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Petrographic Inspection Report

Prepared for:	Douglas Partners
Purchase Order:	PO 144848
Material Source:	131 Barnetts Rd, Gumma NSW
Sample Location:	E:6606041 N:498025
Sample Type:	(Concrete) Sand
Sample Number:	CF-17957A
Project No.:	676744
Date Sampled:	29/05/2023
Sampled By:	Client
Date of Inspection:	30/06/2023
Report Issued:	07/07/2023 *Reissued 25/07/2023 with amendments to classification and risk*
Project/ File Ref.:	P2023_087_01r1

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Enquiries regarding the content of this report should be directed to Groundwork Plus 07 3871 0411*. Samples are disposed of after 3 months from the date of report. Thin sections will remain on site indefinitely. The analysis is based on a limited number of thin sections and sample provided by client, further investigation may be required. Interpretations are specific to the sample examined only.*

Executive Summary

Classification: Quartz sand

For Engineering Purposes AS 2758.1: Natural fine aggregate

Key Material Risk: Negligible risk

Table 1 – Summary of Sample's Compositional Characteristics

Compositional Features	**%**	**Comments**
Robust Phases	100	**Major (>20%):** quartz; **minor (1-5%):** chert, hornblende; **trace (<1%):** metasiltstone lithics, calcite, zircon
Weak Phases	Trace	**Trace (<1%):** goethite
Clays	0	None observed
Micas	0	None observed
Sulphides	0	None observed
Organics	Trace	Charcoal
Textural Features		**Comments**
Fracturing/veins	No	None observed
Voids	No	None observed
Free Silica		**Comments**
Unstrained quartz	56	Occurs as quartz showing low/no strain
Optically strained Quartz	40	Occurs as quartz showing moderate strain
Microcrystalline Quartz	3	Occurs as chert particles and microcrystalline quartz in metasiltstone
Siliceous Volcanic Glass	0	None observed
Opaline/chalcedonic Quartz	0	None observed
Total	99	

Table 2 – Risk Rating for Specific Applications and Source Rock Quality

Product Suitability	**Low**	**Mod**	**High**	**Comments**
Silica sand for metallurgical/mining grinding	✓			Suitable high strength, hard and durable material
Unbound Pavements	✓			Suitable high strength, hard and durable material
Graded Asphalt Aggregate	✓			Suitable high strength, hard and durable material
Expected Performance	**Low**	**Mod**	**High**	**Comments**
Hardness	✓			Very hard
Strength	✓			Very strong
Durability	✓			Durable

Introduction

This report provides the results of a general petrographic assessment of a sand sample, which was submitted to the Groundwork Plus petrographic laboratory, and describes the method and standards used to assess the sample. The supplied sample was sampled by the client and sent to the Groundwork Plus petrographic facility. The thin section was prepared and analysed by Groundwork Plus with instructions from the client to conduct petrographic testing to ASTM C295 and recommend further testing if significant deleterious characteristics are identified pursuant to Clause 16.3 of this standard. The provided modal mineral percentages relate to the supplied sample which is understood to be representative of material on site. Communication of findings are advised by AS 1726-2017 Geotechnical Site Investigations.

Methodology

The petrographic assessment of the slide is carried out using a Nikon polarising microscope equipped with a digital camera at the Groundwork Plus petrographic laboratory. Photographs of the hand specimen and thin section photomicrographs showing grain sizes and any particular aspects of the minerals are included as part of the report (**Plates 1** to **7**). Modal analysis is conducted on the sample using a Pelcon automatic point counter on at least 200 points (**Table 4 – Modal Analysis of Minerals**).

The petrology assessment is based on:

- ASTM C 295 – 2019 Standard Guide for Petrographic Examination of Aggregates for Concrete.
- AS 2758.1 – 2014 Aggregates and Rock for Engineering Purposes Part 1: Concrete Aggregates.
- AS 2758.5 – 2014 Aggregates and Rock for Engineering Purposes Part 5: Asphalt Aggregates.

Hand Specimen Description

In hand specimen, the supplied sample is described as a natural **quartz sand**.

