LAMPIRAN

LAMPIRAN A

JUMLAH JAM KERJA

PT Gag Nikel menerapkan waktu kerja dengan 2 shift kerja tiap harinya. Dilaksanakan pada hari senin sampai minggu. Tiap shift bekerja dalam waktu 11 jam, dengan waktu istirahat 1 jam, yaitu dari jam 12.00-13.00 untuk shift siang dan jam 00.00-01.00 untuk shift malam dan di hari minggu *Longshift* kerja. Jadi rata-rata jam kerja perhari adalah 22 jam. Dan pergantian shift dilakukan 1 minggu 1 kali.

Tabel B1

Jumlah Jam Kerja

Shift I		
Jadwal Kerja	Keterangan	Waktu (jam)
07.00 – 12.00	Waktu kerja	5 jam
12.00 – 13.00	Istirahat	1 jam
13.00 – 18.00	Waktu kerja	5 jam
Total		11 jam
Shift II		
Jadwal Kerja	Keterangan	Waktu (jam)
19.00 – 00.00	Waktu kerja	5 jam
00.00 – 01.00	Istirahat	1 jam
01.00 – 06.00	Waktu kerja	5 jam
Total		11 jam
Total jam kerja *Shift I* dan *Shift* II		22 jam

LAMPIRAN B

SPESIFIKASI ALAT GALI-MUAT

Spesifikasi *Excavator Volvo* EC350

Gambar C.1.

Excavator Volvo EC350

Berat operasi	: 36.950 kg
Jenis mesin	:Volvo D8, tingkat-2
Daya kotor	:286 hp
Torsi maksimum	: 1.340 Nm
Kecepatan mesin	: 1.350 rpm
Pemindahan	: 7,8 liter
Panjang keseluruhan	: 15.530 mm
Lebar keseluruhan	: 3.190 mm
Tinggi keseluruhan	: 3.490
Bucket size	: 2,53 m^3
Kecepatan Swing	: 10,3 rpm
Kecepatan jalan (low/high)	: 3,3/5,1 km/jam
Tinggi penumpahan material	: 6.820 mm
Jangkauan maksimum penggalian	: 10.210 mm
Kedalaman penggalian maksimal	: 6.740 mm

LAMPIRAN C

SPESIFIKASI ALAT ANGKUT

Spesifikasi *Long Dump Truck* FMX 400

Gambar D.1.

Alat Muat LDT FMX 400

Tenaga maksimum	: 410 Hp@ 1.400-1.800 rpm
Torsi maksimum	: 2000 Nm @ 1.050-1.400 rpm
Kapasitas silinder	: 12.823 cc
Panjang	: 8.097 mm
Lebar	: 2.550 mm
Tinggi	: 3.884 mm
Jarak sumbu roda	: 4.300 mm
Jarak terendah ketanah	: 395 mm
Radius putar	: 8,6 meter
Kapasitas tangki	: 200 liter

Spesifikasi *Articulated Dump Truck* A40G

Gambar D.2

Alat Muat ADT A40G

Berat	: 30,7
Ban standart	: 29,5 R 25
Kapasitas Pembuangan	: 24 m
Kecepatan perjalanan	: 57 km/jam
Beban bersih	: 39 ton
Panjang alat	: 9.559 m
Lebar alat	: 3.433 m
Tinggi alat	: 3.597 m
Memuat tinggi	: 3.154 m
Tenaga mesin	: 350 kW
Pemindahan	: 12,8 liter
Revolusi pada torsi maksimum	: 1.900 rpm
Maks. Torsi	: 2.500 Nm

LAMPIRAN D

PERHITUNGAN FAKTOR PENGEMBANGAN

(*SWELL FACTOR*)

$$SF = \frac{Dloose}{Dinsitu} \times 100\%$$

Keterangan :

SF = *Swell factor* (%)

D*loose* = Densitas dalam keadaan lepas (ton/m^3).

D*insitu* = Densitas dalam keadaan asli (ton/m^3).

Dloose = 1,62 Ton/m^3

Dinsitu = 1,67 Ton/m^3

SF $= \frac{Dloose}{Dinsitu} \times 100\% = \frac{1,62}{1,67} \times 100\% = 97\%$

LAMPIRAN E

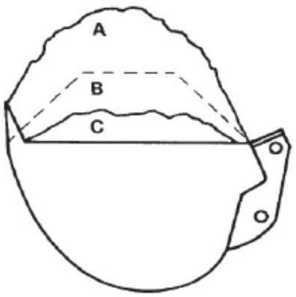
FAKTOR PENGISIAN *BUCKET*

Tabel E1

Perhitungan *Bucket Fill Factor Excavator Volvo EC350*

BUCKET	BERAT (TON)	VOL (M^3)	BD (Ton/M^3)	KB (M^3)	BFF (%)
1	3,61	2,50	1,44	2,53	99%
2	3,26	2,18	1,50	2,53	86%
3	4,.09	2,51	1,63	2,53	99%
4	4,01	2,67	1,50	2,53	105%
5	3,93	2,50	1,57	2,53	99%
6	2,89	2,00	1,45	2,53	79%
7	4,04	2,50	1,62	2,53	99%
8	2,96	2,00	1,48	2,53	79%
9	3,51	2,25	1,56	2,53	89%
10	3,45	2,30	1,50	2,53	91%
11	2,94	2,00	1,47	2,53	79%
12	3,47	2,32	1,50	2,53	92%
13	3,04	2,00	1,52	2,53	79%
14	3,26	2,13	1,53	2,53	84%
15	3,74	2,00	1,87	2,53	79%
16	3,66	2,25	1,63	2,53	89%
17	4,94	2,25	2,20	2,53	89%
18	4,35	2,75	1,58	2,53	109%
19	3,96	2,33	1,70	2,53	92%
20	4,10	2,66	1,54	2,53	105%
21	4,11	2,50	1,65	2,53	99%
22	4,04	2,75	1,47	2,53	109%
23	3,97	2,71	1,47	2,53	107%
24	5,19	3,50	1,48	2,53	138%
25	4,94	3,38	1,46	2,53	133%
26	4,47	3,13	1,43	2,53	124%
27	3,60	2,50	1,44	2,53	99%
28	4,81	3,25	1,48	2,53	128%
29	4,94	3,38	1,46	2,53	133%
30	3,99	2,50	1,60	2,53	99%
31	4,96	3,38	1,47	2,53	133%
32	4,96	3,50	1,42	2,53	138%
RATA-RATA	**4,00**	**2,61**	**1,54**	2,53	**103%**

