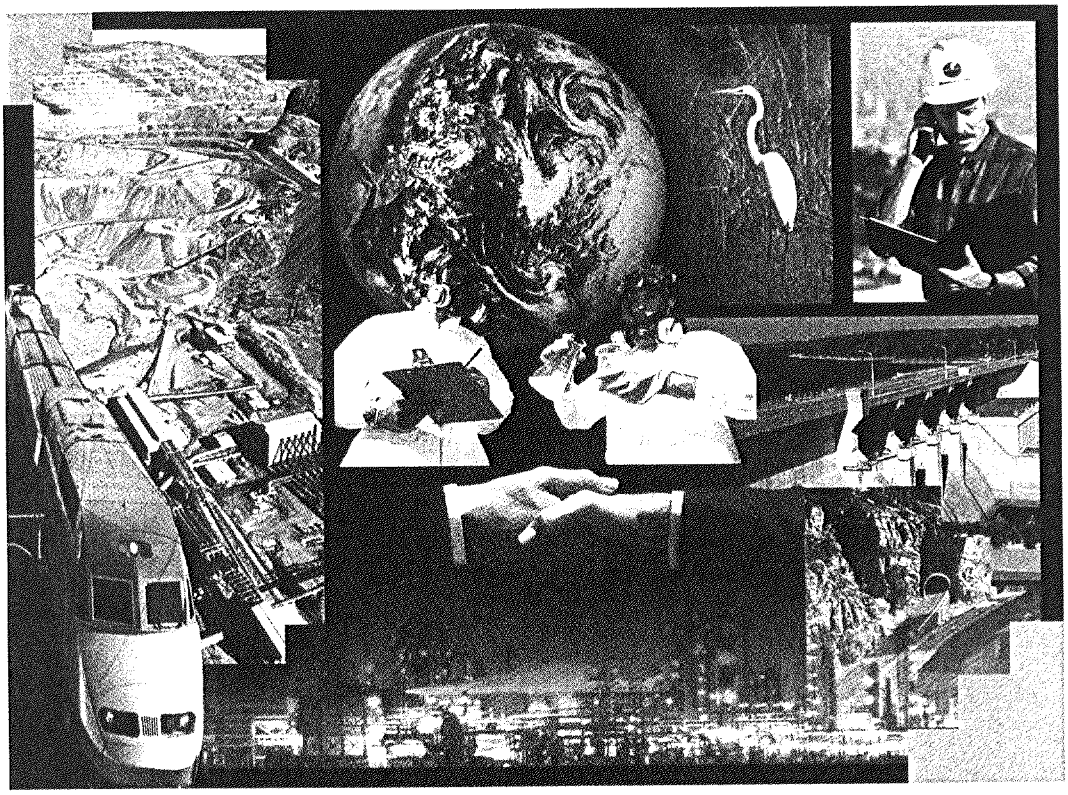
Appendix 5-1

DRAFT REPORT

PRELIMINARY WASTE ROCK CHARACTERISATION - PROPOSED QUEST 29 OPEN PITS



Prepared for
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26 November 1998

Woodward-Clyde

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Engineering &sciences applied to the natural and built environment

2 December 1998
Project No. A320141 l-0001

Sirocco Resources NL
Level 10, Grosvenor Place
225 George Street
SYDNEY NSW 2000

Attention: **Mr Ralph Stagg**
Technical Director

Dear Ralph

RE: QUEST 29 PROJECT PRELIMINARY WASTE CHARACTERISATION STUDY

Please find enclosed the preliminary waste characterisation study report for mine waste from the Proposed Quest 29 pit areas.

If you have any queries on the report please contact Peter Scott on 07 3364 7444. Thank you.

Yours sincerely
AGC WOODWARD-CLYDE PTY LIMITED

Peter Scott
Principal Environmental Geochemist

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Appendix 1 ALS - Analytical Reports

Woodward-Clyde Pty Limited (Woodward-Clyde) was commissioned by Sirocco Resources NL to undertake preliminary waste characterisation and geochemical investigations on potential waste rock to be mined from small open pits in the Quest 29 area. The results of this study will form part of the requirements for the PER to be submitted early December.

It is understood that Sirocco Resources propose to recommence operations at their Toms Gully mine site near Darwin, Initially this will involve mining from a number of small open pits in the Quest 29 area about 14 km from Toms Gully. It is envisaged that high grade ore will be trucked to Toms Gully for treatment. Dump leaching of low grade ore on site is being considered. It is understood that the bulk of both ore and waste will be oxide material. The waste material requires acid base accounting testwork to be undertaken to determine potential environmental impacts and to develop effective management procedures to mitigate acid drainage.

The static acid base accounting testwork is a coarse definition tool for predicting the acid producing potential of mine waste. It provides a theoretical value for the parameters tested and assumes that each parameter measured will be fully available to acid generating and consuming reactions that may occur during the oxidation of waste similar in composition to the material tested, An acid base accounting or net acid producing potential (NAPP) test was conducted on the 20 samples collected from the Quest 29 area during this investigation, Other geochemical static tests conducted during this investigation were the net acid generation (NAG) test, the saturated paste pH and conductivity (EC) tests and the total metal analysis test. The NAG test provides an indication of sulphide reactivity and available neutralising potential. Paste pH and conductivity tests give a preliminary indication of the in-situ pH of waste materials and the immediate reactivity of minerals present in the sample. Sulphide oxidation may enhance the solubility of metal constituents in waste rock. Metal analysis is carried in order to provide an indication of the metal concentration in the waste rock in comparison to that of the background soils and country rock. The chemical and physical properties of the rock will further affect their potential for mitigation from the source. In addition to waste rock analysis, ore grade sample material was also examined for each prospect area.

