

Chapter 5

Gampaha Waste Stream Analysis

A. Household garbage collection service, garden waste and recycling/composting survey data

2.1&2.2 Garbage coll'n	No	%
Have and use	54	36.0
Have but don't use	44	29.3
Don't have	52	34.7
Total	150	100.0

3.8 Garden waste	No	%
Yes	118	78.7
No	32	21.3
Total	150	100.0

Q4-5 to 4-8 Recycling

Qns	Yes	No	Fd/Ki	Paper	Textile	Plastic	Gr/Wd	Le/Ru	Metal	Glass	Ce/St	Other	Total
4.5/4.6 Individual collector	122	28	1	35	0	1	0	0	8	64	0	0	73
4.7/4.8 Take to shop	32	118	0	11	0	0	0	0	1	23	0	0	32
4.9 Comp ki &/or ga waste	5	145	5				5						0

122 are visited but only 73 actually give/sell

Notes:

- Household questionnaire listed paper and cardboard separately and "metal can" and "other metal" separately, whereas these items were a single category in WACS. Hence, as more responses were obtained for paper compared with cardboard, it was assumed total paper = paper (not paper + cardboard). Hence, as more responses obtained for metal can compared with other metal, it was assumed total metal = metal can (not metal can + other).
- Assume same people are both giving/selling things to collectors and taking things to shops so that total doing some recycling is max no from these 2 questions, not sum.

B. Other household survey data and calculation of discharge/behaviour method %s for surveyed area

WACS Collection Vehicle Waste Composition - wt %

	Fd/Ki	Paper	Textile	Plastic	Gr/Wd	Le/Ru	Metal	Glass	Ce/St	other	Total
Kandy	58.21	11.95	1.40	7.94	12.31	0.68	0.84	1.13	5.13	0.40	99.99
Matale	61.29	6.40	1.07	4.35	18.14	1.11	0.42	0.36	6.60	0.26	100.00
Gampaha	57.27	14.35	1.46	7.75	15.25	0.36	0.47	1.35	1.18	0.55	99.99

Average Household waste composition - wt %

	Fd/Ki	Paper	Textile	Plastic	Gr/Wd	Le/Ru	Metal	Glass	Ce/St	other	Total
Kandy	69.90	6.93	1.11	5.08	11.70	0.41	0.96	1.07	2.65	0.18	100.00
Matale	66.50	6.98	1.34	3.59	15.68	0.40	0.37	1.33	3.36	0.46	100.00
Gampaha	65.45	6.95	1.49	5.68	13.84	0.17	0.48	3.14	0.61	0.61	98.42
Adopted	66.51	7.07	1.52	5.77	14.06	0.18	0.49	3.19	0.61	0.61	100.00

H'hold wt avg WACS values
H'hold wt avg WACS values
See note 1

Household survey (150 respondents)	Q3.1 garb disp		5.9 others behaviour	Weighted no of responses to different methods of waste disposal for different waste types											Wt avg	Rev'd	Rev'd %
	Main	Other		F/K: Q4-9	Q4-5-8	Q3.9											
LA colln	48	6	61	39.6	39.6	39.6	39.6	7	39.6	39.6	39.6	39.6	39.6	363.4	26.3	26.3	24.9
Self-disp (OSD)	97	22	105	82	82	82	82	107	82	82	82	82	82	845	65.3	65.3	62.0
Compost	2	3	0	5	2.2	2.2	2.2	5	2.2	2.2	2.2	2.2	2.2	27.6	3.4	2.5	2.4
Recycle	0	0	0	1	3.5	0	1	0	0	8	64	0	0	109	3.2	2.9	2.7
Open dump	3	2	29	2.8	2.8	2.8	2.8	0	2.8	2.8	2.8	2.8	2.8	25.2	1.8	8.3	7.9
Total	150	33	195	130.4	161.6	126.6	127.6	119	126.6	134.6	190.6	126.6	126.6	1370.2	100	105.3	100.0
Weight	0.8	0.2															

Notes:

- Gampaha household weighted average composition data calculated for each waste type as $Gampaha\ VWC \times 0.5 \times (Kandy\ HHWC/Kandy\ VWC + Matale\ HHWC/Matale\ VWC)$ assuming:
 - variations in VWC between towns reflects variations in local conditions; and
 - the ratio of town HHWC/town VWC is approximately constant
 where VWC = vehicle waste composition and HHWC = household waste composition. However, if this is done, the resulting paper composition is considered too high (11.98%), this being due to the three commercial areas within GMC. Hence, in this case, the average of the Kandy and Matale household data is used. %s are then adjusted on a pro rata basis to give a total of 100%.
- Q5.9 generally supports Q3.1 results except for suggesting open dumping is more common and OSD less common. Q3.1 result used in preliminary analysis, applying wts to main/other answers as shown.

i.e. no of households disposing of each kind of waste by particular method = (no using this as main method) x 80% + (no using this as secondary method) x 20% (for LA colln, OSD and open dumping)

3. For compost and recycle options, use answers from other questions as indicated, rather than 3.1.

- a. For those recycling different materials, assumed 90 % of materials generated are recycled - gives revised total shown in last column
- b. From survey results, calculated 75% of F/K & 70% of ga waste composted - as more F/K waste, assumed 74 % of F/K & ga waste composted - gives revised total in last column
- 4. Open dumping % considered to be too low based on observation and Q5.9. Q5.9 open dump % = 14.9 % - revise open dumping % to be avg of tabulated (17.2%) & this value

C. Extension of survey results to entire CUA area

Household waste stream results in final column of above table have been adopted as representative of surveyed areas. This survey was undertaken in areas where 65.3 % of households receive a garbage collection service (see Q2.1 & 2.2). The results must be modified to account for the overall GMC service coverage. This is estimated in the following table, based on discussions with the Gampaha and Yakkala PHIs and field observations:

Area	Pop'n (2001)	Service coverage (%)			Covered pop'n
		GMC	JICA	Adopted	
Gampaha	9438	55-70	60-80	66.3	6253
Bandiyamulla	12393	55-70	70-80	68.8	8520
Yakkala	35598	25-50	25-50	37.5	13349
Total	57429			49	28122

Notes:

- 1. Gampaha PHI said "old area" comprised ~12,000 people - mainly Gampaha/Bandiyamulla = 55% service coverage
- 2. Yakkala PHI said 70% for Bandiyamulla
- 3. Yakkala PHI said 40-50%; Gampaha PHI said 25-50%
- 3. Adopted figures = averages of both estimates

Hence, the calculated %s must be adjusted to account for the service coverage in the surveyed area being different from the entire GMA. This is done below:

Area (fraction)	Formulae			Survey area			Overall		
	Serviced A	Unserviced B	Total Z	Serviced 1	Unserviced 0.35	Total 1	Serv. 0.49	Unserv. 0.51	Total 100
LA collection	X1	0	Z1	38.2	0.00	24.9	38.2	0.0	18.69
Self-disposal	X2	Y2	Z2	51.1	82.62	62.0	51.1	82.6	67.17
Compost	X3	Y3	Z3	2.0	3.22	2.4	2.0	3.2	2.62
Recycle	X4	Y4	Z4	2.2	3.62	2.7	2.2	3.6	2.95
Open dump	X5	Y5	Z5	6.5	10.54	7.9	6.5	10.5	8.57
Total	100	100	100	100	100	100.0	100.0	100.0	100.0

Notes:

- 1. In general:
 - a. $X1 = Z1/A$
 - b. $X2*A + Y2*B = Z2$; $X3*A + Y3*B = Z3$; etc.
 - c. Assume for areas not provided with collection service, waste is disposed of by other methods in proportion to %s in serviced areas. I.e. $X2/(X2+X3+X4+X5) = Y2/(Y2+Y3+Y4+Y5)$ which simplifying becomes $X2/(100-X1) = Y2/100$ as $Y2+Y3+Y4+Y5 = 100$; etc. for X3, X4, X5
 - d. Combining these equations gives $Y2*(A*(100-X1)/100+B) = Z2$; etc.
- Solving these equations gives the relative %s for different disposal methods in serviced and unserved areas within the survey area.
- 2. These %s are then assumed applicable to all GMA:
 - a. Overall %s calculated as $((\% \text{ serviced area}) \times (\text{disposal method \% in that area}) + (\% \text{ unserved area}) \times (\text{disposal method \% in that area}))/100\%$
 - e.g. self-disposal = $(80*17.4+20*40.2)/100 = 22.0\%$

D. Waste Generation Rate (WGR) data

Town/city	Pop'n	WGR (kg/cap.d)	HH Ga waste Comp (%)
Kandy	110,049	0.545	11.70
Matale	36,331	0.451	15.68
Gampaha	57,429		14.06

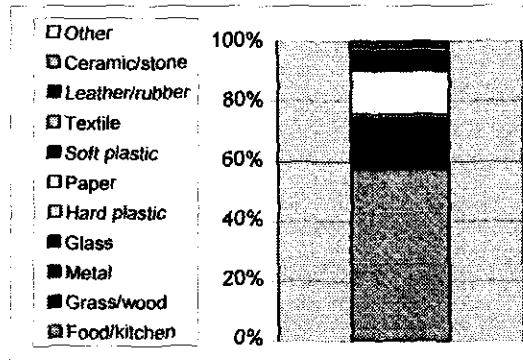
2001 population data quoted here (for comparison purposes only - not used in these calculations)

Notes:

1. These are estimated WGRs based on measured waste discharge rates in Kandy and Matale.
2. Gampaha MC is an unusual municipality, comprising a combination of traditional town (Gampaha) with a relatively small population (9,438), two other commercial areas (Yakkala and Mirriswatta) with the remaining areas being a mixture of urban and semi-rural, low to high density housing and industrial activity. It can be thought of as 1 Urban Council (UC) type area, with the remainder being a Pradeshiya Sabha (PS) type area including two small but busy commercial areas.
3. UNEP (2001) gives some indicative waste discharge/generation rates for UCs = 0.45-0.65kg/cap.d & PSs = 0.20-0.45kg/cap.d
4. Matale WGR determined in this study is considered typical of a UC WGR, as Matale is a new Municipal Council (MC) and the smallest MC in Sri Lanka.
5. Based on these comments, adopted WGR = 100 % of Matale WGR = 0.451 kg/cap.d

Graphical Data

	Food/kitchen	Grass/wood	Metal	Glass	Hard plastic	Paper	Soft plastic	Textile	Leather/rubber	Ceramic/stone	Other	Total
Gampaha	57.27	15.25	0.47	1.35	1.25	14.35	6.5	1.46	0.36	1.18	0.55	99.99



Collection worker recycling (data from collection worker survey)

Item	Total
No of workers collecting items for recycling	7
Total no of workers interviewed	30
Average recycling income (Rs/mth)	62
% of those interviewed collecting recyclables	23
Total no of SWM workers	72
% interviewed/total workers	42
Estimated total no of workers collecting recyclables	17

Notes:

- Collection workers indicated all recyclables go to Nadar Kade
- Total SWM workers = 58 labourers (zones 1-6 + Yakkala) + 7 drivers + 7 other (3 bus stand labourers + 4 drain cleaners) = 72

Collection worker - recycling quantities

Item	No collecting	Qty	Units	Price	Units	Income (Rs/mth)	Est total qty		Revised qty	
							kg/mth	kg/d	kg/mth	kg/d
Bottles	5	50.2	kg/mth	1.5 Rs ea		114.0	120	4.0	792	26.4
Iron	1	15.0	kg/mth	5.0 Rs/kg		75.0	36	1.2	237	7.9
Metal can	2	15.0	kg/mth	3.3 Rs/kg		48.8	36	1.2	237	7.9
Aluminium	2	1.2	kg/mth	50.0 Rs/kg		60.0	3	0.1	19	0.6
Total quantity	7	81.4	kg/mth			297.8	195	6.5	1284	42.8
Est. qty collected/lab'r		11.6	kg/lab'r.mth			42.5	Rs/lab'r.mth			
Est tot qty - all labrs		195	kg/mth							

Range = 1-2Rs ea

Range = 2.5-4Rs/kg

Range = 50Rs/kg

Income < survey figure, suggesting survey qty's are low.

Notes:

- Average weight of bottles (mainly beer and arrack) = 0.66 kg ea (average weight, based on measurements of 5 arrack and 5 beer bottles)
 - No of bottles collected per month = 76 bottles/mth, converted to kg/mth using above average weight
 - Overall quantity recycled = 6.5 kg/d, which seems very small.
 - During time and motion study, Yakkala 2WT labourers indicated they collect the following items:
 - Iron = < 1 kg/wk @ 1.5 Rs/kg = 1.5 Rs/wk
 - Glass = 37.5 kg/wk @ 0.75 Rs/kg (25-50 kg broken glass & bottles) = 28.1
 - Tins = 15 kg/wk @ 1.25 Rs/kg (1-1.5Rs/kg) = 18.8
 - Total = 53.5 kg/wk by 3 labourers, including driver = 48.4 Rs/wk or 16.1 Rs/lab'r.wk
 - Total/lab'r = 17.8 kg/lab'r.wk
- Qty is much higher than suggested by worker survey but income is similar - prices given by Yakkala 2WT crew are lower than survey prices. Yakkala labourers confirmed this, saying local middleman gives low prices so they tend to take them to a middleman in Mirriswatta weekly on Friday where the prices are better. They also said that 4WT labourers tend to collect more recyclables (~1 gunny sack/d).
 If this result is adopted, overall quantity recycled = 1284 kg/mth or 43 kg/d, which is still small. However, household survey indicates a lot of recyclables are collected at discharge + MM survey indicates very few middlemen receive recyclables from collection workers.
- Assume Yakkala figure is more accurate - collection recycling figure adopted = 43 kg/d - still small and has little impact on waste stream.