The sand is composed of mostly fine to medium grains. Coarse grains (>1.18mm) are moderate in abundance and very fine grains (<0.075mm) are trace in abundance. Minor particles greater than 3mm in size are observed. The sand is moderately sorted, and grains are observed to be rounded to subrounded with high sphericity. The sand is a light brown colour overall, due to goethitic staining of grains. Grain-scale variations in colour include dark brown and dark to light grey. Light orangish brown to light grey particles are observed to be quartzose in composition, while darker coloured grains are lithic-derived or ferruginous. Minor charcoal particles and plant material are observed. No sulphides are observed, and the sand is not appreciably magnetic apart from trace, fine, dark ferruginous particles.

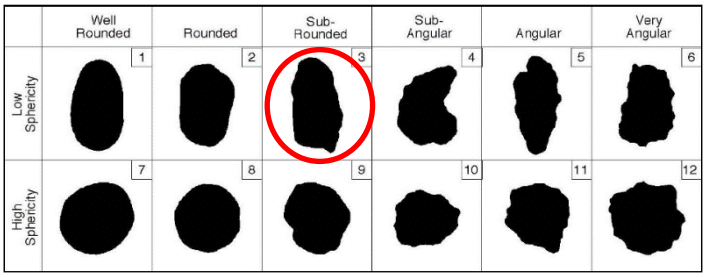

Figure 1: Modified from Frazer 1953 and identifying the sand as subrounded with high sphericity.

Table 3 – Grain size distribution from dry sieve test.

Grain Size (mm)	Abundance (%)
>1.18	7.06
1.18 – 0.3	47.04
0.3 – 0.075	45.81
<0.075	0.09

Plate 1: Photograph showing portions of the dry sieved sample.

Plate 2: Photograph of the sample as provided, showing the moderately sorted quartz sand.

Plate 3: Binocular microphotograph of the sample, showing mostly quartz grains.

Thin Section Description

A modal abundance of minerals based on a count of 200 widely spaced points is listed in **Table 4 – Modal Analysis of Minerals.** Robust minerals make up essentially 100% of the mineral count and include abundant quartz with minor to trace quantities of chert, hornblende, metasiltstone lithics, calcite, and zircon. Weak minerals make up a trace abundance of the sample and include trace goethite and charcoal.

Table 4 – Modal Analysis of Minerals

Robust Phases	Mode (%)	Comments
Quartz	96	Consists of subrounded to subangular grains. 40% of grains show moderate strain and 56% of grains exhibit low/no strain
Chert	3	Rounded microcrystalline quartz grains commonly obscured by ferruginous staining
Hornblende	1	Rare liberated, subhedral hornblende grains with strong pleochroism
Metasiltstone Lithics	Trace	Trace quartzofeldspathic metasiltstone particles
Calcite	Trace	Trace liberated grains of calcite
Zircon	Trace	Rare, fine grained and rounded crystals
Weak Phases		
Goethite	Trace	Emanative ferruginous staining of particles
Charcoal	Trace	Rare rounded to elongate opaque fragments
Total	**100**	

The sand is very quartzose. Quartz occurs as mostly monocrystalline grains of between 0.2mm and 0.5mm in size. Grains are rounded to subangular with varying sphericity. Subordinate polycrystalline grains with varying granoblastic texture are also observed. A moderate abundance of quartz shows minor goethitic staining, and most grains have a thin layer of goethite covering the exterior. Approximately 40% of the sample consists of quartz that shows moderate strain, with 56% being quartz that shows mild or no strain.

Minor, fine to medium grains of microcrystalline quartz are observed and classed as chert. These grains are subrounded and have variable goethite staining. A moderate abundance of these grains contain radiolarians, many of which show strain. Metasiltstone lithics are fine-grained and have a recrystallised quartzofeldspathic composition with relict bedding and/or metamorphic foliation.

Minor hornblende fragments occur as liberated crystals in the sand and these are fine to medium, green and pleochroic. Calcite is observed as rare liberated angular grains of sparry crystals. Zircon occurs as rounded liberated crystals at trace abundance. Minor charcoal fragments occur as opaque rounded to elongate/splintered grains. Rare, liberated accretions of goethite are also observed.

