploration, Road/ Access Track	Cattle	None evident			

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB36	Old (6+ yr)	No evidence	Artificial Wetlands	Flat	Red			Dam	Cattle Grazing	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB37	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB38	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB39	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB40	Old (6+ yr)	No evidence	Ironstone Outcrops	Moderate	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB41	Old (6+ yr)	No evidence	Breakaway/ Cliff	Low	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB42	Old (6+ yr)	No evidence	Stony Plain	Low	Red			Dry	Mining Exploration, Road/ Access Track	Cattle	None evident			

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB43	Old (6+ yr)	No evidence	Waterhole	Flat	Red			Intermittently inundated	Cattle Grazing, Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB44	Old (6+ yr)	No evidence	Artificial Wetlands	Flat	Red			Dam	Cattle Grazing	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB45	Old (6+ yr)	No evidence	Stony Plain	Low	Red			Dry	Road/ Access Track	Cattle	None evident			
1733 TMT Gabanintha Flora	GAB46	Old (6+ yr)	No evidence	Hardpan Plain	Low	Orange	2-5%	0%	Dry	Cattle Grazing	Cattle	None evident	85%	5%	10%
1733 TMT Gabanintha Flora	GAB47	Old (6+ yr)	No evidence	Hardpan Plain	Low	Orange	<1%	0%	Dry	Cattle Grazing	Cattle	None evident	90%	1%	9%
1733 TMT Gabanintha Flora	GAB48	Old (6+ yr)	No evidence	Stony Plain	Low	Orange	<1%	0%	Dry	Cattle Grazing	Cattle	None evident	90%	1%	9%
1733 TMT Gabanintha Flora	GAB49	Old (6+ yr)	No evidence	Hillslope	Moderate	Orange	80%	2-10%	Dry	Cattle Grazing	Cattle	None evident	0%	5%	10%
1733 TMT Gabanintha Flora	GAB50	Old (6+ yr)	No evidence	Hillcrest/ Upper Hillslope	Low	Brown	80%	0%	Dry	Mining Exploration	Cattle	None evident	5%	5%	10%
1733 TMT Gabanintha Flora	GAB51	Old (6+ yr)	No evidence	Stony Plain	Low	Brown	2-5%	0%	Dry	Cattle Grazing	Cattle	None evident	85%	5%	10%

Project	Site	Fire Age	Fire Notes	Landform	Slope	Soil Colour	Rock Coverage	Rock Outcrop	Water Presence	Human Disturbance	Introduced Fauna	Weeds	Bare Soil (%)	Litter (%)	Ground Cover (%)
1733 TMT Gabanintha Flora	GAB52	Old (6+ yr)	No evidence	Drainage Area/ Floodplain	Low	Orange	<1%	0%	Dry	Cattle Grazing	Cattle	None evident	90%	1%	9%
1733 TMT Gabanintha Flora	GAB53	Old (6+ yr)	No evidence	Stony Plain	Low	Brown	50%	0%	Dry	Cattle Grazing	Cattle	None evident	30%	15%	5%
1733 TMT Gabanintha Flora	GAB54	Old (6+ yr)	No evidence	Medium Drainage Line	Low	Orange	75%	0%	Dry	Cattle Grazing	Cattle	None evident	10%	10%	5%
1733 TMT Gabanintha Flora	GAB55	Old (6+ yr)	No evidence	Stony Plain	Low	Orange	80%	0%	Dry	Cattle Grazing	Cattle	None evident	80%	5%	15%
1733 TMT Gabanintha Flora	GABO07	Old (6+ yr)	No evidence	Hillcrest/ Upper Hillslope	Moderate	Orange				Cattle Grazing	Cattle				
1733 TMT Gabanintha Flora	GABO82	Old (6+ yr)	No evidence	Hillslope	Moderate	Brown				Mining Exploration	Cattle				

Appendix F: Vegetation structure definition

NVIS Vegetation Structural Classifications

Cover Characteristics							
Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% Crown cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