Material	Fill Factor Range (Percent of heaped bucket capacity)
Moist Loam or Sandy Clay	A — 100-110%
Sand and Gravel	B — 95-110%
Hard, Tough Clay	C — 80-90%
Rock — Well Blasted	60-75%
Rock — Poorly Blasted	40-50%



Gambar F.1

Persentase Kapasitas Bucket

Gambar F2

Gambar Aktual Kapasitas Bucket

Pada Tabel dapat dilihat hasil pengukuran di lapangan terhadap volume nyata. Dari pengukuran tersebut didapatkan nilai faktor pengisian *bucket* untuk Volvo EC350 sebesar 103 %

LAMPIRAN F

PENGAMATAN DATA *CYCLETIME EXCAVATOR*

- *Cycletime* EXA 306

Tabel G1

Cycletime EXA306

no LDT	CT rata-rata(detik)	jumlah bucket	CT total (detik)
69	15,34	5	76,71
66	16,11	6	96,65
67	13,23	6	79,35
68	13,31	6	79,87
71	14,23	6	85,4
67	15,07	6	90,4
65	12,91	6	77,47
68	12,84	6	77,04
69	13,11	6	78,68
66	13,64	6	81,81
69	17,51	6	105,05
66	19,41	6	116,46
65	19,94	6	119,64
68	20,45	6	122,72
69	20,46	6	122,78
71	21,43	6	128,57
66	19,43	6	116,55
65	20,07	6	120,43
67	21,21	6	127,24
68	21,47	6	128,84
69	20,10	6	120,58
71	19,62	6	117,72
66	20,30	6	121,8

67	20,12	6	120,69
68	20,76	6	124,55
69	19,16	6	114,95
71	20,36	6	122,17
66	18,96	6	113,74
67	20,12	6	120,74
68	18,54	6	111,22
69	17,45	6	104,68
71	19,44	6	116,61
66	20,66	6	123,97
70	20,18	6	121,06
67	21,49	6	128,93
69	20,41	6	122,45
71	21,60	6	129,58
rata-rata	18,39	6	109,92

- *Cycletime* EXA 304

Tabel G2

Cycletime EXA304

no ADT	CT rata-rata (detik)	jumlah bucket	CT total (detik)
71	20,73	8	165,80
72	18,01	8	144,06
70	21,96	8	175,70
71	23,32	9	209,91
72	17,08	7	119,54
70	16,91	8	135,28
71	19,31	9	173,82
72	18,53	8	148,27
70	21,06	8	168,47
71	18,95	9	170,58

72	21,00	8	168,02
70	22,38	9	201,46
71	20,97	8	167,74
72	22,21	9	199,87
70	19,30	9	173,66
71	17,80	7	124,60
72	17,63	10	176,30
70	19,68	8	157,43
71	18,91	10	189,14
72	17,64	8	141,10
70	18,30	8	146,37
71	18,61	7	130,25
72	18,33	8	146,61
70	18,04	8	144,34
71	18,84	9	169,53
72	19,46	9	175,12
70	23,30	8	186,36
71	17,97	9	161,74
72	20,52	9	184,66
70	18,11	8	144,85
71	20,82	8	166,53
Rata-rata	19,54	8	163,46

LAMPIRAN G

PENGAMATAN DATA *CYCLETIME* ALAT ANGKUT (*ORE*)

1. ADT

Tabel H1

Cycletime ADT

Alat Angkut ADT	Kedatangan		Keberangkatan		TOTAL CT
	Jam	Menit	Jam	Menit	
71	13	16	13	20	14
72	13	20	13	23	14
70	13	24	13	26	14
71	13	30	13	33	14
72	13	34	13	37	15
70	13	38	13	40	14
71	13	44	13	47	13
72	13	49	13	51	14
70	13	52	13	55	18
71	13	57	13	59	21
72	14	3	14	6	18
70	14	10	14	13	15
71	14	18	14	20	12
72	14	21	14	24	13
70	14	25	14	28	14
71	14	30	14	33	12
72	14	34	14	37	13
70	14	39	14	42	16
71	14	42	14	45	16
72	14	47	14	50	17
70	14	55	14	58	14
71	14	58	15	1	14
72	15	4	15	7	15
70	15	9	15	11	19
71	15	12	15	15	20
72	15	19	15	21	15
70	15	28	15	30	15
71	15	32	15	35	16
RATA-RATA					15,17

2. LDT

Tabel H2

cycletime LDT

alat angkut	kedatangan		keberangkatan		Total CT
	jam	menit	jam	menit	
65	10	29	10	30	20
68	10	30	10	32	23
69	10	33	10	34	26
66	10	38	10	40	24
71	10	44	10	46	22
67	10	47	10	48	21
65	10	49	10	51	22
68	10	53	10	54	22
69	10	59	11	0	23
66	11	2	11	4	24
67	11	8	11	9	21
69	13	32	13	33	23
71	13	35	13	37	25
66	13	39	13	41	25
65	13	42	13	44	25
67	13	45	13	47	25
68	13	48	13	50	26
69	13	55	13	57	28
71	14	0	14	3	26
66	14	4	14	6	26
67	14	10	14	12	23
68	14	14	14	16	23
69	14	23	14	25	28
71	14	26	14	28	28
66	14	30	14	32	26

67	14	33	14	35	31
68	14	37	14	39	31
69	14	51	14	53	29
71	14	54	14	56	28
66	14	56	15	0	30
67	15	5	15	7	27
68	15	8	15	10	27
69	15	20	15	22	26
71	15	22	15	24	29
66	15	26	15	28	23
70	15	29	15	31	28
68	15	35	15	37	25
69	15	46	15	48	22
66	15	49	15	50	33
71	15	51	15	53	27
70	15	57	15	59	33
68	16	0	16	2	27
69	16	10	16	12	26
71	16	18	16	20	25
66	16	22	16	24	25
68	16	27	16	29	23
70	16	30	16	32	22
69	16	36	16	38	23
71	16	43	16	45	25
66	16	47	16	49	27
68	16	50	16	52	21
70	16	52	16	54	25
69	16	59	17	1	23
RATA-RATA					25,39

LAMPIRAN H

PENGAMATAN DATA *CYCLETIME* ALAT ANGKUT

(*WASTE*)

