ASX Announcement

IRONCLAD
MINING LIMITED

30 October, 2013

Initial Manganese Testwork Results

Highlights:

- Pyrolusite confirmed as the Manganese bearing mineral
- 34.9% manganese concentrate returned from a 29.7% sample
- Outcropping samples grading up to 39% Manganese from Pier Prospect

In January 2013 IronClad Mining Limited undertook regional exploration drilling at its Hercules Iron Ore Project. During this program, significant manganese was intersected. IronClad recently announced a proposed Joint Venture with Trafford Resources whereby IronClad can earn an 80% interest in manganese over the Wilcherry Hill Project area (976Km^2) comprising exploration licence numbers EL5229-Wilcherry Hill, EL4286-Valley Dam, EL4421-Peterlumbo and EL5164-Eurilla Dam.

IronClad is pleased to announce the results of its preliminary metallurgical testwork and its initial exploration review, focusing on the Hercules East and Pier Dam Prospects (Figure 1). Both these prospects lie within the Joint Venture's 100% owned Eurilla Dam EL 5164 tenement approximately 15km east of the Company's Wilcherry Hill iron deposit.

Preliminary Metallurgical Testing

From the January 2013 drilling program RC composite samples from hole 13HRC026, were generated and submitted for metallurgical testwork. The aim of the initial testwork was to identify the mineral hosting the manganese, determine what sort of concentrate could be produced from the material by gravity concentration and identify impurity elements in the ore.

Pyrolusite was identified as the manganese bearing mineral. Pyrolusite is the most sought after manganese mineral as its relatively high specific gravity makes it amenable to beneficiation using simple low cost gravity separation. Metallurgical test work was completed on composite samples from low, medium and high grade manganese intersections.

The low grade manganese sample Wilfley table concentration resulted in a ferromanganese ore up from an average of 7.44% Mn to 10.49% Mn. The medium grade returned a manganese concentration up from 16.7% to 25.9%. While the high grade returned 34.9% manganese concentration up from 29.7%. These initial metallurgical tests indicate the ability to upgrade the manganese via simple processing. Additional work needs to be completed to show a defined processing route for manganese ore to become a saleable product.

Based upon this initial test work, it appears feasible to create a Pyrolusite concentrate using a simple gravity separation plant similar to that planned for IronClad's Stage 2 Wilcherry Hill Iron Ore Project.

ASX CODE: IFE

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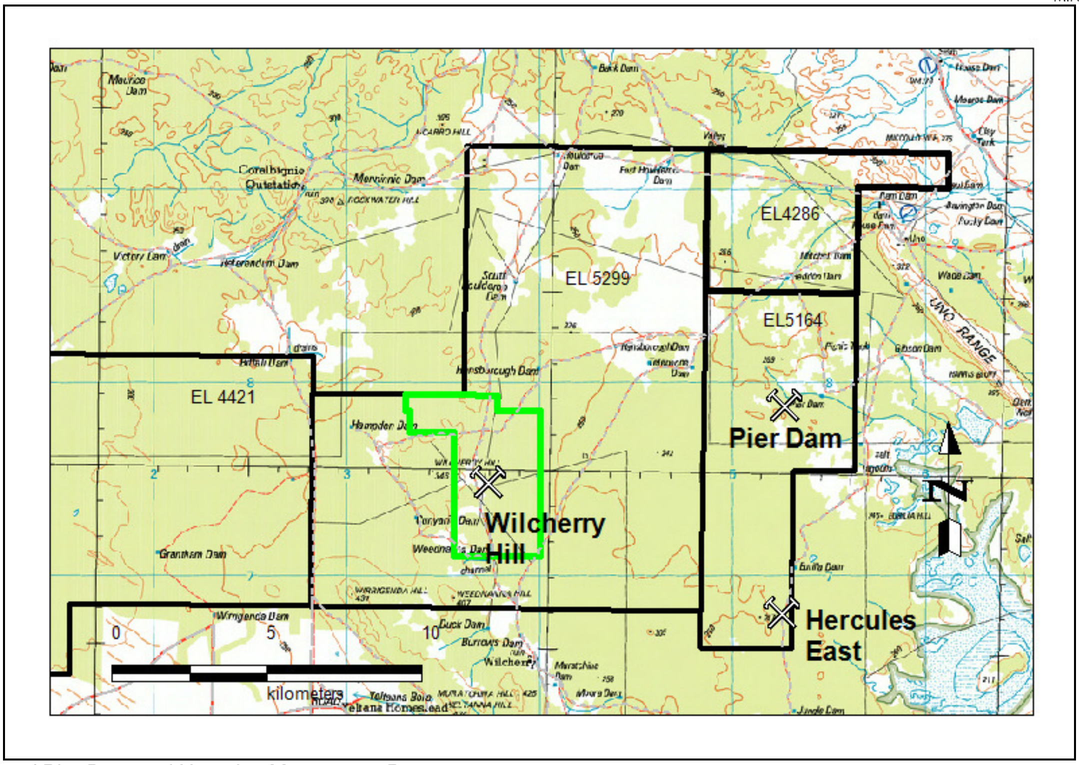

Figure 1 Location of Pier Dam and Hercules Manganese Prospects

Basement geology within the prospect areas consists of the Middleback Subgroup, which is part of the Palaeoproterozoic Hutchison Group metasediments. The prospective host stratigraphic units are considered to be the quartzite, banded iron formation and dolomite units within the Hutchison Group.

Upon signing the Manganese Joint Venture, IronClad plans, in this current quarter, to undertake manganese exploration focused historical data compilation, review of available geophysical data, geological mapping and geochemical sampling at the known manganese occurrences within these two prospect areas.

To take advantage of the good conductive properties of manganese oxide minerals, use of electrical geophysical methods to help delineate mineralised zones will also be evaluated. Surveys will be undertaken in the following quarter if warranted.

Target generation from this initial field work is anticipated to lead to a reverse circulation drilling program in early 2014.

Manganese Prospectivity

Historically, significant manganese mineralisation has been noted at these two areas by Esso Ltd, Aberfoyle Ltd, Trafford Resources Limited, Lincoln Minerals Ltd and IronClad Mining Limited as part of its exploration for iron.