Transfer Station - Yakkala Pola

- Waste discharged at this transfer station comes from handcarts, 2WT or directly from the pola. Normally, it is picked over first by GMC labourers, both during collection and unloading, with most of the discharged waste being burnt. It is believed there are no other scavengers salvaging recyclables at this location. Hence, recycling assumed to be 0 kg/d

Transfer Station - GMC Office

- According to the PHI, about 4 scavengers used to collect recyclables from this transfer station, but now there are none. Hence, recycling assumed to be 0 kg/d

Final disposal site - recycling

- Neither of the two NMC labourers working at the disposal site are believed to collect recyclable materials.
- No other outsiders are involved in scavenging here, partly due to the site's remoteness and it being located on private land
- Total disposal site recycling = 0 kg/d

1. WASTE STREAM HOUSEHOLD, COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL DATA

a. Residential	Permanent		Floating		Gamp-aha	Yakkala	Bandi-yamulla	Notes
	H'holds	People	H'holds	People				
July 2001 census		9438						1
GMC PHI data	15222	57429		60000	9438	35598	12393	2,3,4
Adopted	0	57429	n/a	60000				

Notes:

1. Provisional July 2001 census results - these apply to Gampaha Urban Council only; GMC limits have been expanded since then to include Yakkala - not appropriate to use this data.
 2. GMC PHI households data listed as no of families
 3. Floating population data based on discussions with GMC CPHI - range = 40,000-80,000
 4. Gampaha PHI gave pop'n estimate for Gampaha + Bandiyamulla = 21911 and Yakkala = 35729 giving a total of 57,640 which is 1.004 times higher than the census figure.
 Adopted popn values for each area obtained by multiplying by ratio of 0.996 (= census popn/PHI's G+B & Y popn), + using census value for Gampaha town.
 5. Population growth rate based on the following data:

- a. Census data for the Gampaha district from 1981 & 2001 gives an average annual growth rate of 2.00 %
 b. Very little other data is available due to recent expansion of Gampaha from UC to MC
 c. Adopted value = 2.00 %
 5. GMC 2002 population = 58577

Year	Gamp District Pop'n	Cmpd. growth (%)
1981	1390862	
2001	2066096	2.00

General Notes on Shading

1. Yellow indicates waste generators surveyed/interviewed during this study.
2. Blue relates to specific notes described under relevant items.
3. Purple shows data used in waste stream calculations
4. Brown indicates cells affected by changes in collection tonnages

Abbreviations

1. Waste type codes: Co = coconuts, F = food/kitchen, Fi = coconut fibre, G = garden, Hz = hazardous, P = paper/cardboard, Pl = plastic, M = metal, M/F = meat/fish, R = rubber/leather, In = inert, T = textile
2. Disposal method codes: A-D= LA collection, E-F = on-site disposal, G = recycling, H = composting, I = illegal dumping, J = other
3. Waste stream codes: OSD = on-site disposal, comp = composting, LA colln = NMC collection, Recy = recycling, ID = illegal dumping, DH = direct haulage
4. Other: WDR = waste discharge rate; WGR = waste generation rate; SW = solid waste

2. COMMERCIAL & INDUSTRIAL SECTOR - DETAILED INFORMATION

a. General

Category	Name	Address	Relevant Data		SW gen (kg/d)	Main 3 wastes	Disposal		OSD	Comp	LA colln	Recy	ID	DH	Total	Notes
			No staff	Type			Main	other								
Small																
SW1	Sarasavi book shop	36, Main St, Gampaha		3 Bookshop	1	P>F	C		0	0	1	0	0	0	1	
SW2	Shanthi book shop	Market lane, Gampaha		4 Bookshop	0.5	P>F	D		0	0	0.5	0	0	0	0.5	
SW3	Asiri salon	4, Colombo Rd, Gampaha		4 Salon		O>P	B		0	0	4	0	0	0	4	
SW4	New Crown Communication	15, Main St, Gampaha		1 Communication	0.5	P	D		0	0	0.5	0	0	0	0.5	
SW5	Central Pharmacy	62, Colombo Rd, Gampaha		8 Pharmacy	10	P>PI>F	A		0	0	10	0	0	0	10	
SW6	Asiri Tailors	6, Colombo Rd, Gampaha		2 Tailoring	5	G>T>F	B	F	1.75	0	3.25	0	0	0	5	
SW8	Ruvini Fashion House	Kandy Rd, Yakkala		5 Clothing	3	PI>F>P	F	B	1.95	0	1.05	0	0	0	3	
SW9	Commercial Bank	182, Colombo Rd, Yakkala		10 Bank	4	P>PI>F	D		0	0	4	0	0	0	4	
SW10	Chandana Book Shop	4, Kandy Rd, Yakkala		2 Bookshop	2	P>G>F	B		0	0	2	0	0	0	2	
SW11	C. S. Food Centre	Gampaha Rd, Yakkala		4 Grocery	3	P>PI>F	F	G	2.77	0	0	0.23	0	0	3	
SW12	Rathna Shoe Palace	26, Radawana Rd, Yakkala		1 Shoe sales	1	P>PI>F	B		0	0	1	0	0	0	1	
SW13	Sirisinghe Hardware	32, Kandy Rd, Yakkala		4 Hardware shop	8	P>In>F	F	A	5.2	0	2.8	0	0	0	8	
SW14	Samarakoon Medicals	234, Gampaha Rd, Yakkala		2 Pharmacy	2	P>F>PI	B		0	0	2	0	0	0	2	
SW16	Palitha Hotel	31, Kandy Rd, Yakkala	NA	Hotel	8	In>P>F	B		0	0	8	0	0	0	8	100 customers/d
SW17	Yakkala Eggs Centre	67 Kandy Rd, Yakkala		2 Egg/chicken sales	1.5	In>G>F	B		0	0	1.5	0	0	0	1.5	
SW18	Jayasri Furniture	Kandy Rd, Yakkala		2 Timber depot	0.5	P>F>PI	A		0	0	0.5	0	0	0	0.5	
SW19	Salon Super Fashion	130, Kandy Rd, Miniswatta	NA	1 Salon	3	O>Hz>F	B	A/G	0	0	2.83	0.17	0	0	3	Other = hair; Hz = razor blades
SW18	Sudarna Cafe	Miniswatta, Gampaha	NA	Hotel	10	P>F>In	C		0	0	10	0	0	0	10	150 customers/d
SW20	Saneeppa Ayurveda Rasayana	155, Miniswatta, Mudungoda		7 Ayurvedic medicine	2	O>F>G	F	G	1.93	0	0	0.07	0	0	2	Other = ayurv. medicine waste (mainly organic)
SW21	Lanka Agency Post Office	Colombo Rd, Miniswatta		2 Post office	1	P>PI>F	C		0	0	1	0	0	0	1	
SW22	Sirkatha Pharmacy	140, Miniswatta, Mudungoda		4 Pharmacy	5	P>PI>F	B	F	1.75	0	3.25	0	0	0	5	
Large			WGR =	3.57 kg/shop.d	75				15.4	0.0	59.2	0.5	0.0	0.0	75.0	
LW13	Cargills Food City	245, Bauddhaloka Mw, Gampaha		30 Supermarket	10	F>P>PI	C	G	0.0	0.0	8.3	1.7	0.0	0.0	10	
LW14	Ranjan Lanka Pvt. Ltd	4, Resthouse Rd, Gampaha		150 Supermarket	125	P>PI>F	G	C	0.0	0.0	24.3	100.7	0.0	0.0	125	
LW10	Sri Lanka Telecom	Gampaha		178 Communic.	10	P>F>G	A	F, G	3.3	0.0	6.1	0.7	0.0	0.0	10	
SW1	CWE	Bus Stand, Ja Ela Rd, Gampaha		22 Wholesale coop.	10	F>P>M	C	G	0.0	0.0	9.0	1.0	0.0	0.0	10	
LW15	Keels Supermarket	17, Yakkala Rd, Gampaha		34 Supermarket	30	F>P>PI	J		0.0	0.0	0.0	0.0	0.0	30.0	30	
SW24	Sagatha Madura	22, Gayaba Mw, Gampaha		2 Reception hall	13	F>G>P	D		0.0	0.0	13.0	0.0	0.0	0.0	13	~350 peak guests
LW3	Green Garden Hotel	61 Gampaha Rd, Yakkala		5 Local hotel	40	F>G>P	G	F	9.6	0.0	0.0	30.4	0.0	0.0	40	150 peak customers
SW7	Ajantha Food House	Mangala Rd, Gampaha	NA	Local hotel	20	F>P>PI	D		0.0	0.0	20.0	0.0	0.0	0.0	20	200 avg customers
SW27	Miniswatta Holiday Resort	152, Miniswatta, Mudungoda		2 Hotel	10	F>G>GI	C	F	3.5	0.0	6.5	0.0	0.0	0.0	10	4 avg & 250 peak customers/guests
LW28	Memonto Tourist Hotel	24, Wijaya Rd, Gampaha		9 Hotel	8	F>G>P	D	G	0.0	0.0	5.0	3.0	0.0	0.0	8	60 avg & 125 peak customers/guests
LW30	Esala Hotel	50, Kirindiwela Rd, Yakkala		2 Hotel	1.5	F>G>PI	F	G	1.0	0.0	0.0	0.5	0.0	0.0	1.5	2 avg & 250 peak customers/guests
	Total				427.5	0			32.7	0.0	151.4	138.4	0.0	30.0	352.5	

Notes:

1. Additional waste generation data based on information supplied by GMC:

a. Ranjan Lanka produces 1/3 4WT/d of mainly paper/plastic waste =

b. CWE produces about 1/3 of a 2WT/d =

c. Sagatha Madura Hotel produces about 5 polysacks/d =

2. Waste stream breakdown based on the following:

a. SW6 - assume LA collection =

b. SW8 - assume OSD =

c. SW11 recycles 7kg/mth of cardboard =

d. SW13 - assume OSD =

e. SW15 recycles 10 bottles/mth @0.5kg/bottle (assumed)=

f. SW20 recycles 2kg/mth of broken glass =

g. SW22 - assume LA collection =

h. LW13 recycles 50kg/mth of cardboard =

i. LW14 recycles 3000kg/mth of cardboard & 20kg/mth of animal feed =

j. LW10 recycles 20kg/mth of paper/cardboard =

k. LW11 recycles 30kg/mth of cardboard =

l. LW31 recycles 10kg/mth of br. glass & 4500kg/mth of F/K waste for animal feed =

is irregular, occurring on wedding days - hence, assume recycling =

m. LW15 transports its garbage directly to the GMC final disposal site using its own lorry (direct haulage)

n. LW27 - assume LA collection =

197 kg/d, based on average 4WT vol of

247 kg/d, based on average 2WT vol of

75 kg/d assuming 1 polysack weighs

65 %; remainder = OSD

65 %; remainder = LA collection

0.23 kg/d

65 %; remainder = LA collection

0.17 kg/d (lower weight used than beer/arack bottles as likely to be smaller bottles)

0.07 kg/d

65 %; remainder = OSD

1.67 kg/d

101 kg/d

0.67 kg/d; assume for remaining waste, LA coll'n=

1.00 kg/d

152 kg/d. This is too high compared with stated waste generation (40kg/d). Survey states G is main disposal method while F/K recycling

30 kg/d; i.e. 20 % of calculated figure

65.00 %; remainder = OSD

5.92 m3 & pa/pl waste density of

3.01 m3 & Gamp CV waste density of

15.0 kg - much higher than JICA survey value - assumed to represent peak waste gen - JICA survey value used.

100 kg/m3 - much > than survey amt - use JICA survey data.

246 kg/m3 - much > than survey amt - use JICA result

Adopted 12.0 0.0 53.7 29.2 0.0 4.3 100.0

o. LW28 recycles 600 large and 60 small bottles/mth & 180kg/mth of F/K waste for animal feed = 20 kg/d; assuming large bottles = 0.66kg ea; small = 0.4kg ea. This is too high compared with stated waste generation (8kg/d).
 Survey states G is secondary method - assume recycling = 3 kg/d; i.e. 15.0 % of calculated figure

p. LW30 recycles 15kg/mth of F/K waste for animal feed = 0.50 kg/d;

3. Waste collection based on GMC Supervisors data:

a. Zone 1 is mainly comm; -1 4WT/d is collected from Z1 + some large waste generators (resid+instint) in Z3. Subtracting Z3 places gives

0.75 4WT/d = 1.00 T/d, based on 1.33 T/avg load

b. Zone 2 is -30% commercial and about 2 2WT/d are collected from here - commercial waste collection =

0.6 2WT/d = 0.37 T/d based on 0.61 T/avg load

c. Zone 3 is -35% commercial and about 1.29 2WT/d are collected from here - commercial waste collection =

0.45 2WT/d = 0.28 T/d based on 0.61 T/avg load

d. Zone 4 is -60% commercial and about 1 4WT/d is collected from here - commercial waste collection =

0.6 4WT/d = 0.80 T/d based on 1.33 T/avg load

e. Night shift collects 2 x 4WT/d from commercial areas, including one from market - commercial, non-market waste =

1 4WT/d = 1.33 T/d based on 1.33 T/avg load

f. Yakkala is a mixed residential/commercial area (assume 25% comm) with about 2 x 4WT/d being collected from whole area =

0.5 4WT/d = 0.67 T/d based on 1.33 T/avg load

g. Total

4.43 T/d

h. This is considered too high, given that tot avg GMA waste disposal to landfill = 3.1 T/d. GMC Supervisors data is 1 4WT/d higher than actual amount delivered to disposal site (after allowing for only one load from Yakkala to disposal) + above commercial %s do not take into account residential population in commercial area. Hence, subtracting 1 4WT/d (for too high estimate) and 0.5 4WT/d for resid places =

1.5 4WT/d = 2.00 T/d based on 1.33 T/avg load

Revised commercial waste collection =

2.44 T/d, equiv to 1.83 4WT/d

4. Waste generation based on estimated collection quantity and survey LA collection % - LA colln = 53.7 % representing 2.44 T/d, gen = 4.54 T/d

Total GMA trade licences (TLs) = 1541 which gives a comm WGR of 2.95 kg/TL d - quite low, due to TLs being issued on activity rather than enterprise basis (+ includes some industries - specified separ

Gampaha PHI estimates actual no of enterprises =

25 % of trade licence no (this seems too high - implies every enterprise has 4 TLs); consider 50 % more reasonable - adopt average =

37.5 %, giving

578 enterprises less 33 industries counted separately, giving tot comm enterprises = 545 (market stalls not subtracted as do not appear to be in TL list)

5. Summary: No of commercial enterprises =

545 enterprises with waste gen = 4.54 T/d, equiv to 8.34 kg/enterprise d (similar to Negombo & Kandy - OK)

b. Markets

ID	Name	Address	No of stalls				Stalls		Total	WD (kg/d)	WDR (kg/stall wastes)	Main F>P>PI	OSD	LA colln	Recy	Notes
			Meat/Fish	Veg/Fruit	Goods	Other	Retail	W/s								
MG2	Public market	Gampaha	26	90	32	10	NA	NA	158	730	4.62	F>P>PI	0	720	10.0	Open Mon-Sat from 7:30am-7:30pm
MG1	Sunday Pola	Yakkala	6	150	25	0	NA	NA	181	188	N/A	F>P>M/F	131.4	56.31	0.0	Open Sun from 8am-5pm
	Total		32	240	57	10	0	0	339				131.4	776.3	10.0	
									Equiv daily stalls = 184	918		Disp %	14.32	84.59	1.08	Allows for Pola being on only 1d/wk
									Average WGR =	4.99	kg/stall d					

Notes: In this case, F/K = vegetable/fruit waste/leaves, coconut shells, etc; W/s = wholesale