1) LDT

Tabel I1

Cycletime LDT Waste

no	alat angkut	kedatangan		keberangkatan		CYCLE TIME (menit)
		jam	menit	jam	menit	
1	68	9	4	9	6	14
2	68	9	18	9	20	20
3	71	9	27	9	29	21
4	68	9	38	9	40	14
5	71	9	48	9	51	18
6	71	10	6	10	8	20
7	71	10	26	10	29	16
8	71	10	42	10	44	18
9	68	10	52	10	55	13
10	71	11	0	11	2	17
11	66	9	6	9	9	17
12	71	9	10	9	13	17
13	68	9	13	9	15	16
14	66	9	23	9	26	22
15	71	9	27	9	28	15
16	68	9	29	9	31	11
17	71	9	42	9	44	18
18	66	9	45	9	47	18
19	68	9	40	9	50	26
20	69	9	5	9	7	28
21	66	9	12	9	14	24
22	71	9	15	9	17	26

23	70	9	18	9	20	26
24	65	9	22	9	24	34
25	69	9	33	9	35	19
26	66	9	36	9	38	25
27	71	9	41	9	43	20
28	66	10	1	10	3	16
29	67	8	53	8	56	17
30	65	9	1	9	4	19
31	67	9	10	9	13	18
32	65	9	20	9	22	23
33	67	9	28	9	30	20
34	65	9	43	9	45	26
35	68	9	52	9	54	21
RATA-RATA						19,8

2) ADT

Tabel I2

cycletime ADT Waste

NO	alat angkut	kedatangan		keberangkatan		CYCLETIME (MENIT)
		jam	menit	jam	menit	
1	71	7	26	7	29	7
2	71	7	33	7	34	6
3	71	7	39	7	43	8
4	71	7	47	7	50	10
5	70	7	53	7	56	8
6	71	7	57	8	0	6
7	70	8	1	8	3	6
8	71	8	3	8	6	8
9	70	8	7	8	10	8
10	71	8	11	8	14	7

11	70	8	15	8	18	7
12	71	8	18	8	22	12
13	70	8	22	8	25	11
14	71	8	30	8	32	6
15	70	8	33	8	35	8
16	71	8	36	8	40	9
17	70	8	41	8	44	9
18	71	8	45	8	49	10
19	70	8	50	8	53	14
20	71	8	55	9	0	13
21	70	9	4	9	7	9
22	71	9	8	9	12	8
23	70	9	13	9	15	8
24	71	9	16	9	20	9
25	70	9	21	9	24	9
26	71	9	25	9	28	8
27	70	9	30	9	32	7
28	71	9	33	9	36	7
29	70	9	37	9	40	8
30	71	9	40	9	43	8
31	70	9	45	9	47	8
32	71	9	48	9	52	9
33	70	9	53	9	56	9
34	71	9	57	10	1	9
RATA-RATA						8,5

LAMPIRAN I

PERHITUNGAN AKTUAL WAKTU EFEKTIF ALAT GALI MUAT DAN ANGKUT

Tabel J1

Waktu Hambatan Kerja

Hambatan	*Loose time* (menit)	
	Alat gali-muat	Alat angkut
a. Hambatan Yang Bisa Dihindari		
Safety Talk	16	16
Mobilisasi Pekerja	30	30
Pemeriksaan Alat	23	25
Menuju Lokasi Kerja	19	19
Istirahat Terlalu Awal	11	11
Terlambat Setelah Istirahat	20	20
Berhenti Kerja Sebelum Pulang	31	21
Perbaikan Alat	46	20
b. Hambatan Yang Tidak Bisa Dihindari		
Hujan	28	28
Sliperry	68	68
Istirahat	60	60
TOTAL	352	318

Waktu kerja efektif alat gali-muat

$Wp = Waktu\ kerja\ tersedia - waktu\ hambatan\ kerja$

Wp = 660 menit – 352 menit

= 308 menit

Dari data di atas di dapat waktu effisiesi kerja adalah

$$EK = \frac{Waktu\ kerja\ efektif}{waktu\ kerja\ tersedia} \times 100\%$$

$$EK = \frac{308\ menit}{660\ menit} \times 100\% = 47\%$$

Waktu kerja efektif alat angkut

$Wp = Waktu\ kerja\ tersedia - waktu\ hambatan\ kerja$

Wp = 660 menit – 318 menit

= 342 menit

Dari data di atas di dapat waktu effisiesi kerja adalah

$$EK = \frac{Waktu\ kerja\ efektif}{waktu\ kerja\ tersedia} \times 100\%$$

$$EK = \frac{342\ menit}{660\ menit} \times 100\% = 52\%$$

LAMPIRAN J

PERHITUNGAN KETERSEDIAAN UNIT

Tabel K1

Ketersediaan Unit Produksi

UNIT	STANDBY (Jam:Menit:Detik)	REPAIR (Jam:Menit:Detik)	WORKING (Jam:Menit:Detik)	MA (%)	PA (%)	UA (%)	EU (%)
EXA306	04:22:20	00:51:25	06:46:15	89%	93%	61%	56%
EXA304	04:18:34	01:11:23	06:30:03	85%	90%	60%	54%
ADT70	04:39:10	00:15:00	07:05:50	97%	98%	60%	59%
ADT71	03:55:12	00:59:00	07:05:48	88%	92%	64%	59%
ADT72	04:41:50	00:39:00	06:39:10	91%	95%	59%	55%
LDT65	05:00:26	00:35:17	06:24:17	92%	95%	56%	53%
LDT66	05:11:00	00:49:09	05:59:51	88%	93%	54%	50%
LDT67	04:23:00	00:42:34	06:54:26	91%	94%	61%	58%
LDT68	05:04:09	00:56:43	05:59:09	86%	92%	54%	50%
LDT69	04:43:40	01:43:28	05:32:52	76%	86%	54%	46%
LDT70	05:10:00	01:28:43	05:21:17	78%	88%	51%	45%
LDT71	04:18:21	01:54:17	05:47:22	75%	84%	57%	48%

- Perhitungan ketersediaan unit *Excavator* 306

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{06:46:15}{06:46:15 + 00:51:25} \times 100\% = 89\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{06:46:15 + 04:22:20}{06:46:15 + 00:51:25 + 04:22:20} \times 100\% = 93\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{06:46:15}{06:46:15 + 04:22:20} \times 100\% = 61\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{06:46:15}{06:46:15 + 00:51:25 + 04:22:20} \times 100\% = 56\%$$

- Perhitungan ketersediaan unit *Excavator* 304

e) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{06:30:03}{06:30:03 + 01:11:23} \times 100\% = 85\%$$

f) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{06:30:03 + 04:18:34}{06:30:03 + 01:11:23 + 04:18:34} \times 100\% = 90\%$$

g) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{06:30:03}{06:30:03 + 04:18:34} \times 100\% = 60\%$$

h) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{06:30:03}{06:30:03 + 01:11:23 + 04:18:34} \times 100\% = 54\%$$

