E.5.3 Schedule of the Survey

The Survey Schedule was as follows:

Table E.5.3a Schedule of the Time and Motion Survey

Date in 1994	Category of Collection Area	Type of Vehicle
16th May, Mon	Residential Area (Route 4-2)	Compactor Truck (14 m^3)
17th May, 18th	Residential Area (Route 5-9)	Compactor Truck (15.3 m^3)
May,Wed	Residential Area (Route 3-B)	Cart Tractor
19th May, Thu	Market, Supermarket, Office	Screw Type Collection Truck
20th May, Fri	Market	Roll-on Roll-off Truck
21th May, Sat	Oriental Market, Small Dumping Site	Wheel Loader and Dump Truck

E.5.4 Survey Results

a. Collection Activities

aa. Residential Area Collection by Compactor Trucks (Route 4-2)

The municipal collection areas are divided into 82 sections. The areas covered by the collection vehicle and the collection as the well routes are fixed. Out of 82 collection areas, 71 are covered by compactor trucks and 11 are covered by cart tractors. In the study, a typical residential area was selected and the compactor truck covering the area was traced to establish the route.

After a brief inspection and maintenance, collection vehicles leave the depot at 6:10 am to start collection work. The collection crew consists of one driver and three assistants. The collection vehicles usually arrive at the 1st designated collection area at 6:20 am.

The income level of households in the collection area is observed to range between low and middle levels. Collection frequency is three times a week, i.e. Monday, Wednesday and Friday.

Approximately 80 percent of the residents use nylon sacks as waste discharge container, while some use plastic bags, plastic buckets and drum cans.

Residents discharge waste in front of their premises, on the roadside, before the arrival of the collection vehicle. Some however, discharge waste when upon the arrival of the collection vehicle. Two of the collection crew collects the waste and brings it to the rear of the compactor truck where another crew awaits to unload the waste into the whooper. After unloading the waste, the containers including the nylon sacks, are returned to the residents; this is supposed to be very difficult, especially the nylon sacks, for the collection crew. Recycling activities, such as the separation of bottles and cans into sacks which hung from the back of the vehicle, are simultaneously carried out with the collection work. These activities were carried out smoothly and efficiently.

Collection work rate is slow when on unpaved roads as the speed of the vehicle is reduced to avoid any unexpected event. Although this area is covered by the regular collection service, scattering of waste was observed in the vacant lots.

Some houses have illegal electric outlets and the collection vehicles occasionally cut these lines.

Collection work was observed to take a total of 9 hours, including inspection and preparation before collection work and the time it took to fill up the tank and wash the vehicles after they returned to the depot. The collection work involves 2 trips, and a total of 1,051 collection points. The total amount of waste weighed by the portable type truck scale was 8.36 tons.

ab. Residential Area Collection by Compactor Trucks (Route 5-9)

The collection activities by compactor trucks were similar to the ones carried out on route 4-2. The collection area, however, is wider than other collection areas.

After a brief inspection and maintenance, collection vehicles leave the depot at 6:00 am to start collection work. The collection crew consist of one driver and three assistants. The collection vehicle arrives at the 1st designated collection area at 6:15 am. The area is a high income area. Collection frequency is three times a week, i.e. Tuesday, Thursday and Saturday. The residents mostly use plastic bags and drum cans. The nylon sacks used in the low and middle income areas is seldom used here. The collection of drum cans posed difficulties for the assistants. The waste collected contained a high percentage of kitchen waste; water content was also high. Waste water could be seen dripping from the collection vehicles.

Waste is discharged by the residents in front of their premises on the ground or on the garbage stands. Some residents discharge waste upon the arrival of the collection vehicles thereby disturbing collection activities.

