



A M D E L

Project No. 3217

**Northern Mining
Manganese Ore Beneficiation**

July 2011

AMDEL MINERAL LABORATORIES

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EXECUTIVE SUMMARY

Amdel Mineral Laboratories was requested by Dr. Michael Green from Remote Area Geoscience, acting on behalf of Mr. Alan Lockett from Northern Mining to conduct gravity separation testwork on a sample of Manganese Ore.

Crushing to -6.3mm was used to liberate the ore and wet tabling and jigging was then used to beneficiate the ore. Initially Heavy Liquid Separation (HLS) was conducted on the sample to determine its suitability to gravity separation.

HLS was conducted on the -6.3mm+1mm, -1mm+250µm and -250µm+63µm fractions at an SG of 3.32. The results showed an upgrade in Manganese, however, only 6 to 7% of the sample reported to sinks.

Wilfley tabling showed a similar response where a concentrate grade of 17.72% with a 8.49% mass recovery was achieved. The results for the Wilfley table testwork is summarised below.

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Concentrate	8.49%	17.72	16.54%	1.78	14.71%	59.23	6.41%	3.91	15.12%
Middlings	11.29%	11.62	14.42%	1.25	13.70%	72.86	10.48%	2.78	14.28%
Tailings	80.22%	7.83	69.04%	0.92	71.59%	81.27	83.11%	1.93	70.61%
Calculated Head	100.00%	9.10	100.00%	1.03	100.00%	78.45	100.00%	2.20	100.00%

Jigging was shown to be ineffective in upgrading the ore with a layer 1 concentrate of 22.36% Mn and a mass recovery of 20.95%. This was however a better result compared to wet tabling. The jig results are summarized below.

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Layer 1	20.95%	22.36	42.93%	2.11	34.35%	48.48	13.67%	4.78	41.67%
Layer 2	17.10%	13.73	21.53%	1.42	18.89%	68.43	15.75%	2.91	20.69%
Layer 3	16.10%	7.28	10.74%	0.96	12.00%	82.81	17.94%	1.62	10.85%
Layer 4	16.21%	6.89	10.23%	1.12	14.06%	82.64	18.03%	1.63	11.01%
Layer 5	15.68%	5.98	8.59%	0.90	10.97%	85.48	18.03%	1.40	9.15%
Layer 6	13.95%	4.67	5.97%	0.90	9.73%	88.44	16.59%	1.14	6.63%
Calculated Head	100.00%	10.91	100.00%	1.29	100.00%	74.33	100.00%	2.41	100.00%

While gravity separation was able to upgrade the ore, about 50% of the manganese reported to middlings and tails. The overall Jig and wet table separation has been summarized below.

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Concentrate	32.76%	15.41	48.75%	1.57	41.52%	64.41	27.95%	3.32	45.81%
Middlings	21.71%	7.48	15.67%	1.06	18.50%	81.80	23.52%	1.77	16.22%
Tailings	45.53%	8.09	35.58%	1.09	39.98%	80.48	48.53%	1.98	37.97%
Calculated Head	100.00%	10.35	100.00%	1.24	100.00%	75.50	100.00%	2.37	100.00%

The overall concentrate grade takes into account the wet table concentrate and layers 1, 2 and 3 of the Jigging.

It can be concluded that the jigging and wet table showed no significant upgrade in Manganese. Mineralogical examination would assist in helping to understand why the manganese failed to significantly upgrade.

1.0 INTRODUCTION

Amdel Mineral Laboratories was requested by Dr. Michael Green from Remote Area Geoscience on behalf of Mr. Alan Lockett from Northern Mining to conduct gravity separation testwork on Manganese Ore.

The aim of the testwork was to upgrade the Manganese ore via beneficiation.

The testwork was conducted in two stages:

- The first stage involved crushing and size by assay analysis of the ore, followed by HLS tests on selected size fractions and assays on sinks and floats;
- Stage two involved Wilfley table separation and jig testwork

The following sections describe the samples used for the testwork program, the procedures used to carry out the testwork and a discussion of the results obtained. Further details of the general testwork program are provided in the Flowsheet in Appendix 1.

2.0 SAMPLES

Table 2.1 summarises the samples submitted for testing. Further details are given in the sample Submission Sheet in Appendix 2.