1. GMC public mkt data: Part 2 = 27 stalls, part 3 = 53 stalls, part 4 = 49 stalls; fish mkt part A = 14 stalls, fish mkt part B = 13 stalls (differs by 2 from survey data)

2. Waste generation based on:

a. MG1 said it produces 3 2WT of waste on Sun but PHI stated waste gen = 1 4WT/d - latter figure considered more reasonable = 1.3 T using 1 TL = 1.48 T, assuming 90 % full or 0.19 T/d

b. MG2 stated it produces 2 TL waste/d but JICA disposal site survey data indicates 0.5 TL/d - latter considered more accurate = 0.73 T/d using 1.48 T/4WT from JICA disposal site survey

c. Yakkala PHI said there is no permanent mkt in Yakkala area, other than 3 fruit/vege, 3 fish & 3 meat stalls + some other retail shops selling fruit/veges - assumed their waste included in commercial waste amount

3. Waste stream breakdown based on:

a. Pola market waste is collected by labourers during Mon-Tues and taken to the MC transfer station at the Pola site, with the waste being taken from there to landfill once per 2wks according to the pola survey. JICA disposal site survey shows only 1 TL/d comes from Yakkala to disposal site, with no increase on Mon-Tues due to pola waste. Assume 70 % = OSD (at transfer stn) with residual = LA coll'n (supported by Yakkala PHI comments)

b. All public market waste is collected by GMC, except for some scavenging of recyclables by individuals - assumed to be

10 kg/d

c. Industries

1. Garment Factories

Industries	Address	No of Staff	SW Gen (kg/d)	Main 3 wastes	Waste disposal		Waste disposal				Total		
					Main	Other	OSD	Comp	LA colln	Recy			
LW16	Ranaviru Apparel	David Pens Mw, Yakkala	600	50	T>G>F	F	G	29.8	0.0	0.0	20.2	0.0	50.0
LW17	Milan Safti Equipment	92/1/48, Alithgama Watta, Yakkala	35	25	T>R>F	D	E	8.8	0.0	16.3	0.0	0.0	25.0
LW18	Richard & Roberts Lanka Pvt	Keenagahalanda Watta, Kalagedi	600	200	T>F>P	G	D	0.0	0.0	37.0	163.0	0.0	200.0
LW21	K.K. Garments	Keenagahalanda Watta, Kalagedi	350	100	T>P>F	G	F	95.2	0.0	0.0	4.8	0.0	100.0
LW23	Politex Garment	Werallawatta, Yakkala	1200	160	T>F>G	C	G	0.0	0.0	148.3	11.7	0.0	160.0
LW24	Deewoon Lanka Pvt. Ltd	7, Parakrama Rd, Gampaha	30	10	T>F>G	D	F, G	3.5	0.0	6.5	0.0	0.0	10.0
	Sub-total		2815	545				137.2	0.0	208.1	199.8	0.0	545.0
			Waste generation rate =	0.194	kg/worker d	% disposal	25.2	0.0	38.2	36.7	0.0	100.0	

Notes:

1. Waste stream breakdown based on JICA survey:

a. LW16 recycles 10kg/mth of c/board, 5 polythene bags/mth, 8kg/mth other plastics & 1500kg/mth of F/K wastes for animal feed = 50.6 kg/d, ignoring the polythene bags. This exceeds the stated waste generation.

Survey data indicates recycling is secondary disposal method - adjust calculated recycling amount to 20.24 kg/d; i.e. 40 % of calculated value

b. LW17 - assume LA collection = 65 %; remainder = OSD

c. LW18 recycles 3075kg/mth of paper/cardboard, 15kg/mth of polythene bags, 300kg/mth of steel & 1500kg/mth of F/K waste for animal feed = 163 kg/d - consistent with stated waste generation & disposal methods.

d. LW21 recycles 75kg/mth of paper/cardboard, 50 polythene bags, 10kg/mth other plastics & 60kg/mth of F/K wastes for animal feed = 4.8 kg/d - lower than expected based on stated disp. methods - adopted in absence of other data

e. LW23 recycles 70kg/mth of cardboard, 200kg/mth of other plastics & 80kg/mth of F/K wastes for animal feed = 11.7 kg/d

f. LW24 recycles 1.5kg/mth of plastic = 0.05 kg/d; assume 65 % of remaining waste = LA coll'n; residual = OSD

2. Desiccated coconut mills

	Other Industries	Address	Type	No of Staff	SW Gen (kg/d)	Main 3 wastes	Waste disposal		Waste disposal					Total
							Main	Other	OSD	Comp	LA colln	Recy	ID	
LW22	Bandarawatta DC Mill	Gampaha Rd, Yakkala	Coconut mill	80	5260	Co>F>P	F	G,I	3375	0	0	1885	0	5260
LW25	Bogamuwa DC Mill	Yakkala	Coconut mill	150	1850	Co>F>G	D	G,I	0	0	180	953	718	1850
	Total			230	7110			3375	0	180	2837	718	7110	
			WGR =	30.9	kg/worker.d			47.5	0.0	2.5	39.9	10.1	100.0	

Notes:

1. Waste stream breakdown based on JICA survey data:

- a. LW22 generates 10kg/d of normal waste and 30,000 waste coconuts/d. It recycles 12kg/mth of paper, 400,000-500,000 coconut shells & 36000kg/mth of coconut inner layer (polkurutu).
 Total waste generation = 5260 kg/d, based on given data and measured weight of one shell = half nut = 87.5 g (avg weight of 40 shells)
 Recycling = 2513 kg/d, using given data and avg of 450,000 coconut shells recycled per mth - adjust by 75.0 % to be consistent with stated waste disposal methods
 Assume for remaining waste, OSD = 100 % as i = illegal dumping refers to coconut processing wastewater only.
- b. LW25 generates 350kg/d of normal waste and 1.5T of coconut shells. It recycles 600,000 coconut shells/mth, 3,600kg of polkurutu and 6,000 broken nuts - treat as for LW22:
 Total waste generation = 1850 kg/d. Recycling = 1905 kg/d - exceeds gen'n, adjust by 50 % to be consistent with stated waste disposal methods.
 Assume LA colln = 20 % of residual waste (i.e. approx 50% of normal waste); remainder = illegal dumping to vacant land

3. Sawmills

No	Name	Location	Avg no workers	SW gen (kg/d)	Waste disposal					Total
					OSD	Comp	LA colln	Recy	ID	
SW1	Kusum Sawmill	Bandarawatta, Gampaha	5	153	40	0	0	113	0	153
SW2	Jayasiri Sawmill	Gaitotamulla, Yakkala	5	57	25	0	0	32	0	57
SW3	Kumara Sawmill	Radawana Rd, Yakkala	7	408	0	0	0	408	0	408
SW4	M.A.C. Sawmill	Kandy Rd, Yakkala	8	1167	188	0	0	979	0	1167
SW5	Ranjanees Sawmill	137/1 Kandy Rd, Yakkala	5	201	69	0	0	132	0	201
	Total		30	1986	321	0	0	1665	0	1986
			Disposal %	18.2	0.0	0.0	83.8	0.0	0.0	100
			WGR =	66.2	kg/worker.d			397	kg/sawmill.d	

Notes:

1. Waste stream breakdown based on:

- a. SW1: 1.5T/mth sawdust & 0.24T/mth bark are given away for free (recy); 2.5TL (2.38T/mth) of woodchips used on-site or given to lab'rs (assume 50% OSD, 50% recy) and 0.5TL (0.48T/mth) of woodchips is sold (recy).
 b. SW2: 0.75T/mth sawdust is burnt (OSD) while 0.95T/mth woodchips are given away (recy).
 c. SW3: 7.5T/mth of sawdust is given away for free while 4.75T/mth of woodchips are sold (both recy).
 d. SW4: 11.25T/mth of sawdust is given away for free or burnt on-site (assume 50% OSD, 50% recy), while 23.75T/mth of woodchips are given away/sold (recy).
 e. SW5: 4.13T/mth of sawdust is given away or burnt on-site (assume 50% OSD, 50% recy), while 1.90T/mth of woodchips are given away (recy).
 2. Trade licence data gives a total of 13 sawmills in GMA - hence total waste generation = 5163 kg/d

4. Other Industries

	Other industries	Address	Type	No of Staff	SW Gen (kg/d)	Main 3 wastes	Waste disposal		Waste disposal					Total
							Main	Other	OSD	Comp	LA colln	Recy	ID	
LW19	Saniro Industries Pvt. Ltd.	Aluthgama, Bogamuwa, Yakkala	Steel furnit. prod'n	53	10	T>H>G	G	F	6.67	0	0	3.33	0	10.00
LW20	Super Steel Industries	125 Kandy Rd, Yakkala	Scrap steel recycling	16	1.7	M	A-D		0.00	0	1.7	0.00	0	1.67
LW21	Super Plastic Industries	1/166 Kandy Rd, Yakkala	Plast. recy/prod'n	17	16.7	PI	A-D		0.00	0	16.7	0.00	0	16.67
LW20	Revimal Bag Industries	57/8, Yakkala Rd, Bandarawatta	Bag production	40	100	P>F>R	D	G	0	0	32.5	67.5	0	100.00
LW25	Siddhaurweda Laboratory	171, Kandy Rd, Yakkala	Ayur medic. prod'n	125	500	F>G>P	F	G	495.83	0	0	4.17	0	500.00
LW32	St Jude Industries Ltd.	Indigolla, Gampaha	Coir processing	100	74.3	F>M>F	F	G	40.0	0.0	0.0	34.3	0	74.33
	Sub-total			351	702.7				542.5	0.0	50.8	109.3	0.0	702.7
			% disposal						77.2	0.0	7.2	15.6	0.0	100.0
			Average WGR =	117	kg/industry.d									

Notes:

1. Waste stream breakdown based on JICA survey data:

- a. LW19 recycles 50 tins/mth at an assumed weight of 2kg (most likely to be paint tins) = 3.33 kg/d - lower than expected based on stated disposal methods - adopted in absence of other data
 b. LW20 recycles 2025kg/mth of paper/cardboard = 67.5 kg/d - higher than expected based on stated disposal methods - adopted as consistent with paper/cardboard being main waste type
 c. LW25 recycles 100-150kg/mth of broken glass = 4.17 kg/d, based on 125kg/mth
 d. LW32 produces 40kg/mth waste & recycles 30kg/mth metals + 1000kg/mth fibre = 34.3 kg/d of recycling - believed this is not included in waste disch amt - hence gen increased to account for this.
 2. Total other industry waste generation based on a total of 12 industries, of which 6 were sampled = 1405 kg/d

3. INSTITUTIONS - DETAILED INFORMATION

a. Schools

	Name	Address	Type	Student	Staff	St + Staff	Hostel
1	Thaksila MV	Sri Bodhi Rd, Gampaha	1C	1332	54	1386	N
2	Anura MV	Veediawatta, Dewalaya	1AB	1450	62	1512	N
3	Gamini Primary (KV)	Karaniyakamulla	2	43	6	49	N
4	Jinarathna Primary (KV)	Mahattuwa	2	31	7	38	N
5	Parakkrama MV	Bandarawatta	1C	2820	101	2921	N
6	Chandrayothi MV	Yakkala	1C	1335	55	1390	N
7	Wijitha Vidyalaya	Indigolla	2	299	18	317	N
8	Keppetipola MV	Henarthgoda	NA	1286	56	1342	N
9	Gajaba Junior School	Bandiyamulla	NA	299	19	318	N
10	Rathnawali Balika V	Colombo Rd, Gampaha	1AB	2600	91	2691	N
11	St Peters College	Pokuna Rd, Gampaha	1AB	268	18	286	N
12	Sri Siddhartha Kumara V	Siddhartha Rd, Gampaha	1C	1250	55	1305	N
13	Yasodara Devi BV	Nandana Mw, Gampaha	1AB	2500	95	2595	N
14	Gothami College	Vishaka Rd, Gampaha	2	2169	81	2250	N
15	Anura Primary (KV)	Veediawatta, Dewalaya	NA	1017	33	1050	N
16	Sri Bodhi Primary	Sri Bodhi Rd, Gampaha	3	1205	44	1249	N
17	Holy Cross College	Colombo Rd, Gampaha	1AB	3108	135	3243	N
18	Bandaranayake MV	Yakkala Rd, Gampaha	1AB	3720	160	3880	N
Total				26732	1090	27822	

School Survey Results			Students	Staff	St + St	SW (kg/d)	Waste Types	Disposal		Waste Stream Data					
								Main	Other	OSD	Comp	LA colln	Recy	iD	Total
LW1	Gothami College	Gampaha	2169	81	2250	12	P>G>P	C	G, I	0.0	0.0	7.7	0.1	4.2	12.0
LW2	Sri Siddhartha Kumara V	Gampaha	1250	55	1305	50	Pl>G>P	C	G, H	0.0	0.2	49.7	0.1	0.0	50.0
LW3	Yasodara Devi BV	Gampaha	2500	95	2595	300	P>G>F	D	F, G, H	117.3	3.3	176.0	3.3	0.0	300.0
LW4	Rathnawali Girls College	Gampaha	2600	91	2691	520	P>Pl>F	F	G	519.6	0.0	0.0	0.2	0.0	519.8
LW5	Parakkrama MV	Gampaha	2820	101	2921	30	Pl>G>F	F		30.0	0.0	0.0	0.0	0.0	30.0
LW6	Chandrayothi MV	Yakkala	1335	55	1390	250	Pl>P>G	D	F	87.5	0.0	162.5	0.0	0.0	250.0
LW7	Anura MV	Yakkala	1450	62	1512	15	Pl>P>G	E	F	15.0	0.0	0.0	0.0	0.0	15.0
Bandaranayake MV			3720	160	3880	372		A-D		0.0	0.0	372.5	0.0	0.0	372.5
Total			17844	700	18544	1549				769.4	3.5	768.4	3.7	4.2	1549.2

Notes:

WGR =	0.084 kg/(stud+staff) d	Waste strn %	49.7	0.2	49.6	0.2	0.3	100.0
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1. Waste generation data:

- a. Rathnawali Girls Coll. produces 2 Tr/d, assume small tr= 2.1 m³ x 82.5 % full x 150 kg/m³ density (< Gampaha CV vehicle, based on P/Pl waste being most common)
- b. GMC suprs indicated Gothami + Yasodara Devi BV produce ~1/8 4WT/d = 183 kg/d, based on 1.48 T/4WT load - consistent with estimated LA colln quantities from these two schools.
- c. GMC suprs indicated they collect 1 x 2WT load/d from Bandaranayake MV = 372 kg/d, based on 3.03 m³(avg 2WT) with dens= 150 kg/m³ & 82.5 % full (typically 80-85%)
- d. GMC Supr's said Holy Cross College garbage collected by MC - as waste generation not known, assume waste strn %s provide for this.