Overall, the sand is regarded as very hard, very strong, and durable, due to the robust, quartzose composition. Pending testing, the sand is expected to be well suited to use as a silica grinding sand in mining/metallurgy, and also as fine aggregate in unbound pavements and graded asphalt.

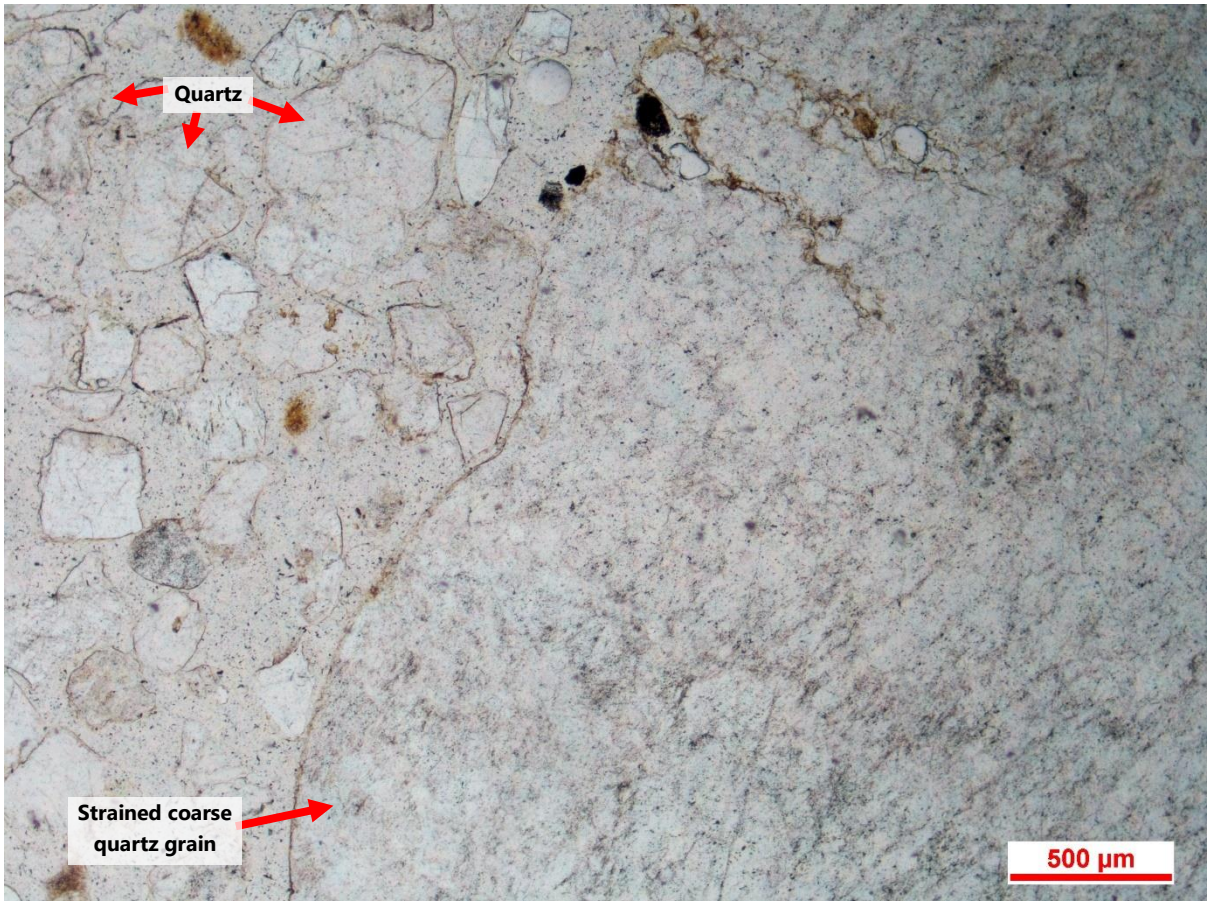

Plate 4: Microphotograph of the sample, showing a very coarse strained quartz grain and various finer grains of quartz. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.7mm.