Growth Form	Height ranges (m)	Structural Formation Classes						
tree, palm	>30 Tall	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
	10-30 Mid							
	<10 Low							
tree mallee	10-30 Tall	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
	<10 Mid							
	<3 Low							
shrub, cycad, grass-tree, fern	>2 Tall	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
	1-2 Mid							
	<1 Low							
mallee shrub	10-30 Tall	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
	<10 Mid							
	<3 Low							

Growth Form	Height ranges (m)	Structural Formation Classes						
heath shrub	>2 Tall 1-2 Mid <1 Low	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	>2 Tall 1-2 Mid <1 Low	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	>0.5 Low <0.5 Low	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	>2 Tall <2 Tall	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	>0.5 Mid <0.5 Low	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	>0.5 Mid <0.5 Low	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	>0.5 Mid <0.5 Low	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	>0.5 Mid <0.5 Low	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	>0.5 Mid <0.5 Low	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs

Growth Form	Height ranges (m)	Structural Formation Classes						
fern	>2 Tall 1-2 Tall <1 Low	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumpsof ferns	ferns
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	>30 Tall 10-30 Med <10 Low	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	<1 Tall 0-0.5 Low	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	<1 Tall 0-0.5 Low	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

From: NVIS Structural Formation Terminology (Australian Vegetation Attribute Manual Version 6.0 August 2003 http://www.environment.gov.au/erin/nvis/publications/avam/pubs/vegetation-attribute-manual-6.pdf)

* Foliage Cover is defined for each stratum as ‘the proportion of the ground, which would be shaded if sunshine came from directly overhead’. It includes branches and leaves and is similar to the Crown type of Walker and Hopkins (1990) but is applied to a stratum or plot rather than an individual crown. It is generally not directly measured in the field for the upper stratum, although it can be measured by various line interception methods for ground layer vegetation. For the attribute COVER CODE in the Stratum table, the ground cover category refers to ground foliage cover not percentage cover.

** Crown Cover (canopy cover) as per Walker and Hopkins (1990). Although relationships between the two are dependent on season, species, species age etc. (Walker & Hopkins, 1990), the crown cover category classes have been adopted as the defining measure.

*** The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect methods on ground layer, or overstorey vegetative cover. That is for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Appendix G: Vegetation condition rating

Sourced from EPA (2016)

Code	Description
E = Excellent	=Pristine of Bush Forever Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good	=Excellent of Bush Forever Some relatively slight damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Bidens bipinnata* or **Malvastrum americanum*, or occasional vehicle tracks.
G = Good	=Very Good of Bush Forever More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Cenchrus* spp.
P = Poor	= Good of Bush Forever Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man, such as grazing, partial clearing (chaining) or frequent fires. Weeds as above, probably plus some more aggressive ones such as **Cenchrus* spp.
VP = Very Poor	= Degraded of Bush Forever Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not without intensive management. Usually with a number of weed species including very aggressive species.
D = Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix H: Flora taxa list