The samples received were larger than expected and hence a two stage crushing process was employed to break down the samples to a workable size of -6.3mm.

TABLE 2.1 – SAMPLES

Sample ID	Weight (kg)
HEN 11 001	11.97
HEN 11 001	10.03
HEN 11 001	11.22
HEN 11 001	11.22
HEN 11 001	9.48
HEN 11 001	10.31

3.0 RESULTS AND DISCUSSIONS

3.1 HEAD GRADES

Table 3.1 summarises the assay head grade of the HEN 11001 sample. Full head assay is presented in Appendix 3.

TABLE 3.1 – ASSAYED HEAD GRADES

Composite	Assay (%)				
	Mn	Fe	SiO ₂	Al ₂ O ₃	LOI1000
HEN11001	9.76	1.08	75.37	2.6	3.04

3.2 FEED SIZE / ASSAY DISTRIBUTION

Size by assay analysis was conducted on HEN11001 with the results used to determine what fractions to send for HLS separation. The full size by assay analysis logsheet is attached in Appendix 3.

TABLE 3.2 – SIZE BY ASSAY ANALYSIS OF HEN11001

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
3.35	27.09%	9.97	28.73%	1.21	28.59%	75.29	26.61%	2.24	26.59%
-3.35+2.36	19.46%	9.45	19.57%	1.01	17.15%	77.13	19.59%	2.21	18.85%
-2.36+1.00	27.26%	9.66	28.02%	1.09	25.93%	76.23	27.12%	2.34	27.96%
-1.00+0.50	13.18%	8.94	12.54%	1.32	15.18%	77.25	13.29%	2.32	13.40%
-0.50+0.25	6.25%	8.36	5.56%	1.00	5.45%	78.64	6.41%	2.25	6.16%
-0.25+0.106	5.16%	7.88	4.32%	1.34	6.03%	78.86	5.31%	2.35	5.31%
-0.106+0.063	1.48%	7.41	1.17%	1.20	1.55%	79.78	1.54%	2.48	1.61%
-0.063	0.12%	7.41	0.09%	1.20	0.12%	79.78	0.12%	2.48	0.13%
Calculated Head	100.00%	9.40	100.00%	1.15	100.00%	76.63	100.00%	2.28	100.00%

3.3 HLS SEPARATION

Heavy Liquid Separation (HLS) was conducted on three size fractions. The 3 fractions were selected based on assay analysis and physical appearance of the fractions. HLS was conducted on the -6.3mm+1mm, -1mm+250µm and -250µm+63µm fractions. Due to the high SG of Manganese, HLS was initially done at a SG of 4.05. However, as there were no sinks at this SG, a lower SG of 3.32 was tested.

The floats and sinks from each size fraction were assayed. The results have been summarized in Table 3.3 with full results in Appendix 3.

TABLE 3.3 – ASSAY RESULTS ON HLS PRODUCTS

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+1mm float	59.79%	6.95	41.72%	1.40	58.67%	82.43	65.32%	1.57	39.16%
+1mm sink	14.02%	25.70	36.19%	2.17	21.33%	38.58	7.17%	6.12	35.80%
-1mm+250µm float	16.90%	6.04	10.25%	0.89	10.54%	85.17	19.08%	1.71	12.06%
-1mm+250µm sink	2.50%	26.70	6.71%	2.51	4.40%	36.37	1.21%	5.95	6.21%
-250+63µm float	6.15%	6.10	3.77%	0.86	3.71%	84.09	6.86%	2.03	5.21%
-250+63µm sink	0.42%	28.10	1.19%	3.23	0.95%	31.85	0.18%	5.61	0.98%
-63µm	0.21%	8.05	0.17%	2.62	0.38%	70.00	0.19%	6.58	0.57%
Calculated Head	100.00%	9.96	100.00%	1.43	100.00%	75.45	100.00%	2.40	100.00%

The results show that there was definitely an upgrading of Manganese; however the mass recovery was low. The highest Mn grade was achieved in the -0.250+0.063mm sinks fraction however only 6.4% of the sample reported to sinks.