The working methodology and procedures of the collection crew was similar to the one seen in route 4-2. Since there were some blind alleys in the area, the collection vehicle was forced to perform thirteen U-turns. Though it is a regular collection area, wide spread scattering of waste could be observed in vacant lots. During the residential waste collection activities, industrial waste discharge from a paint factory was collected.

ac. Residential Area Collection by Cart Tractor (Route 3-B)

Areas with poor road condition and no access for collection vehicles are covered by cart tractors. The Municipality has four cart tractors. They cover a total of 11 collection routes in the city. In the study, one of them was traced to observe the present collection work in route 3-B.

After a brief inspection and maintenance, the tractors leave the garage at 5:56 am to start collection. The collection crew consist of one driver and three assistants. The tractor arrives at the 1st designated collection area at 6:04 am. Upon arrival, the driver rings a bell in order to inform the residents of their arrival.

The roads are not paved and the flow of sewage ruin road conditions. Illegal electric outlets hanging low obstruct tractor movement and collection work.

Residents discharge waste in front of their premises, on the road, before the arrival of the tractor. Some residents, however, discharge waste upon the arrival of tractor or after it has left.

The residents living along paths not accessible to the collection tractor or at the back side of the collection road bring their waste to the corner for collection.

Residents mostly use nylon sacks. Some used plastics buckets.

Two of the collection crew collect the waste and pass it on to the other crew working on the cart. The crew unloads the waste in the container and returns the empty container back to the residents.

The collection work is very hard for the crew because of the height of the cart (1.8 m from the ground to the edge of cart). The crew working on the cart loaded up the waste with care so as not to drop it. Although the height of side protection of the cart is only 0.4 m, the height of the waste reaches a maximum of 1.2 m.

The residents sweep their own premises clean; large amounts of garden waste was included in the collected household waste.

When the tractor loaded the waste collected to the disposal site a large amount of waste was blown by the wind and scattered on the road.

Collection work took 170 minutes for the first trip and 80 minutes for the second trip excluding a short rest of 15 minutes. A total of approximately 500 collection points and 3.9 tons of waste was collected.

ad. Market and Supermarket Waste Collection with (0.83 m^3) Container

Large generation sources, i.e., large markets, supermarkets, banks, offices, hospitals, small factories and public areas use small containers (0.83 m^3) for waste discharge. These containers are hauled by a screw type collection truck with an attachment (LIAZ), six times a week except on Sundays. The study traced one of the trucks to observe the present collection work.

The departure time of the vehicle was delayed due to engine troubles; the vehicle left the garage at 6:22 am. The collection crew consist of one driver and three assistants. The collection vehicle arrived at the 1st designated collection area at 6:25 am.

The containers collected by the screw type collection truck were almost in good condition. Loading time of waste was approximately 30 seconds to 1 minute per container.

Collection work involves 2 trips per day and there are 35 total collection points with 57 containers. Containers were mainly placed outside small markets, supermarkets, banks and government and municipal offices, schools, hotels, public places and factories. The containers were placed behind each premise. Collection work is not very efficient at some points where container location is not suitable because of the following reasons:

- vehicles are parked near containers
- no space to unload an empty container
- closing gate

Scattering of waste near containers were observed.

ae. Market Waste Collection (15 m^3)Container

Large generation sources, i.e. large markets and factories, use large size containers

(15 m^3) for waste discharge. Container collection section is responsible for collection work. Three roll-on roll-off trucks are operated in the collection areas. One covers the Oriental Market, the others cover the eastern and western part of the city. The study traced one of the trucks (the one covering the eastern part of the city) to observe the present collection work by roll-on roll-off trucks.

After a brief inspection and maintenance, the truck left the garage at 6:14 am to start collection work. The collection crew consist of one driver and one assistant. The first collection point was the Central Market. There were two containers placed behind the market; one was full and the other was approximately filled by 80 percent. An empty container was unloaded from the truck to replace the full container. The whole operation takes about 7 minutes. During the transport of the container waste is usually blown off by the wind on to the roads. Unloading time at Acahualinca disposal site including the time going to the dumping point and back to the gate, was about 12 minutes. After dumping, collection work continues according to the regular collection route.