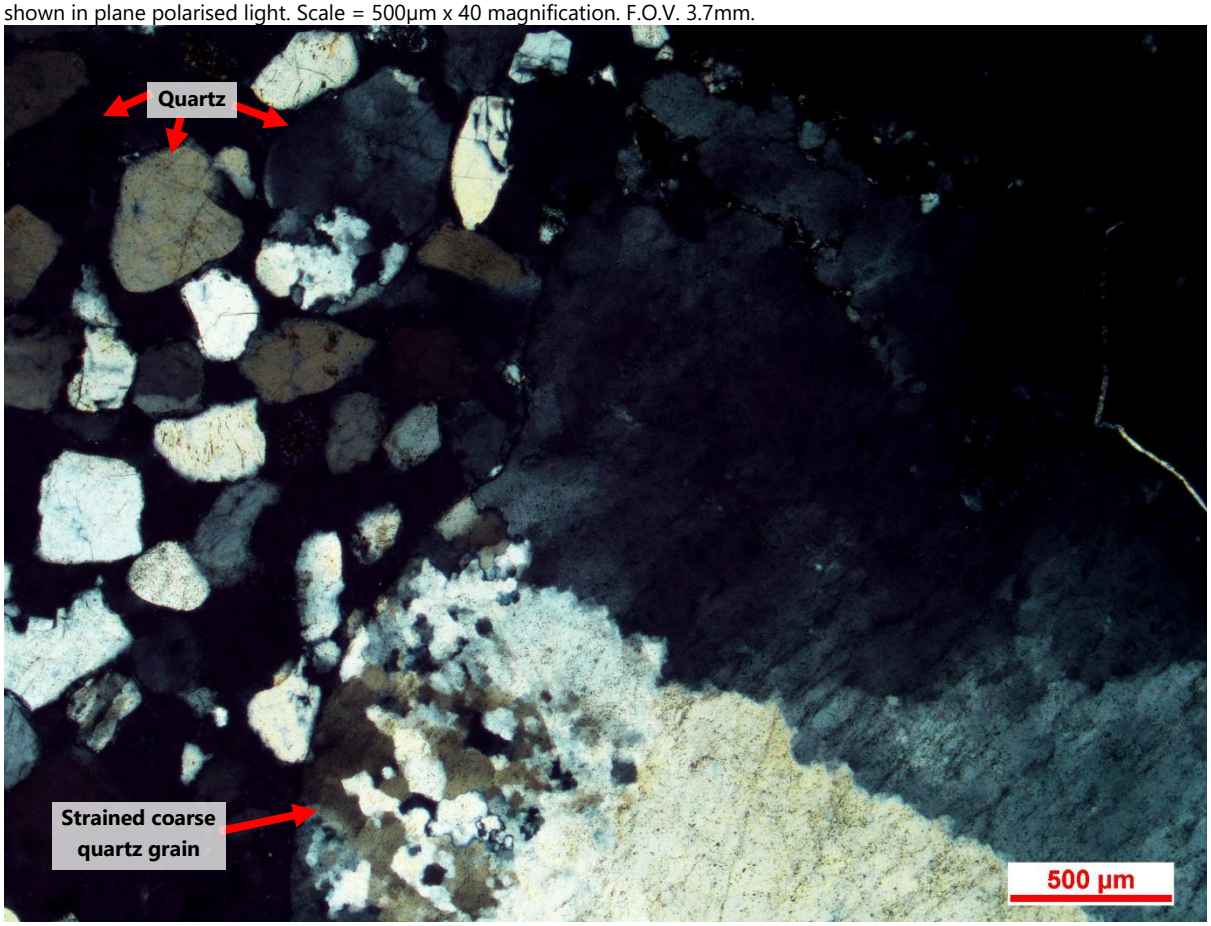

Plate 5: The same image from **Plate 4** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.7mm.