- Perhitungan ketersediaan unit ADT 70

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{07:05:50}{07:05:50 + 00:15:00} \times 100\% = 97\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{07:05:50 + 04:39:10}{07:05:50 + 00:15:00 + 04:39:10} \times 100\% = 98\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{07:05:50}{07:05:50 + 04:39:10} \times 100\% = 60\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{07:05:50}{07:05:50 + 00:15:00 + 04:39:10} \times 100\% = 59\%$$

- Perhitungan ketersediaan unit ADT 71

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{07:05:48}{07:05:48 + 00:59:00} \times 100\% = 88\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{07:05:48 + 03:55:12}{07:05:48 + 00:59:00 + 03:55:12} \times 100\% = 92\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{07:05:48}{07:05:48 + 03:55:12} \times 100\% = 64\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{07:05:48}{07:05:48 + 00:59:00 + 03:55:12} \times 100\% = 59\%$$

- Perhitungan ketersediaan unit ADT 72

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{06:39:10}{06:39:10 + 00:39:00} \times 100\% = 91\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{06:39:10 + 04:41:50}{06:39:10 + 00:39:00 + 04:41:50} \times 100\% = 95\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{06:39:10}{06:39:10 + 04:41:50} \times 100\% = 59\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{06:39:10}{06:39:10 + 00:39:00 + 04:41:50} \times 100\% = 55\%$$

- Perhitungan ketersediaan unit LDT 65

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{06:24:17}{06:24:17 + 00:35:17} \times 100\% = 92\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{06:24:17 + 05:00:26}{06:24:17 + 00:35:17 + 05:00:26} \times 100\% = 95\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{06:24:17}{06:24:17 + 05:00:26} \times 100\% = 55\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{06:24:17}{06:24:17 + 00:35:17 + 05:00:26} \times 100\% = 53\%$$

- Perhitungan ketersediaan unit LDT 66

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{05:59:51}{05:59:51 + 00:49:09} \times 100\% = 88\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{05:59:51 + 05:11:00}{05:59:51 + 00:49:09 + 05:11:00} \times 100\% = 93\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{05:59:51}{05:59:51 + 05:11:00} \times 100\% = 54\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{05:59:51}{05:59:51 + 00:49:09 + 05:11:00} \times 100\% = 50\%$$

- Perhitungan ketersediaan unit LDT 67

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W+R} \times 100\%$$

$$MA = \frac{06:54:26}{06:54:26 + 00:42:34} \times 100\% = 91\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W+S}{W+R+S} \times 100\%$$

$$PA = \frac{06:54:26 + 04:23:00}{06:54:26 + 000:42:34 + 04:23:00} \times 100\% = 94\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W+S} \times 100\%$$

$$UA = \frac{06:54:26}{06:54:26 + 04:23:00} \times 100\% = 61\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W+R+S} \times 100\%$$

$$EU = \frac{06:54:26}{06:54:26 + 00:42:34 + 04:23:00} \times 100\% = 58\%$$

- Perhitungan ketersediaan unit LDT 68

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W+R} \times 100\%$$

$$MA = \frac{05:59:09}{05:59:09 + 00:56:43} \times 100\% = 86\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W+S}{W+R+S} \times 100\%$$

$$PA = \frac{05:59:09 + 05:04:09}{05:59:09 + 00:56:43 + 05:04:09} \times 100\% = 92\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W+S} \times 100\%$$

$$UA = \frac{05:59:09}{05:59:09 + 05:04:09} \times 100\% = 54\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{05:59:09}{05:59:09 + 00:56:43 + 05:04:09} \times 100\% = 50\%$$

- Perhitungan ketersediaan unit LDT 69

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W + R} \times 100\%$$

$$MA = \frac{05:32:52}{05:32:52 + 01:43:28} \times 100\% = 76\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W + S}{W + R + S} \times 100\%$$

$$PA = \frac{05:32:52 + 04:43:40}{05:32:52 + 01:43:28 + 04:43:40} \times 100\% = 86\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W + S} \times 100\%$$

$$UA = \frac{05:32:52}{05:32:52 + 04:43:40} \times 100\% = 51\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{05:32:52}{05:32:52 + 01:43:28 + 04:43:40} \times 100\% = 45\%$$

- Perhitungan ketersediaan unit LDT 70

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W+R} \times 100\%$$

$$MA = \frac{05:21:17}{05:21:17 + 01:28:43} \times 100\% = 78\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W+S}{W+R+S} \times 100\%$$

$$PA = \frac{05:21:17 + 05:10:00}{05:21:17 + 01:28:43 + 05:10:00} \times 100\% = 88\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W+S} \times 100\%$$

$$UA = \frac{05:21:17}{05:21:17 + 05:10:00} \times 100\% = 51\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W+R+S} \times 100\%$$

$$EU = \frac{05:21:17}{05:21:17 + 01:28:43 + 05:10:00} \times 100\% = 45\%$$

- Perhitungan ketersediaan unit LDT 71

a) *Mechanical Availability* (MA).

$$MA = \frac{W}{W+R} \times 100\%$$

$$MA = \frac{05:47:22}{05:47:22 + 01:54:17} \times 100\% = 75\%$$

b) *Physical Availability* (PA)

$$PA = \frac{W+S}{W+R+S} \times 100\%$$

$$PA = \frac{05:47:22 + 04:18:21}{05:47:22 + 01:54:17 + 04:18:21} \times 100\% = 84\%$$

c) *Use of Availability* (UA)

$$UA = \frac{W}{W+S} \times 100\%$$

$$UA = \frac{05:47:22}{05:47:22 + 04:18:21} \times 100\% = 57\%$$

d) *Effective Utilization* (EU)

$$EU = \frac{W}{W + R + S} \times 100\%$$

$$EU = \frac{05:47:22}{05:47:22 + 01:54:17 + 04:18:21} \times 100\% = 48\%$$

LAMPIRAN K

PERHITUNGAN PRODUKTIVITAS ALAT GALI-MUAT

$$P = \frac{KB \times BFF \times SF \times EK \times 3.600}{CT}$$

Keterangan :

P = Produksi alat gali-muat (Ton/jam)

KB = Kapasitas teoritis *bucket* alat gali-muat (m^3).

BFF = *Bucket Fill factor* (%)

SF = *Swell factor* (%)

EK = Efisiensi kerja.

CT = Waktu edar alat gali-muat (detik).