Collection work was 1 hour ahead of schedule as the containers placed at two markets and public places were not transported because they were not full. The total distance between these places was 31.5 km.

The truck arrived at the first collection point, and transported the 80% full container to the disposal site. The third collection point was the Coca Cola factory. Containers are placed behind the factory and collection took 15 minutes due to the lack of space for unloading the empty container.

Before arriving at the disposal site, many scavengers (churequeros) mounted the container and began scavenging for reusable materials. This conduct is very dangerous and results in the scattering of large amounts of waste.

The truck arrived at the garage at 10:30 am. The collection work terminated at 11:00 am after refueling and washing of the vehicle.

Total working time including inspection, preparation, refueling and washing time before and after collection work was 4 hours 46 minutes.

af. Registered Illegal Dump Sites Collection by Wheel Loader

Waste from the Oriental Market, which is the largest market in the city, is collected using the container (15 m^3) collection system. However, the amount of waste generated from the market is so great that waste is heaped on the ground in the market. On the other hand, there are spontaneous discharge points surrounding

non-collection areas.

Waste is collected by a combination of wheel loaders and dump trucks that belong to the Dumpsite Collection Section.

The survey traced a wheel loader to observe the present collection work in the Oriental Market and illegal discharge points in non-collection area.

After a brief inspection and maintenance, one wheel loader and 8 dump trucks left for the Oriental Market which was the first collection point. Wastes are heaped in the market grounds in an area of 1,700 m^2 enclosed by a 3m high concrete wall.

The container for the waste of the oriental market is placed along the side of a platform to facilitate discharge. Primary collectors fill up the container. Waste that cannot be discharged in the container are heaped on the ground and later loaded into dump trucks by wheel loaders and transported to the disposal site. Heaped waste is collected twice or thrice a week. When collecting the waste, the wheel loader produces a hollow in the ground which is usually wet from the water content of the waste. The dump trucks loaded with waste are usually dripping with water.

The last collection work was executed 3 days before this survey and the total number of trips made was 15 trips, total volume of waste loaded was about 112 m^3, e.g., about 30 tons.

112 m^3 x 0.28 t/m^3 x 0.9 = 30 tons

0.28 : apparent specific gravity of waste generated in market
0.90 : rate of operation vehicle

The second collection point for the wheel loader is Villa Progreso which is divided into a collection area and non-collection area because of the road condition.

In the non-collection area is a vacant area owned by the municipality. A section of this vacant area is used as a spontaneous discharge place.

The waste collection method applied is the same as in the first collection point, the Oriental Market. The last time collection work was conducted at this point was approximately ten days ago.

The total number of trips performed by dump trucks was 21 trips, total volume of waste loaded wa about 141 m^3 and the total amount of waste was estimated to be about 36.2 tons.

141 m^3 x 0.25 t/m^3 x 0.9 = 36.2 tons

0.25 : apparent specific gravity of waste generated in low income group areas (t/m^3)
0.90 : rate of operation vehicle

The third collection point has a round container placed by the municipality at the discharge point for the residents of Villa Progreso. Although the container was almost half full, large amounts of waste was scattered around the container. It seems like the community should give guidance to the residents on proper waste discharge methods.

The total number of trips performed by dump trucks was 6, total volume of waste loaded was about 49 m^3 and total amount of waste was estimated to be about 11 tons.

49 m^3 x 0.25 t/m^3 x 0.9 = 11.0 tons

0.25 : apparent specific gravity of waste generated in low income group areas (t/m^3)
0.90 : rate of vehicle operation

b. Time, Distance and Loading Weight of Waste

The working time, trip distance and loading weight of waste observed in the Time and Motion survey are summarized in Table E.5.4a.