Surface rock chip sampling by Trafford Resources Limited over the Pier Dam Prospect (Figure 2) in 2007 and 2011 confirmed the 4km West-North West trending zone of manganese anomalism first identified by explorers in the early 1980's. High grade manganese values (Table A1-1) ranging from 15.5% - 31.4% Mn were recorded (*see Trafford ASX release 26 November 2007 & 21 September 2011).* IronClad as part of its regional iron exploration program collected a number of surface grab samples on one outcrop at the western end of this trend (Table A1-2). A distinct manganese rich zone averaging 38.8% Mn from five grab samples was delineated from an iron rich zone averaging 52% Fe from three grab samples.

In early 2013 IronClad completed a drilling campaign testing the northern and eastern extents of the Inferred resource at the Hercules prospect for direct shipping iron ore (*IFE ASX Release March 2013 Quarterly Report*).
The drilling intersected 22m @ 22% Mn from 56m in hole 13HCRC026 and 7m @ 20% Mn from 55m in hole

13HCRC001 (Figure 3, Appendix 2 for location and assay data). This discovery on the +2km eastern flank of the Hercules Prospect opened up a new manganiferous zone to add to the existing 7km strike length of the main Hercules Prospect.

IronClad has previously reported a manganese resource at its Hercules Iron Deposit, (*IFE ASX Release 22nd December 2008*). Mn rich drillholes that underpin the resource are shown in Figure 3, assays and locations are listed in Appendix 2. This manganiferous portion of the resource will be targeted in future drilling campaigns to delineate higher grade Mn zones amenable to surface mining and gravity beneficiation.

The presence of this Mn resource further highlights the upside available to IronClad to develop a multi commodity, complementary project based on extracting Mn in addition to Fe.

With IronClad's planned iron ore exports already supporting the construction of mine and port infrastructure, IronClad's M.D. Robert Mencel said that "Additional Manganese revenue has the potential to significantly enhance the economics of the Wilcherry Hill Project."

Competent Person Statement

The information in this announcement that relates to Mineral Resources and geological results is based on information compiled by Chris Mroczek, who is a Member of The Australasian Institute of Mining and Metallurgy and who has more than five years' experience in the field of activity being reported on and is the Chief Geologist of the Company.

The information in this announcement that relates to metallurgical results is based on information compiled by Munya Maidza, who is a Member of The Australasian Institute of Mining and Metallurgy and who has more than five years' experience in the field of activity being reported on and is the Senior Process Engineer with Trafford Resources Ltd.

Mr. Mroczek and Mr. Maidza have sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity undertaken to qualify as a Competent Person as defined in the 2004 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Mr. Mroczek and Mr. Maidza consent to the inclusion in the report of the matters based on his information in the form and context in which it appears.