2. Waste stream breakdown data:

- b. LW1 recycles 3kg/mth of books = 0.1 kg/d; assume LA colln = 65 % for remaining waste; residual = Illegal dumping
- c. LW2 recycles 4kg/mth books & composts 5kg/mth garden waste for own use = 0.13 kg/d recycling & 0.17 kg/d composting; remaining waste = LA coll'n
- d. LW3 recycles 100kg/mth of paper & composts 100kg/mth of garden waste = 3.33 kg/d recycling & 3.33 kg/d composting; assume LA coll'n for 60 % of remaining waste, OSD for residual
- e. LW4 recycles 5kg/mth of paper = 0.17 kg/d
- f. LW6 - assume LA colln = 65.0 %, remainder = OSD

3. Surveyed schools comprise

69.4 % of staff+student population - assumed representative

b. Other Educational Institutes

Name	Address	Type	Staff	Students	Total	Hostel	Gen (kg/d)	Waste Stream Data					ID	Total
								OSD	Comp	LA coll	Recy			
1 Municipal Pre-school (PS)	Kumartunga Mw, Gampaha	Pre-school	5	150	155	IR								
2 Weerasinghe Pre-school	Vijaya Rd, Gampaha		14	500	514	IR								
3 Buddhi Daycare Centre/PS	29, Mihindu Mw, Gampaha		4	140	144	IR								
4 Gunaratna Pre-school	29, Mihindu Mw, Gampaha		3	100	103	IR								
5 Gampaha Montessori	3/12, Santhi Mw, Gampaha		2	60	62	IR								
6 Lusiya Pre-school	Nuwanthi Convent, Colombo Rd, Gampaha	Gampaha	2	75	77	IR								
7 Sama Vihara Pre-school	242, Colombo Rd, Gampaha		2	60	62	IR								
8 Sanasa Pre-school	No. 3/115, Colombo Rd, Gampaha		3	150	153	IR								
9 Husena Daycare Centre/PS	Yakkala Rd, Gampaha		1	25	26	IR								
10 Angel Vision Pre-school	Goseta Rd, Gampaha		10	250	260	IR								
11 Play School	Minuwangoda Rd, Gampaha		3	100	103	IR								
12 Arkadium Pre-school	No. 3/206, Siyane Rd, Gampaha		1	20	21	IR								
13 Visakha Pre-school	No. 62, Visakha Rd, Gampaha		13	500	513	IR								
14 Daycare Centre & PS	Courts Lane, Gampaha		1	35	36	IR								
Pre-school sub-total			64	2165	2229		186.2	92.5	0.4	92.4	0.4	0.5	186.2	
Ward International School	Queen Marys Rd, Gampaha	Internat.	18	160	178		14.9	7.4	0.0	7.4	0.0	0.0	14.9	
Samadi Educational Inst.	Yakkala Rd, Gampaha	Tuition	10	750	760	IR	105.0	105.0	0.0	0.0	0.0	0.0	105.0	
Sipsara	Gampaha		22	1500	1522		213.1	181.1	0.0	32.0	0.0	0.0	213.1	
Sorbonne	Gampaha		20	2000	2020		282.8	240.4	0.0	42.4	0.0	0.0	282.8	
Montana	Gampaha		30	5000	5030		704.2	598.6	0.0	105.6	0.0	0.0	704.2	
Nanik	Gampaha		16	2000	2016		282.2	239.9	0.0	42.3	0.0	0.0	282.2	
Vidyaravinda	Gampaha		10	1000	1010		141.4	120.2	0.0	21.2	0.0	0.0	141.4	
Salasika	Gampaha		10	1000	1010		141.4	120.2	0.0	21.2	0.0	0.0	141.4	
Oriented Higher Educ. Inst.	1/21 Queen Marys Rd, Gampaha		5	1200	1205		168.7	143.4	0.0	25.3	0.0	0.0	168.7	
TEC Sri Lanka	Gampaha	Comp	NA	NA	100	IR	14.0	14.0	0.0	0.0	0.0	0.0	14.0	Estimated staff and students
Technical College	Gampaha	tech Coll	35	120	155		50.0	17.3	0.0	32.5	0.2	0.0	50.0	
Total			240	16895	17235		2304	1880	0.5	422	0.7	0.5	2304	
WGR =		0.134 kg/(staff+stud).d					Waste stream disposal (%)	81.8	0.0	18.3	0.0	0.0	100.0	

JICA Survey data

ID	Name	Address	Type	Staff	No of students	Staff + students	No of residents	Wt (kg)	WGR (kg/(S+R))	Waste types	1.6		Waste Stream Data					
											Main	Oth	OSD	Comp	LA coll	Recy	ID	Total
LW8	Technical collage	Gampaha	tech Coll	35	120	155	0	50	0.417	F>G>T	D	F, G	17.3	0.0	32.5	0.2	0.0	50.0
LW9	Samadi Education Centre	69/4, Yakkala Rd, Gampaha	Tuition	10	750	760	0	105	0.140	NA	E	F	105.0	0.0	0.0	0.0	0.0	105.0
LW9	WAAV	Yakkala	Univ+hosp	See note 2e		988	200	1356	1.373	G>F>P	F		1356.1	0.0	0.0	0.0	0.0	1356.1

Notes: (WAAV = Wikrama Arrachchi Ayurveda Vidyayatanaya)

1. Specific JICA survey results:

a. LW9 produces 3.5 Tr/d, assume small tr= 2.1 m3 x 75 % full x 246 kg/m3 density (as per Gampaha CV vehicle)
 b. LW8 recycles 6.25kg/mth metal = 0.21 kg/d, assume 65 % of residual waste = LA coll'n; residual = OSD

2. Waste generation and waste stream breakdown based on:

a. For pre-schools & Ward Int'l School, assumed school WGR applicable = 0.084 kg/(staff+students).d & use school waste stream breakdown %
 b. For tuition classes & TEC Sri Lanka, use surveyed WGR & OSD = 85 %, residual = LA coll'n & assume TEC Sri Lanka staff + students = 100
 c. For Technical College & WAAV, use surveyed WGR & waste stream %.

d. WAAV specified separately due to large waste generation relative to other educational institutes and because hospital and university waste dealt with together. Staff/student/patient details are as follows:

University: staff = 155 ; students = 275 ; staff+students = 430
 Hospital: beds = 120 with avg occup of 90 %; outpatients = 300-350/d = 325 ; clinical patients 60 pat/d; staff = 65 ; tot= 558

Total university staff+students + hospital patients (bed patients, OPD and clinical) & staff = 988 /d

e. WAAV (hospital; tel interview) indicated it privatised its university+hospital waste collection service about 1.5mths ago (i.e. after JICA survey), following which all waste is collected by private contractors and burnt on-site.

The hospital indicated they produce about 0.5TL/d of waste, while the university stated it produces about 3.5TL/d, as stated above. Hence, JICA survey interview results were modified as per tel conversation.

c. Hospitals

	Name	Address	Type	Beds	Bed occu Rate (%)	Out-pat./d	Clin pat./d	Staff	Total St+pat	Waste Types	Waste Stream Data						Total
											OSD	Comp	LA colln	Recy	ID	DH	
1	Gampaha Base Hospital	Yakkala Rd, Gampaha	Govt	501	79%	985	334	595	2310	F>P>G	486.3	0.0	198.2	49.2	0.0	9.6	743.3
2	Arogya Hospital	Colombo Rd, Gampaha	Private	42	100%	60	40	54	196	P>F>M	2.0	0.0	68.0	2.0	0.0	0.0	72.0
3	Co-operative Hospital	Queen Marys Rd, Gampaha	Semi-govt	27	95%	80	45	60	211	F>P>P	2.0	0.0	39.6	0.5	0.0	0.0	42.0
Total				570	81.4%	1125	419	709	2717		490.3	0.0	305.8	51.6	0.0	9.6	857.3
Waste Disposal %s											57.2	0.0	35.7	6.0	0.0	1.1	100

Notes:

- Additional waste generation data from GMC:
 - Coop Hosp produces ~2/3 barrel/d = 33kg/d (200L x 246kg/m³) - consistent with JICA survey.
 - Arogya hosp produces 2.5 barrels/d = 105kg/d (assuming 85% full) - exceeds survey data.
- In both cases, JICA survey data used.
- Waste stream breakdown based on:
 - BH-norm waste, assume LA colln= 30 %; remainder = OSD
- This is consistent with landfill survey records, which recorded only 2 x 50% full trips from the hospital over a continuous 7d period = 1420kg/full load = 203 kg/d
- BH - post-mortem waste and placentas taken to cemetery - assume direct haulage. HI waste - urine and blood disposed to drains (WWTP), other is burnt on-site.
- BH - for clinical waste & body parts, assume 75 % burnt on site, with remainder being taken to cemetery
- BH - mth recycling = 200kg c/board, 400kg plast., 4 kg polyth.bags, 15kg condemned metal items, 675kg glass, 118kg coconut shells & 6,274 saline bott. = 49.2 kg/d, assuming 10g/saline bottle
- AH - for normal waste, recycling = 45 pl bottles/mth + 50kg/mth glass = 1.97 kg/d; other normal waste = LA colln; all HH waste = incineration (OSD)
- CH - for normal waste, recycling = 3-4kg/mth of cardboard and 10kg/mth of glass = 0.45 kg/d; other normal waste = LA colln; clin+BP+sharps = OSD
- Overall waste generation rate = 0.316 kg/(staff+patients).d

JICA survey

ID	Waste generation (kg/d)						Disposal methods				
	Nor	Clin	BP	Plac	Sharps	HI	Nor	Cl+BP	Plac	Sharps	HI
BH	710	10.46	w clin	7	16	NA	D,F	F,K	K	F	K,F
AH	70	2	small	small	small	small	A,G	I	I	I	I
CH	40	2	N	N	0.000	N	A,G	F	IR	F	IR

d. Government Offices

	Name	Address	Workers	Notes
1	District Secretariat	Kachcheri, Gampaha	54	
2	Provincial Secretariat	Ananda Mw, Gampaha	85	
3	Office of Assist. Comm'r of Local Govt	Kachcheri, Gampaha	43	
4	Office of Reg. Dir'r of Health Services	Kachcheri, Gampaha	114	
5	National Youth Services Council	Kachcheri, Gampaha	39	
6	Audit Sub Office	Kachcheri, Gampaha	16	
7	Provincial Revenue Dept	Kachcheri, Gampaha	29	
8	District Survey Office	Kachcheri, Gampaha	33	
9	Land Use Planning Office	Kachcheri, Gampaha	68	
10	Industrial Information Centre	Kachcheri, Gampaha	11	
11	District Samurdhi Office	Kachcheri, Gampaha	38	
12	District Planning Directors Office	Kachcheri, Gampaha	29	
13	Motor Vehicles Transport Section	Kachcheri, Gampaha	8	
14	District Irrigation Enquiries Office	Kachcheri, Gampaha	15	
15	Dept of Wildlife Conservation	Kachcheri, Gampaha	3	
16	Office of Deputy Reg. Dir'r of Agric	Sri Bodhi Rd, Gampaha	25	
17	Agrarian Development District Office	Sri Bodhi Rd, Gampaha	34	
18	Samurdi Banku Sangamaya	Colombo Rd, Gampaha	6	
19	Office of the Medical Officer of Health	Colombo Rd, Gampaha	18	
20	District Labour Office	Church Rd, Gampaha	30	
21	Land Registration Office	Vijaya Rd, Gampaha	43	
22	Magistrate Court	Court St, Gampaha	47	
23	High Court	Court St, Gampaha	47	
24	District Court	Court St, Gampaha	68	
25	Office of Zonal Dir'r of Education	Gampaha	102	LW12
26	Gampaha M.C.	Queen Marys Rd, Gampaha	214	LW35: Cadre = 284
27	Prison	Gampaha	80	30 workers, 50 inmates
28	Police Station	Sri Saranankara Rd, Gampaha	286	
Total			1585	

Notes:

- Ranaviru Apparel, Army Camp counted under industries
- Following govt institutes not included in above list of govt offices, as more commercially oriented/service enterprises:
 - Sri Lanka Telecom, Court St (107 workers)
 - Post Office, Colombo Rd, Gampaha (3 workers)
 - Post Office, Court St, Gampaha (83 workers)
- MC cadre = 284, including Yakkala; actual workers = 186 at Gampaha and 28 at Yakkala

JICA survey data

ID	Name	Workers (+ inmates for prison)	Wt (kg)	Waste types	Disposal method		Waste Stream Data						
					Main	Oth	OSD	Comp	LA colln	Recy	ID	Total	
LW12	Divisional Education Office	102	12	P>F>G	F	G	11.8	0.0	0.0	0.2	0.0	12.0	
LW35	Municipal Council	286	50	G>F>P	D	F	17.5	0.0	32.5	0.0	0.0	50.0	
	Prison	80	24.6		D		0.0	0.0	24.6	0.0	0.0	24.6	
	Courts	162	12.3		D		0.0	0.0	12.3	0.0	0.0	12.3	
Total		630	98.9				29.3	0.0	69.4	0.2	0.0	98.9	
Notes:							Waste stream %s	29.7	0.0	70.2	0.2	0.0	100.0

- Additional waste stream data from GMC Supervisor interviews:
 - Prison produces about 0.5 barrels/d = 24.6 kg/d, assuming 200 L barrel and waste density = 246.0 kg/m³
 - Courts produce about 0.25 barrels/d = 12.3 kg/d, which is collected by GMC
- Waste generation rate = 0.157 kg/worker.d - OK within typical range measured for other study towns
- Waste stream breakdown based on:
 - LW12 recycles 5kg/mth of paper = 0.167 kg/d
 - LW35 - assume LA collection = 65 %; remainder = OSD
- Prison has 30 staff and 50 inmates

e. Religious

Name	No	No of "workers"
1 Buddhist		8
2 Hindu		3
3 Mosques		2
4 Churches		5
Total		18

Notes:

- Waste stream data based on:
 - buddhist institutes - based on data supplied by GMC (below) and JICA survey data for one place
 - Hindu kovil - assumed 3 kovils with 3 clergy at each place (Gampaha PHI said none but seems unusual in area this size)
 - Mosque - assumed 2 mosques with 3 clergy at each place (Gampaha PHI said none but seems unusual in area this size)
 - Churches - average of 3 clergy at each place
- Assume average 1.01 kg/clergy.d, with OSD = 50 % and LA coll'n = 50 %, based on data for Matale and Kandy, with OSD being increased to account for survey result & unserviced areas in GMC; LA collection decreased accordingly.
- Assumed WGR is consistent with surveyed value - OK.