The average waste collection time per trip was calculated as follows:

Zone 4-2	: 381 min/2 trips	= 190 min/trip
Zone 5-9	: 289 min/2 trips	= 145 min/trip
Zone 3-B	: 251 min/2 trips	= 126 min/trip
Market/Office	: 115 min/2 trips	= 58 min/trip
Market	: 31 min/3 trips	= 10 min/trip
Market & Villa Progreso	: 234 min/3 trips for wheel loader	= 78 min/trip
Oriental (small dumping site)	: 234 min/42 trips for dump trucks	= 6 min/trip

The average distance traveled in the collection area per trip was calculated as follows:

Zone 4-2	: 25.6 km/2 trips	= 12.8 km/trip

Zone 5-9	: 31.1 km/2 trips	= 15.6 km/trip
Zone 3-B	: 12.8 km/2 trips	= 6.4 km/trip
Market/Office	: 46.7 km/2 trips	= 23.4 km/trip
Market		= 0
Market & Villa Progreso :		= 0
Oriental (illegal dumping site) :		-

The average loading weight of waste per trip was calculated as follow:

Zone 4-2	: 8.36 tons/2 trips	= 4.18 tons/trip
Zone 5-9	: 2.39 tons/2 trips	= 1.20 tons/trip
Zone 3-B	: 4.05 tons/2 trips	= 2.03 tons/trip
Market/Office	: 2.59 tons/2 trips	= 1.03 tons/trip
Market	:10.98 tons/3 trips	= 5.49 tons/trip
Market & Villa Progreso	:77.20 tons/3 trips for wheel loader	= 25.73 tons/trip
Oriental (illegal dumping site)	:77.20 ton/42 for dump trucks	= 1.84tons/trip

c. Type of Container

The most commonly used discharge container for low and middle income residents is nylon sacks (about 80% of the users). On the other hand, for high income residents, plastic bags and drum cans are commonly used as discharge containers. Plastic/metal buckets, metal pans, bamboo baskets and cardboard boxes are other discharge containers in the collection area. The work involved in waste collection and returning of containers is very hard for collectors.

Large generation sources, i.e. markets, hospitals, factories and public areas, use containers for waste discharge. There are two container types – a 0.83 m^3 container capacity with a lid and collected by screw type collection trucks, and a 15 m^3 container collected by roll-on roll-of trucks. The containers were in good condition, however a lot of waste was scattered around the containers.

d. Discharge Point

Primarily, the waste discharged from houses and shops is collected by the curb collection system which requires the residents and shop owners to discharge their waste in front of their premises or shops (on the road or sidewalk). There are waste stands on the sidewalk in front of some houses in the high income area made of metallic structures to keep the waste on a high area out of reach of animal's scavenging.

The containers are placed behind markets, hospitals, factories, offices, etc. Some of the containers are located in unsuitable areas, thereby affecting collection efficiency. The locations are unsuitable because of the following:

- vehicles parked near containers
- no space for unloading empty containers
- closing gate

e. Working Efficiency of Collection Workers and Level of User Cooperation

Before the commencement of collection work, drivers and assistants briefly check and clean the vehicles for approximately 20 minutes. The washing of the vehicle and refuelling are done by other staff members after collection work, at the garage.

Collection work normally lasts for six hours, from six o'clock to twelve o'clock. The driver and the crew continuously execute collection, haulage and dumping of waste except for short breaks. Collection activities and the workmanship of the crew are satisfactory.

The work involved in waste collection and the returning of containers is very hard for the collection crew. The crew also carries out recycling activities simultaneously by separating bottles and cans into sacks hanging at the back of the vehicle. Collection activities were carried out smoothly and efficiently.

Generally, waste should be discharged by the residents before the arrival of the collection vehicle. Some residents, however, discharged their waste upon the arrival of the collection vehicle, thereby interrupting the smooth conduct of collection activities.