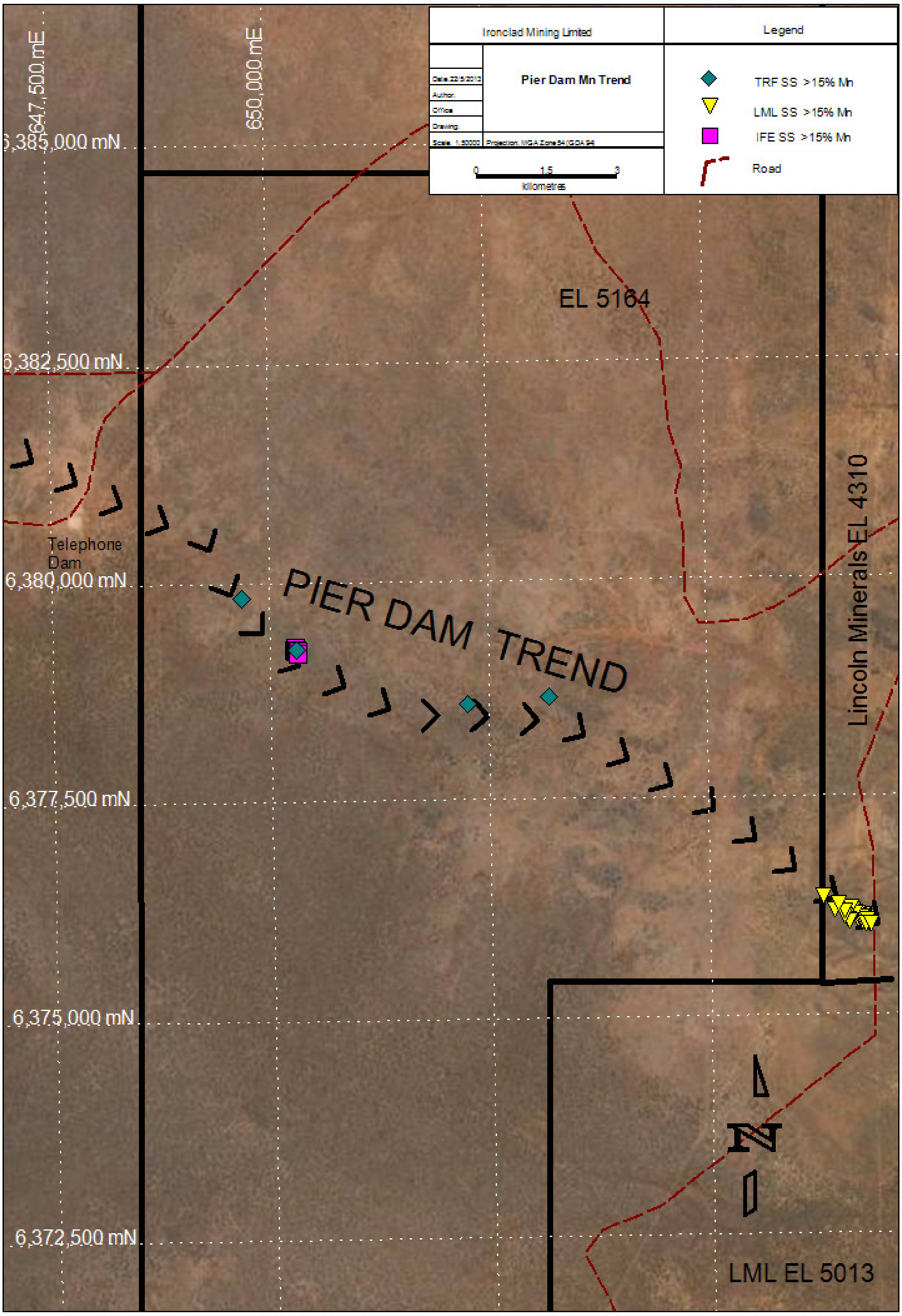

Figure 2 Pier Prospect Trend showing historic surface grab sample sites

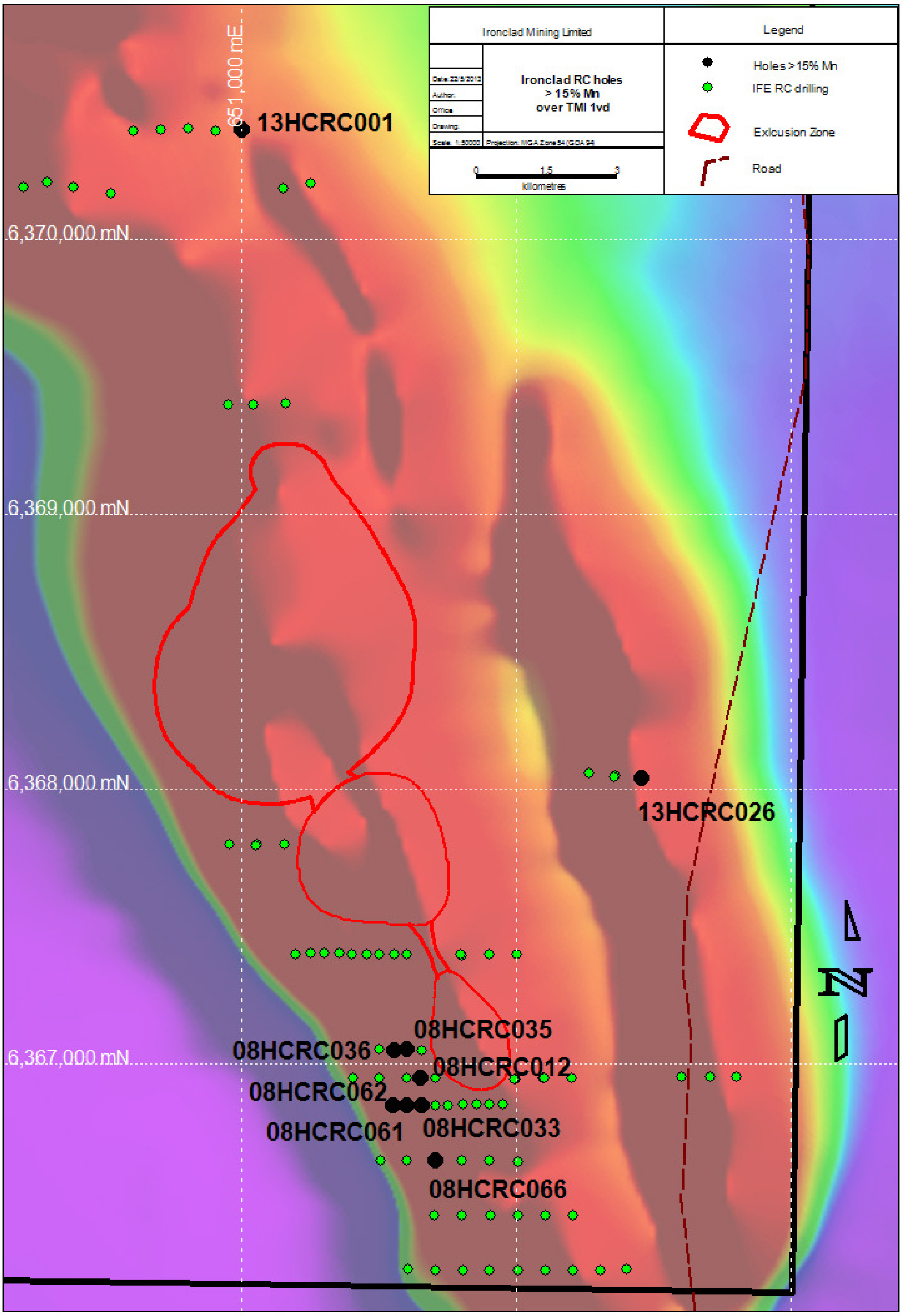

Figure 3 Location of significant manganese bearing drillholes at the Hercules & Hercules East Prospect (underlying image is Total Magnetic Intensity)

Appendix 1 Rock Chip Assay Data

The rock chip information contained in this appendix relates to the selective sampling completed by IronClad at the Pier Dam Prospect. Six (6) samples were collected; selected information is listed in Table A1.

The co-ordinate system is MGA94_53.

Analysis of the samples was carried out at Bureau Veritas Laboratory. Analysis was carried out using XRF for a routine suite of 11 elements and a gravimetric method was used to analyse LOI (loss on ignition). Only Mn and Fe assays are reported in the tables below.

Prospect	Sample	Easting	Northing	Mn %	Fe%
Pier Dam	WH37841	649679	6379837	**31.4**	14.8
Pier Dam	WH37842	649679	6379837	**20.8**	13.8
Pier Dam	WH37843	650304	6379238	**19.7**	35.6
Pier Dam	WH37844	652255	6378590	**20.4**	24.6
Pier Dam	WH37845	653178	6378658	**15.5**	24.6

Table A1-1 Trafford 2011 surface grab sample results

Prospect	Sample	Easting	Northing	Mn %	Fe%
Pier Dam	WH37841	650281	6379267	**35.1**	19.2
Pier Dam	WH37842	650283	6379247	**43.1**	10.1
Pier Dam	WH37843	650275	6379244	**36.7**	16.0
Pier Dam	WH37844	650290	6379220	**37.6**	12.6
Pier Dam	WH37845	650293	6379231	**41.7**	11.0
Pier Dam	WH37846	650303	6379240	0.42	**54.9**
Pier Dam	WH37847	650315	6379226	0.26	**47.3**
Pier Dam	WH37848	650319	6379200	0.59	**53.6**

Table A1-2 IronClad surface grab sample results

Appendix 2 Selected Manganese Reverse Circulation Drilling Results Assay Data

The selected drillhole information contained in this appendix relates to drilling completed by IronClad at its Hercules prospect in mid-2008 and early 2013 as part of its iron exploration programs.