3.4 WILFLEY TABLE SEPARATION

Crushed ore was wet screened at 2.00 mm and 106 µm. The -106 µm fraction was not processed (overall tails), the +2mm fraction was used for Jigging work and the -2.00 mm+106 µm fraction was used for Wilfley table separation where a concentrate, a middling and a tail product were taken. Each of the products was then screened at 1.00 mm and 250 µm with the results summarized in Table 3.5 below. Full results are presented in Appendix 3.

The size fractions for each product were assayed with the results summarized in Tables 3.4, 3.5 and 3.6. Full assay results are in Appendix 3. The overall wet table summary is tabulated in Table 3.7.

TABLE 3.4 – WET TABLE CONCENTRATE ASSAY RESULTS

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
-2mm+1mm	34.27%	23.50	45.46%	1.95	37.45%	46.56	26.94%	5.10	44.65%
-1mm+0.25mm	40.86%	15.80	36.44%	1.49	34.12%	64.25	44.32%	3.44	35.91%
-0.25mm	24.87%	12.90	18.11%	2.04	28.43%	68.46	28.74%	3.06	19.44%
Calculated Head	100.00%	17.72	100.00%	1.78	100.00%	59.23	100.00%	3.91	100.00%

TABLE 3.5 – WET TABLE MIDLINGS ASSAY RESULTS

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
-2mm+1mm	32.69%	15.40	43.34%	1.40	36.62%	64.70	29.03%	3.50	41.17%
-1mm+0.25mm	54.20%	10.20	47.58%	1.14	49.43%	76.10	56.61%	2.48	48.36%
-0.25mm	13.11%	8.05	9.08%	1.33	13.95%	79.84	14.36%	2.22	10.47%
Calculated Head	100.00%	11.62	100.00%	1.25	100.00%	72.86	100.00%	2.78	100.00%

TABLE 3.6 – WET TABLE TAIL ASSAY RESULTS

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
-2mm+1mm	53.46%	8.05	54.97%	0.89	51.77%	81.04	53.30%	1.91	52.78%
-1mm+0.25mm	41.27%	7.82	41.23%	0.94	42.21%	81.06	41.16%	1.98	42.24%
-0.25mm	5.27%	5.64	3.80%	1.05	6.02%	85.34	5.54%	1.83	4.99%
Calculated Head	100.00%	7.83	100.00%	0.92	100.00%	81.27	100.00%	1.93	100.00%

TABLE 3.7 – OVERALL WET TABLE SUMMARY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Concentrate	8.49%	17.72	16.54%	1.78	14.71%	59.23	6.41%	3.91	15.12%
Middlings	11.29%	11.62	14.42%	1.25	13.70%	72.86	10.48%	2.78	14.28%
Tailings	80.22%	7.83	69.04%	0.92	71.59%	81.27	83.11%	1.93	70.61%
Calculated Head	100.00%	9.10	100.00%	1.03	100.00%	78.45	100.00%	2.20	100.00%

8.5% of the sample reported to concentrate with a head grade of 17.72% Mn and a recovery of 16.54%. Significant amount of Mn is being lost to Tails due to high mass % reporting to tails. The loss to tails could be reduced by increasing the concentrate and middling cuts and re-passing them through a cleaner and possibly a re-cleaner stage.

3.5 JIG WORK

The -6.3mm+2mm fraction from wet screening was used for Jig testwork resulting in 6 products (layers). Each layer was then screened at 3.35mm with the results summarized in Table 3.8 to 3.13 below. Full assay results are in Appendix 3. The overall jiggling summary is tabulated in Table 3.14.

TABLE 3.8 – JIGGING LAYER 1 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	77.70%	21.60	75.06%	2.12	78.11%	50.09	80.29%	4.60	74.73%
-3.35mm+2mm	22.30%	25.00	24.94%	2.07	21.89%	42.85	19.71%	5.42	25.27%
Calculated Head	100.00%	22.36	100.00%	2.11	100.00%	48.48	100.00%	4.78	100.00%

TABLE 3.9 – JIGGING LAYER 2 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	64.13%	12.30	57.43%	1.41	63.64%	71.66	67.15%	2.55	56.22%
-3.35mm+2mm	35.87%	16.30	42.57%	1.44	36.36%	62.66	32.85%	3.55	43.78%
Calculated Head	100.00%	13.73	100.00%	1.42	100.00%	68.43	100.00%	2.91	100.00%