The collection system using 15 m^3 containers should be examined to determine whether the collection frequency corresponds to the capacity of the containers.

f. Condition of Collection Area

Areas where road condition is poor and without access for collection vehicles are serviced using cart tractors. The roads are not paved and sewage flow make conditions worse. Residents illegally extend outlets from the national grid and as the cords are low this disturbs maneuvering of the tractor and some collection work. Some of the areas covered by the cart tractor also have blind alleys, forcing collection vehicles to perform several u-turns.

Table E.5.4a Collection Time, Distance and Loading Weight of Waste observed in the Time and Motion Survey

Item	1	2	3	4	5	6
Basic Information						
Date	16th, May, 1994	17th, May, 1994	18th, May, 1994	19th, May, 1994	20th, May, 1994	21st, May, 1994
Type of waste	Household Waste	Household Waste	Household Waste	Market Waste/Institutional Waste	Market Waste	Market/Illegal Dumping Waste
Collection area	Route 4–2	Route 5–9	Route 3–B	Market/Office	Market	Oriental Market/Villa Progreso
Responsible	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality
Crew	4 persons (1 driver, 3 collectors)	4 persons (1 driver, 3 collectors)	4 persons (1 driver, 3 collectors)	4 persons (1 driver, 3 collectors)	2 persons (1 driver, 1 assistant)	9 persons (1 operator, 8 drivers)
Type of collection vehicle	Compactor Truck	Compactor Truck	Cart Tractor	Screw Type Collection Truck	Roll–on Roll–off Truck	Wheel Loader, 8 Dump Trucks
Loading capacity	14 m^3	15.3 m^3	7 m^3	22 m^3	15 m^3	7 m^3 (7 dump truck), 14 m^3 (dump truck)
Vehicle Number	04–K–105	04–K–80	07–A–27	04–K–65	04–C–22	–
Year of fabrication	1993	1993	–	–	–	–
Working hour	05:50 – 15:08 (9 hr. 18 min.)	05:40 – 14:05 (8 hr. 25 min.)	05:36 – 12:15 (6 hr. 39 min.)	06:03 – 12:13 (6 hr. 9 min.)	05:54 – 11:01 (5 hr. 07 min.)	05:49 – 12:00 (6 hr. 11 min.)
Number of trips	2 trips	2 trips	2 trips	2 trips	3 trips	42 trips
Number of collection points	1,051 (518+533)	308 (207+101)	654 (447+207)	36 (25+11)	3	3
Time (min.)						
Collection time	381	289	251	115	31	234
Transportation and Haulage time	86	107	62	167	194	88
Unloading time	28	44	24	37	32	0
Others (lunch, repair, etc.)	63	65	62	50	50	49
Total time	558	505	399	369	307	371
Distance (km)						
Collection area	25.6	31.1	12.8	46.7	0	0
Other trip	30.3	58.8	30.6	25.1	89.0	24.5
Total distance	55.9	89.9	43.4	71.8	89.0	24.5
Weight of loading waste (ton)	8.36	2.39	4.05	2.59	10.98	77.20

Table E.5.4b(1) Data of Time and Motion Survey (1/6)

Date	: 16th,May, 1994
Type of waste	: Household waste
Collection Area	: Route 4-2
Municipality or Private Contractor	: Municipality
Crew	: 4 persons (1 driver, 3 collectors)
Type of collection vehicle	: Compactor Truck
Loading capacity (m^3)	: 14 m3
Vehicle No. (year of fabrication)	: 04-K-105 (1993)
Working hours	: 05:50 to 15:08 (9 hr. 18 min.)
Number of Trips	: 2 trips
Distance required for work	: 55.9 Km
Number of collection points	: 1st 518 points, 2nd 533 points, Total 1,051 points.
Waste amount	: 1st 4.14 ton, 2nd 4.22 ton, Total 8.36 ton.