Drillhole collar information is listed in Table A2-1. The co-ordinate system is MGA94_53.

The drilling method was reverse circulation using a 4.5" hammer. Holes were drilled at an angle of 60° to the East.

The sampling interval in ore was 2m for the 2008 drilling and 1m for the 2013 drilling with sub-samples for assays split using a 2 tier riffle splitter. Analysis of the sub-samples was carried out at Bureau Veritas Laboratory. Analysis was carried out using XRF for a routine suite of 11 elements and a gravimetric method was used to analyse LOI (loss on ignition).

Selected assay information for the holes, based on a 15% Mn cut off width is listed in Table A2-2. Drillholes listed were selected to highlight the manganese content only.

HOLE_ID	DEPTH(m)	EASTING	NORTHING	HEIGHT	DIP	AZIMUTH
13HCRC001	84	651000	6370400	233	-60	90
13HCRC026	84	652450	6368050	230	-60	90
08HCRC012	154	651650	6366949	245	-60	90
08HCRC033	118	651651	6366849	241	-60	90
08HCRC035	86	651599	6367052	245	-60	90
08HCRC036	148	651551	6367051	243	-60	90
08HCRC047	197	652003	6366250	225	-60	90
08HCRC048	208	651899	6366250	225	-60	90
08HCRC061	138	651598	6366849	241	-60	90
08HCRC062	124	651549	6366851	239	-60	90
08HCRC066	160	651701	6366647	235	-60	90

Table A2-1 Selected Hercules Drillhole Collar Information

HOLE_ID	DEPTH FROM (m)	DEPTH TO (m)	Mn%	Fe%	HOLE_ID	DEPTH FROM (m)	DEPTH TO (m)	Mn%	Fe%
08HCRC012	28	30	**18.3**	31.8	13HCRC001	24	25	**23.4**	13.1
08HCRC012	30	32	**24.0**	27.6	13HCRC001	25	26	**18.1**	16.1
08HCRC033	12	14	**19.5**	26.7	13HCRC001	26	27	**19.4**	18.6
08HCRC033	14	16	**27.8**	18.7	13HCRC001	55	56	**15.1**	13.3
08HCRC033	24	26	**21.8**	24.7	13HCRC001	56	57	**26.6**	10.1
08HCRC035	14	16	**18.4**	24.6	13HCRC001	57	58	**19.2**	11.8
08HCRC035	16	18	**17.4**	31.7	13HCRC001	58	59	**21.5**	14.5
08HCRC035	22	24	**15.6**	31.9	13HCRC001	59	60	**22.1**	11.7
08HCRC035	24	26	**18.5**	30.9	13HCRC001	60	61	**22.1**	10.1
08HCRC035	26	28	**17.3**	31.3	13HCRC001	61	62	**15.0**	13.8
08HCRC035	28	30	**21.1**	31.4	13HCRC026	2	3	**21.3**	14.2
08HCRC035	30	32	**22.4**	27.5	13HCRC026	26	27	**16.7**	32.4
08HCRC035	32	34	**16.1**	29.0	13HCRC026	31	32	**18.2**	14.0
08HCRC036	28	30	**16.8**	23.1	13HCRC026	32	33	**23.1**	18.1
08HCRC036	30	32	**24.2**	30.6	13HCRC026	56	57	**27.2**	18.5
08HCRC047	24	26	**23.2**	32.4	13HCRC026	57	58	**29.1**	19.8
08HCRC047	26	28	**18.9**	26.9	13HCRC026	58	59	**28.4**	20.4
08HCRC047	28	30	**18.7**	29.1	13HCRC026	59	60	**31.5**	16.9
08HCRC048	32	34	**16.4**	38.0	13HCRC026	60	61	**19.9**	26.3
08HCRC048	34	36	**27.7**	29.3	13HCRC026	61	62	**16.2**	26.8
08HCRC048	36	38	**29.9**	23.8	13HCRC026	62	63	**20.8**	22.5
08HCRC061	42	44	**23.6**	21.0	13HCRC026	65	66	**19.8**	7.3
08HCRC061	44	46	**21.1**	25.3	13HCRC026	67	68	**18.6**	11.4
08HCRC062	28	30	**25.2**	29.9	13HCRC026	68	69	**15.3**	10.3
08HCRC062	30	32	**33.7**	18.7	13HCRC026	70	71	**26.2**	7.1
08HCRC066	36	38	**17.2**	12.3	13HCRC026	71	72	**30.0**	9.2
08HCRC066	38	40	**17.9**	13.2	13HCRC026	72	73	**26.2**	17.4
08HCRC066	58	60	**17.6**	8.4	13HCRC026	73	74	**32.0**	16.5
08HCRC066	76	78	**17.9**	29.2	13HCRC026	74	75	**22.1**	27.4
08HCRC066	88	90	**27.6**	26.6	13HCRC026	75	76	**30.1**	17.5
08HCRC066	90	92	**28.3**	23.9	13HCRC026	76	77	**36.0**	15.5
08HCRC066	92	94	**24.9**	20.3	13HCRC026	77	78	**18.5**	27.6
08HCRC066	96	98	**19.7**	31.7					
08HCRC066	98	100	**26.5**	25.3					

Table A2-2 Selected Hercules Drillhole Mn and Fe assay results

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Appendix 3 Preliminary Metallurgical Results

MEMORANDUM

IRONCLAD
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To:	Robert Mencel Managing Director, IronClad Mining
From:	Munya Maidza Senior Process Engineer, Trafford Resources
Date:	21 October 2013
Subject:	**PRELIMINARY HERCULES MANGANESE GRAVITY TESTWORK**

A. INTRODUCTION

An RC hole, 13HRC026, sunk at Hercules returned very interesting manganese values with the zone between 56 and 78m giving an average manganese grade of 22.5%. A few RC composite samples were submitted to Amdel Laboratory in Wingfield Adelaide to quickly

(i) Identify the mineral hosting the manganese

(ii) Assess what sort of concentrate could be produced from the material by gravity concentration

(iii) Identify the minor and impurity elements in the ore.