This report is a preliminary assessment of the acid producing potential of mine waste from the Quest 29 Project, and describes the sampling strategy used, outlines the static testwork procedure, and provides discussion of the results. The investigation is indicative rather than quantitative and simply provides a preliminary indication of the acid producing potential of the material to be extracted from the proposed pits. Before mining commences a further testwork program for waste block modelling and mine waste scheduling will be undertaken.

1 .I SCOPE OF STUDY

The study is to assess the potential for acid drainage from typical mine waste (rock, tailings) that will be extracted in mining the Quest 29 open pits. This includes the assessment of potential mine waste for the Koolpin Hill, Koolpin North, Taipan Hill and Dolerite areas.

The scope of work for the waste rock study included the following:

- Identification of the acid producing potential of the waste rock material utilising acid base accounting, NAG testing, saturated paste pH and conductivity (EC) testing and geochemical analysis by selective elemental scan on the selected samples.
- Identification of the selected waste and ore samples' potential to produce acid

The Quest 29 area is situated about 14 km from Sirocco's Toms Gully mine site approximately 100 km ESE from Darwin. This area lies within the Pine Creek Geosyncline. 'The main components of this geosyncline are a series of late Archaean basement domes overlain by a Paleoproterozoic sedimentary and volcanic sequence deposited in a shallow intracontinental rift.' (Miller, G. C., *et al* 1998 p. 410). These sedimentary sequences were deformed during the 'Top End Orogeny at 1870 to 1800 Myr resulting in tight folds and lower greenschist metamorphism'. (Miller, G. C., et *al* 1998 p. 411). Two main episodes of granitic intrusion also occurred at about this time.

The South Alligator Group lies at the base of the Paleoproterozoic sequence. The Koolpin Formation is the host rock to the mineralisation at the Koolpin Hill, Koolpin North and Taipan Hill prospects at Quest 29. The Koolpin Formation lies at the base of the South Alligator Group. Table 1 below gives the rock types and thicknesses of the Formations within the South Alligator Group.

Unit	Rock type	Thickness (m)
Mount Bonnie Formation	Greywacke, carbonaceous argillite, argillite, chert, cherty tuff, BIF	150-400
Gerowie Tuff	Argillite, chert, cherty tuff	200-400
Koolpin Formation	Carbonaceous argillite, chert, BIF, silicified dolomite	300-1000

Table 1 - South Alligator Group stratigraphy (from Nicholson, Ormsby and Farrar (1994)).

This sedimentary sequence is intruded by the Zamu Dolerite. Mineralisation is hosted by Zamu Dolerite at the Dolerite prospect.

There are two major types of mineralisation recognised in the central Pine Creek Geosyncline. Firstly there is the quartz vein set or stockwork style such as at Mount Todd, Enterprise, Union Reefs and Woolwonga Second is the stratiform style represented at Cosmo Howley in part, Golden Dyke, Mount Bonnie and Rustlers Roost. (Miller, G. C., *et al* 1998 p. 411). Mineralisation in the region has been associated with granite intrusions (high temperature hydrothermal), shearing, chemical controls and skarn alteration. In the Quest 29 area mineralisation is likely to be linked to structural processes including deformation and shearing. Mineralisation at the Koolpin Hill, Koolpin North and Taipan Hill prospects is hosted mainly by carbonaceous siltstone containing disseminated pyrite and minor arsenopyrite in the primary zone. At the Dolerite prospect ore is strongly arsenopyritic with some pyrite.

3.1 SAMPLE SELECTION

Samples for waste characterisation were collected from four areas, Koolpin Hill, Koolpin North, Taipan Hill and Dolerite. The sample selection was based on a review of the geological cross-sections, the drill hole database and examination of the diamond core from the mine sequence. A suite of material types were selected to identify the potential for acid generation in mine waste from each. It is noted that although the data set is small, it is designed to provide indicative information on Acid Mine Drainage (AMD) only. Representative samples of mineralised, waste, oxide and fresh rock were collected for each area.

Proposed Pit Areas

The sample material selected for assessment relates to material that may be mined from pits in each area. Samples were selected from Reverse Circulation drill holes from these areas. A total of 20 samples were collected from 18 drill holes from the various potential pit areas. Samples were collected from oxidised and partially oxidised material as described in Tables 2 and 3. Sample depths ranged from 3 to 65 m. Samples were collected as composites of intervals ranging from 2 to 5 m. To preserve sample representativeness, intervals generally should not exceed 2 m. It was concluded from examination of the diamond drill core that the composition of the waste and ore rocks was relatively homogenous. Due to the homogeneous nature of the rock units, composites of 2 to 5 m were considered representative of the major rock units.

Koolpin Hill

A total of 5 RC drill holes were sampled from the Koolpin Hill area. Sample depths range from 10 to 39 m below ground surface. A total of 5 representative samples were collected as 3 to 5 m composites. Samples were representative high grade ore, low grade ore, oxide waste, oxide and fresh mineralised waste. The material sampled is Koolpin Formation siltstone.

Kooipin North

A total of 5 representative samples were collected as 4 to 5 m composites from 5 RC drill holes. Sample depths range from 10 to 30 m below ground surface. Samples collected were representative high grade ore, low grade ore, oxide mineralised waste, fresh and transition mineralised waste. The material sampled is Koolpin Formation siltstone.