- Produktivitas EXA 306

Kapasitas *bucket* x *Density* = 2,53 m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill factor = 103%

Efisiensi kerja = 47 %

Swell factor = 97%

Cycletime = 18,39

$$\mathrm{P} = \frac{4{,}09 \times 103\% \times 97\% \times 47\% \times 3.600}{18{,}39}$$

$$= 376{,}78 \text{ Ton/Jam}$$

- Produktivitas EXA 304

kapasitas bucket x Density = 2,53m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill factor = 103%

Efisiensi kerja = 47%

Swell factor = 97%

Cycle time = 19,54

$$P = \frac{4{,}09 \times 103\% \times 97\% \times 47\% \times 3.600}{19{,}54}$$

$$= 354{,}61 \text{ Ton/Jam}$$

LAMPIRAN L

PERHITUNGAN PRODUKTIVITAS ALAT ANGKUT

$$P = \frac{n \times KB \times BFF \times SF \times EK \times 3.600}{CT}$$

Keterangan :

P = Produksi alat angkut (Ton/jam)

n = Jumlah pengisian bak alat angkut.

CT = Waktu edar alat angkut (detik).

Unit LDT (ore)

- Produktivitas LDT (*ore*)

Kapasitas *bucket* x *Density* = 2,53 m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill factor = 103%

Efisiensi kerja = 52 %

Swell factor = 97%

Cycletime = 1.523,77 detik

n = 6

$$P = \frac{6 \times 4{,}09 \times 103\% \times 97\% \times 52\% \times 3.600}{1.523{,}77}$$

$$= 30{,}19\ Ton/Jam$$

Unit ADT (*ore*)

- Produktivitas ADT (ore)

Kapasitas *Bucket* x *Density* = 2,53 m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill Factor = 103%

Efisiensi Kerja = 52 %

Swell Factor = 97%

Cycle Time = 909,6 detik

n = 8

$$P = \frac{8 \times 4{,}09 \times 103\% \times 97\% \times 52\% \times 3.600}{909{,}6}$$
$$= 67{,}34\ Ton/Jam$$

Unit LDT (waste)

- Produktivitas LDT (waste)

Kapasitas *Bucket* x *Density* = 2,53 m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill Factor = 103%

Efisiensi Kerja = 52 %

Swell Factor = 97%

Cycle Time = 1.188 detik

n = 6

$$P = \frac{6 \times 4{,}09 \times 103\% \times 97\% \times 52\% \times 3.600}{1.188}$$
$$= 38{,}72\ Ton/Jam$$

Unit ADT (waste)

- Produktivitas ADT (waste)

Kapasitas *Bucket* x *Density* = 2,53 m^3 X 1,62 ton/m^3 = 4,09 Ton

Bucket Fill Factor = 103%

Efisiensi Kerja = 52 %

Swell Factor = 97%

Cycle Time = 510 detik

n = 10

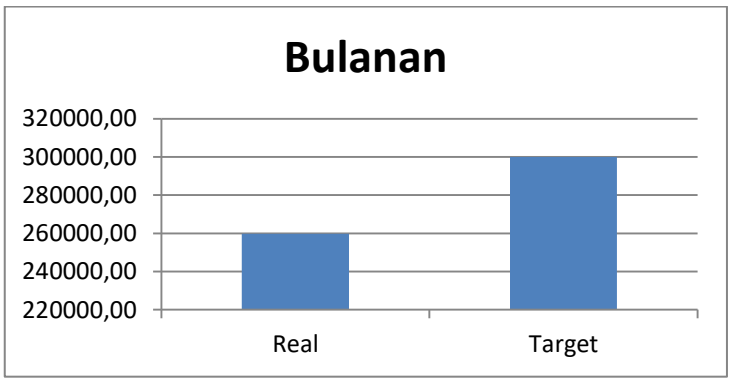
$$P = \frac{8 \times 4{,}09 \times 103\% \times 97\% \times 52\% \times 3600}{510}$$
$$= 120{,}25\ Ton/Jam$$

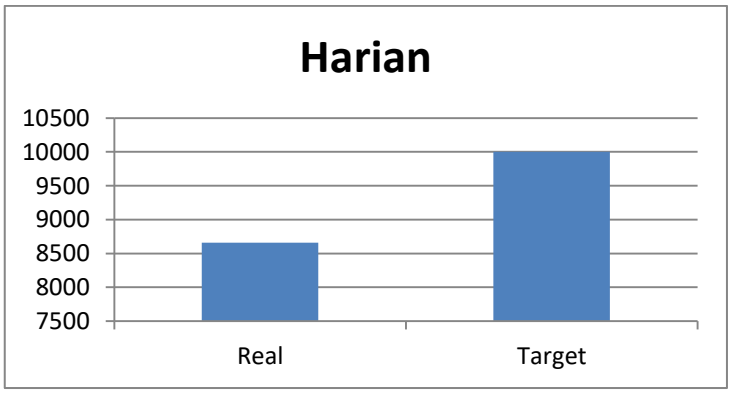
Tabel L1

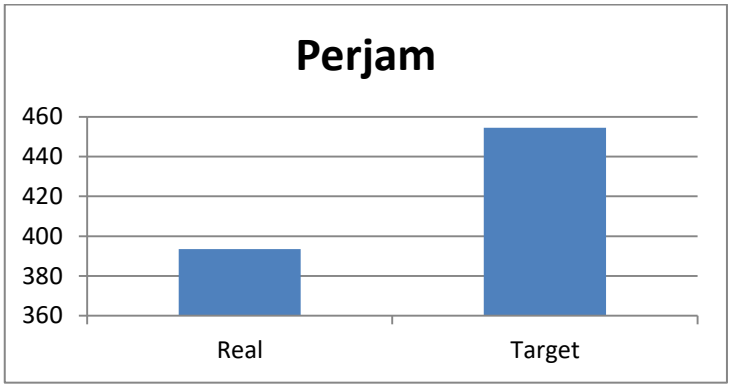
Produktivitas alat angkut

Material	Jumlah Unit		Jarak (Meter)		CT (Menit)		P (Ton/jam)	
	ORE	*WASTE*	*ORE*	*WASTE*	*ORE*	*WASTE*	*ORE*	*WASTE*
ADT	3	2	1.046	194,64	15,18	8,5	67,34	120,25
LDT	7	6	1.653	843,63	25,40	19,8	30,19	38,72
Rata-rata			1.349,5	519,135	20,29	14	48,76	79,49

	Bulanan	Harian	Perjam
Real	259.727,33	8657,578	393,52
Target	300.000	10.000	454,54






Perjam
460
440
420
400
380
360
Real
Target

LAMPIRAN M

PERHITUNGAN *MATCH FACTOR*

$$MF = \frac{Na \times (CTm \times n)}{Nm \times CTa}$$

MF = Faktor keserasian kerja (*Match factor*).