Name	Address	Workers/residents	Gen (kg/d)	Waste Types	Disp method (%)	Notes
					Main Other	
1 Vidyasekara Maha Pirivena	Bendiyamulla, Gampaha	8				
2 Samarakkody Aramaya	Sri Bodhi Rd, Gampaha	0				
3 Bogamuwa Temple	Bogamuwa	6				
4 Mahawita Temple/Pirivena	Mahawita	6				
5 Papalgahadeniya Temple	Papalgahadeniya	3				
6 Chandrajothi Temple	Yakkala	6				
7 Wedyawansa Temple	Indigolla	6				
8 Vidyaravinda Pirivena	Pahalagama, Gampaha	55	45	G>F>PI	E F	Avg guests = 18; peak = 300 LW33
Total		90				

4. OTHER

a. Public Spaces

- There are no large parks, etc. located within GMA, with the Henarthgoda Botanical Gardens being situated just outside GMA limits.
- There are some sportsgrounds, playgrounds, etc. for which a nominal waste generation amount of 108 T/d has been allowed; i.e. 1 HC/d @ avg 108 kg/HC
- It is assumed that public space waste is disposed of as follows: 50 % to OSD; 50 % to LA collection

b. Roads, drains and canals

	Length cleaned by MC	Gampaha	Bandiyamu	Yakkala	Total
Roads (km)		19	3	48.5	70.5
Drains (km)		20	5	12	37
Canals (km)		2	0	1	3
Total		41	8	61.5	110.5

Notes:

- GMC suffers from a shortage of road and drain cleaners for a number of reasons including labourer absenteeism and the long lengths of major roads and associated drains (e.g. Kandy-Colombo Rd) requiring cleaning. Hence, it is reasonable to assume that the actual cleaning coverage is relatively low.
- Average road sweeping waste estimate = 49.1 kg/km.d from three other JICA studies in Poland, Honduras and Dar-es-salaam
- Assuming that 4 % of all roads are swept daily, total waste gen'n = 138 kg/d or 1.3 HC/d based on 108 kg/HC
- Assuming drain/canal cleanings are of similar magnitude to road sweepings = 138 kg/d
- Total road/drains/canal cleaning waste = 277 kg/d or 2.6 HC/d
- This is considered reasonable, by comparison with other study towns and taking into account specific conditions within GMA, as described under note 1.
- It is assumed that 50 % of this waste is left at the side of the roads/drains/canals and 50 % collected by GMC.

5. WASTE STREAM ESTIMATION

Waste Source	Waste Generation Rate (WGR)		No	Gen'n (T/d)	Sub-total		OSD Disp	Comp	LA colln	Recycle	ID	DH	Total (check)	Notes
	WGR	Units			(T/d)	(%)								
Households	0.451	kg/cap.d	58577	26.42	26.42	49.2	17.75	0.69	4.94	0.78	2.26	0.00	26.42	1
Commercial	8.34	kg/trade licence.d	545	4.54	4.54	8.5	0.59	0.00	2.44	1.32	0.00	0.19	4.54	2
Markets	4.99	kg/stall.d	184	0.92	0.92	1.7	0.13	0.00	0.78	0.01	0.00	0.00	0.92	3
Institutions														
a. Schools	0.084	kg/(stud+staff).d	27822	2.32			1.15	0.01	1.15	0.01	0.01	0.00	2.32	4
b. Other Education	0.134	kg/(stud+staff).d	17235	2.30			1.88	0.00	0.42	0.00	0.00	0.00	2.30	5
c. WAAV	1.373	kg/(stud+staff).d	988	1.36			1.36	0.00	0.00	0.00	0.00	0.00	1.36	6
b. Hospitals	0.316	kg(patients+staff).d	2717	0.86			0.49	0.00	0.31	0.05	0.00	0.01	0.86	7
d. Govt offices + Police/Prison	0.157	kg/worker.d	1585	0.25			0.07	0.00	0.17	0.00	0.00	0.00	0.25	8
e. Religious	1.01	kg/clergy.d	120	0.12	7.21	13.4	0.06	0.00	0.06	0.00	0.00	0.00	0.12	9
Industries														
a. Garment Factories	0.194	kg/worker.d	2815	0.55			0.14	0.00	0.21	0.20	0.00	0.00	0.55	10
b. Coconut Mills	30.9	kg/worker.d	230	7.11			3.38	0.00	0.18	2.84	0.72	0.00	7.11	11
c. Sawmills	397.1	kg/sawmill.d	13	5.16			0.83	0.00	0.00	4.33	0.00	0.00	5.16	12
d. Other industries	117.1	kg/industry.d	12	1.41	14.22	26.5	1.09	0.00	0.10	0.22	0.00	0.00	1.41	13
Other														
a. Parks	0.11	T/d		0.11			0.05	0.00	0.05	0.00	0.00	0.00	0.11	14
b. Road and drain cleaning	0.28	T/d		0.28	0.38	0.7	0.14	0.00	0.14	0.00	0.00	0.00	0.28	15
Total	0.92	kg/cap.d	58577	53.70	53.70	100.0	29.10	0.70	10.95	9.76	2.99	0.20	53.70	
Recycling from discharge									0.00	0.00				16a
Recycling from collection									-0.04	0.04				16b
Recycling from transfer stations									0.00	0.00				16c
Adjustment to collection amount									-1.35		1.35			18
Adjusted totals						Adjust =	1.35	29.10	0.70	9.56	9.80	4.33	0.20	53.70
Burning at Yakkala Pola							1.16		-1.16					17
Disposal to landfill from within GMA (GMC vehicle data)									8.40			0.20		19
Recycling from final disposal									0.00	0.00				16d
Recycling from illegal dumps									0.05	-0.05				16e
Revised total				53.70	53.70		30.26	0.70	8.40	9.85	4.28	0.20	53.70	

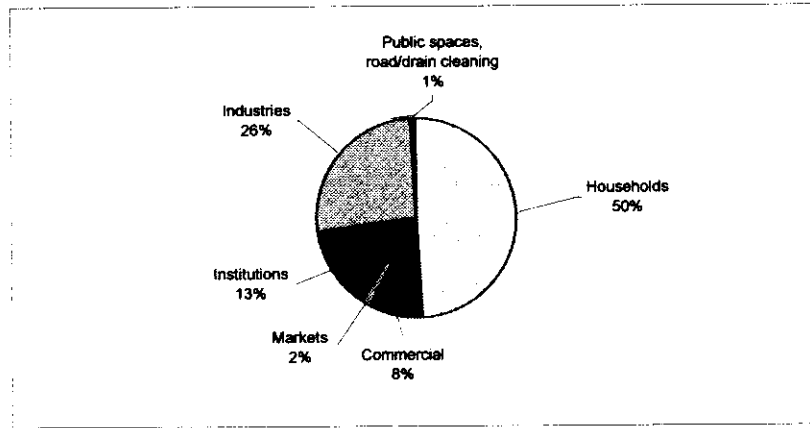
Notes:

- Household WGR was determined from Kandy, Matale & Gampaha WACS data & UNEP (2001) while waste stream %s calculated using household survey data and taking into account service coverage, which gave the following %s:

Method	OSD	Comp	Disch	Recy	ID	DH	Total
%	56.4	1.3	15.6	18.3	8.0	0.4	100.0
%	67.2	2.6	18.7	2.9	8.6	0.0	100.0
- Commercial waste generation calculated from interview survey results and other data collected. % details on separate sheet
- Market waste generation calculated from interview survey results and other data collected - see details above.
- School's waste stream data calculated from interview survey results - see calculations under school staff and students data - assumed recycling figure includes recycling going to middlemen
- Other educational institute data calculated from school and tuition centre survey data, with a very high proportion of this waste being assumed to be disposed of on-site - see details above.
- Hospital waste stream data calculated from interview survey results - see calculations under hospital data; assumed recycling figure includes recycling going to middlemen
- Govt offices + police/prison calculated based on no of workers and estimated WGR (obtained using limited data); includes police & prison as "Forces" were not specified separately in this case
- All religious institutes treated together, with one of these being surveyed.
- Garment factory waste generation and waste stream %s estimated from survey data for all 6 garment factories within GMA.
- Coconut mill waste generation and waste stream %s estimated from survey data for both coconut mills within GMA - waste generation is very high but mainly comprises coconuts.
- Sawmills waste estimated from survey interview data - see details above.
- Other industries comprise a wide range of industries of which a representative cross-section were surveyed - see industry and supporting data.
- GMA has no large public spaces other than some small sportsgrounds, playgrounds, etc. Hence, a nominal waste generation amount of 1 HC/d was assumed for this category.
- Road and drain cleaning estimated based on approx. total length of roads/drains, data from other studies, and estimated % of roads/drains cleaned daily.
- 16a. Recycling at discharge: 0.00 T/d, assumed negligible due to high at source recycling (collectors/direct to shops) + very few scavengers seen collecting recyclables after discharge
- 16b. Recycling during collection: 0.04 T/d, from collection worker survey and time and motion study data
- 16c. Recycling at transfer stations: 0.00 T/d, based on observations and PHI comments.
- 16d. Recycling at landfill: 0.00 T/d, from disposal site survey, PHI & Supervisor comments.
- 16e. Recycling from illegal dumps: 0.05 T/d, nominal allowance
- Waste discharged at Yakkala Pola transfer station = 2 2WT loads @ 0.88 T/avg load, 3.5 HC/d (3-4 loads/d) @ 0.126 T/load & Sun Pola waste (already counted for under mkt waste) Based on observations and PHI comments, assumed 70% of this waste is burnt on-site rather than being taken to the final disposal site = 70 % of 1.66 T/d = 1.16 T/d, which must be subtracted from the collection amt
- Illegal dumping amount adjusted to account for difference between estimated collection and final disposal amounts (direct haulage not included in final disposal amount).
- GMC collection vehicle trips data gave a total of 8.4 T/d
- Total at source recycling excluding sawmill and coconut mill waste = 2.59 T/d

Data for Waste Generation by source graph

Waste Source	Generation (T/d)
Households	26.4
Commercial	4.5
Markets	0.9
Institutions	7.2
Industries	14.2
Public spaces, road/drain cleaning	0.4
Total	53.7



Trade Licence Details

No	Category	Gampaha	Yakkala	Bandiyamulla	Total	Notes
1	Bakeries	7	22	12	41	
2	Tea shops	50	46	20	118	
3	Hotels (local+accomodation)	21	21	15	57	mainly local hotels (eating places)
4	Restaurants	6			6	
5	Spice shops		84		84	
6	Fruit Shops		13		13	
7	Vegetable Shops		5		5	
8	Meat stalls	7	3	3	13	
9	Furniture shops	9	5		14	
10	Furniture production		4		4	
11	Furniture		8	4	12	
12	Sawmills	1	13		14	
13	Firewood & Carpentry Shops	7	4		11	
14	Mechanical carpentry shops		32	NA	32	
15	Lathes	4	6		10	
16	Motor Garages	4	12		16	
17	Motorcycle repair		10		10	
18	Bicycle repair		5		5	
19	Vehicle repair	8	1		9	
20	Vehicle service	4	6		10	
21	Cleaning of vehicle interiors		3		3	
22	Vehicle electrical work		2		2	
23	Rice mill		3		3	
24	Chilli mill		4		4	
25	Cut coconut production		2		2	Assume DC mills
26	Copra stores		1		1	
27	Oil mill		2		2	
28	Welding works	6	20		26	
29	Battery charge		2		2	
30	Tyre vulcanising		7		7	
31	Lime storage		2		2	
32	Cement stores		3		3	
33	Electrical items repair		4		4	
34	Fibreglass production		3		3	
35	Printers	8	5		13	
36	Brush production		1		1	
37	Production of artificial limbs		1		1	
38	Paint Selling		8		8	
39	Jewelry		8		8	
40	Firewood		1		1	
41	Copra production		1		1	
42	Petrol shed		1		1	
43	Hardware		6		6	
44	Tin workshop		2		2	
45	Quarry		1		1	
46	Quartz polishing		1		1	
47	Honey shop		1		1	
48	New/old steel storage	2	1		3	
49	Frozen chicken selling		3		3	
50	Western medicine sales		3		3	
51	Ayurvedic medicine sales		5		5	
52	TV/radio repairs		8		8	
53	Rice sales		5		5	
54	Building materials		13		13	
55	Confectionery sales		2		2	
56	Ferrous workshop		2		2	
57	Catering		1		1	
58	Chinese restaurant		2		2	
59	Lime selling		3		3	
60	Mechanical rubber production		1		1	
61	Processed food items		5		5	
62	Electrolysis/galvanizing		3		3	
63	Metal casting factory		1		1	
64	Vehicle gas conversion		1		1	
65	Cement sales		5		5	

No	Category	Gampaha	Yakkala	Bandiyamulla	Total	Notes
66	Timber shops			12	12	
67	Vehicle garage			3	3	
68	Aquariums			3	3	
69	Tea sales			2	2	
70	Animal husbandry			1	1	
71	Poultry farm			3	3	
72	Studio	8		3	11	
73	Wrist watch repair			4	4	
74	L.P gas production places			2	2	
75	Spray painting			2	2	
76	Silencer making			2	2	
77	Plastic goods production			1	1	
78	Steel goods production			3	3	
79	Food packing			2	2	
80	Salons	12		16	28	
81	Cast goods selling			1	1	
82	Cushion materials sales			1	1	
83	Laundry	3		1	4	
84	Refrigerator repair			2	2	
85	Mechanized stone breaking			1	1	Assume quarry
86	Cool drinks stores	13		1	14	
87	Yoghurt production			1	1	
88	Grinding mills	6			6	
89	Fish stalls	3			3	
90	Various stores	12			12	
91	Coffin store/sales	3			3	
92	Cinema hall and club	3			3	
93	Gem cutting	1			1	
94	Liquor bar				2	
95	Retail			NA	0	
96	Reception Hall				10	
97	Explosives	2			2	
98	Coir production			1	1	
	Total	210	527	66	803	

Notes:

1. Combined total for Gampaha, Yakkala and Bandiyamulla = 803 but Bandiyamulla record is incomplete.
2. Trade licence data for three areas supplemented by ECL data, as appropriate.
3. 2001 trade licence data for Gampaha gives the following business place details:

A	Tax paying business places	600
B	Tax paying trade licence places	150
C	Hotels	21
Total		771

4. Additional data obtained from Gampaha PHI gave tax and trade licences =

Gampaha	825	Slightly greater than note 3 total
Bandiyamulla	66	Agrees with total in table
Yakkala	650	Slightly > total in above table
Total	1541	- this figure has been adopted.