Taipan Hill

A total of 6 representative samples were collected as 3 to 5 m composites from 5 RC drill holes. Sample depths ranged from 3 to 33 m below ground surface. Samples collected were representative high grade ore, low grade ore, oxide waste, oxide, oxide shale and fresh mineralised waste. The material sampled is Koolpin Formation siltstone and shale.

D olerite

A total of 4 representative samples were collected as 2 to 5 m composites from 3 RC drill holes. Sample depths ranged from 10 to 39m below ground surface. Samples collected were representative high grade ore, oxide and fresh mineralised waste. The material sampled is Zamu Dolerite. The Dolerite prospect contains a relatively small proportion of oxide and a higher proportion of primary rock in comparison with the above sedimentary-hosted prospects.

Samples were collected from selected Reverse Circulation drill holes, Tables 2 and 3 provide hole locations, sample depths and sample types.

3.2 SAMPLE PREPARATION AND ANALYSIS

Samples were dried, crushed and pulverised to 80% passing 75 µm.

Acid base accounting and geochemical analyses were performed by Australian Laboratory Services (ALS) Brisbane and Woodward-Clyde (Brisbane). The results of the testwork are presented in Tables 2, 3 and 4.

3.2.1 Geochemistry

Geochemical analysis of all samples was undertaken by ICP optical emission spectrometry on a mixed acid digest (total extraction) for copper, lead, zinc arsenic, molybdenum, cobalt, cadmium, and nickel.

These elements were selected in consultation with Sirocco Resources geological staff on the basis of trace element concentrations common to the Quest 29 deposit. These elements are also common to many of the major deposits in the region including Brocks Creek and Union Reefs. The Quest 29 results may therefore be used in comparison to other deposits in the future.

The results of the geochemical testwork are presented in Table 2.

3.2.2 Acid Base Accounting

Acid base accounting was undertaken on all samples submitted for analysis. Acid base account testwork included:

- total sulphur content by high temperature Leco furnace method (ALS method Al 6-l);
- acid neutralising capacity (ANC) by titrametric analysis.

Total sulphur was selected as a conservative assessment of the acid producing potential of the waste material tested. (MPA) was calculated directly using the stoichiometric relationship with total sulphur and sulphuric acid.

The results of the acid base account testwork are presented in Table 3. ANC:MPA ratios are also shown in Table 3. ANC versus MPA is plotted in Figure 1.

3.2.3 Net Acid Generation (NAG)

NAG testwork was undertaken on all samples submitted for analysis.. Sample selection was weighted towards samples with positive NAPP results, with sulphur levels >0.2%, in order to verify the positive acid base accounting results. The results of the NAG testwork including final pH and NAG values in kg H_2SO_4/t are presented in Table 3.

3.2.4 Paste pH and Conductivity

Paste pH and conductivity tests were carried out in order to give a preliminary indication of the in-situ pH of waste materials and the immediate reactivity of minerals present in the sample. The results of the pH and conductivity tests are presented in Table 4.

Table 2
Geochemical Scan Results

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm	Co ppm	Cd ppm	Ni ppm
QR268	Koolpin Hill	9400	4990	10-13	High Grade	161	292	165	802	5	<5	<5	22
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	135	22	76	1120	9	<5	<5	28
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	207	752	180	726	7	34	<5	45
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	226	680	220	638	5	<5	<5	43
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	63	327	150	295	16	36	<5	115
QR263	Koolpin North	10025	4827	25-30	High Grade	462	137	145	327	33	11	<5	69
QR191	Koolpin North	10150	4870	20-25	Low Grade	395	216	196	818	30	9	<5	51
QR189	Koolpin North	10100	4854	10-15	Fresh Mineralised Waste	53	216	54	53	7	<5	<5	<5
QR188	Koolpin North	10075	4852	15-19	Oxide Mineralised Waste	201	407	143	151	21	5	<5	43
QR184	Koolpin North	9975	4860	19-24	Transition Mineralised Waste	133	289	107	216	8	6	<5	15
QR172	Taipan Hill	9040	4837	30-33	High Grade	247	367	443	9390	9	21	18	169
QR168	Taipan Hill	9000	4839	17-22	Low Grade	282	1730	326	2720	19	7	<5	64
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	149	200	142	1370	14	9	<5	27
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	100	771	872	725	12	11	9	75
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	249	102	345	1060	11	22	6	176
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	198	179	493	1650	8	28	7	47
QR137	Dolerite	9275	5300	30-32	High Grade	104	62	116	43600	7	216	<5	94
QR134	Dolerite	9025	5194	10-15	Oxide Waste	103	29	216	1690	5	79	<5	305
QR137	Dolerite	9275	5300	25-30	Fresh Waste	178	38	115	2340	<5	72	<5	57
QR132	Dolerite	8975	5091	61-65	Fresh Waste	107	28	108	2300	<5	52	<5	103
Shale - Average abundance						50	20	100	15	3	20	0.2	70
Environmental Trigger levels for Surface Soils						60	300	200	20	4		3	

* Average crustal abundance in the earth's crust (Field Geologists Manual AusIMM, 1989, p 54)