Na = Jumlah alat angkut.

Nm = Jumlah alat gali-muat.

n = Banyak pemuatan.

CTm = Waktu edar alat gali-muat.

CTa = Waktu edar alat angkut.

MATCH FACTOR ORE

Jumlah alat angkut : 5

Jumlah alat gali-muat :1

Jumlah bucket : 6

Cycletime alat angkut : 1.523,77

Cycletime alat gali-muat : 18,39

$$\text{LDT: } \frac{5 \times (18{,}39 \times 6)}{1 \times 1.523{,}77} = 0{,}36$$

Jumlah alat angkut : 3

Jumlah alat gali-muat :1

Jumlah bucket : 8

Cycletime alat angkut : 909,6

Cycletime alat gali-muat : 19,54

$$\text{ADT: } \frac{3 \times (19{,}54 \times 8)}{1 \times 909{,}6} = 0{,}51$$

Jadi, jika MF < 1 maka ada waktu tunggu untuk alat gali-muat

MATCH FAKTOR WASTE

Jumlah alat angkut : 5

Jumlah alat gali-muat :1

Jumlah bucket : 6

Cycletime alat angkut : 1.188

Cycletime alat gali-muat : 18,39

$$\text{LDT: } \frac{5\times(18,39\times6)}{1\times1.188} = 0,46$$

Jumlah alat angkut : 3

Jumlah alat gali-muat :1

Jumlah bucket : 8

Cycletime alat angkut : 510

Cycletime alat gali-muat : 18,39

$$\text{ADT: } \frac{3\times(18,39\times8)}{1\times510} = 0,91$$

LAMPIRAN N

SIMULASI MEMPERDEKAT JARAK FRONT KE STOCKYARD

Table N1

Simulasi Perpendek Jarak *Hauling*

Unit	Jumlah Unit	Jarak (Meter)		CT (Menit)		P (Ton/jam)		MF	
		ORE	*WASTE*	*ORE*	*WASTE*	*ORE*	*WASTE*	*ORE*	*WASTE*
ADT	3	858,15	194,64	12,31	8,5	83,03	120,25	0,63	0,92
LDT	5	1.053,63	643,63	16,79	19,8	45,66	38,72	0,55	0,46
Rata-rata		955,89	419,13	14,55	14,15	64,35	79,49	0,59	0,69

a) Simulasi untuk ADT *ore*

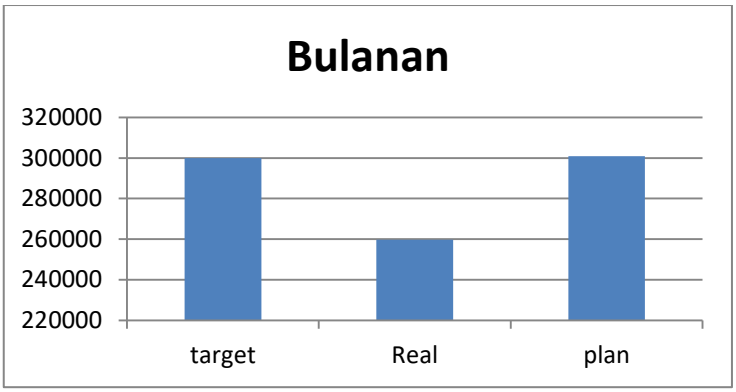
- *Excavator loading* ke LDT 8 bucket = 19,54 x 8 = 163,46 detik atau 2,72 menit
- Waktu untuk *hauling* LDT = CT LDT – CT EXA = 15,17 menit – 2,72 menit = 12,45 menit
- Jarak awal LDT pulang pergi yaitu :1.058,12 m x 2 = 2.116,3 m
- Waktu yang dibutuhkan LDT per 1 meter didapatkan dari waktu hauling dibagi dengan jarak LDT pergi dan pulang = $\frac{12{,}45\ menit}{2.116{,}3\ m}$= 0,0058 menit/m
- Cycle Time LDT yang di dapatkan untuk simulasi 858,15 m, jika bolak-balik menjadi 1.716,3 m ialah = 0,0058 menit/m x 1.716,3 m = 12,31 menit.

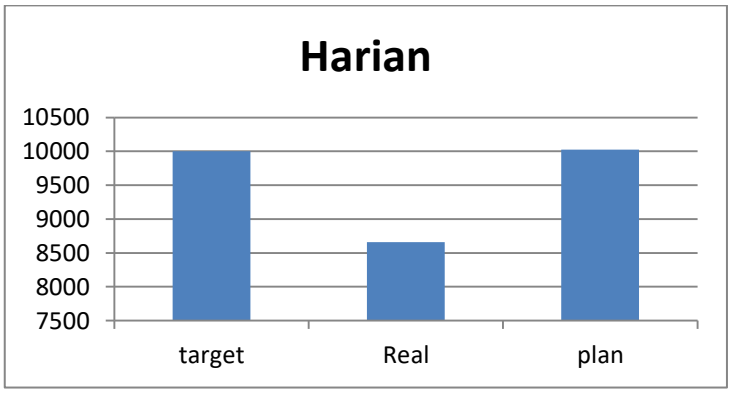
b) Simulasi untuk LDT *ore*

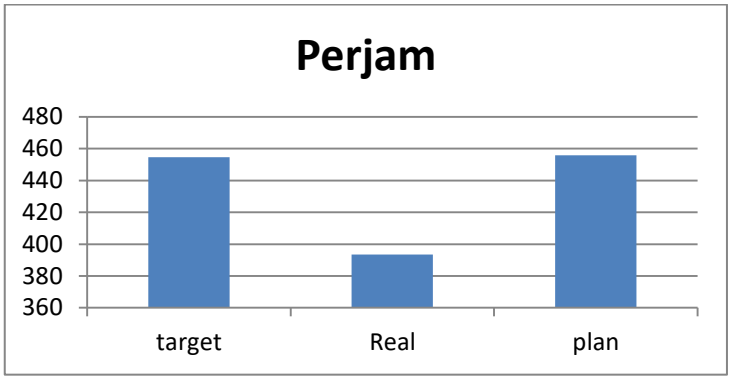
- *Excavator loading* ke LDT 6 bucket = 18,39 x 6 = 110,33 detik atau 1.83 menit
- Waktu untuk *hauling* LDT = CT LDT – CT EXA = 25,40 menit – 1,83 menit = 23,56 menit
- Jarak awal LDT pulang pergi yaitu :1.653,63 m x 2 = 3.307,26 m

- Waktu yang dibutuhkan LDT per 1 meter didapatkan dari waktu hauling dibagi dengan jarak LDT pergi dan pulang = $\frac{23.56\ menit}{3.306{,}26\ m}$= 0,0071 menit/m
- Cycle Time LDT yang di dapatkan untuk simulasi 1.053,63 m, jika bolak-balik menjadi 2.107,26 m ialah = 0,0071 menit/mx2.107,26 m= 16,79 menit.