5. Gampaha Hotels and restaurants breakdown given below:

Hotels

No	Name	Address
1	Anura Gunasiri Zoysa	98, Colombo Rd, Gampaha
2	O. Rajapaksha	126, Jaela Rd, Gampaha
3	S.A. Nimalsiri	16, Bauddaloka Mw, Gampaha
4	L.D.A. Gunawardana	300, Colombo Rd, Gampaha
5	Priyanthi Karunanayaka	234, Colombo Rd, Gampaha
6	G.G.M. Lukas	114, Colombo Rd, Gampaha
7	A.K. Jayasinghe	93, Yakkala Rd, Gampaha
8	K.G.G. Indrarathna	24, Vijaya Rd, Gampaha
9	M.D. Anil Kumara	15, Saranankara Rd, Gampaha
10	K.A.D. Amarasinghe	9, Mangala Rd, Gampaha
11	M.W.A.R. Vijesooriya	4, Mangala Rd, Gampaha
12	Nimal Satharasinghe	35, Orutota Rd, Gampaha
13	K.M.G. Upul Shantha	15, Minuwangoda Rd, Gampaha
14	M.A. Mallawa Arachchi	228, Colombo Rd, Gampaha
15	B.A. Wimalasena	532, Colombo Rd, Gampaha
16	Nilpigera	96, Jaela Rd, Gampaha
17	A. Candrapema	27, Ranathunga Rd, Gampaha
18	W.A. Waruna Pradeep	130, Bauddaloka Mw, Gampaha
19	Sampath Jayendra Dadigama	58, Bauddaloka Mw, Gampaha
20	I.A.J. Wijerathna	32, Court Rd, Gampaha
21	Dayani Salpitigala	127, Minuwangoda Rd, Gampaha

Restaurants

No	Name	Address
1	K.P.A.S. Krunanayaka	236, Colombo Rd, Gampaha
2	P.L.A.P.M. Perera	350, Colombo Rd, Gampaha
3	Priyanwada Alahakoon	24, Vijaya Rd, Gampaha
4	U.P. Wikramaratna	33/1 Kumaratunga Mw, Gampaha
5	Wimal Gamage	234, Colombo Rd, Gampaha
6	L.H.P. Somathilake	20, Sudarsana Mw, Gampaha

Gampaha MC - Industries requiring an Environmental Conservation Licence

Type	No	Owner's Name	Address	Notes
Sawmill	13	M.A.C.Munasinghe W.R.U.R.Ranasinghe J.A.Chandra Jayakody J.M.Nandalal R.A.W.Perera R.S.V.Sirisighe R.S.V.Sirisighe R.L.M.Samanmalee S.D. Amaraseena H.H.S.Piurni Kumari A.K.C.Perera J.K.D.C.Jayasekara J.A.Jayawardana	166,Kandy Rd,Yakkala Aluthgama,Bogamuwa,Yakkala Puwakgahakotuwa,Galthotamulla, Yakkala Bulathgmgoda,Yakkala Alubogahalanda,Bandarawatta, Gampaha 17,Pichchamal Uyana, Pituwalgoda, Yakkala 51,Salmal Uyana,Kiridiwela Rd,Yakkala 21/2,Moranna Yakkala 4/32 Radawana Rd, Yakkala (Kumara sawmill) 1,Pituwalgoda,Yakkala 142, Kandy Rd Yakkala Kandy Rd Yakkala 77/A Galthotamulla Yakkala	Also woodshop Also mech. Carpentry shop Also mech. Carpentry shop Not on ESL list Also shop Ranjaneer sawmill Also carpentry shop
Mech. carpentry shop	20	W.A.N.Weerathna J.K.A.Gunasinghe K.P.Chandrasiri Rajapaksa M.A.C.Munasinghe, A.Ashoke Nihal Chandrasiri M.P.Siman. K.Rohini Upamallika M.Z.M.Ameen M.Predeep Caminda Alviis P.P.Lal Gamini T.M.A.M.Thilakarathna D.Upul Nishantha M.D.Chandrasiri Lakshman Rohitha Daipadalu K.K.Gunasekara W.P.Wimalaweera K.A.D.Piyasiri Rukmon Perera D.Sarath Somapala J.A.Nihal Perera	Weralla watta,Kandy Rd,Yakkala 24/24c Vickrama Pl, Bandarawatta, Gampaha 110/1,Aluthgama,Bogamuwa, Yakkala 92/16/01,Kandy Rd,Yakkala 113/1,Bandarawatta, Gampaha 178,Bogamuwa,Aluthgama,Yakkala 145,Kandy Rd,Yakkala 121,Aluthgama, Bogamuwa,Yakkala 2/86 D,Thiththalapitigoda,Yakkala 204/2,Keselwathugoda Yakkala 57/9 A,Yakkala Rd Gampaha 8/1 Papolgahadeniya,Yakkala 175/5,Aluthgama, Bogamuwa,Yakkala 33/1,(865/A/1) Vishaka Pl, Madagatama, Gampaha 43/A Morann,Yakkala 64,Indigolla, Gampaha 93,Kandy Rd, Yakkala 47,Waturugama Rd,Miriswatta,Mudungoda 129/1B,Keedagammulla,Gampaha 62A,Aluthgama Bogamuwa,Yakkala	Also timber shop Also timber shop
Carpentry/furniture	1	D.R.Vijitha/A.M.Priyantha bandula	221,Bogamuwa,Yakkala	Carpentry shop & furniture sales
Timber factory	2	E.B.Sarath Pushpakumara J.A.Sarath Pushpakumara	150/4 Weediya watta,Yakkala 67,Kandy Rd, Yakkala	Timber goods production
Plastic goods prod'n	1	A.K.Sarath Kumara Perera	166/Y Kandy Rd, Yakkala	
Steel goods prod'n	3	A.K.Sarath Kumara Perera J.A.V.K.W.Jayasundara Saniro Steel Furniture	125, Kandy Rd, Yakkala In front of the tower, 34 Alubogamuwa,Yakkala Aluthgama,Bogamuwa,Yakkala	
Coconut mill	2	D.C.Mill D.C.Mill	Bandarawatta Yakkala Aluthgama,Bogamuwa,Yakkala	S Vijayasiri SN Jayasinghe
Coir	1	St Jude Coir Factory		
Quarry	2	K.D.Gunasekara LDAA Dissanayake/LDDS Dissanayake	Henipitamulla, Kandy Rd Yakkala 1/C, Seedeve Mw, Yakkala	
Vehicle repairs	1	Devi Gunawardana	Gampaha Rd Yakkala	
Accomm, festival hall, restaurant, canteen	16	Chandra Jayakody J.K.D.M.Jayasekara W.A.S.Weerasinghe K.Wimalasena NAC Kosthiriarchehi KA Somarathna EJ Sanjeewa MPN Ratnasiri RA Upasena HA Sirithninga MGP Madarage KADP Kumarasinghe Hotel Jayamal Hotel Lettona K.A.Dayan Nilantha M.V.Sirisena	Kandy Rd Yakkala Hotel Dilsha, 123/A, Kandy Rd Yakkala 52/19 Radawana Rd Yakkala 16/52/A,Bulathgasgoda,Yakkala Nicos, 3,Bandarawatta, Gampaha Habitala Inn, Horagalla, Bogamuwa 63/A/28 Koppetipola Mw, Bandarawatta 52/17,Radawoma Rd, Yakkala Aluthgama Watta,Yakkala 16/52 Bulathgmgoda, Yakkala 50 Racharam Rd, Yakkala 274/4 Hansagiri Rd, Gampaha Galthotmulla,Yakkala Kandy Rd, Yakkala 361,Yakkala Rd Bandarawatta,Gampaha Lane 4,Pituwalgoda Rd,Aluthgamawatta,Yakkala	Accom Guesthouse, reception hall Guesthouse, reception hall rest Guesthouse, reception hall Guesthouse, reception hall Guesthouse, reception hall Guesthouse, reception hall Guesthouse, reception hall Guesthouse, reception hall Guesthouse, reception hall Accom hotel Accom hotel canteen Reception hall
Bakery	2	W.G.Dayarathna Saymon Sinno (H Bakery)	1/6/1, Seedeve Mw, Gampaha Rd, Yakkala 156, Miriswatta, Mudungoda	

Type	No	Owner's Name	Address	Notes
Garment	6	Richard and Roberts Lanka P Ranaviru Apparel Everbest garment (P.V.T) limit Milan Soft Equipment Deewoon Lanka Pvt. Ltd. K.K. Garments Pvt Ltd	Keenagahalanda Watta, Kalagedihena David Peris Mw, Yakkala Werallawatta Yakkala 92/1/48, Alithgama Watta, Yakkala 7, Parakrama Rd, Gampaha Keenagahalanda Watta, Kalagedihena	Same as Polytex
Steel lathe	1	A.K.B.K.Perera	125, Kandy Rd, Yakkala	
Grill workshop	1	K.Wijayadasa	82, Kandy Rd Yakkala	
Animal farm	1	R.K.J.A.Ranasinghe	3/2, Mirisawatta, Mudungoda	
???	1	Sameera Industries	Aiuthgamawatta, Yakkala	
???	1	K.N.B Fernando-Hina Industri	Indigolla, Gampaha	
Bag production	1	Ravimal Bag Production	Indigolla, Gampaha	
???	1	Lankuloka Hardware		Formerly State Hardware Corp & was closed for 5yrs - reopened Jul 02 as private co.
Ayur medicine prodn	1	Siddhaurweda Laboratory Ltd.	171, Kandy Rd, Yakkala	
Total	78			

Notes:

1. Designated industries for this study = blue shaded items which includes the following sub-categories

a. Garment factories=	6 with all surveyed	surveyed
b. Deseccated coconut mills=	2 with both surveyed	surveyed
c. Sawmills =	13 from TL data with	5
d. Other =	12 from above data with	6

2. Other enterprises are included in "commercial" category.

Chapter 6

Gampaha Waste Collection Analysis

Jan-02

No	Vehicle	Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Tot	Avg	CF	Tonnage	
		4WT Reg	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th		trips/d	T/trip	T/mth	T/d
1	4WT	49-8156	2	2	2	2	2	0	2	2	2	2	2	2	0	0	2	2	2	2	1	0	2	2	2	1	2	1	0	0	3	2	2	48	1.5	1.38	66	2.14
2	4WT	49-9561	1	2	2	2	0	2	2	1	1	2	2	1	1	1	1	3	2	2	1	1	2	2	2	2	2	1	1	1	2	2	2	49	1.6	1.30	64	2.05
3	4WT	49-2722	2	2	2	3	2	0	3	3	2	2	1	3	0	0	3	0	3	1	2	0	1	3	2	2	2	1	0	0	2	1	2	50	1.6	1.13	57	1.83
Total			5	6	6	7	4	2	7	6	5	6	5	6	1	1	6	5	7	5	4	1	5	7	6	5	6	3	1	1	7	5	6	147	4.7		187	6.0

Note: Conversion factor takes into account the trailer volume, fill factor and garbage density.

Days 31

Jul-02

No	Vehicle	Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Tot	Avg	CF	Tonnage		
		Reg No	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th	F	Sa	Su	M	Tu	W	Th		trips/d	T/trip	T/mth	T/d
1	4WT	49-8156	2	2	1	2	2	1	2	3	1	2	2	2	2	2	1	1	2	2	2	1	1	1	2	2	0	2	1	1	0	1	48	1.5	1.38	66	2.14		
2	4WT	49-9561	2	2	2	2	2	2	0	2	2	2	2	2	2	0	1	3	2	2	2	1	1	2	2	1	2	2	1	1	2	0	2	51	1.6	1.30	66	2.13	
3	4WT	49-2722	0	2	2	3	2	3	0	3	3	2	1	2	1	0	3	2	1	2	1	2	0	2	0	2	3	2	2	0	2	3	2	53	1.7	1.13	60	1.93	
4	4WT	49-9178	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	0	1	1	0	0	0	1	0	0	2	1	2	22	0.7	1.51	33	1.07	
5	4WT	25-9190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	4	0.1	1.33	5	0.17	
Total			5	7	6	8	7	7	3	9	7	7	6	6	5	50	6	6	5	7	6	5	3	6	3	5	7	5	6	2	8	6	7	178	5.7		231	7.5	

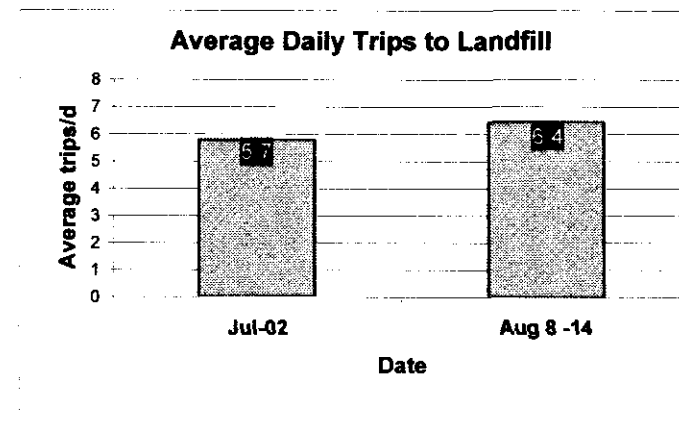
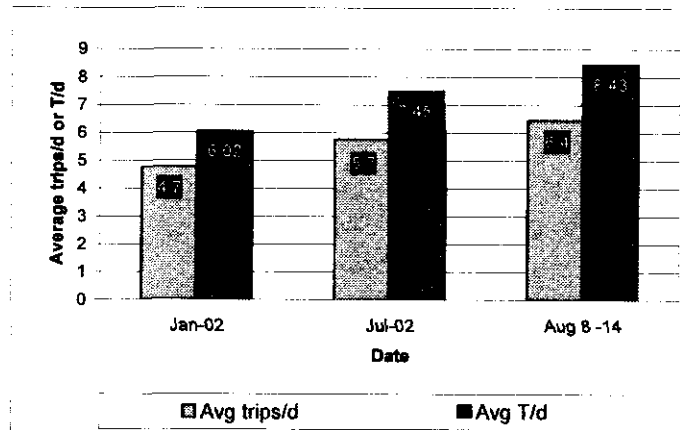
Note: Conversion factor takes into account the trailer volume, fill factor and garbage density.