Family	Taxon	Current Survey	Onshore (2017)
Aizoaceae	*Trianthema oxycalyptrum*	•	
Aizoaceae	*Trianthema triquetrum*	•	•
Amaranthaceae	*Alternanthera ? nodiflora*	•	
Amaranthaceae	*Ptilotus ? obovatus*	•	
Amaranthaceae	*Ptilotus aervoides*		•
Amaranthaceae	*Ptilotus gomphrenoides*	•	
Amaranthaceae	*Ptilotus helipteroides*	•	•
Amaranthaceae	*Ptilotus luteolus*	•	
Amaranthaceae	*Ptilotus nobilis*	•	
Amaranthaceae	*Ptilotus obovatus*	•	•
Amaranthaceae	*Ptilotus roei*	•	
Amaranthaceae	*Ptilotus rotundifolius*	•	
Amaranthaceae	*Ptilotus schwartzii*	•	
Apocynaceae	*Marsdenia australis*	•	•
Apocynaceae	*Rhyncharrhena linearis*	•	
Asteraceae	*Centipeda crateriformis*	•	
Asteraceae	*Cratystylis subspinescens*	•	
Asteraceae	*Streptoglossa liatroides*	•	
Boraginaceae	*Heliotropium inexplicitum*	•	
Brassicaceae	*Lepidium oxytrichum*		•
Chenopodiaceae	*Atriplex codonocarpa*	•	
Chenopodiaceae	*Dysphania kalpari*	•	
Chenopodiaceae	*Dysphania melanocarpa* forma *melanocarpa*	•	
Chenopodiaceae	*Enchylaena tomentosa*	•	•
Chenopodiaceae	*Maireana georgei*	•	•
Chenopodiaceae	*Maireana planifolia*	•	
Chenopodiaceae	*Maireana pyramidata*	•	
Chenopodiaceae	*Maireana* sp. indet	•	
Chenopodiaceae	*Maireana tomentosa*	•	
Chenopodiaceae	*Maireana triptera*	•	•
Chenopodiaceae	*Maireana villosa*	•	•
Chenopodiaceae	*Rhagodia drummondii*	•	•
Chenopodiaceae	*Rhagodia eremaea*	•	
Chenopodiaceae	*Salsola australis*	•	
Chenopodiaceae	*Sclerolaena cuneata*	•	
Chenopodiaceae	*Sclerolaena densiflora*	•	
Chenopodiaceae	*Sclerolaena eriacantha*	•	•
Chenopodiaceae	*Tecticornia disarticulata*	•	

Family	Taxon	Current Survey	Onshore (2017)
Cleomaceae	*Cleome viscosa*	•	
Convolvulaceae	*Duperreya commixta*	•	
Cucurbitaceae	*Citrullus colocynthis*	•	
Cucurbitaceae	*Cucumis myriocarpus*	•	
Cyperaceae	*Bulbostylis barbata*	•	
Cyperaceae	*Bulbostylis turbinata*	•	
Cyperaceae	*Cyperus iria*	•	
Euphorbiaceae	*Euphorbia australis*	•	
Euphorbiaceae	*Euphorbia drummondii*	•	
Euphorbiaceae	*Euphorbia tannensis* subsp. *eremophila*	•	
Fabaceae	*Acacia aneura*	•	
Fabaceae	*Acacia aptaneura*	•	•
Fabaceae	*Acacia caesaneura*	•	
Fabaceae	*Acacia caesaneura* (narrow phyllode variant)	•	•
Fabaceae	*Acacia craspedocarpa*	•	
Fabaceae	*Acacia fuscaneura*	•	•
Fabaceae	*Acacia grasbyi*	•	
Fabaceae	*Acacia incurvaneura*	•	•
Fabaceae	*Acacia pruinocarpa*	•	•
Fabaceae	*Acacia pteraneura*	•	
Fabaceae	*Acacia quadrimarginea*	•	•
Fabaceae	*Acacia ramulosa* var. *linophylla*	•	
Fabaceae	*Acacia rhodophloia*	•	
Fabaceae	*Acacia sclerosperma* subsp. *sclerosperma*	•	
Fabaceae	*Acacia speckii*	•	
Fabaceae	*Acacia synchronicia*	•	•
Fabaceae	*Acacia tetragonophylla*	•	•
Fabaceae	*Glycine ? tomentella*	•	
Fabaceae	*Indigofera chamaeclada* subsp. *chamaeclada*	•	
Fabaceae	*Indigofera monophylla*	•	
Fabaceae	*Senna artemisioides* subsp. *filifolia*		•
Fabaceae	*Senna artemisioides* subsp. *helmsii*	•	
Fabaceae	*Senna artemisioides* subsp. *helmsii x sturtii*	•	
Fabaceae	*Senna artemisioides* subsp. *oligophylla*		•
Fabaceae	*Senna artemisioides* subsp. *x sturtii*	•	•
Fabaceae	*Senna glaucifolia*	•	•
Fabaceae	*Senna glutinosa* subsp. *chatelainiana*	•	
Fabaceae	*Senna glutinosa* subsp. *x luerssenii*	•	