TABLE 3.10 – JIGGING LAYER 3 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	42.13%	5.89	34.09%	0.93	40.86%	85.80	43.65%	1.29	33.55%
-3.35mm+2mm	57.87%	8.29	65.91%	0.98	59.14%	80.63	56.35%	1.86	66.45%
Calculated Head	100.00%	7.28	100.00%	0.96	100.00%	82.81	100.00%	1.62	100.00%

TABLE 3.11 – JIGGING LAYER 4 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	37.69%	4.70	25.72%	1.29	43.59%	86.76	39.57%	1.21	27.92%
-3.35mm+2mm	62.31%	8.21	74.28%	1.01	56.41%	80.14	60.43%	1.89	72.08%
Calculated Head	100.00%	6.89	100.00%	1.12	100.00%	82.64	100.00%	1.63	100.00%

TABLE 3.12 – JIGGING LAYER 5 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	42.80%	4.00	28.63%	0.90	42.80%	89.84	44.98%	0.98	29.89%
-3.35mm+2mm	57.20%	7.46	71.37%	0.90	57.20%	82.21	55.02%	1.72	70.11%
Calculated Head	100.00%	5.98	100.00%	0.90	100.00%	85.48	100.00%	1.40	100.00%

TABLE 3.13 – JIGGING LAYER 6 ASSAY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
+3.35mm	36.98%	3.78	29.90%	0.86	35.42%	90.36	37.78%	0.98	31.68%
-3.35mm+2mm	63.02%	5.20	70.10%	0.92	64.58%	87.31	62.22%	1.24	68.32%
Calculated Head	100.00%	4.67	100.00%	0.90	100.00%	88.44	100.00%	1.14	100.00%

TABLE 3.14 – OVERALL JIGGING SUMMARY

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Layer 1	20.95%	22.36	42.93%	2.11	34.35%	48.48	13.67%	4.78	41.67%
Layer 2	17.10%	13.73	21.53%	1.42	18.89%	68.43	15.75%	2.91	20.69%
Layer 3	16.10%	7.28	10.74%	0.96	12.00%	82.81	17.94%	1.62	10.85%
Layer 4	16.21%	6.89	10.23%	1.12	14.06%	82.64	18.03%	1.63	11.01%
Layer 5	15.68%	5.98	8.59%	0.90	10.97%	85.48	18.03%	1.40	9.15%
Layer 6	13.95%	4.67	5.97%	0.90	9.73%	88.44	16.59%	1.14	6.63%
Calculated Head	100.00%	10.91	100.00%	1.29	100.00%	74.33	100.00%	2.41	100.00%

The jigging was more successful as it gave a layer one grade of 22.36% Mn with a recovery of 42.93%. However there was still significant loss of manganese in the other layers.

Table 3.15 below shows the overall summary of the Wet table and Jigging.

TABLE 3.15 – OVERALL SUMMARY (WET TABLE AND JIGGING)

Product	Mass	Mn		Fe		SiO ₂		Al ₂ O ₃	
	%	%	Dist.	%	Dist.	%	Dist.	%	Dist.
Concentrate	32.76%	15.41	48.75%	1.57	41.52%	64.41	27.95%	3.32	45.81%
Middlings	21.71%	7.48	15.67%	1.06	18.50%	81.80	23.52%	1.77	16.22%
Tailings	45.53%	8.09	35.58%	1.09	39.98%	80.48	48.53%	1.98	37.97%
Calculated Head	100.00%	10.35	100.00%	1.24	100.00%	75.50	100.00%	2.37	100.00%

The overall concentrate grade takes into account the wet table concentrate and layers 1, 2 and 3 of the Jigging.

The overall concentrate gave a grade of 15.41% Mn with a recovery of 48.75%. This gave an upgrade of approximately 6% from a head grade of 9.76%. The tailings have a grade of 8.09% with a manganese content of 35.58%. The high grade and portion is due to the fact that the results also comprise the -106um fraction that was not processed.

It can be concluded that the jigging and wet table showed no significant upgrade in Manganese. Mineralogical examination would assist in helping to understand why the manganese failed to significantly upgrade.