Table 3
Acid Base Accounting Results

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	S %	pH after oxidation	NAG kg/t	ANC kg/t	MPA kg H_2SO_4 /t	NAPP kg H_2SO_4 /t	ANC: MPA ratio
QR268	Koolpin Hill	9400	4990	10-13	High Grade	0.16	3.5	6.4	0.6	4.9	4.3	0.12:1
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	0.06	4.2	12.8	0.6	1.8	1.2	0.33:1
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	0.02	4.4	6.3	1.2	0.6	-0.6	2.00:1
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	0.58	3.8	10.2	0.4	17.8	17.4	0.02:1
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	20.78	2.4	564	<0.1	636.4	636.3	0.00:1
QR263	Koolpin Nth	10025	4827	25-30	High Grade	8.22	2.4	224	<0.1	251.7	251.7	0.00:1
QR191	Koolpin Nth	10150	4870	20-25	Low Grade	0.38	3.9	5.2	0.7	11.6	10.9	0.06:1
QR189	Koolpin Nth	10100	4854	10-15	Fresh Mineralised Waste	1.84	3.6	11.5	<0.1	56.4	56.3	0.00:1
QR188	Koolpin Nth	10075	4852	15-19	Oxide Mineralised Waste	0.63	3.8	7.8	<0.1	19.3	19.2	0.00:1
QR184	Koolpin Nth	9975	4860	19-24	Transition Mineralised Waste	0.13	4.4	6.6	1.3	4.0	2.7	0.33:1
QR172	Taipan Hill	9040	4837	30-33	High Grade	4.89	2.5	73.6	3.5	149.8	146.3	0.02:1
QR168	Taipan Hill	9000	4839	17-22	Low Grade	0.65	3	12.3	<0.1	19.9	19.9	0.00:1
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	0.12	3.7	6.1	0.7	3.7	3.0	0.19:1
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	1.3	2.6	33.9	3	39.8	36.8	0.08:1
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	0.07	4.8	4.4	4.7	2.1	-2.6	2.24:1
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	0.27	4.9	4.3	0.6	8.3	7.7	0.07:1
QR137	Dolerite	9275	5300	30-32	High Grade	2.55	7.5	<0.1	93.4	78.1	-15.3	1.20:1
QR134	Dolerite	9025	5194	10-15	Oxide Waste	0.03	5.5	4.8	9.4	0.9	-8.5	10.4:1
QR137	Dolerite	9275	5300	25-30	Fresh Waste	2.53	2.6	49.4	13.6	77.5	63.9	0.18:1
QR132	Dolerite	8975	5091	61-65	Fresh Waste	1.19	3.2	13.4	16.7	36.4	19.7	0.45:1

Table 4

Summary of Paste pH and EC Results

Sample Number	Paste pH	Paste EC µS/cm
QR268	4.72	30
QR269	4.60	30
QR140	5.93	30
QR145	4.48	20
QR115	1.13	*700.00
QR263	1.81	7970
QR191	4.33	100
QR189	3.82	10
QR188	4.02	20
QR184	5.10	90
QR172	3.69	1500
QR168 17-22 m	4.04	800
QR168 10-15 m	4.87	20
QR180	4.32	1680
QR175	4.77	320
QR162	4.92	20
QR137 30-32 m	7.43	630
QR134	7.14	340
QR137 25-30 m	7.04	940
QR132	7.09	1000

*Paste EC as mS/cm

4.1 ACID BASE ACCOUNT STATIC TESTWORK

4.1.1 Total Sulphur

The total sulphur content of the samples tested ranged from 0.02 to 20.78 %. Out of 20 samples 7 recorded low total sulphur content (less than 0.25 % S). Five ore grade samples recorded total sulphur contents of >0.25%. The remaining 8 waste samples had total sulphur contents >0.25% and were collected from both the carbonaceous siltstone at the Koolpin Hill, Koolpin North and Taipan Hill areas and the dolerite from the Dolerite area.

4.1.2 Maximum Potential Acidity

Conventional wisdom and experience suggests that a material sulphur content of generally >0.25 %S would be potentially acid producing in the absence of acid neutralising minerals such as calcite. (0.25 %S is equivalent to 0.5 % pyrite or trace pyrite).

The acid producing potential for the majority of the waste rock material examined in this study is moderate to high, with 62% of samples tested exceeding 0.25% sulphur.

4.1.3 Acid Neutralising Capacity (NAC)

The ANC results of the material tested ranged from the detection limit of <0. 1 kg H_2SO_4/tonne to a high of 93.4 kg H_2SO_4/tonne. The highest ANC reading was recorded for a sample of high grade dolerite ore. The ANC results of the waste rock material tested ranged from the detection limit of <0. 1 kg H_2SO_4/tonne to a high of 16 kg H_2SO_4/tonne. The highest reading for the waste rock material was also in dolerite.

The acid neutralising capacity is limited in the carbonaceous siltstone waste rock material examined and relatively high in the dolerite waste.

4.1.4 Net Acid Producing Potential (NAPP)

The classification system used to categorise the samples into three classes are described in Table 5. The classification is based on established procedures developed through Canadian AMD research (Brodie *et al* 199 1; Smith and Barton Bridges 199 1; Ferguson and Morin 199 1; Ferguson and Robertson 1994; Miller 1998) and built upon by Woodward-Clyde. The three categories used are shown in Table 5. The ANC was plotted against MPA in Figure 1. The plot shows that the acid producing potential of most of the samples tested is low to moderate and the neutralising capacity is low.

Ore Samples

The majority of ore rock material tested was classified as potentially acid forming (PAF) in Table 5.

Waste Samples

The majority of waste rock material tested (9 of 13 samples) was also classified as potentially acid forming (PAP) in Table 5.

4.1.5 Net Acid Generation (NAG)

The results of the testing suggest the following, based on the system of classification developed by Miller (1998) which is summarised in Table 5.

Ore Samples

The samples of ore from the Koolpin Hill, Koolpin North and Taipan Hill areas. have final NAG pH values <4.5, NAG values of >5 kg H_2SO_4/t and positive NAPP results indicating they are PAF material. The dolerite ore sample from the Dolerite area has a final NAG pH value >4.5, NAG values of <5 kg H_2SO_4/t and negative NAPP results indicating it is non-acid forming (NAP) material.