	Bulanan	Harian	Perjam
Target	300.000	10.000	454,55
Real	259.727,33	8.657,57	393,52
Plan	300.793	10.026,44	455,75






Perjam
480
460
440
420
400
380
360
target
Real
plan

LAMPIRAN O

OPTIMALISASI PEMAKAIAN ALAT ANGKUT

Tabel O.1

Pengoptimalan alat angkut

Unit	EK	KB	BF	FF	CT		n	unit	MF	Produktivitas	
					Ore	Waste				Ore	Waste
ADT	52%	4,09 ton	103%	97%	910,71 detik	510 detik	8	3	0.72	202,01 ton/jam	360,74 ton/jam
LDT	52%	4,09 ton	103%	97%	1.523,77 detik	1.188 detik	6	7	0.65	211,29 ton/jam	271,01 ton/jam

Perhitungan kebutuhan alat angkut

$$ADT = \frac{Target\ produksi}{produksi\ alat\ \div jumlah\ alat\ aktual}$$

$$= \frac{150.000}{146.035{,}59 \div 3}$$

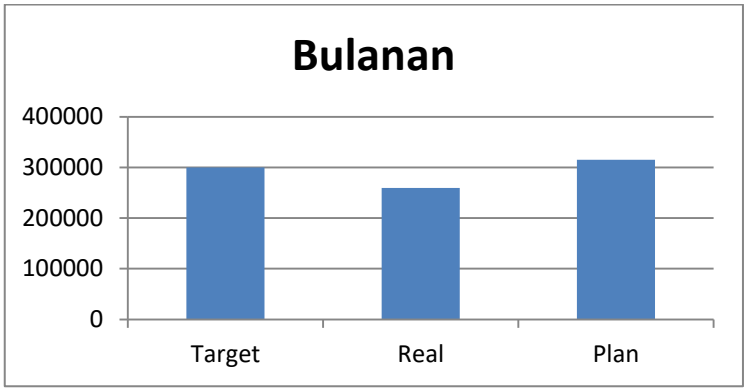
$$= 3\ unit$$

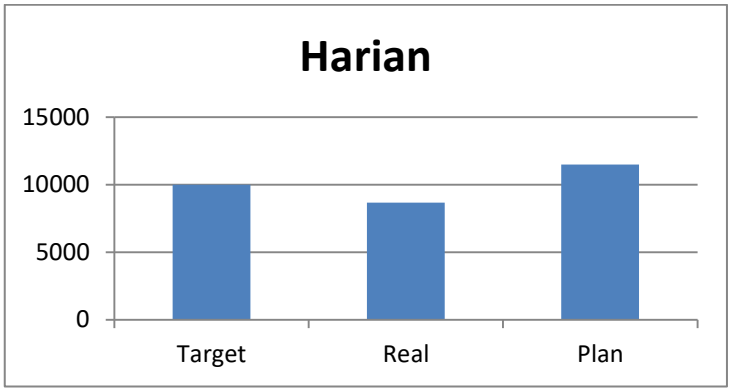
$$LDT = \frac{Target\ produksi}{produksi\ alat\ \div jumlah\ alat\ aktual}$$

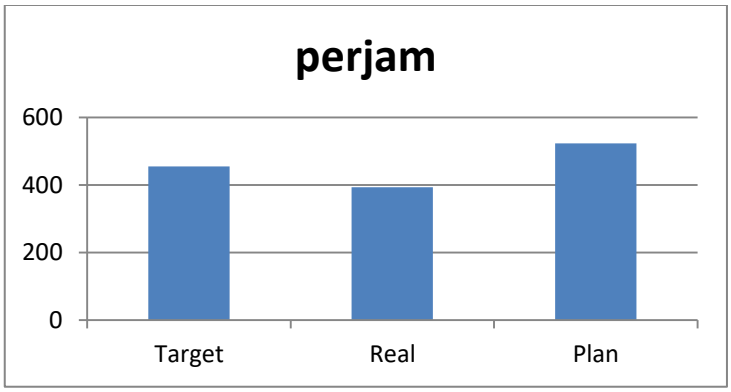
$$= \frac{150.000}{113.691{,}73 \div 5}$$

$$= 6{,}6 = 7\ unit$$

	Bulanan	Harian	Perjam
Target	300.000	10.000	454,54
Real	259.727,33	8.657,57	393,52
Plan	315.255,77	11.495,54	522,52