APPENDIX 1 – GENERAL TESTWORK PROGRAM

**AMDEL MINERAL LABORATORIES**

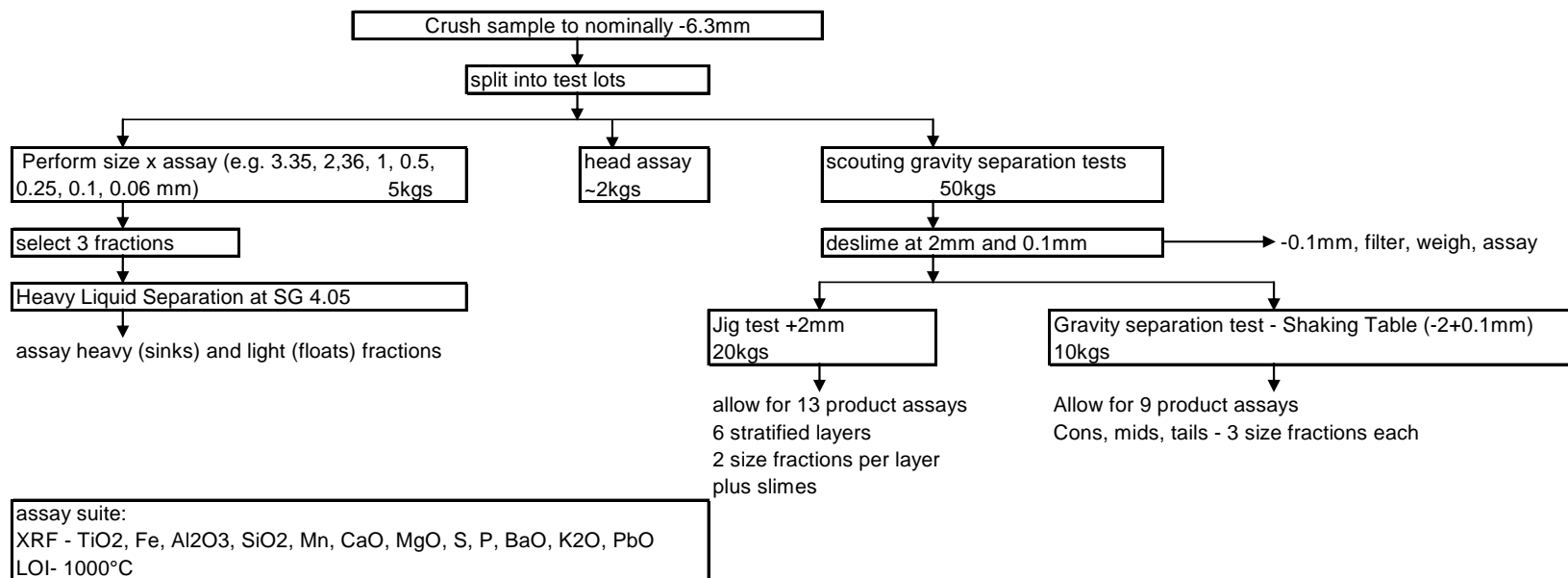
ABN: 30 008 127 802

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3.0 FLOWSHEET

Date: 9-Feb-11
Client: Remote Area Geoscience. Dr Michael Green
Project: Manganese Ore Beneficiation
Proposal No: AU.0946393
Amdel Contact: craig.kenna@au.bureauveritas.com





APPENDIX 2 – SAMPLE RECEIPT FORM



Sample Receipt

Job No.	3217	Metallurgist:	Rimal Shah
Client:	Northern Mining		
Testwork:	HLS and Gravity separation		
Sample Description (tick as required)	PQ (83 mm)		Full Core
	HQ (63 mm)		1/2 Core
	NQ (45 mm)		1/4 Core
	RC Chip		Rock Sample X
	Slurry		Pulp
	Solution		Site Water
Quarantine Sample:	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Paperwork Received: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Forwarding Agent:			

MAWB NUMBER: _____

HAWB NUMBER: _____

SAMPLE LABEL	WEIGHT
HEN 11 001	11.97 Kg
HEN 11 001	10.03 Kg
HEN 11 001	11.22 Kg
HEN 11 001	11.22 Kg
HEN 11 001	9.48 Kg
HEN 11 001	10.31 Kg