Family	Taxon	Current Survey	Onshore (2017)
Fabaceae	*Senna* sp. Meekatharra (E. Bailey 1-26)	•	•
Frankeniaceae	*Frankenia setosa*	•	
Goodeniaceae	*Goodenia berardiana*	•	
Goodeniaceae	*Scaevola spinescens*	•	
Lamiaceae	*Prostanthera* sp. indet	•	
Lamiaceae	*Spartothamnella teucriiflora*	•	
Loranthaceae	*Amyema nestor*	•	
Loranthaceae	*Lysiana murrayi*	•	•
Malvaceae	*Abutilon cryptopetalum*	•	
Malvaceae	*Abutilon fraseri*	•	
Malvaceae	*Hibiscus burtonii*		•
Malvaceae	*Hibiscus goldsworthii*	•	
Malvaceae	*Hibiscus krichauffianus*	•	
Malvaceae	*Sida burtonii*	•	
Malvaceae	*Sida ectogama*	•	•
Malvaceae	*Sida fibulifera*	•	
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)	•	•
Montiaceae	*Calandrinia* sp. indet	•	
Myrtaceae	*Calytrix desolata*	•	
Myrtaceae	*Melaleuca stereophloia*	•	
Myrtaceae	*Thryptomene decussata*	•	
Nyctaginaceae	*Boerhavia coccinea*	•	•
Nyctaginaceae	*Boerhavia repleta*	•	
Phrymaceae	*Peplidium* sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)	•	
Phyllanthaceae	*Phyllanthus erwinii*	•	
Pittosporaceae	*Pittosporum angustifolium*	•	
Poaceae	*Aristida contorta*	•	
Poaceae	*Cymbopogon ambiguus*	•	
Poaceae	*Cynodon prostratus*	•	•
Poaceae	*Dactyloctenium radulans*	•	
Poaceae	*Dichanthium sericeum* subsp. *humilius*	•	
Poaceae	*Digitaria brownii*	•	
Poaceae	*Enneapogon caerulescens*	•	•
Poaceae	*Enneapogon polyphyllus*	•	
Poaceae	*Eragrostis dielsii*	•	
Poaceae	*Eragrostis eriopoda*	•	•

Family	Taxon	Current Survey	Onshore (2017)
Poaceae	*Eragrostis falcata*	•	
Poaceae	*Eragrostis leptocarpa*	•	
Poaceae	*Eragrostis pergracilis*	•	
Poaceae	*Eriachne aristidea*	•	
Poaceae	*Eriachne helmsii*	•	
Poaceae	*Eriachne pulchella* subsp. *dominii*	•	
Poaceae	*Eriachne pulchella* subsp. *pulchella*	•	
Poaceae	*Iseilema membranaceum*	•	
Poaceae	*Monachather paradoxus*	•	•
Poaceae	*Paspalidium clementii*	•	•
Poaceae	*Tripogon loliiformis*	•	
Portulacaceae	*Portulaca oleracea*	•	•
Proteaceae	*Grevillea nematophylla* subsp. *supraplana*	•	
Proteaceae	*Grevillea striata*	•	
Proteaceae	*Hakea lorea* subsp. *lorea*	•	
Proteaceae	*Hakea preissii*	•	•
Pteridaceae	*Cheilanthes brownii*		•
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	•	
Rubiaceae	*Psydrax latifolia*	•	•
Rubiaceae	*Psydrax suaveolens*	•	•
Rubiaceae	*Synaptantha tillaeacea* var. *tillaeacea*	•	
Santalaceae	*Exocarpos aphyllus*	•	
Santalaceae	*Santalum lanceolatum*	•	
Santalaceae	*Santalum spicatum*	•	
Sapindaceae	*Dodonaea amplisemina*	•	
Scrophulariaceae	*Eremophila ? linearis*	•	
Scrophulariaceae	*Eremophila exilifolia*	•	
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*	•	
Scrophulariaceae	*Eremophila galeata*	•	•
Scrophulariaceae	*Eremophila glutinosa*	•	•
Scrophulariaceae	*Eremophila jucunda* subsp. *jucunda*	•	
Scrophulariaceae	*Eremophila lachnocalyx*	•	
Scrophulariaceae	*Eremophila latrobei* subsp. *latrobei*	•	•
Scrophulariaceae	*Eremophila linearis*	•	
Scrophulariaceae	*Eremophila longifolia*	•	
Scrophulariaceae	*Eremophila macmillaniana*		•
Scrophulariaceae	*Eremophila maculata* subsp. *brevifolia*	•	
Scrophulariaceae	*Eremophila malacoides*	•	