B. SAMPLES

Six composite samples were made from hole 13HRC026 RC chips. The samples were classified into low, medium and high Mn grade as shown in Table 1. Quantitative XRD and XRF analysis was done on the head samples.

HCM006, 007 and 008 were combined to form a single low grade Mn composite HCM012 for gravity concentration. HCM010 and 011 were also combined to form a single high grade Mn composite HCM013. HCM009 was put over the Wilfrey Table as the medium grade Mn sample.

Table 1: Samples submitted for testwork

Category	Sample	Mn Grade	WT[1] Composite
Low grade Mn	HCM006, 007, 008	5.0% <Mn < 10%	HCM012
Medium Grade Mn	HCM009	10% < Mn < 20%	HCM009
High grade Mn	HCM010, 011	>20% Mn	HCM013

The three composites, HCM009, 012 and 013 were first crushed to - 2.0mm before the Wilfrey Table test. Five cuts were taken during the Wilfrey Table run and each of the cut was filtered, dried weighed and analysed by XRF.

C. RESULTS

(i) Head Assays

Table 2 below shows the XRF analysis of the head samples. The low Mn grade samples have a significantly high Fe content around the 30% mark which is in contrast to the high Mn grade samples HCM010 and HCM011 whose Fe content averages 17%.

The high grade Mn sample's silica and alumina levels, averaging 19.3% and 2.2% respectively, are significantly low for the Fe grades reported. HCM009 had only 12% Fe but a huge amount of silica at 51.0%.

The LOI values of all the samples were elevated due to the presence of goethite and kaolin as suggested by the q-XRD results shown in Table 3.

Table 2: Head assay results

SAMPLE ID	Fe	SiO_2	Al_2O_3	TiO_2	Mn	CaO	P	S	MgO	K_2O	LOI
	%	%	%	%	%	%	%	%	%	%	%
HCMO06	27.68	33.80	4.84	0.18	8.31	0.21	0.24	0.030	0.33	0.55	8.13
HCMO07	29.08	38.44	2.97	0.12	6.45	0.12	0.14	0.020	0.27	0.26	6.67
HCMO08	34.67	27.58	2.62	0.08	8.57	0.15	0.17	0.020	0.31	0.35	6.86
HCMO09	12.01	51.03	1.64	0.06	16.16	0.15	0.13	0.020	0.18	0.45	6.22
HCMO10	19.06	19.51	1.08	0.03	30.23	0.19	0.14	0.020	0.22	0.37	8.32
HCMO11	15.94	19.17	3.44	0.10	29.34	0.28	0.17	0.020	0.28	0.71	11.00

(ii) XRD Analysis Results

(a) Pyrolusite was identified as the manganese bearing mineral in all the six samples. Pyrolusite, which contains 63.2% Mn, has a specific gravity of 5.

(b) Goethite was also identified as the main Fe bearing mineral in the low grade Mn samples HCM006, 007 and 008. However, the samples with a slightly darker texture i.e HCM007, 008, and 010 showed a significant amount of hematite mixed with the goethite. Goethite and hematite have a specific gravity of 4.3 and 5.05 respectively.

(c) The silica in the sample is mainly in the form of quartz. Kaolin minerals account for some of the silica and all of the Al_2O_3 in the samples. Quartz and kaolin's specific gravity is around 2.60.

Table 3: Q-XRD results on head samples

Minerals	Composition	Low Grade (5 – 10%Mn)			Medium Grade	High Grade (>20% Mn)	
		HCM006	HCM007	HCM008	HCM009	HCM010	HCM011
Quartz	SiO_2	46	49	39	71	30	29
Hematite	Fe_2O_3	6	12	23	3	20	
Goethite	FeO(OH)	30	26	25	10	5	29
Pyrolusite	MnO_2	4	4	3	12	42	29
Unknown		*					
Kaolin	$Al_2Si_2O_5(OH)_4$	14	8	11	5	3	13

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In the world of gravity concentration, the concentration criterion (CC) is used to determine the suitability of gravity concentration processes to a given type of ore. In summary, the index takes into account the difference in the specific gravity of the minerals to be separated. Table 4 shows the CC values between the minerals reported in the Q- XRD report and Table 5 is a guide of how to interpret the CC values.

Table 4: 13HRC0026 minerals concentration criterion

	Pyrolusite	Hematite	Geothite	Quartz	Kaolin
Pyrolusite		1.01	1.21	2.42	2.50
Hematite	1.01		1.23	2.45	2.53
Geothite	1.21	1.23		2.00	2.06
Quartz	2.42	2.45	2.00		1.03
Kaolin	2.50	2.53	2.06	1.03	

The results in red indicate that it is impossible to separate the pyrolusite from the hematite and goethite using gravity concentration since the CC values between the three minerals are well below the CC threshold of 1.25. Provided there is ample pyrolusite liberation, the concept shows that it is theoretically feasible to separate pyrolusite from quartz and alumina even at particle sizes between 75 and 150 microns. Any associated hematite and goethite will follow pyrolusite to the concentrate.

Table 5: Concentration Criterion guide for gravity separation[1]

Concentration Criterion, CC	Suitability to Gravity separation
CC > 2.50	Easy down to 75µm
1.75 < CC < 2.50	Possible down to 150µm
1.50 < CC < 1.75	Possible down to 1.70mm
1.25 < CC < 1.50	Possible down to 6.35mm
CC < 1.25	Impossible at any size

(iii) Wilfrey Table Results

(a) Low grade manganese composite sample (HCM012)

Table 6 below shows the Wilfrey Table results from the low grade composite HCM0012 which was made up of HCM006, HCM007 and HCM008.