Saved to Job File	Sample Sub x 2	Sample Register
Sample Disposal Advice	AQIS Paperwork	

Submitted by : _____

Date : _____



APPENDIX 3 – FEED SIZE / ASSAY DISTRIBUTION LOG SHEETS

**AMDEL MINERAL LABORATORIES**

ABN: 30 008 127 802

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Size x Assay Results

Sample ID	Fe	SiO ₂	Al ₂ O ₃	TiO ₂	CaO	Mn	P XRF	S XRF	MgO	K ₂ O	BaO	PbO	LOI1000
HEN11001 Head Sample	1.08	75.37	2.60	0.18	0.07	9.76	0.019	0.021	0.07	0.832	1.43	0.003	3.04
HEN11001 +3.35	1.21	75.29	2.24	0.16	0.08	9.97	0.019	0.017	0.07	0.795	1.52	0.007	3.04
HEN11001 -3.35+2.36	1.01	77.13	2.21	0.17	0.08	9.45	0.017	0.018	0.07	0.783	1.38	0.006	2.85
HEN11001 -2.36+1	1.09	76.23	2.34	0.18	0.06	9.66	0.017	0.015	0.07	0.807	1.44	0.006	2.98
HEN11001 -1+0.5	1.32	77.25	2.32	0.16	0.06	8.94	0.018	0.015	0.07	0.739	1.31	0.006	2.79
HEN11001 -0.5+0.25	1.00	78.64	2.25	0.15	0.05	8.36	0.019	0.014	0.06	0.682	1.19	0.005	2.66
HEN11001 -0.25+0.106	1.34	78.86	2.35	0.14	0.06	7.88	0.021	0.016	0.06	0.672	1.10	0.004	2.69
HEN11001 -0.106+0.063	1.20	79.78	2.48	0.17	0.07	7.41	0.023	0.026	0.07	0.750	1.07	0.004	2.65
HEN11001 -0.063	2.62	70.00	6.58	0.37	0.12	8.05	0.052	0.041	0.25	1.093	0.97	0.004	4.67

**AMDEL MINERAL LABORATORIES**

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Client:	Northern Mining
Project:	Manganese Ore Grab Sample
Technician:	
Job No:	21/10/1908
Date:	4/04/2011

Assay Results for Sinks and Floats at SG separation of 3.32

Sample ID	Wt %	Fe	P XRF	SiO ₂	Al ₂ O ₃	MgO	CaO	Mn	S XRF	TiO ₂	K ₂ O	PbO	BaO	LOI1000
+1mm Float	81.00	1.40	0.016	82.43	1.57	0.06	0.08	6.95	0.018	0.11	0.516	0.008	1.100	2.12
+1mm Sink	19.00	2.17	0.028	38.58	6.12	0.17	0.06	25.70	0.010	0.61	2.342	0.012	3.790	6.84
-1 + 0.25mm Float	87.10	0.89	0.015	85.17	1.71	0.07	0.06	6.04	0.010	0.11	0.486	0.011	0.855	1.88
-1 + 0.25mm Sink	12.90	2.51	0.035	36.37	5.95	0.16	0.06	26.70	0.011	0.57	2.272	0.022	4.110	7.34
-0.25 + 0.063mm Float	93.60	0.86	0.017	84.09	2.03	0.08	0.06	6.10	0.009	0.14	0.567	0.017	0.793	2.20
-0.25 + 0.063mm Sink	6.40	3.23	0.049	31.85	5.61	0.12	0.07	28.10	0.026	0.46	2.065	0.031	4.620	7.63