Waste Samples

Samples of fresh, oxide and transition mineralised waste from Koolpin Hill and Koolpin North areas returned final NAG pH values <4.5, NAG values of >5 kg H_2SO_4/t and positive NAPP results indicating they are PAF material. The sample of oxide waste from Koolpin Hill returned an uncertain result with a final NAG pH value <4.5, NAG value of >5 and negative NAPP suggesting the material is most likely to be relatively neutral.

Samples of oxide and fresh mineralised waste material from the Taipan Hill area showed final NAG pH values <4.5, NAG values >5 kg H_2SO_4/t, and a positive NAPP, suggesting this material is PAF. The sample of oxide mineralised waste from Taipan Hill showed a final NAG pH value >4.5, NAG value <5 and negative NAPP suggesting this material is NAP. The sample of shale oxide waste from Taipan Hill returned an uncertain result with a final NAG pH value >4.5, NAG value of <5 and positive NAPP suggesting the material is most likely to be PAP.

Samples of fresh waste material from the Dolerite area showed final NAG pH values <4.5, NAG values >10 kg H_2SO_4/t, and a positive NAPP, suggesting this material is PAF. The sample of oxide waste from Dolerite showed a final NAG pH value >4.5, NAG value <5 and negative NAPP suggesting this material is NAF.

4.1.6 Paste pH and Conductivity

'A sample with a pH less than 4 indicates the sample is naturally acidic regardless of the NAPP, while an EC greater than 2000 microSiemens per metre (μS/m) indicates a high level of soluble constituents.' (Environment Australia 1997, p 29).

The results of the paste pH testing revealed that 4 of the 20 samples tested were naturally acidic. These were fresh mineralised waste from Koolpin Hill, high grade ore and fresh mineralised waste from Koolpin North, and high grade ore from Taipan Hill.

Only 2 of the 20 samples had an EC greater than 2000 μS/m. This was the fresh mineralised waste sample from the Koolpin Hill area and the high grade ore sample from the Koolpin North area.

The results of the pH and conductivity tests are presented in Table 4.

Table 5

Classification of Mine Waste using NAG testing

Mine Waste Type	Final NAG pH	Static NAG value kg H_2SO4/t	NAPP kg H_2SO4/t
Potentially Acid Forming - High Capacity (PAF)	<4.5	>5	positive
Potentially Acid Forming - Low Capacity (PAF-LC)	<4.5	≤5	positive
Non-Acid Forming (NAF)	24.5	0	negative
Acid Consuming (ACM)	24.5	0	less than - 100
Uncertain	24.5	0	positive
	<4.5	>0	negative

After: Brodie *et al* 1991; Smith and Barton Bridges 1991; Ferguson and Morin 1991; Ferguson and Robertson 1994: Miller 1998.

4.2 CLASSIFICATION OF WASTE ROCK

The classification system used to categorise the samples into three classes are described in Table 5. The classification is based on established procedures developed through Canadian AMD research (Brodie *et al* 1991; Smith and Barton Bridges, 1991; Ferguson and Morin, 199 1; Ferguson and Robertson, 1994) and built upon by Woodward-Clyde. The three categories used are shown in Table 5.

The ANC was plotted against MPA in Figure 1. The plot shows that the acid producing potential of most of the samples tested is low to moderate and the neutralising capacity is low. It appears that the majority of carbonaceous siltstone samples from the Koolpin Hill, Koolpin North and Taipan Hill areas are PAF with the exception of the oxide mineralised waste sample from Taipan Hill. This is likely to be a function of the samples' low ANC results.

The majority of waste rock material tested was classified as potentially acid forming (PAP) in Table 5. The ANC: MPA ratios confirm this.

4.3 GEOCHEMICAL TESTWORK

The results of the geochemical analyses are contained in Table 2. Average crustal abundance levels of the selected elements in sediments have been provided for comparison. In addition, environmental 'trigger levels' for soil contaminants have also been provided for comparison. The discussion below will refer to elevated levels of metal ions with respect to crustal abundances and trigger levels. Trigger levels are used as a guide only, and when interpreting results in mineralised areas should be used with discretion. The effects of elevated metal concentrations depend on numerous site specific factors, not least being the sensitivity of the receiving environment. However, the trigger levels are useful in providing an indication of which particular metals may potentially impact on rehabilitation procedures.

Proposed Pit Areas

In summary arsenic is the dominant metal ion exhibiting extremely elevated concentrations in the test material with respect to crustal abundance for sediments and environmental trigger levels. Moderately elevated levels of copper, lead, zinc and molybdenum were also recorded for some samples. Slightly elevated levels of cobalt and nickel were recorded for some samples, Cadmium was slightly elevated in the Taipan Hill samples, The ore samples show the highest concentrations in the elements selected for testing. The oxide waste samples of siltstone from Koolpin Hill, Koolpin North and Taipan Hill appear to show higher levels of arsenic and copper than the fresh siltstone samples,

Kooipin Hill

The samples from the Koolpin Hill area are elevated in arsenic, copper, lead and molybdenum with respect to crustal abundances and environmental trigger levels.

Koolpin North

Highly elevated levels of arsenic are shown for the ore samples at Koolpin North. The waste samples are also elevated in arsenic. All samples are elevated in copper and molybdenum. There are also minor elevations in lead with respect to crustal abundances and environmental trigger levels.