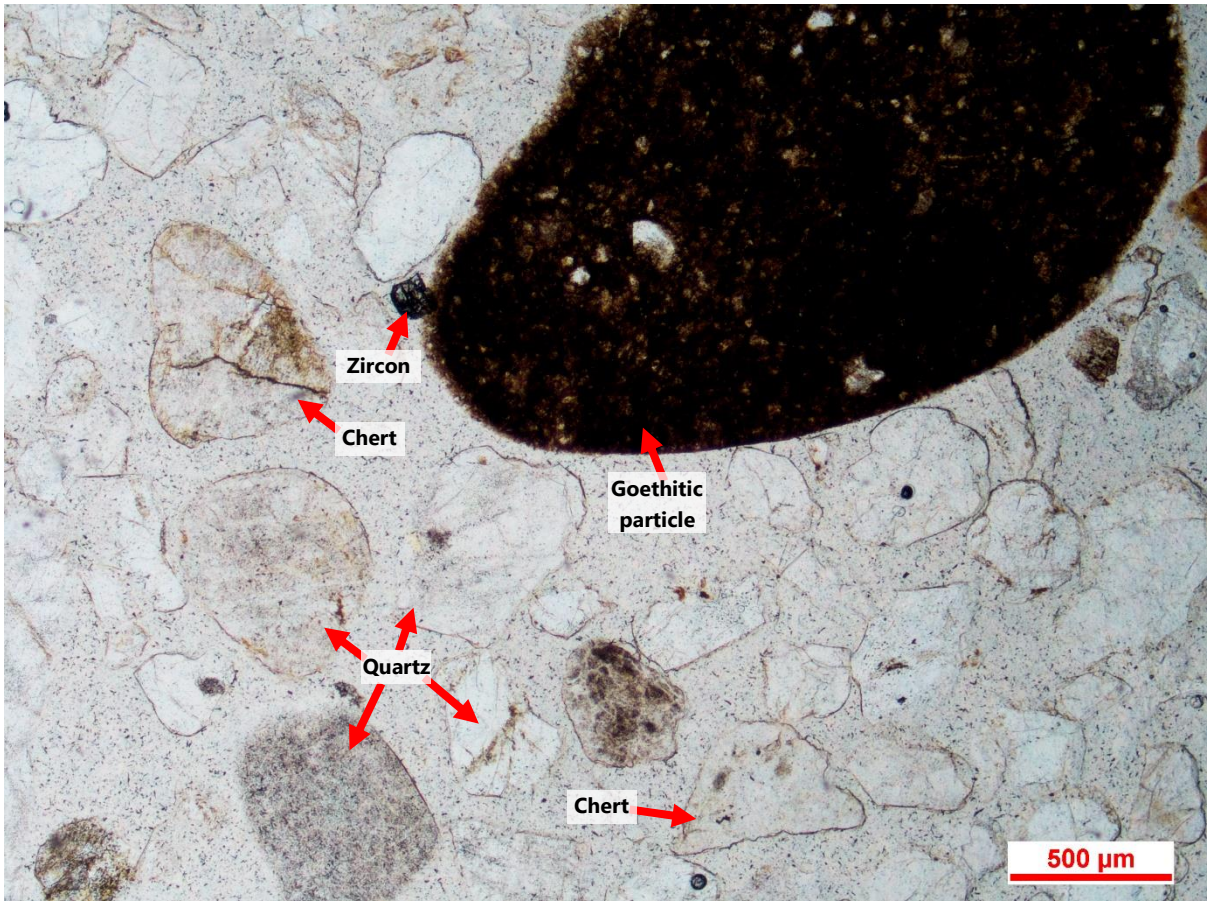

Plate 6: Microphotograph of the sample, showing abundant variably sized grains of quartz, zircon, chert and goethite. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.7mm.