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection points	Waste amount (ton)
05:50-06:10	20	-	Inspection, Preparation		
06:10-06:20	10	5.1	Garage to collection area (1st trip)		
06:20-09:49 (07:19-07:27) (09:12-09:17)	196 8 5	13.6	Waste collection work rest rest	518 rest rest	* 4.14
09:49-10:17	28	6.4	Collection area to disposal site		
10:17-10:29	12	1.8	Unloading		
10:29-10:41	12	5.2	Disposal site to collection area (2nd. trip)		
10:41-13:46	185	12.0	Waste collection work	533	* 4.22
13:46-14:07	21	4.9	Collection area to disposal site		
14:07-14:23	16	1.8	Unloading		
14:23-14:38	15	5.1	Disposal site to garage		
14:38-15:08	30	-	Refueling, washing		

* : Waste amount was weighed by portable truck-scale.

Table E.5.4b(2) Data of Time and Motion Survey (2/6)

Date	: 17th, May, 1994
Type of waste	: Household waste
Collection Area	: Route 5-9
Municipality or Private Contractor	: Municipality
Crew	: 4 persons (1 driver, 3 collectors)
Type of collection vehicle	: Compactor Truck
Loading capacity (m^3)	: 15.3 m3
Vehicle No. (year of fabrication)	: 04-K-80 (1993)
Working hours	: 05:40 to 14:05 (8 hr. 25 min.)
Number of Trips	: 2 trips
Distance required for work	: 89.9 Km
Number of collection points	: 1st 207 points, 2nd 101 points, Total 308 points.
Waste amount	: 1st 2.07 ton, 2nd 0.32 ton, Total 2.39 ton.

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection points	Waste amount (ton)
05:40-06:00	20	-	Inspection, Preparation		
06:00-06:15	15	10.5	Garage to collection area (1st trip)		
06:15-08:15	120	13	Waste collection work	80	* 2.07
08:15-08:30	15	0	rest		
08:30-10:09	99	12.0	Waste collection work	127	
10:09-10:40	31	13.3	Collection area to disposal site		
10:40-11:03	23	1.9	Unloading		
11:03-11:30	27	13.4	Disposal site to collection area (2nd trip)		
11:30-12:40	70	6.1	Waste collection work	101	* 0.32
12:40-13:02	22	11.9	Collection area to disposal site		
13:02-13:23	21	1.8	Unloading		
13:23-13:35	12	6.0	Disposal site to garage		
13:35-14:05	30	-	Refueling, Washing		

* : Waste amount was weighed by portable truck-scale.

Table E.5.4b(3) Data of Time and Motion Survey (3/6)

Date	: 18th, May, 1994
Type of waste	: Household waste
Collection Area	: 3-B
Municipality or Private Contractor	: Municipality
Crew	: 4 persons (1 driver, 3 collectors)
Type of collection vehicle	: Cart Tractor
Loading capacity (m^3)	: 7 m3
Vehicle No. (year of fabrication)	: 07-A-27
Working hours	: 05:36 to 12:15 (6 hr. 39 min.)
Number of Trips	: 2 trips
Distance required for work	: 39.2 Km
Number of collection points	: 1st 447 points, 2nd 207 points, Total 654 points.
Waste amount	: 1st 2.70 ton, 2nd 1.35 ton, Total 4.05 ton.

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection point	Waste amount (ton)
05:36-05:56	20	-	Inspection, Preparation,		
05:56-06:04	8	3.7	Garage to collection area (1st trip)		
06:04-08:05	121	6.2	Waste collection work	277	
08:05-08:17	12	0	rest		*1 2.7
08:17-09:04	47	1.7	Waste collection work	170	
09:04-09:21	17	5.7	Collection area to disposal site		
09:21-09:34	13	1.5	Unloading		
09:34-09:45	11	3.4	Disposal site to collection area (2nd trip)		
09:45-11:08	83	4.9	Waste collection work	207	*2 1.35
11:08-11:20	12	4.3	Collection area to disposal site		
11:20-11:31	11	1.8	Unloading		
11:31-11:45	14	6.0	Disposal site to garage		
11:45-12:15	30	-	Refueling, washing		