**AMDEL MINERAL LABORATORIES**

ABN: 30 008 127 802

6 Gauge Circuit, Canningvale, Western Australia, 6155

Phone +61 8 6218 5700 Fa x +61 8 6218 5702

Client:	Northern Mining
Project:	3217
Technician:	JT
Date:	17/06/2011

Wet Tabling

	Sample ID	Weight (kg)	Weight %	Fe	SiO ₂	Al ₂ O ₃	TiO ₂	CaO	Mn	P XRF	S XRF	MgO	K ₂ O	BaO	PbO	LOI1000
Cons	-2mm+1mm	555.1	34.27	1.95	46.56	5.1	0.49	0.07	23.5	0.03	0.013	0.14	2.002	3.46	0.01	6.43
	-1mm+0.25mm	661.8	40.86	1.49	64.25	3.44	0.27	0.06	15.8	0.027	0.012	0.08	1.233	2.35	0.01	4.4
	-0.25mm	402.8	24.87	2.04	68.46	3.06	0.23	0.06	12.9	0.031	0.024	0.06	1.005	1.96	0.004	3.96
	Calc Head	1619.7	100.00	1.78	59.23	3.91	0.34	0.06	17.72	0.03	0.02	0.10	1.44	2.63	0.01	4.99
Mids	-2mm+1mm	704.2	32.69	1.4	64.7	3.5	0.3	0.12	15.4	0.024	0.013	0.13	1.289	2.28	0.008	4.38
	-1mm+0.25mm	1167.4	54.20	1.14	76.1	2.48	0.18	0.06	10.2	0.02	0.011	0.06	0.827	1.48	0.006	3.02
	-0.25mm	282.3	13.11	1.33	79.84	2.22	0.15	0.08	8.05	0.021	0.013	0.07	0.678	1.11	0.005	2.54
	Calc Head	2153.9	100.00	1.25	72.86	2.78	0.22	0.08	11.62	0.02	0.01	0.08	0.96	1.69	0.01	3.40
Tails	-2mm+1mm	8181.9	53.46	0.89	81.04	1.91	0.13	0.06	8.05	0.016	0.011	0.05	0.64	1.2	0.005	2.33
	-1mm+0.25mm	6316.4	41.27	0.94	81.06	1.98	0.13	0.06	7.82	0.017	0.01	0.05	0.63	1.11	0.005	2.37
	-0.25mm	806.8	5.27	1.05	85.34	1.83	0.11	0.06	5.64	0.018	0.012	0.05	0.497	0.73	0.003	1.92
	Calc Head	15305.1	100.00	0.92	81.27	1.93	0.13	0.06	7.83	0.02	0.01	0.05	0.63	1.14	0.00	2.32

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Jigging

Sample ID	Weight (kg)	Weight %	Fe	SiO ₂	Al ₂ O ₃	TiO ₂	CaO	Mn	P XRF	S XRF	MgO	K ₂ O	BaO	PbO	LOI1000	
Layer 1	+3.35mm	1260.75	77.70	2.12	50.09	4.6	0.44	0.07	21.6	0.028	0.02	0.12	1.864	3.15	0.005	5.87
	-3.35mm+2mm	361.89	22.30	2.07	42.85	5.42	0.55	0.06	25	0.028	0.014	0.15	2.206	3.63	0.008	6.74
	Calc Head	1622.64	100.00	2.11	48.48	4.78	0.46	0.07	22.36	0.03	0.02	0.13	1.94	3.26	0.01	6.06
Layer 2	+3.35mm	849.28	64.13	1.41	71.66	2.55	0.21	0.08	12.3	0.023	0.019	0.08	0.999	1.83	0.006	3.5
	-3.35mm+2mm	475.1	35.87	1.44	62.66	3.55	0.31	0.06	16.3	0.023	0.015	0.09	1.332	2.39	0.005	4.49
	Calc Head	1324.38	100.00	1.42	68.43	2.91	0.25	0.07	13.73	0.02	0.02	0.08	1.12	2.03	0.01	3.86
Layer 3	+3.35mm	525.39	42.13	0.93	85.8	1.29	0.06	0.08	5.89	0.013	0.019	0.04	0.421	0.88	0.004	1.88
	-3.35mm+2mm	721.7	57.87	0.98	80.63	1.86	0.13	0.07	8.29	0.017	0.016	0.06	0.646	1.25	0.008	2.48
	Calc Head	1247.09	100.00	0.96	82.81	1.62	0.10	0.07	7.28	0.02	0.02	0.05	0.55	1.09	0.01	2.23
Layer 4	+3.35mm	473.24	37.69	1.29	86.76	1.21	0.05	0.16	4.7	0.013	0.026	0.22	0.338	0.7	0.005	2.06
	-3.35mm+2mm	782.36	62.31	1.01	80.14	1.89	0.13	0.07	8.21	0.017	0.015	0.06	0.638	1.26	0.005	2.55
	Calc Head	1255.6	100.00	1.12	82.64	1.63	0.10	0.10	6.89	0.02	0.02	0.12	0.52	1.05	0.01	2.37
Layer 5	+3.35mm	519.5	42.80	0.9	89.84	0.98	0.04	0.1	4	0.01	0.017	0.05	0.28	0.59	0.003	1.42
	-3.35mm+2mm	694.37	57.20	0.9	82.21	1.72	0.11	0.07	7.46	0.014	0.015	0.06	0.58	1.1	0.004	2.28
	Calc Head	1213.87	100.00	0.90	85.48	1.40	0.08	0.08	5.98	0.01	0.02	0.06	0.45	0.88	0.00	1.91
Layer 6	+3.35mm	399.33	36.98	0.86	90.36	0.98	0.03	0.1	3.78	0.01	0.018	0.05	0.256	0.56	0.003	1.29
	-3.35mm+2mm	680.66	63.02	0.92	87.31	1.24	0.06	0.07	5.2	0.014	0.013	0.04	0.375	0.79	0.004	1.67
	Calc Head	1079.99	100.00	0.90	88.44	1.14	0.05	0.08	4.67	0.01	0.01	0.04	0.33	0.70	0.00	1.53