Taipan Hill

The samples from the Taipan Hill area are elevated in arsenic, copper, lead, molybdenum and zinc with respect to crustal abundances and environmental trigger levels.

Dolerite

The samples from the Dolerite area are elevated in arsenic, copper, cobalt and nickel with respect to crustal abundances and environmental trigger levels. Slightly elevated levels of zinc and molybdenum are also displayed.

5.1 ACID PRODUCING POTENTIAL

The potential for acid mine drainage from waste rock for the Quest 29 area is moderate to high with a low acid neutralising capacity for all siltstone waste from the Koolpin Hill, Koolpin North and Taipan Hill areas. The fresh waste at the Dolerite prospect has the potential to produce acid, yet the oxide sample from this area appears to be less reactive. All siltstone ore from the Koolpin Hill, Koolpin North and Taipan Hill areas also has the potential to produce acid. Ore samples from the Dolerite area are less reactive. Table 6 classifies the samples using the categories outlined in Table 5.

5.1.1 Acid Base Accounting

Of the 7 ore samples tested, 6 are PAP. The results from the Dolerite area ore sample suggest the potential of the material to form acid is uncertain. Of the 13 waste samples tested, 10 are PAF. Results indicate that the oxide waste from the Dolerite area is NAF. The oxide waste sample from the Koolpin Hill area and the oxide mineralised waste sample from the Taipan Hill area returned uncertain results. The data suggests that both fresh and oxidised waste rock material that will potentially be extracted from pits at the Koolpin Hill and Koolpin North areas is likely to be potentially acid producing. Three of the four waste samples taken from the Taipan Hill area suggest that the waste will be acid forming. Results for one of the samples indicated that the oxide mineralised waste would not be acid forming. Further tests to confirm this may be necessary. The Dolerite samples suggest that the fresh waste has a greater potential to generate acid than the oxide waste and that the oxide waste may in fact be NAF. Sampling of the sediments surrounding this dolerite intrusion is also recommended if it is to be included in the waste material for this area. It is suggested from this that special waste handling procedures such as encapsulation of the potentially reactive waste may be necessary.

The distribution and volume of this material should be quantified through further investigation including waste resource modelling and management strategies defined for it if deemed necessary.

5.1.2 Net Acid Generation (NAG)

The testing for NAG capacity on selected samples confirmed that the samples tested were potentially acid forming. The samples of oxidised mineralised waste from the Taipan Hill area and oxide waste from the dolerite area are potentially non acid forming.

5.2 GEOCHEMISTRY

The metals content of the test samples generally is elevated in arsenic for the waste and ore rock material. Copper, cobalt and nickel are slightly elevated in some of the sample material tested. Lead, zinc and molybdenum is slightly to moderately elevated in the siltstone samples from the Koolpin Hill, Koolpin North Taipan Hill areas, This is common to deposits in the Pine Creek Geosyncline.

The acid base accounting results indicate that there may be a potential for acid leachate generation and hence potential for mineral mobilisation from the material tested.

Special handling of the waste from the potential pit areas may be required, subject to further static based testwork. Kinetic based testwork would also be necessary in order to confirm this.

Table 6 - Waste Characterisation - Classification of Samples

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	ANC: MPA	Class
QR268	Koolpin Hill	9400	4990	10-13	High Grade	0.12:1	PAF
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	0.33:1	PAF
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	2.00:1	uncertain
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	0.02:1	PAF
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	0.00:1	PAF
QR263	Koolpin North	10025	4827	25-30	High Grade	0.00:1	PAF
QR191	Koolpin North	10150	4870	20-25	Low Grade	0.06:1	PAF
QR189	Koolpin North	10100	4854	10-15	Fresh Mineralised Waste	0.00:1	PAF
QR188	Koolpin North	10075	4852	15-19	Oxide Mineralised Waste	0.00:1	PAF
QR184	Koolpin North	9975	4860	19-24	Transition Mineralised Waste	0.33:1	PAF
QR172	Taipan Hill	9040	4837	30-33	High Grade	0.02:1	PAF
QR168	Taipan Hill	9000	4839	17-22	Low Grade	0.00:1	PAF
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	0.19:1	PAF
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	0.08:1	PAF
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	2.24:1	uncertain
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	0.07:1	PAF
QR137	Dolerite	9275	5300	30-32	High Grade	1.20:1	uncertain
QR134	Dolerite	9025	5194	10-15	Oxide Waste	10.4:1	NAF
QR137	Dolerite	9275	5300	25-30	Fresh Waste	0.18:1	PAF
QR132	Dolerite	8975	5091	61-65	Fresh Waste	0.45:1	PAF

KEY: • PAF - Potentially Acid Forming • NAF - Non-Acid Forming

(* Assessment of ANC:MPA ratio; >3: 1 -NAF, l-3: 1 - uncertain, <1: 1 -PAF)

5.3 CONCLUSIONS

This preliminary characterisation of waste rock from the Quest 29 proposed pits has found the majority of samples (10 of 13) to be potentially acid forming. Two results were uncertain and the oxide waste from the Dolerite area was NAF. There was a large contrast between some of the sample results (for example sample QR 115 / 34-39 m had a S % of 20.78 compared to sample QR 140 / 1 l-l 5 m with a S % of 0.02). This is acceptable for the purpose of this preliminary assessment report. Due to the acid forming capacity of the majority of samples, it is concluded that if the project is to proceed a larger set of samples would need to be collected and assessed.

Further information on the deposit's mineralogy is necessary in order to characterise the waste rock on this basis. A more detailed lithology description, a description of the sulphides and their abundance, a description of the carbonates and their abundance, more detailed oxidation state description, and alteration descriptions would be useful if available.