1. For 25-9190, average filling factor used

2. Yakkala area added since April 2002 - hence more loads than Jan 2002

Days 31

1-9



Landfill survey			Tractor Registration				
Date	Time	From	49-9561	49-8156	49-2722	49-9178	Total
8-Aug Thu	5:30	Gampaha		1			1
	9:45	Mkt		0.5			0.5
	10:20	Yakkala	1				1
	11:30	Gampaha		1			1
	11:50	Gampaha			1		1
	15:30	Gampaha		1			1
	15:40	Gampaha			1		1
9-Aug Fri	6:00	Gampaha		1			1
	9:15	Mkt			0.5		0.5
	10:30	Yakkala	1				1
	11:30	Gampaha		1			1
	13:20	Gampaha			1		1
	16:30	Gampaha		1			1
10-Aug Sat	6:00	Gampaha			1		1
	9:00	Mkt			0.5		0.5
	10:30	Yakkala	1				1
	13:20	Gampaha	1				1
	13:30	Gampaha			1		1
11-Aug Sun	6:00	Gampaha	1				1
	9:30	Mkt		0.5			0.5
12-Aug Mon	6:00	Gampaha		1			1
	9:15	Mkt			0.5		0.5
	11:30	Gampaha		1			1
	11:45	Gampaha	1				1
	12:15	Yakkala				1	1
	12:30	Hosp			0.5		0.5
	15:45	Gampaha				1	1
13-Aug Tues	6:00	Gampaha		1			1
	10:00	Mkt			0.5		0.5
	11:00	Yakkala				1	1
	11:30	Gampaha	1				1
	11:45	Gampaha		1			1
	15:45	Gampaha		1			1
14-Aug Wed	6:00	Gampaha				1	1
	9:15	Mkt			0.5		0.5
	11:45	Gampaha				1	1
	11:50	Gampaha		1			1
	12:05	Hosp			0.5		0.5
	12:10	Yakkala	1				1
	15:45	Gampaha			1		1
Total			8	17	14	6	45

Item	Date	Tractor Registration					Total	Avg/4WT
		49-9561	49-8156	49-2722	49-9178			
No of trips/d	8-Aug	1	5	2	0		8	2
	9-Aug	1	3	3	0		7	1.75
	10-Aug	2	0	3	0		5	1.25
	11-Aug	1	1	0	0		2	0.50
	12-Aug	1	3	2	2		8	2.00
	13-Aug	1	3	1	2		7	1.75
	14-Aug	1	2	3	2		8	2.00
	Total		8	17	14	6	45	11.25
Average		1.14	2.43	2.00	0.86	6.43	1.61	
No of equiv full loads/d	8-Aug	1	4.5	2	0		7.5	1.88
	9-Aug	1	3	2.5	0		6.5	1.63
	10-Aug	2	0	2.5	0		4.5	1.13
	11-Aug	1	0.5	0	0		1.5	0.38
	12-Aug	1	3	1	2		7	1.75
	13-Aug	1	3	0.5	2		6.5	1.63
	14-Aug	1	2	2	2		7	1.75
	Total		8	16	10.5	6	40.5	10.13
Average		1.14	2.29	1.50	0.86	5.79	1.45	
Avg FF		1.00	0.94	0.75	1.00	0.90		
Daily disposal tonnage (T/d)	8-Aug	1.29	6.61	3.01	0.00		10.92	2.73
	9-Aug	1.29	4.41	3.77	0.00		9.47	2.37
	10-Aug	2.59	0.00	3.77	0.00		6.36	1.59
	11-Aug	1.29	0.73	0.00	0.00		2.03	0.51
	12-Aug	1.29	4.41	1.51	3.11		10.32	2.58
	13-Aug	1.29	4.41	0.75	3.11		9.56	2.39
14-Aug	1.29	2.94	3.01	3.11		10.36	2.59	
Total		10.36	23.50	15.82	9.33	59.01	14.75	
Average		1.48	3.36	2.26	1.33	8.43	2.11	

Notes:

1. Average fill factor (FF) = no of equiv full loads/no of trips
2. Daily disposal tonnage = No of equiv full loads x Full tonnage
3. Average no of trips/d from Yakkala = 1 trip/d except for Sun = 0.86 trips/d
4. Average no of market trips/d = 1 trips/d or 0.5 equiv full loads/d
4 of these trips are done by 49-9561 & 2 trips by 49-9178. Avg tonnage/d = 1.18 T/d (averaged over week)
- Market waste tonnage = 0.75 T/d (based on 2 x 49-8156 & 5 x 49-2722 tractor trips over week @ 50% full)
5. Average no of hospital waste trips/d = 0.29 trips/d or 0.14 equiv full loads/d
- Hospital waste tonnage = 0.20 T/d (based on 2 x 49-2722 tractor trips with hospital trailer over week @ 50% full)
6. By difference, waste from other areas of Gampaha = 6.30 T/d

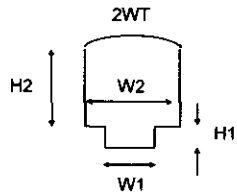
Measured Vehicle Dimensions

Vehicle Type	Reg No	Ext. dimensions				Int. dimensions				Avg FF	Act (kg)	Full (kg)	
		H (m)	L (m)	W (m)	Vol (m3)	H (m)	L (m)	W (m)	Vol (m3)				
Handcart	IR					0.44	1.20	0.74	0.39	0.95	91.3	96.1	Gampaha: 4ftx2.5ftx1.5ft
	IR					0.59	1.21	0.75	0.54	0.95	125	132	Yakkala: 4ftx2.5ftx1.9ft (higher than normal handcarts)
4WT	25-9190	Not measured											
4WT	49-9561	1.08	3.02	1.85	6.03	1.03	2.92	1.75	5.26	1.00	1296	1295	
4WT	49-8156	1.24	3.00	1.83	6.81	1.19	2.90	1.73	5.97	0.94	1384	1469	
4WT	49-2722	1.23	3.05	1.86	6.98	1.18	2.95	1.76	6.13	0.75	1132	1507	includes two hospital trailer loads
4WT	49-9178	1.31	2.95	1.86	7.19	1.26	2.85	1.76	6.32	1.00	1509	1555	
4WT	Average								5.92	0.92	1330	1456	
4WT	Hosp trailer					1.29	2.95	1.78	5.77	0.5	711	1420	Rectangular base height = 0.4m; semi-circular top height = 0.89m

Notes:

- Dimensions measured by JICA
- Internal dimensions calculated from external dimensions based on wall and floor thickness of 5 cm (measured)
- Average fill factors based on JICA disposal site survey over 7day period from Aug 8-14, 2002.
- Gampaha collection vehicle waste density (for extracted sample) was measured to be 150 kg/m3. This is considerably lower than all other measured CV densities during this study and may possibly be due to the low number of trips made at Gampaha making it difficult to obtain representative samples. This density has been increased to 200kg/m3 for use in calculations. This is considered more reasonable, given that all trailers are 3-4ft high, and are normally full apart from the market and hospital waste trailers.
- Tractor volumes converted to tonnages initially based on internal vol x fill factor x density, where density = 246 kg/m3 (Gampaha CV density/(0.5*(Kandy + Matale CV density)) x weighbridge density)
Data: W'bridge 4WT density = 390 kg/m3; Kandy coll'n veh (CV) density = 303.4 kg/m3; Matale CV density = 330 kg/m3; Gampaha CV density = 200 kg/m3
- For handcart tonnage, a waste density of 246 kg/m3 as per tractor data

6-3



$Vol = (W1 \times H1 + W2 \times H2) \times L$
(ignoring top curved bit)

Vehicle Type	Reg No	Trailer Reg No	Int. dimensions						Avg FF	Act Wt (kg)	Full Wt (kg)	
			H1 (m)	H2 (m)	L (m)	W1 (m)	W2 (m)	Vol (m3)				
2WT	75-3817	N/a	0.40	1.06	1.70	1.06	1.45	3.33	0.83	677	821	Yakkala 2WT
2WT	NA	N/a	0.40	0.9	1.71	1.05	1.36	2.81	0.83	571	692	
2WT	NA	N/a	0.40	0.89	1.80	1.04	1.33	2.88	0.83	585	709	
2WT	Avg		0.40	0.95	1.74	1.05	1.38	3.01	0.83	611	741	

Notes:

- Filling factor based on observation during JICA time and motion study - 80-85% full for Yakkala 2WT when travelling to transfer station. Assumed same filling factor for other 2WTs (only observed empty).
- Zone 4 supervisor noted that 1 4WT trailer can take 2.5-3.0 2WT loads.

Average No of Trips - Summary

Tractor	Average No of Trips			Average Tonnage			
	Jan-02	Jul-02	Aug 8-14	Tractor	Jan-02	Jul-02	Aug 8-14
49-8156	1.5	1.5	2.4	49-8156	2.1	2.1	3.4
49-9561	1.6	1.6	1.1	49-9561	2.0	2.1	1.5
49-2722	1.6	1.7	2.0	49-2722	1.8	1.9	2.3
49-9178	0.0	0.7	0.9	49-9178	0.0	1.1	1.3
25-9190	0.0	0.1	0	25-9190	0.0	0.2	0
Total	4.7	5.7	6.4	Total	6.0	7.5	8.4
Avg/vehicle	1.58	1.15	1.61	Avg	2.01	1.49	2.11

Graphical data

Date	Avg trns/d	Avg T/d
Jan-02	4.7	6.02
Jul-02	5.7	7.45
Aug 8-14	6.4	8.43

A. General Notes

Gampaha MC

1. SWM Staff Salary + allowance costs

Item	Salary	Allowance	Total	Adopted
Driver	3800	2200	6000	6,000
Labourer	3400	2200	5600	5,600

Notes:

- Driver - class 1 salary = 3765Rs/mth + 110Rs/yr increase; class 2 salary = 4540 + 110Rs/yr increase (GMC Revenue section)
- Labourer - class 1 salary = 3,400Rs/mth + 80Rs/yr annual increase; class 2 salary = 3,990Rs/mth + 110Rs/yr increase (GMC Revenue section)
- Collection worker survey gave average salary of 5,296 Rs/mth, including allowances, or 3,096 Rs/mth basic salary
- Gampaha PHI said driver salary = 5780 Rs/mth; labourer salary = 5400 Rs/mth - both of these are less than class 1 salary - too low
- Adopt labourer salary = 3400 Rs/mth; driver salary = 3800 Rs/mth + 2200 allowance for both, as per Chilaw

2. Equipment Costs

Item	Cost (Rs)	Lifetime	Notes	
Ekel broom	34.5	1 mth	Assume lifetime = 1mth	
Small basket	82.5	1 mth		
Large basket	245.5	2 wks		
Rake	85	2yrs		
Brush	85	1mth		
Shovel	220	1yr		Use whenever needed
Fork	139	2.5yrs		Landfill worker only
Mamoti	480	5yrs		Landfill worker only
Gumboots		3yrs		Landfill workers and drain cleaners
Gloves	50	6mths		Normally only issued during wet weather
Raincoats			Issued during wet weather only	
Uniforms			No uniforms have been issued to labrs for at least 1yr	
Aprons			On order	

Notes:

- Gampaha PHI gave annual cost for gloves of 11500 Rs/yr for 42 labrs = 274 Rs/labr.yr
- Gampaha PHI gave annual cost for protective equipment = 72685 Rs/yr = 1731 Rs/labr.yr (costs apply to Gampaha + Bandyamulla staff only)
- Check calculated equipment costs below against annual cost (Gampaha+Bandyamulla only):

	No	Equip cost	Total	Labrs/veh	Total	Notes
Handcart	2	2089	4177	2-3	5	avg cost for 2-3 labrs per HC
2WT	4	3006	12023	2	8	
4WT	3	8954	26862	4	12	
Total			43061		25	equiv to 1722 Rs/Lr.yr

The equipment cost per labourer is close enough to that calculated directly from the PHI's data and hence these costs have been adopted.

3. Other Costs

These were determined using data provided by GMC which generally gave total expenditure for all GMC vehicles, excluding the Yakkala area. These were divided between the 2WT and 4WT based on relative costs from other towns/cities covered by this study.

GMC costs are:

- Diesel = 300000 Rs/yr
- Oil = 12000 Rs/yr
- Tractor maintenance = 178,802 Rs/yr, comprising 152,727 Rs/yr for tyres/tubes & 26075 Rs/yr for other maintenance
The tyres and tube cost is very high relative to other towns/cities, while the maintenance cost is low. When these two items are combined, the overall tractor maintenance cost is of similar magnitude to that found in other towns/cities and hence this figure has been used here.
- Trailer maintenance = 104000 Rs/yr
- Licence cost = 705 Rs/yr which equates to 101Rs/vehicle - normally this is 150Rs/yr for tractors - hence, latter figure has been adopted.
- Insurance = 42699 Rs/yr

B. SWM Vehicles - Current Costs

Handcart - 2 labourers	Rate	Unit	No	Amt (Rs)	Notes
Labourers	5600	Rs/mth	24	134400	Labrs = 2
Protective gear/equipment	1952	Rs/yr	1	1952	
Oil	0	Rs/mth	12	0	
Wheel set (2)	1440	Rs/yr	1	1440	1,800Rs/set @ 1-1.5yr/set (from NMC)
Maintenance	1000	Rs/yr	1	1000	Based on NMC costs
Insurance	0	Rs/yr	1	0	
Rev Licence	0	Rs/yr	1	0	
Depreciation	3500	Rs/yr	1	3500	
Total				142292	
Avg no of trips per day		trips/d	3		GMC PHI estimates
Avg amt collected per mth		T/mth	8.0		
Average amount collected per yr		T/yr	96		
Unit cost		Rs/T		1482 Rs/T	

Notes:

1. Staff protective equipment based on GMC equipment data and current prices:

a. Gloves	2 labourers/HC x	274 annual cost/labr =	548 Rs/yr	
b. Uniforms	2 labourers/HC x	0 Rs/yr =	0 Rs/yr	No uniforms
c. Ekel broom	1 broom/HC x	12 sets/yr @ 35 Rs ea =	414 Rs/yr	
d. Small basket	1 basket/HC x	12 sets/yr @ 83 Rs ea =	990 Rs/yr	
Total labourer protective equipment costs			1952 Rs/yr	

2. Assume, HC does 3 trips/d (as advised by PHI) with avg tonnage = 0.103 T/load

(i.e. 3 HCs - 2 x Gampaha HC capacity + 1 x Yakkala HC capacity divided by 3 to get average tonnage per load)

No of trips/d = 3 Average tonnage per HC per d = 0.31 T/HC.d or 8.00 T/HC.mth, using 26 working days/mth

3. Capital cost = 10,500 Rs with estimated lifetime of 3 yrs (GMC)

Depreciation = 3500 Rs/yr (straight line method)

Handcart - 3 labourers	Rate	Unit	No	Amt (Rs)	Notes
Labourers	5600	Rs/mth	36	201600	Labrs = 3
Protective gear/equipment	2225	Rs/yr	1	2225	
Oil	0	Rs/mth	12	0	
Wheel set (2)	1440	Rs/yr	1	1440	1,800Rs/set @ 1-1.5yr/set (from NMC)
Maintenance	1000	Rs/yr	1	1000	Based on NMC costs
Insurance	0	Rs/yr	1	0	
Rev Licence	0	Rs/yr	1	0	
Depreciation	3500	Rs/yr	1	3500	
Total				209765	
Avg no of trips per day		trips/d	3		
Avg amt collected per mth		T/mth	8.0		
Average amount collected per yr		T/yr	96		
Unit cost		Rs/T		2185 Rs/T	

Notes:

1. Staff protective equipment based on GMC equipment data and current prices:

a. Gloves	3 labourers/HC x	274 annual cost/labr =	821 Rs/yr	
b. Uniforms	3 labourers/HC x	0 Rs/yr =	0 Rs/yr	No uniforms
c. Ekel broom	1 broom/HC x	12 sets/yr @ 35 Rs ea =	414 Rs/yr	
d. Small basket	1 basket/HC x	12 sets/yr @ 83 Rs ea =	990 Rs/yr	
Total labourer protective equipment costs			2225 Rs/yr	

2. Assume, HC does 3 trips/d (as advised by PHI) with HC tonnage = 0.103 T/load

(i.e. 3 HCs - 2 x Gampaha HC capacity + 1 x Yakkala HC capacity divided by 3 to get average tonnage per load)

No of trips/d = 3 Average tonnage per HC per d = 0.31 T/HC.d or 8.00 T/HC.mth, using 26 working days/mth

3. Capital cost = 10,500 Rs with estimated lifetime of 3 yrs (GMC)

Depreciation = 3500 Rs/yr (straight line method)

Two Wheel Tractor	No	Rate	Unit	Total	Notes
Driver	12	6,000	Rs/mth	72000	
Labourers	24	5,600	Rs/mth	134400	No of labourers = 2
Protective gear/equipment	LS	3006	Rs/yr	3006	
Diesel	1	18370	Rs/yr	18370	
Oil	1	1190	Rs/yr	1190	
Tractor Maintenance	1	20983	Rs/yr	20983	Includes tyres and tubes
Insurance	LS	1584	Rs/yr	1584	
Licence	LS	150	Rs/yr	150	
Depreciation	LS	6044	Rs/yr	6044	
Total				257727	
Avg trips/d (GMC data)		trips/d		1.8	Range = 0.5 -3.0trips/d
Avg amt collected		T/d		1.1	T/d
Average amount collected per yr		T/yr		338	
Unit cost		Rs/T		733	Rs/T

Notes:

- Staff protective equipment based on GMC equipment data and current prices:

a. Gloves	2 labourers/2WT x	274 annual cost/labr =	548 Rs/yr	
b. Uniforms	2 labourers/2WT x	2 sets/yr @	0 Rs ea =	0 Rs/yr No uniforms
c. Rake	1 rake/2WT	0.5 sets/yr @	85 Rs ea =	8.5 Rs/yr-Yakkala only-x 0.2 (1 of 5 2WT)
d. Fork (sometimes)	1 fork/2WT x	0.4 sets/yr @	139 Rs ea =	56 Rs/yr - assume life accounts for partial use
e. Ekel broom	1 ekel broom/2WT x	12 sets/yr @	35 Rs ea =	414 Rs/yr
f. Small baskets	2 baskets/2WT x	12 sets/yr @	83 Rs ea =	1980 Rs/yr
Total labourer protective equipment costs =				3006 Rs/yr
- Capital cost data: tractor = 105775 with estimated lifetime of 17.5 yrs (15-20yrs as per KMC)
 Straight line deprec'n = 6044 Rs/yr
 (For tractor, capital cost based on average cost of all 2WT units)
- Annual tonnage based on avg T/d of 0.61 T/2WT x 26 working days/mth x 12 mth/yr

Four Wheel Tractor	No	Rate	Unit	Total	Notes
Driver	12	6,000	Rs/mth	72000	
Labourers	48	5,600	Rs/mth	268800	No of labourers = 4
Protective gear/equipment	LS	8954	Rs/yr	8954	
Diesel	1	75510	Rs/yr	75510	
Oil	1	2420	Rs/yr	2420	
Tractor Maintenance	1	31623	Rs/yr	31623	Includes tyres and tubes
Trailer Maintenance	1	26000	Rs/yr	26000	maintenance cost for 3 trailers spread across 4 tractors
Insurance	LS	6639	Rs/yr	6639	
Licence	LS	150	Rs/yr	150	
Depreciation	LS	33069	Rs/yr	33069	
Total				525164	
Avg no of trips/d (Aug 8-14)		trips/d		1.61	
Avg amt collected (Aug 8-14)		T/d		2.1	T/d
Average amount collected per yr		T/yr		658	
Unit cost		Rs/T		799	Rs/T

Notes:

- Staff protective equipment based on GMC equipment data and current prices:

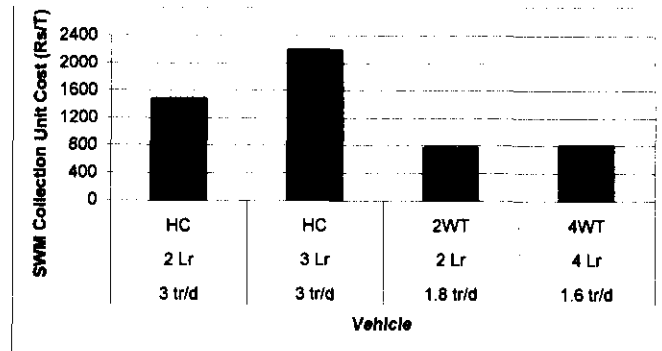
a. Gloves	4 labourers/4WT x	274 annual cost/labr =	1095 Rs/yr	
b. Uniforms	4 labourers/4WT x	2 sets/yr @	0 Rs ea =	0 Rs/yr No uniforms
c. Fork (sometimes)	1 fork/4WT x	0.4 sets/yr @	139 Rs ea =	56 Rs/yr - assume life accounts for partial use
d. Ekel broom	1 ekel broom/4WT x	12 sets/yr @	35 Rs ea =	414 Rs/yr
e. Small baskets	3 baskets/4WT x	12 sets/yr @	83 Rs ea =	2970 Rs/yr (2-4 baskets per 4WT)
f. Big baskets	1.5 baskets/4WT x	12 sets/yr @	245.5 Rs ea =	4419 Rs/yr (1-2 baskets per 4WT)
Total labourer protective equipment costs =				8954 Rs/yr
- Capital cost data: tractor = 443400 with estimated lifetime of 17.5 yrs (15-20yrs as per KMC)
 Straight line deprec'n = 25337 Rs/yr
- Capital cost data: trailer = 69,583 with estimate lifetime of 9 yrs (8-10yrs)
 Straight line deprec'n = 7731 Rs/yr
 (For both tractor and trailer, capital cost based on average cost of all units)
- Annual tonnage based on avg T/d x 26 working days/mth x 12 mth/yr

Summary

	Item	SW Amt (T/yr)	Cost (Rs/yr)	Unit cost (Rs/T)
Current				
	2WT (2Lr, 1.8 trips/d)	338	257727	764
	4WT (4Lr, 1.6 trips/d)	658	525164	799
	2WT -> TS -> 4WT			
	2WT (2Lr, 1.8trips/d)	338	257727	764
	4WT (4Lr, 1.6 trips/d)	658	525164	799
	Total	658	782891	1191

C. Graphical Data

Trips/d	No of Labrs	Vehicle	Unit costs (Rs/T)
3 tr/d	2 Lr	HC	1482
3 tr/d	3 Lr	HC	2185
1.8 tr/d	2 Lr	2WT	764
1.6 tr/d	4 Lr	4WT	799



GMC Supervisor Interview Survey Results

Area	Basic SWM Data	Problems	Ideas for Improvement
Zone 1	<ul style="list-style-type: none"> Area: commercial Vehicles: 4WT, HC Labrs: 4 Tr, 2 Sw, 1 DC, 3 mkt CPs: None LWG: Public market (1 4WT/d), Ranjan Lanka (1/3 4WT/d – mainly Ca/Pl) + from Zone 3: Police Quarters (0.125 4WT/d), Court Complex (0.25 barrels/d), Gothami College and Yasodara Devi BV (0.125 4WT/d) Loads: 1 4WT/d 	<ul style="list-style-type: none"> Labourer absenteeism – normally 7 absent; very high absenteeism during April and December). Drainage system needs repair – some concrete base slabs missing; stagnant water common. No footpath along Main St, resulting in garbage being discharged directly to the road. 	<ul style="list-style-type: none"> Repair drainage system.
Zone 2	<ul style="list-style-type: none"> Area: 70% residential; 30% commercial Vehicles: 2WT Labrs: 2 Tr, 2 Sw, 1 DC CPs: none LWG: CWE (0.33 2WT/d) Loads: 2 2WT/d 	<ul style="list-style-type: none"> Drains need repairing – lots of stagnant water. Scattering of waste by stray dogs is sometimes a problem. 	<ul style="list-style-type: none"> Replace 2WT with 4WT – more efficient, saving labour and time, primarily by eliminating need for transfer station. Implement kerbside or bell collection system, with people using sili bags for waste storage.
Zone 3	<ul style="list-style-type: none"> Area: 60-70% residential. 30-40% commercial Vehicles: 2WT Labrs: 2 Tr, 2 SW (twice/wk), 1 DC (3x/wk) CPs: 1 perm, 7 temp LWG: Garment factory – 3-4 polysacks/d; PO & surrounds: 6 big baskets/d Loads: M-Sa: 1-2 2WT loads/d (9/wk) 	<ul style="list-style-type: none"> Poor public co-operation High garden waste discharge (this was banned by former mayor with a letter being sent to households but no followup). One vehicle is insufficient if they collect all garden waste. Labourer absenteeism Supervisors have to travel around by own bicycles. 	<ul style="list-style-type: none"> Replace 2WT with 4WT for same reasons as zone 2. Build permanent bins.
Zone 4	<ul style="list-style-type: none"> Area: 40% residential, 60% commercial Vehicles: 1 4WT Labrs: 4 Tr, 2 Sw CPs: None LWG: Base Hospital, Cooperative Hospital (2/3 barrel/d) Loads: 1 4WT/d from zone + 2-3 trips from GMC transfer station. 	<ul style="list-style-type: none"> Base and Cooperative hospitals waste sometimes contains needles. They don't collect the Cooperative hospital waste is needles are present. No spare trailers at the GMC transfer station. The first 2WT discharges its load around 10am, while the first trailer is brought to the transfer station around 1:30pm. 	<ul style="list-style-type: none"> There are 4 2WTs currently in service in the Gampaha and Bandiyamulla areas. These could all be replaced by 2 4WTs, which could then go directly to the disposal site, saving time, labour and money.

Area	Basic SWM Data	Problems	Ideas for Improvement
Zone 5	<ul style="list-style-type: none"> Area: mainly residential; some scattered industry Vehicles: 2WT Labrs: 2 Tr, 1 SW, 1 DC (actual is normally 3 – see problems) CPs: 0 perm, 13 temp LWG: Sagatha Madura Hotel (5 PS/d); Deewoon Lanka Pvt (garment); Carpentry shop – 1.5-2 PS/d of sawdust; Children’s home – 3 dustbins/d; Arogya hospital (2.5 barrels/d) Loads: 2.5 2WT/d M-F, 1 2WT/d Sat; no collection Sun; sometimes 3L/d Mon 	<ul style="list-style-type: none"> Poor public cooperation, especially from residents in Church Rd area. Labourer absenteeism – sweeper and drain cleaner only assigned if sufficient labourers come for work. Typically, they have 1 SW and 1 DC once/week. The supervisor believes they actually need 2 SW and 1 DC. High garden waste generation, which is discharged at temporary CPs. Garment factory discharges waste at roadside- very difficult to collect as it comprises mainly cardboard and textile waste. Arogya hospital waste sometimes contains sharps and clinical waste. Sharps from the Base Hospital are sometimes thrown over the rear wall of the hospital into this zone (denied by hospital; not confirmed by JICA). Scattering of waste by stray dogs. 	<ul style="list-style-type: none"> Replace 2WT with 4WT. Provide 3 more labourers, including DC. Build permanent bins to avoid scattering by stray dogs.
Zone 6	<ul style="list-style-type: none"> Area: mainly residential Vehicles: 2WT Labrs: 2 Tr, 1 DC (2x/wk), 2 SW (2x/wk) (actual = 3) CPs: 0 perm, 4 temp LWG: Bandaranayake MV (1 x 2WT/d) Loads: 3L/d M, 2 L/d Tu-F, 0.5L/d Sa, none on Sun 	<ul style="list-style-type: none"> One 2WT is insufficient. Labourer absenteeism. 	<ul style="list-style-type: none"> Replace 2WT with 4WT. Public education throughout all GMA (many people are not aware of GMC’s rules regarding garden and construction waste discharge).
Night shift (zone 1 + parts of zones 2-4)	<ul style="list-style-type: none"> Vehicles : 4WT Labrs: 4 Tr, 2 Sw, 1 fish mkt, 3 vege mkt CPs: counted under other zones LWG: Counted under other zones Loads: 2 4WT loads/d (1 market, 1 other areas) 	<ul style="list-style-type: none"> Poor public cooperation with some people discharging waste during night-time following collection, so that some areas are dirty by the morning. Labourer absenteeism (normally 7-8 present out of 10; sometimes 4). No rotation of labourers between day and night shifts. 	<ul style="list-style-type: none"> Rotate labourers between day and night shifts.
Yakkala	<ul style="list-style-type: none"> Area: mixed residential and commercial Vehicles: 1 4WT, 1 2WT, 1 HC, 1 WB Labrs: 4 4WT, 2 2WT, 2 HC, 1 toilets/pola, 1 SW/DC, 1 IDP, 2 drivers CPs: Pola transfer station LWG: Sunday Pola (1 x 4WT) Loads: 2 x 2WT/d to TS + 1 x 4WT/d to disposal site 	<ul style="list-style-type: none"> Shortage of labourers and collection equipment. 	<ul style="list-style-type: none"> Provision of another 4WT and 10 more labourers. Public education/awareness raising.

Notes:

- CP = collection point, DC = drain cleaner, HC = handcart, LWG = large waste generators, L/d = loads/day, PS = polysacks, SW = sweeper, Tr = tractor, TS = transfer station, 2WT = two wheel tractor, 4WT = four wheel tractor; M = Monday, Tu = Tuesday, W = Wednesday, Th = Thursday, F = Friday, Sa = Saturday, Su = Sunday.
- Some places in zone 3 are collected by the zone 1 4WT – Police Quarters, Yasodara Devi BV, Gothami College, Courts.
- Total 4WT loads sum to 5 x 4WT direct trips/d + 2-3 x 4WT trips/d from the transfer station = 7-8 4WT/trips/d, compared with average of 6.4 measured at the disposal site. This suggests the total number of trips indicated is one higher than the actual – it is considered that the night shift + transfer station trips may be one too high.
- Total Gampaha/Bandiyamulla 2WT loads sum to 6.9trips/d (average over week) x 0.61T/2WT = 4.2T/d, equivalent to 2.9 x 4WT trips (1.46T/4WT), which is reasonably consistent with the stated number of 4WT trips from the transfer station (2-3/day).

**jica**