Family	Taxon	Current Survey	Onshore (2017)
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*	•	
Scrophulariaceae	*Eremophila* sp. Indet.	•	
Scrophulariaceae	*Eremophila spathulata*	•	•
Solanaceae	*Lycium australe*	•	
Solanaceae	*Nicotiana occidentalis* subsp. *obliqua*	•	
Solanaceae	*Solanum cleistogamum*	•	
Solanaceae	*Solanum lasiophyllum*	•	•
Zygophyllaceae	*Tribulus adelacanthus*	•	
Zygophyllaceae	*Tribulus astrocarpus*	•	
Zygophyllaceae	*Tribulus suberosus*	•	•
Total		**153**	**47**

Appendix I: Conservation Significant Flora Locations

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Acacia speckii	Priority 4	GDA94	50	659589	7022599	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659596	7022589	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659601	7022577	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659623	7022580	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659642	7022539	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659685	7022571	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659583	7022633	2	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659572	7022571	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659597	7022492	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	659660	7022625	3	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661367	7021899	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661384	7021870	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661412	7021848	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661438	7021819	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661373	7021939	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661652	7021751	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661635	7021748	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661617	7021728	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661612	7021719	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661605	7021711	1	Good	Sterile

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Acacia speckii	Priority 4	GDA94	50	661637	7021676	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661631	7021664	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661596	7021661	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661557	7021695	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661600	7021820	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661571	7021890	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661875	7021151	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661872	7021156	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661869	7021160	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661857	7021172	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661863	7021182	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661817	7021207	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661822	7021225	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661679	7021267	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661686	7021269	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661728	7021283	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661771	7021324	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661779	7021314	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661839	7021317	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661841	7021310	1	Good	Sterile

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Acacia speckii	Priority 4	GDA94	50	661868	7021238	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661885	7021205	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661892	7021184	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661898	7021186	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661911	7021195	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661920	7021187	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661893	7021173	2	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661921	7021151	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661932	7021169	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661942	7021157	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661952	7021155	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661954	7021149	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661957	7021153	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661963	7021145	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661982	7021149	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662008	7021184	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662052	7021215	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662058	7021220	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662037	7021190	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662033	7021187	1	Good	Sterile

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Acacia speckii	Priority 4	GDA94	50	662034	7021182	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662050	7021173	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662052	7021168	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662050	7021161	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662051	7021156	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662046	7021152	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	662034	7021160	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661966	7021108	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661854	7021072	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661958	7020967	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661949	7020945	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661912	7020944	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661905	7020923	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661894	7020901	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661893	7020891	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661893	7020891	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661868	7020895	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661857	7020883	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661828	7020887	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661778	7021048	1	Good	Sterile

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Acacia speckii	Priority 4	GDA94	50	661779	7021048	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661866	7020717	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661870	7020723	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661884	7020716	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661891	7020713	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661892	7020712	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661941	7020677	1	Good	Sterile
Acacia speckii	Priority 4	GDA94	50	661942	7020675	1	Good	Sterile
Dodonaea amplisemina	Priority 4	GDA94	50	661530	7021810	20	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661522	7021791	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661512	7021784	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661515	7021774	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661499	7021765	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661547	7021746	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661565	7021755	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661853	7021212	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661850	7021209	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661790	7021255	6	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661794	7021258	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661792	7021261	1	Good	Generally sterile or old fruits