Due to the limited number of samples tested, this data is indicative only. Further sampling and testing of the potential waste from the proposed Quest 29 pit areas will be required to develop a waste resource model. This will enable volumes and distribution of potentially acid forming waste to be quantified and waste handling strategies to be developed to minimise acid drainage, The discussions and conclusions contained within this report are based on a limited number of samples. The sample sites were selected by Sirocco Resources staff, Samples were selected from RC holes drilled at proposed pit sites in the Quest 29 area. Woodward-Clyde take no responsibility for the accuracy of identification of the geological units sampled.

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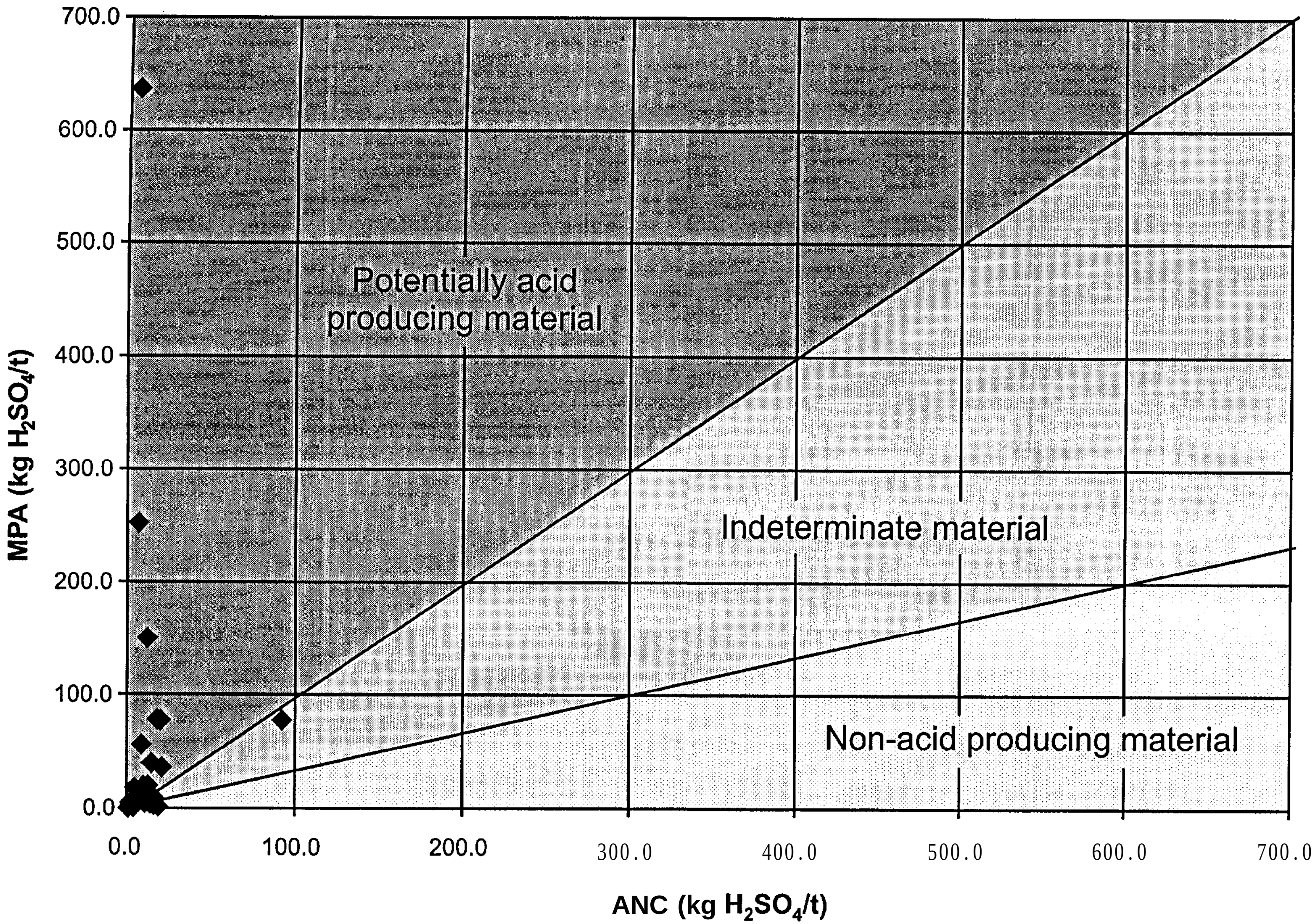

PREPARED: LL DRAWING No: A3201411-0001-G-001
CHECKED: CAD FILE No: -G-001
APPROVED: REVISION: A
DATE: DEC 98

LEGEND

◆ QUEST 29 Samples - ANC vs MPA

SOURCE: S:\A32\01411\0001\XLS\T001-1.xls chart

CLIENT **SIROCCO RESOURCES NI**

PROJECT **PRELIMINARY WASTE ROCK CHARACTERISATION - PROPOSED QUEST 29 OPEN PITS**

TITLE ACID BASE ACCOUNTING - ANC vs MPA

FIGURE **1**

Woodward-Clyde

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ANALYTICAL REPORT

LABORATORY: STAFFORD
BATCH NUMBER: ST24370
SUB BATCH: 0
No. OF SAMPLES: 20
DATE RECEIVED: 29/10/98
DATE COMPLETED: 03/11/98