Table 6: Low grade sample Wilfrey Table results

Cut	% Mass Yield	Fe	SiO2	Al_2O_3	TiO_2	Mn	CaO	P	S	MgO	K_2O	LOI
1	4.5	45.84	10.85	1.24	0.10	10.81	0.16	0.17	<0.01	0.20	0.38	5.96
2	41.1	32.60	28.46	1.66	0.08	10.46	0.16	0.19	<0.01	0.22	0.44	7.08
3	33.8	24.93	47.15	3.20	0.11	4.86	0.16	0.16	<0.01	0.25	0.30	5.86
4	7.0	31.32	31.80	7.25	0.23	4.70	0.24	0.19	<0.01	0.43	0.36	7.82
5	13.6	32.44	27.15	8.61	0.25	5.03	0.26	0.20	<0.01	0.45	0.35	8.85
Calc Head	100.0	30.49	34.04	3.49	0.12	7.44	0.18	0.18	0.00	0.28	0.37	6.91

At 10.49%, the Mn values in concentrate were marginally higher than the head assay which was 7.44%. Al_2O_3 and SiO_2 rejection to tails is significant. P is in indifferent.

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Previous mineralogy work on Hercules[2] has shown that the P is associated with goethite.

The low Mn concentration in the concentrate was a result of dilution effect of goethite and hematite in the sample. Based on the Q-XRD analysis, goethite and haematite combined account for between 36 and 48% of the low grade samples mineral content. In this respect, the low grade Mn composite can be regarded as more of a ferromanganese ore instead of a ferruginous manganese ore.

(d) Medium Grade Manganese sample (HCM009)

The Wilfrey Table results from the medium grade Mn sample are shown in Table 7. The manganese content came up from 16.7% in the head sample to a weighted average of 25.9% at a mass yield of 36.5% in the first two cuts.

Table 7: Wilfrey Table results for medium grade Mn sample HCM009

Cut	% Mass	Fe	SiO2	Al_2O_3	TiO_2	Mn	CaO	P	S	MgO	K_2O	LOI
1	3.8	22.43	16.84	0.65	0.04	29.54	0.22	0.19	<0.01	0.18	0.63	7.50
2	32.7	14.44	34.42	0.78	0.04	25.45	0.21	0.18	0.01	0.19	0.63	6.90
3	15.3	15.94	42.27	5.19	0.17	14.66	0.20	0.17	<0.01	0.26	0.43	7.73
4	6.2	13.20	52.78	2.93	0.10	12.97	0.16	0.14	<0.01	0.18	0.37	6.03
5	42.0	8.90	67.63	0.93	0.04	10.05	0.11	0.10	<0.01	0.11	0.31	3.79
Calc Head	100.0	12.57	50.03	1.65	0.06	16.72	0.16	0.14	0.00	0.17	0.45	5.69

The results also show that;

- The Fe reported to the concentrate alongside the manganese.
- A fair amount of silica was rejected to tails with the weighted average silica concentration in the first two cuts being 32.3% down from 50.0% in the head samples.
- Al_2O_3 rejection was also significant with the concentration in the first two concentrate cuts being 0.77% from a feed grade of 1.65%.
- P upgraded slightly in concentrate which also points to it's association with the heavy minerals

(e) High Grade Manganese sample (HCM013)

The Wilfrey Table results from the high grade Mn samples are shown in Table 8. A 34.9% Mn concentrate at a mass yield of 44.4% was produced from head sample of 29.7%.

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Table 8: Wilfrey Table results for the high grade Mn sample (HCM0013)

Cut	% Mass	Fe	SiO2	Al_2O_3	TiO_2	Mn	CaO	P	S	MgO	K_2O	LOI
1	5.3	25.12	4.24	1.23	0.05	33.79	0.25	0.23	<0.01	0.20	0.55	8.84
2	39.1	17.83	9.37	1.74	0.06	35.90	0.29	0.27	<0.01	0.24	0.74	10.30
3	39.1	15.41	29.71	2.29	0.07	25.12	0.25	0.23	<0.01	0.24	0.59	8.65
4	4.1	16.97	24.75	5.08	0.11	24.28	0.26	0.23	<0.01	0.30	0.45	10.10
5	12.5	17.46	21.73	6.41	0.13	24.43	0.27	0.25	<0.01	0.32	0.47	10.90
Calc Head	100.0	17.19	19.22	2.65	0.07	29.67	0.27	0.25	0.00	0.25	0.63	9.64

Silica concentration in the 2 cuts in the Silica in the first 2 cuts was 8.76% from an initial concentration of 19.22%. Al_2O_3 concentration was halved in concentrate.

D. DISCUSSION

(i) Potential Concentrate Grade and Mass Recovery

(a) The testwork did show that there is potential to upgrade the pyrolusite concentration by gravity means. However, contained goethite and hematite will also upgrade to the concentrate since their specific gravities are very close to that of pyrolusite.

(b) Although Mn grades in concentrate of about 35% were achieved in the high grade sample, the potential Mn concentrate grade and mass yield cannot be estimated from this test given because;

- RC samples instead of diamond core sample were used. Gravity concentration is heavily influenced by particle size distribution and RC samples are not suitable for such work.
- The Wilfrey table test method was chosen for quick and economic indicative work. A more comprehensive procedure like heavy liquid separation could have been employed. However, given the quality of the sample and the turn-around time required, it was deemed not worthwhile spending that much money and time on such procedures.

(c) The amount of quartz and kaolin rejected was very promising. However, the samples were crushed down to 2mm to allow processing over the Wilfrey Table. Further work will be required on diamond core samples to determine the liberation characteristics of the ore.

(ii) Potential Processing Methods

Based on the XRD and XRF analysis of the samples HCM006 to HCM011 from RC hole 13HRC026, the manganese containing zones can be roughly classified into these classes based on the potential products and potential metallurgical processing routes;

(a) High Fe, Low Mn ore

The most appropriate term from this material would be manganiferrous iron ore and samples HCM006, 007 and 008 are typical examples. The Fe occurs as a mixture of goethite and hematite and the ratio of these two depends on the degree of oxidation. Depending on liberation characteristics and with a

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bit of grade controlling, there is potential to produce a high LOI Fe gravity concentrate in the low end of the 50s with some manganese.

(b) High Si, Low Fe
HCM009 has low Fe content at 12% and very high silica content at 50%. Given the difference between pyrolusite and quartz's specific gravities, there is potential to produce a product similar or better to the blast furnace lump/fines shown in Table 9 using heavy media separation. This is dependent on the liberation characteristics.

(c) High Mn, Low Fe
Similarly, the high grade ore can be subjected to heavy media separation to rid of the silica and the kaolin and potentially end up with a 35 to 40% manganese concentrate with an Fe content less than 25%. Further studies will be required to confirm this potential.