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Dodonaea amplisemina	Priority 4	GDA94	50	661790	7021245	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661791	7021240	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661733	7021241	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661725	7021239	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661713	7021237	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661708	7021237	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661702	7021231	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661702	7021245	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661701	7021246	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661697	7021251	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661672	7021265	10	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661660	7021267	6	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661658	7021270	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661679	7021276	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661695	7021272	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661708	7021274	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661709	7021279	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661707	7021279	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661714	7021277	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661720	7021277	1	Good	Generally sterile or old fruits

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Dodonaea amplisemina	Priority 4	GDA94	50	661721	7021259	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661717	7021256	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661720	7021253	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661720	7021253	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661724	7021254	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661728	7021256	5	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661796	7021320	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661827	7021346	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661831	7021340	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661835	7021329	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661838	7021324	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661839	7021319	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661839	7021311	4	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661864	7021281	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661869	7021276	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661875	7021241	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661874	7021238	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661874	7021235	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661881	7021205	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661886	7021193	1	Good	Generally sterile or old fruits

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Dodonaea amplisemina	Priority 4	GDA94	50	661913	7021196	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661913	7021183	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661907	7021186	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661906	7021185	7	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661908	7021179	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661903	7021176	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661900	7021174	7	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661893	7021177	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661893	7021173	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661899	7021163	5	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661957	7021160	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661962	7021163	4	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661968	7021164	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661966	7021161	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661965	7021160	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661958	7021150	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661957	7021148	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662012	7021185	7	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662017	7021188	4	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662014	7021190	1	Good	Generally sterile or old fruits

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Dodonaea amplisemina	Priority 4	GDA94	50	662032	7021207	3	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662034	7021208	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662036	7021207	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662038	7021208	4	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662046	7021198	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662039	7021194	2	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662043	7021175	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662049	7021177	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662051	7021175	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662051	7021165	10	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662052	7021163	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662041	7021148	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662040	7021144	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662030	7021165	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662029	7021165	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662012	7021165	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662012	7021164	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662008	7021161	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	662000	7021154	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661999	7021148	1	Good	Generally sterile or old fruits

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Dodonaea amplisemina	Priority 4	GDA94	50	661996	7021146	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661995	7021145	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661986	7021140	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661984	7021140	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661965	7021125	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661923	7020941	1	Good	Generally sterile or old fruits
Dodonaea amplisemina	Priority 4	GDA94	50	661919	7020942	1	Good	Generally sterile or old fruits
Hibiscus krichauffianus	Priority 3	GDA94	50	660283	7021536	1	Good	Sterile
Hibiscus krichauffianus	Priority 3	GDA94	50	660270	7021539	9	Good	Old flowers and fruits
Hibiscus krichauffianus	Priority 3	GDA94	50	660280	7021524	1	Good	Sterile
Ptilotus luteolus	Priority 3	GDA94	50	661506	7021778	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661499	7021789	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661495	7021791	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661626	7021731	6	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661873	7021144	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661866	7021187	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661868	7021186	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661860	7021202	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661694	7021251	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661754	7021282	1	Good	Young flowers or sterile

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Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Ptilotus luteolus	Priority 3	GDA94	50	661787	7021314	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661817	7021332	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661921	7021197	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661905	7021157	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661926	7021154	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	661989	7021155	1	Good	Young flowers or sterile
Ptilotus luteolus	Priority 3	GDA94	50	662060	7021215	1	Good	Young flowers or sterile
Tribulus adelacanthus	Priority 3	GDA94	50	659909.81	7022969.3	5	Good	Fruit
Tribulus adelacanthus	Priority 3	GDA94	50	659688.64	7022614	5	Good	Fruit

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