Bulanan
400000
300000
200000
100000
0
Target
Real
Plan

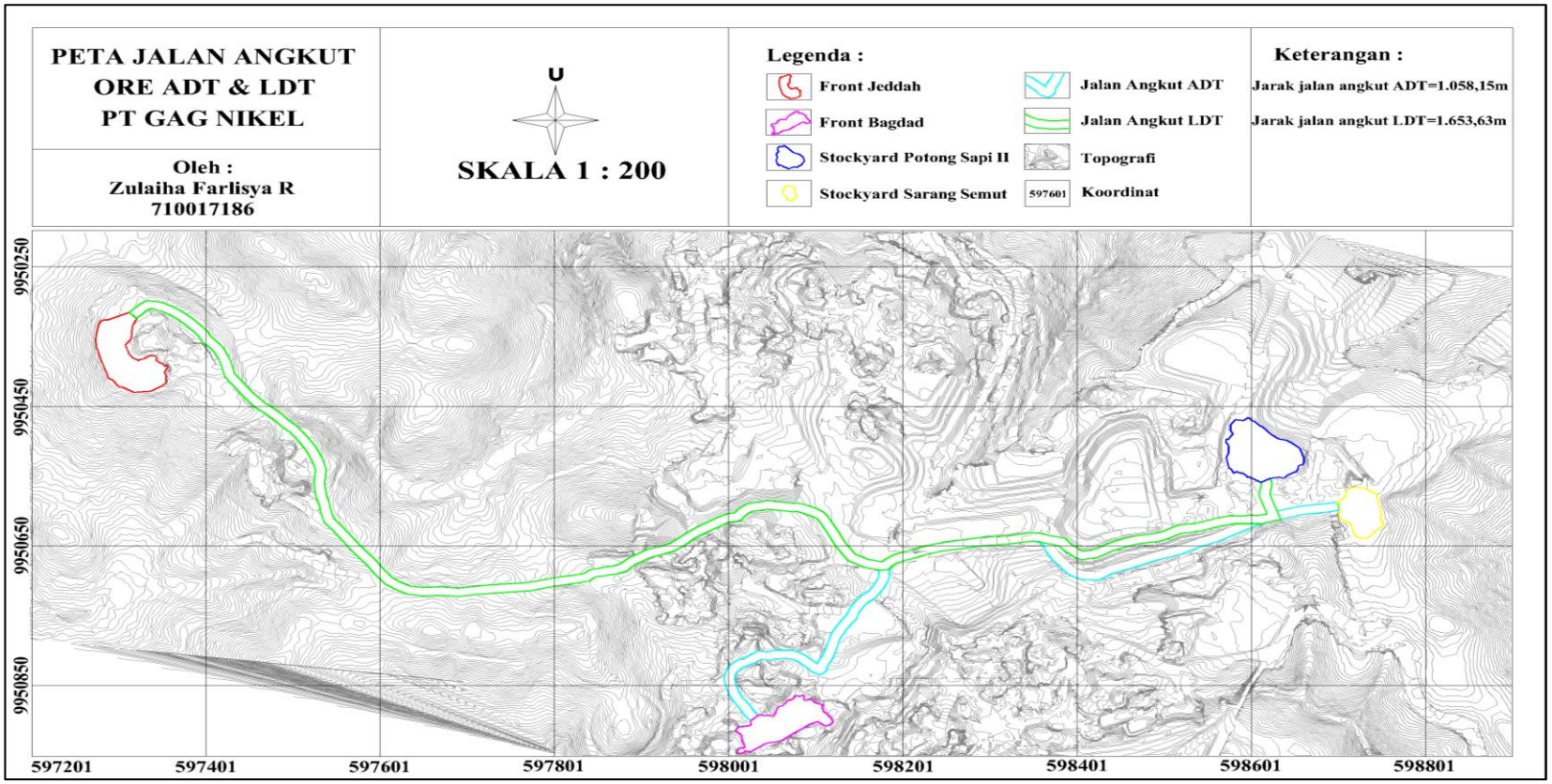

Harian
15000
10000
5000
0
Target
Real
Plan


perjam
600
400
200
0
Target
Real
Plan

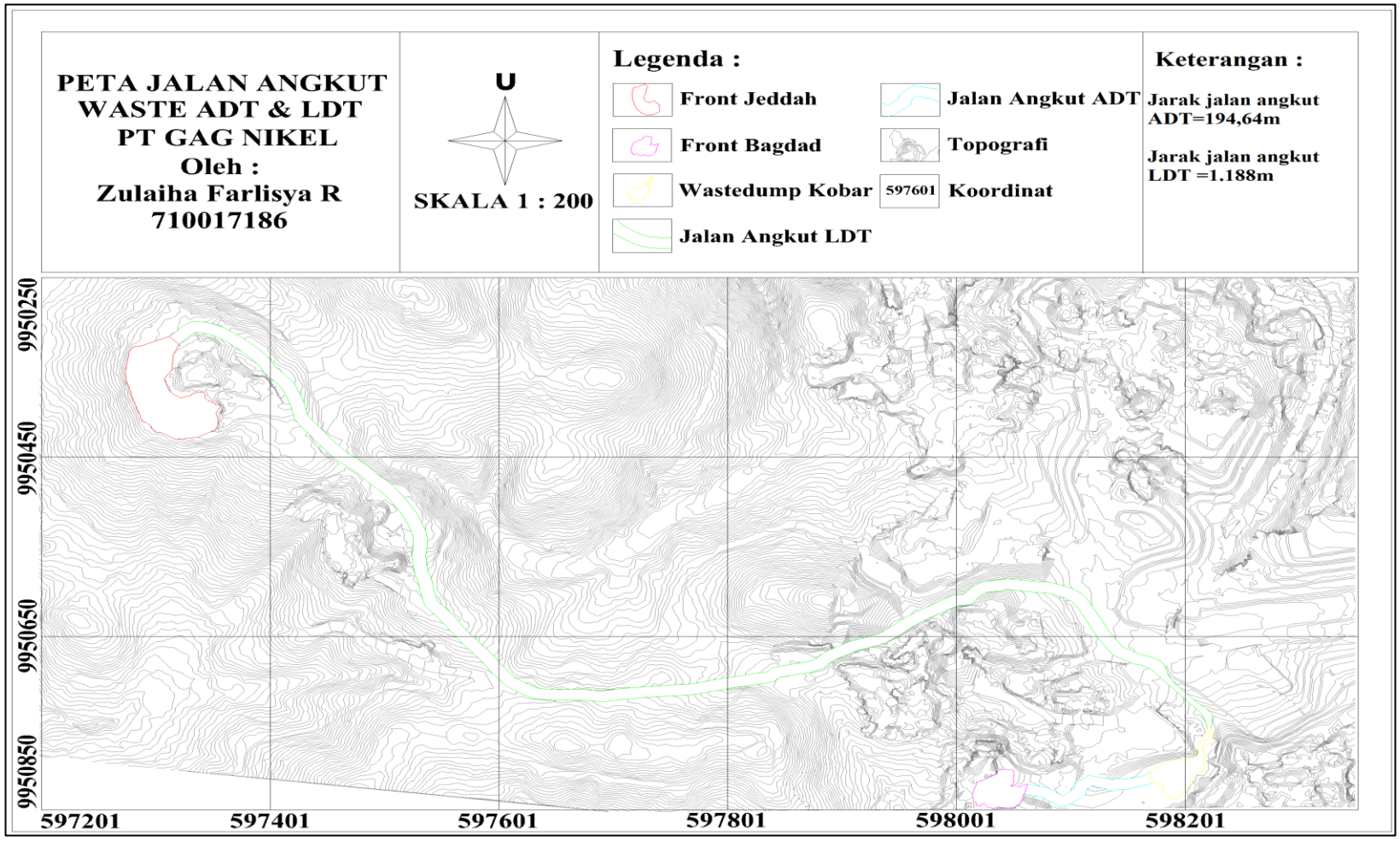
LAMPIRAN P

PETA JALAN ANGKUT TAMBANG

- Jalan angkut material *Ore*



- Jalan angkut material *Waste*



LAMPIRAN P

PETA SIMULASI JALAN ANGKUT TAMBANG