The pyrolusite and the iron minerals in the resulting concentrate can be separated in a number of ways to potentially upgrade the resulting concentrate's manganese grade.

(i) The hematite content in the concentrate can potentially be removed by High Intensity Magnetic Separation (HIMS).

(ii) A magnetising roast can convert goethite to magnetite which can be removed by magnetic separation methods.

(iii) Some hydrometallurgical processes have been proposed similar to the lateritic Ni process. These are highly capital intensive.

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Table 9: Typical Australian Mn Operation range of products

Manganese ore specification.							
WW48L – super high grade lump			**Typical**	**WW44F – high grade fines**			**Typical**
Mn	48%	Minimum	49%	Mn	44%	Minimum	45%
Fe	5%	Maximum	5%	Fe	9%	Maximum	8%
SiO_2	13%	Maximum	10%	SiO_2	13%	Maximum	10%
Al_2O_3	2%	Maximum	1%	Al_2O_3	2%	Maximum	1%
P	0.05%	Maximum	0.04%	P	0.07%	Maximum	0.05%
H_2O			3%	H_2O			6%
Size 6.3 mm - 75 mm 85% min			95%	Size 1.0 mm - 12.5 mm 85% min			95%
WW46L – high grade lump			**Typical**				
Mn	46%	Minimum	47%				
Fe	6%	Maximum	5%				
SiO_2	20%	Maximum	16%				
Al_2O_3	2%	Maximum	1%				
P	0.05%	Maximum	0.04%				
H_2O			3%				
Size 6.3 mm - 75 mm 85% min			95%				
WW40L – medium grade lump			**Typical**	**WW40F – medium grade fines**			**Typical**
Mn	40%	Minimum	41%	Mn	40%	Minimum	41%
Fe	15%	Maximum	14%	Fe	15%	Maximum	14%
SiO_2	13%	Maximum	10%	SiO_2	13%	Maximum	10%
Al_2O_3	2%	Maximum	1%	Al_2O_3	2%	Maximum	1%
P	0.07%	Maximum	0.05%	P	0.07%	Maximum	0.05%
H_2O			3%	H_2O			6%
Size 6.3 mm - 75 mm 85% min			95%	Size 1.0 mm - 12.5 mm 85% min			95%
WW32L – blast furnace lump			**Typical**	**WW32F – blast furnace fines**			**Typical**
Mn	32%	Minimum	34%	Mn	32%	Minimum	34%
Fe	25%	Minimum	20%	Fe	26%	Minimum	22%
SiO_2	13%	Maximum	10%	SiO_2	13%	Maximum	10%
Al_2O_3	2%	Maximum	1%	Al_2O_3	2%	Maximum	1%
P	0.07%	Maximum	0.09%	P	0.07%	Maximum	0.08%
H_2O			3%	H_2O			6%
Size 6.3 mm - 75 mm 85% min			95%	Size 1.0 mm - 12.5 mm 85% min			95%

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E. APPENDICES

1. LOW GRADE SAMPLE COMPOSITION

(a) HCM006

The following intervals were included in the composite HCM006. The chips had a clayey yellow colour to them and a dash of whitish carbonate or kaolin aspect them. Figure 1 is a picture of the intervals.

Table 10: 13HRC026 intervals into HCM006

DEPTH		SAMPLE	FE%	SiO2%	Al2O3	MgO	CaO	P	Mn	S	LOI
FROM	TO	ID		%	%	%	%	%	%	%	
42.0	43.0	ABF894	22.32	34.84	8.54	0.336	0.273	0.132	7.80	0.018	9.57
43.0	44.0	ABF895	29.86	37.45	3.49	0.201	0.159	0.168	5.61	0.015	7.02
78.0	79.0	ABF934	24.63	36.78	3.37	0.319	0.194	0.269	8.81	0.041	10.04
82.0	83.0	ABF938	26.95	34.10	4.71	0.241	0.156	0.214	7.74	0.027	9.91
83.0	84.0	ABF939	31.47	25.40	2.95	0.251	0.173	0.283	9.74	0.024	10.93
HCM006			**27.05**	**33.71**	**4.61**	**0.27**	**0.19**	**0.21**	**7.94**	**0.02**	**9.49**

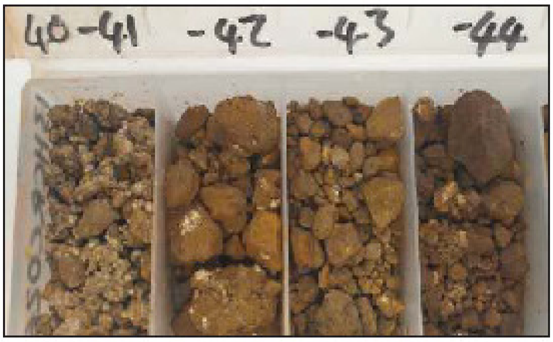

Figure 1: 13HRC026 intervals into HCM006

(b) HCM007

Table 11: 13HRC026 intervals into HCM007

DEPTH		SAMPLE	FE%	SiO2%	Al2O3	MgO	CaO	P	Mn	S	LOI
FROM	TO	ID		%	%	%	%	%	%	%	
47.0	48.0	ABF899	24.54	45.05	2.77	0.214	0.120	0.129	5.46	0.023	7.74
48.0	49.0	ABF900	24.87	44.86	2.95	0.235	0.129	0.132	5.32	0.026	7.49
50.0	51.0	ABF904	36.68	25.33	2.87	0.171	0.113	0.155	7.38	0.016	7.68
HCM007			**28.70**	**38.42**	**2.86**	**0.21**	**0.12**	**0.14**	**6.05**	**0.02**	**7.64**

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Figure 2: 13HRC0026 intervals into HCM007