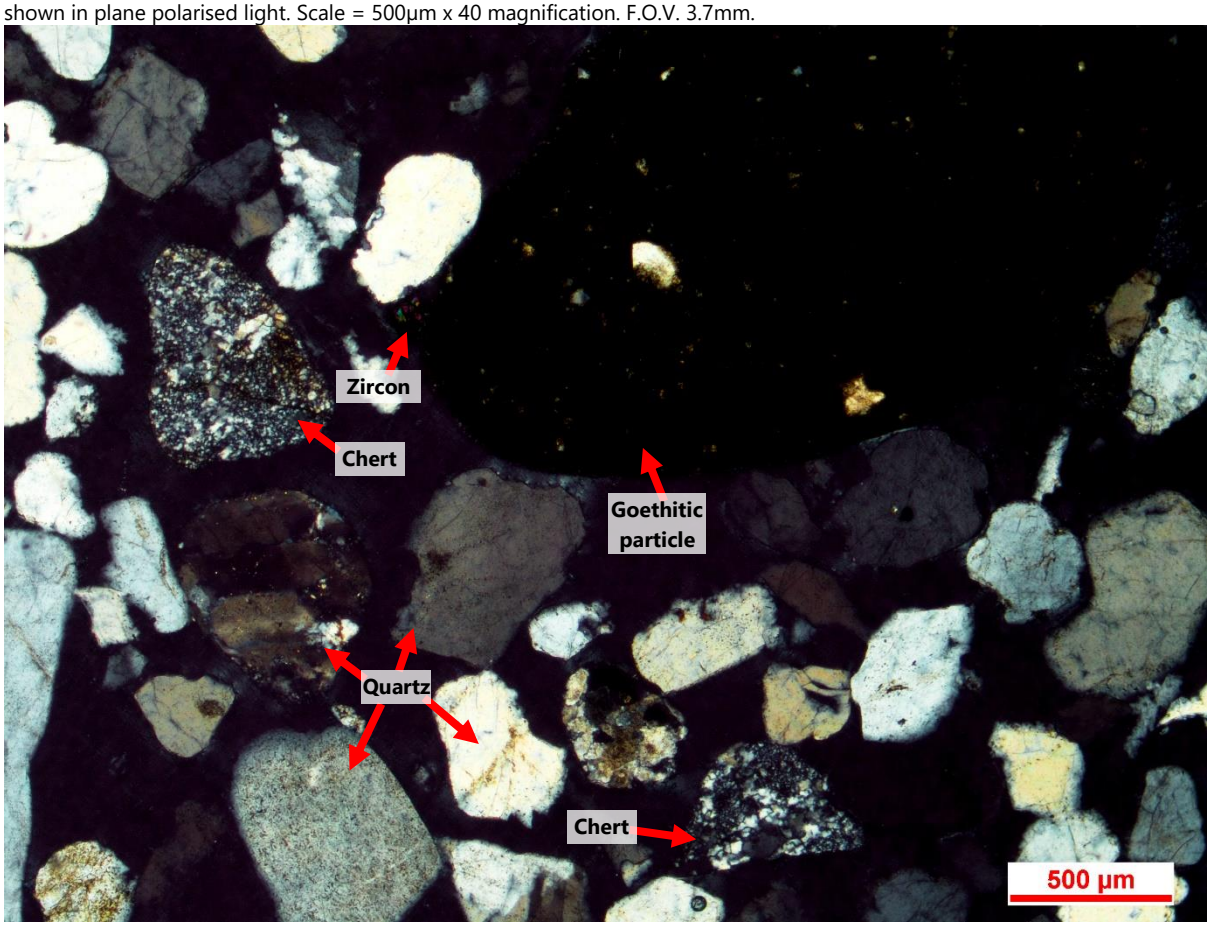

Plate 7: The same image from **Plate 6** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.7mm.

Asbestiform Minerals

Asbestos can be defined mineralogically and by crystal habit. For the purposes of health screening asbestiform habit is relevant, which is defined as being hair-like (filiform) and flexible with a high aspect ratio. Based on the observable minerals in the thin section, the sample contains **no observable asbestiform minerals**.

Summary

The sample is identified as a natural quartz sand. Pending testing, the sand is expected to be well suited to use as a silica grinding sand in mining/metallurgy, and also as fine aggregate in unbound pavements and graded asphalt.

- A medium grained **quartz sand.**
- Moderately sorted, subrounded and of high sphericity.
- Composed principally of **robust quartz and lithic grains (100%)** with trace weak phases.
- Containing 99% free silica including 40% moderately strained quartz and 3% microcrystalline quartz.
- Regarded as very **hard**, **strong**, and **durable**.