CONTACT: MS B HYNCH
CLIENT: AGC WOODWARD-CLYDE (QLD)
ADDRESS: 49 PARK ROAD
MILTON QLD 4064

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

SAMPLE NUMBER / ELEMENT UNIT METHOD L.O.R.	S % A16-1 0.01	Cu ppm IC587 5	Pb ppm IC587 5	Zn ppm IC587 5	As ppm IC587 5	Mo ppm IC587 5
QR268	0.16	161	292	165	802	5
QR269	0.06	135	22	76	1120	9
QR140	0.02	207	752	180	726	7
QR145	0.58	226	680	220	638	5
QR115	20.78	63	327	150	295	16
QR263	8.22	462	137	145	327	33
QR191	0.38	395	216	196	818	30
QR189	1.84	53	216	54	53	7
QR188	0.63	201	407	143	151	21
QR184	0.13	133	289	107	216	8
QR172	4.89	247	367	443	9390	9
QR168 17-22	0.65	282	1730	326	2720	19
QR168 10-15	0.12	149	200	142	1370	14
QR180	1.30	100	771	872	725	12
QR175	0.07	249	102	345	1060	11
QR162	0.27	198	179	493	1650	8
QR137 30-32	2.55	104	62	116	4.36%	7
QR134	0.03	103	29	216	1690	5
QR137 25-30	2.53	178	38	115	2340	<5
QR132	1.19	107	28	108	2300	<5

COMMENTS:

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• Results apply to sample(s) as submitted by client.

All pages of this report have been checked and approved for release.

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ANALYTICAL REPORT

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CONTACT: MS B HYNCH
CLIENT: AGC WOODWARD-CLYDE (QLD)
ADDRESS: 49 PARK ROAD
MILTON QLD 4064

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

ELEMENT UNIT METHOD UMBER L.O.R.	Co ppm IC587 5	Cd ppm IC587 5	Ni ppm IC587 5			
QR268	<5	<5	22			
QR269	<5	<5	28			
QR140	34	<5	45			
QR145	<5	<5	43			
QR115	36	<5	115			
QR263	11	<5	69			
QR191	9	<5	51			
QR189	<5	<5	<5			
QR188	5	<5	43			
QR184	6	<5	15			
QR172	21	18	169			
QR168 17-22	7	<5	64			
QR168 10-15	9	<5	27			
QR180	11	9	75			
QR175	22	6	176			
	28	7	47			
QR137 QR162 30-32	216	<5	94			
QR134	79	<5	305			
QR137 25-30	72	<5	57			
QR132	52	<5	103			

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CONTACT: MR P SCOTT
CLIENT: AGC WOODWARD-CLYDE (QLD)
ADDRESS: 49 PARK ROAD
MILTON QLD 4064

LABORATORY: ENV BRISBANE
BATCH NUMBER: EB17518
SUE BATCH: 0
No. OF SAMPLES: 20
DATE RECEIVED: 30/10/98
DATE COMPLETED: 10/11/98

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

SAMPLE NUMBER	ELEMENT / UNIT / METHOD / L.O.R.	Volume mL ALS 0.05	pH (H2O2 EA-002 0.1	NAG kg/t EA-011 0.1	ANC kg/t EA-013 0.1		
	QR268	0.30	3.5	6.4	0.6		
	QR269	<0.05	4.2	12.8	0.6		
	QR140	<0.05	4.4	6.3	1.2		
	QR145	0.15	3.8	10.2	0.4		
	QR115	104	2.4	564	<0.1		
	QR263	7.80	2.4	224	<0.1		
	QR191	0.05	3.9	5.2	0.7		
	QR189	0.35	3.6	11.5	<0.1		
	QR188	0.25	3.8	7.8	<0.1		
	QR184	<0.05	4.4	6.6	1.3		
	QR172	5.70	2.5	73.6	3.5		
QR168	17-22	0.55	3.0	12.3	<0.1		
QR168	10-15	0.25	3.7	6.1	0.7		
	QR180	2.45	2.6	33.9	3.0		
	QR175	<0.05	4.8	4.4	4.7		
	QR162	<0.05	4.9	4.3	0.6		
QR137	30-32	<0.05	7.5	<0.1	93.4		
	QR134	<0.05	5.5	4.8	9.4		
QR137	25-30	3.45	2.6	49.4	13.6		
	QR132	2.20	3.2	13.4	16.7		

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COMMENTS: ANC by WWC supplied method. ANC expressed as kg H_2SO_4/tonne. NAG by WWC supplied method. pH in "final" solution after reaction. Volume is mL ot titrant required to bring "final" solution to pH 4.0. ALS is not NATA Accredited for NAG and ANC. This report supersedes any previous preliminary reports of the same batch number.

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CLIENT: AGC WOODWARD-CLYDE (QLD)
ADDRESS: 49 PARK ROAD
MILTON QLD 4064

LABORATORY: ENV BRISBANE
BATCH NUMBER: EB17518
SUB BATCH: 0
No. OF SAMPLES: 20
DATE RECEIVED: 30/10/98
DATE COMPLETED: 10/11/98

ORDEA No.: A3201411/0001 SAMPLE TYPE: QUALITY CONTROL PROJECT: SIRROCCO

SAMPLE NUMBER	ELEMENT UNIT METHOD L.O.R.	Volume mL ALS 0.05	pH (H202 EA-002 0.1	NAG kg/t EA-011 0.1	ANC kg/t EA-013W 0.1		
*** METHOD	BLANK	----	4.1	<0.1	----		
*** QR184	CHK	<0.05	4.4	6.1	0.6		
*** QR132	CHK	2.25	3.2	13.2	16.8		

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COMMENTS:
Results which appear on this report are routine laboratory checks for QUALITY CONTROL purposes.

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