(c) HCM008

Table 12: 13HRC026 intervals into HCM008

DEPTH		SAMPLE	FE%	SiO2%	Al2O3	MgO	CaO	P	Mn	S	LOI
FROM	TO	ID		%	%	%	%	%	%	%	
51.0	52.0	ABF905	39.52	25.86	1.88	0.133	0.091	0.191	5.15	0.014	6.96
52.0	53.0	ABF906	33.13	31.31	2.20	0.138	0.116	0.142	8.42	0.017	6.99
53.0	54.0	ABF907	38.07	28.15	2.01	0.174	0.108	0.112	5.85	0.020	6.25
54.0	55.0	ABF908	30.81	26.89	5.14	0.509	0.211	0.149	8.98	0.028	9.40
55.0	56.0	ABF909	29.59	23.72	2.38	0.441	0.250	0.192	14.31	0.034	11.79
HCM008			34.22	27.19	2.72	0.28	0.16	0.16	8.54	0.02	8.28

Figure 3: 13HRC026 intervals into HCM008

(d) HCM012

Composite of HCM006, HCM007 and HCM009

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2. MEDIUM GRADE SAMPLE COMPOSITION

(a) HCM009

Table 13: 13HRC026 intervals into HCM009

DEPTH FROM	DEPTH TO	SAMPLE ID	FE%	SiO2% %	Al2O3 %	MgO %	CaO %	P %	Mn %	S %	LOI
60.0	61.0	ABF914	26.26	24.27	0.89	0.166	0.173	0.182	19.85	0.019	9.45
61.0	62.0	ABF915	26.84	26.14	1.71	0.298	0.193	0.157	16.18	0.029	10.08
63.0	64.0	ABF917	14.13	46.00	3.63	0.218	0.199	0.165	13.46	0.033	9.45
65.0	66.0	ABF919	7.29	49.51	3.16	0.078	0.172	0.116	19.76	0.019	8.17
66.0	67.0	ABF920	3.45	70.19	0.84	0.010	0.130	0.076	12.62	0.018	4.53
67.0	68.0	ABF923	11.39	47.09	1.13	0.082	0.178	0.227	18.56	0.015	8.03
68.0	69.0	ABF924	10.29	54.37	0.64	0.084	0.169	0.180	15.31	0.015	6.81
69.0	70.0	ABF925	5.49	64.21	0.72	0.035	0.137	0.098	14.54	0.013	4.55
HCM009			**13.14**	**47.72**	**1.59**	**0.12**	**0.17**	**0.15**	**16.29**	**0.02**	**7.63**

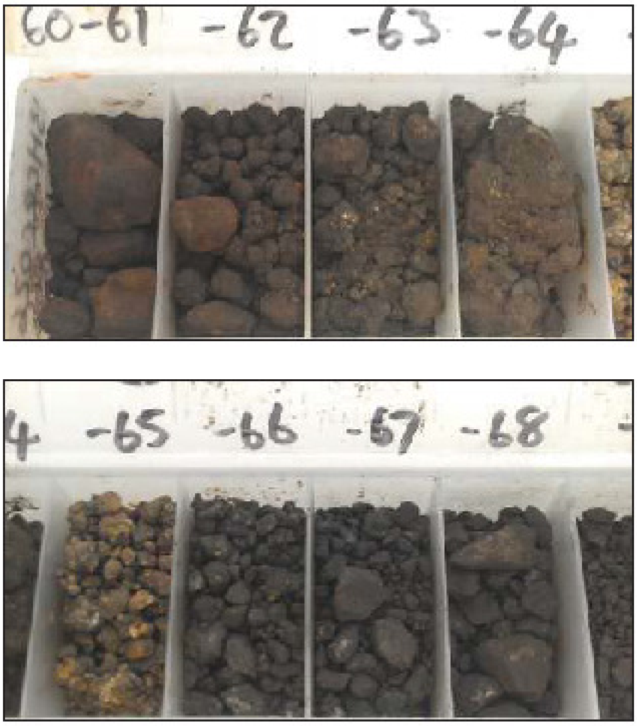

Figure 4: 13HRC026 intervals into HCM009

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3. HIGH GRADE SAMPLE COMPOSITION

(a) HCM010

Table 14: 13HRC026 intervals into HCM010

DEPTH		SAMPLE	FE%	SiO2%	Al2O3	MgO	CaO	P	Mn	S	LOI
FROM	TO	ID		%	%	%	%	%	%	%	
56.0	57.0	ABF910	18.52	23.54	1.05	0.172	0.225	0.163	27.16	0.020	10.51
57.0	58.0	ABF911	19.80	18.09	1.71	0.176	0.209	0.135	29.07	0.016	10.04
58.0	59.0	ABF912	20.40	19.81	0.92	0.112	0.163	0.139	28.36	0.013	9.10
59.0	60.0	ABF913	16.92	18.61	0.92	0.207	0.195	0.138	31.50	0.015	9.90
HCM010			18.91	20.01	1.15	0.17	0.20	0.14	29.02	0.02	9.89

Figure 5: 13HRC026 intervals into HCM010

(b) HCM011

Table 15: 13HRC026 intervals into HCM011

DEPTH		SAMPLE	FE%	SiO2%	Al2O3	MgO	CaO	P	Mn	S	LOI
FROM	TO	ID		%	%	%	%	%	%	%	
70.0	71.0	ABF926	7.11	37.52	1.89	0.117	0.212	0.199	26.18	0.016	8.73
71.0	72.0	ABF927	9.23	28.76	1.71	0.089	0.202	0.259	29.96	0.016	9.98
72.0	73.0	ABF928	17.40	17.27	5.44	0.200	0.278	0.361	26.25	0.018	13.15
73.0	74.0	ABF929	16.50	12.49	3.24	0.208	0.298	0.362	31.99	0.017	13.03
74.0	75.0	ABF930	27.43	8.62	4.00	0.256	0.290	0.490	22.06	0.017	13.74
75.0	76.0	ABF931	17.46	12.42	4.05	0.349	0.366	0.287	30.14	0.027	13.75
76.0	77.0	ABF932	15.48	8.87	2.99	0.379	0.406	0.282	35.95	0.026	14.36
HCM011			15.80	17.99	3.33	0.23	0.29	0.32	28.93	0.02	12.39

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Figure 6: 13HRC026 intervals into HCM011

(c) **HCM0013**

Composite of HCM010 and HCM011

F. REFERENCES

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2. *D J Roberts, R S Francis*, Woodie Woodie Operation Consolidated Minerals, Australian Mining and Metallurgical Operating Practices, 3rd Edition, page 1875

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