APPENDIX 4 – SAMPLE STORAGE POLICY

AMDEL MINERAL LABORATORIES **SAMPLE STORAGE POLICY**

1.0 FREE STORAGE PERIOD

Unused samples, residues and solutions will be stored free of charge for a period of 1 month after the date of issue of the Testwork Report. At the end of this period the samples will, at the option of the client, either be discarded or stored for a further period subject to the payment of a storage fee.

2.0 NOTIFICATION

The onus is placed on the client to notify in writing (by completing the "Sample Disposal Advice", PMPF007 Sample Disposal Advice – attached) its storage requirements as soon as possible after the receipt of the report to ensure storage instructions are implemented prior to the expiry of the free storage period.

If no instructions are received by the end of the free storage period, storage fees will accumulate and be charged automatically on the assumption that continued storage is required.

3.0 STORAGE FEES

3.1 General Storage

A storage fee of \$20.00 per month per 0.1m³ of sample volume or part thereof, will be charged and invoiced monthly. The minimum storage fee will be \$20.00 per month.

3.2 Cold Storage

Limited sample storage is available for low temperature storage to prevent oxidation of reactive samples.

A storage fee of \$50.00 per month per 0.1m³ of sample volume or part thereof, will be charged and invoiced monthly. The minimum storage fee will be \$50.00 per month.

3.3 Quarantine Storage

Amdel Mineral Laboratories facilities are Quarantine Registered and we can provide a limited amount of quarantine sample storage.

A storage fee of \$50.00 per month per 0.1m³ of sample volume or part thereof, will be charged and invoiced monthly. The minimum storage fee will be \$50.00 per month. Any freight and / or quarantine fees associated with the disposal of these samples will be charged on an 'at cost' basis.



4.0 DISPOSAL

Samples will be disposed of at the end of the nominated (by the client) paid storage period by Amdel at a cost of \$20 per 0.1m³ for general samples and \$50 per 0.1m³ for quarantine samples.

A minimum disposal cost of \$20 per sample applies.

If samples are to be transferred to an alternate storage facility, Amdel will arrange this and charge the client at cost.

Julian Johnson
Technical Manager
Mineral Processing WA



APPENDIX 5 – INDEMNITY STATEMENT

INDEMNITY STATEMENT

This report has been prepared for **Northern Mining** by Amdel Mineral Laboratories. Other parties, at the discretion of **Northern Mining** may be given access to the report or receive copies of the report, but only in full including this page, the title page and appendices.

While Amdel Mineral Laboratories has taken all reasonable care to ensure that the facts and opinions expressed in this report are accurate it does not accept any legal responsibility for any loss or damage suffered resulting from use of this report howsoever caused and whether by breach of contract, negligence or otherwise.

The results presented in this report pertain only to the sample received for testing.