* : Waste amount was estimated as follows:
*1 (4.5 m length x 2.25 m width x 1.2 m high) x 0.25 x 0.9 = 2.7 ton
*2 (4.5 m length x 2.25 m width x 0.6 m height) x 0.25 x 0.9 = 1.35 ton
0.25 = ASG of waste in low income area
0.8 = Rate of operation of vehicle

Table E.5.4b(4) Data of Time and Motion Survey (4/6)

Date	: 19th, May, 1994
Type of waste	: Market Waste and Industrial Waste
Collection Area	: Route : Market/Supermarket
Municipality or Private Contractor	: Municipality
Crew	: 4 persons (1 driver, 3 collectors)
Type of collection vehicle	: Screw Type Collection Truck
Loading capacity (m^3)	: 22 m3
Vehicle No. (year of fabrication)	: 04-K-65
Working hours	: 06:03 to 12:12 (6 hr. 9 min.)
Number of Trips	: 2 trips
Distance required for work	: 71.8 Km
Number of collection points	: 1st 25 points, 2nd 11 points, Total 39 points.
Waste amount	: 1st 19.1 ton, 2nd 0.68 ton, Total 2.59 ton.

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection point	Waste amount (ton)
06:03-06:23	20	-	Inspection, Preparation		
06:23-06:26	3	1.5	Garage to collection area (1st trip)		
06:26-09:14	168	30.8	Waste collection work (Collection time : 85 min, Trip time : 83 min)	24 (42 containers)	* 1.91
09:14-09:26	12	5.2	Collection area to disposal site		
09:26-09:45	19	1.9	Unloading		
09:45-09:58	13	5.7	Disposal site to collection area (2nd trip)		
09:58-11:05	67	15.9	Waste collection work (Collection time: 30 min , trip time : 37 min)	11 (15 containers)	* 0.68
11:05-11:11	6	3.0	Collection Area to disposal site		
11:11-11:29	18	1.8	Unloading		
11:29-11:42	13	6.0	Disposal site to garage		
11:42-12:12	30	-	Refueling, washing		

* : Waste amount was weighed by a portable truck-scale.

Table E.5.4b(5) Data of Time and Motion Survey (5/6)

Date	: 20th, May, 1994
Type of waste	: Market Waste and Industrial Waste
Collection Area	:
Municipality or Private Contractor	: Municipality
Crew	: 2 persons (1 driver, 1 assistant)
Type of collection vehicle	: Roll-on Roll-off Truck
Loading capacity (m^3)	: 15 m3
Vehicle No. (year of fabrication)	: 04-C-22
Working hours	: 05:54 to 11:01 (5 hr. 07 min.)
Number of Trips	: 3 trips
Distance required for work	: 89.6 Km
Number of collection points	: Total 3 points
Waste amount	: 1st 4.20 ton, 2nd 3.78 ton, 3rd 3.00 ton, Total 10.98 ton.

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection point	Waste amount (ton)
05:54-06:14	20	-	Inspection, Preparation		
06:14-06:29	15	8.9	Garage to collection point		
06:29-06:36	7	-	Waste collection work (1st. trip)	1	*1 4.20
06:36-06:56	20	10.2	Collection area to disposal site		
06:56-07:07	11	1.9	Unloading		
07:07-08:33	86	31.5	Disposal site to collection point		
08:33-08:41	8	-	Waste collection work (2nd trip)	1	*2 3.78
08:41-09:01	20	10.2	Collection point to disposal site		
09:01-09:11	10	1.7	Unloading		
09:11-09:31	20	9.3	Disposal site to collection point		
09:31-09:47	16	-	Waste collection work (3rd trip)	1	*3 3.00
09:47-10:08	21	8.2	Collection point to disposal site		
10:08-10:19	11	1.6	Unloading		
10:19-10:31	12	6.1	Disposal site to garage		
10:31-11:01	30	-	Refueling, washing		

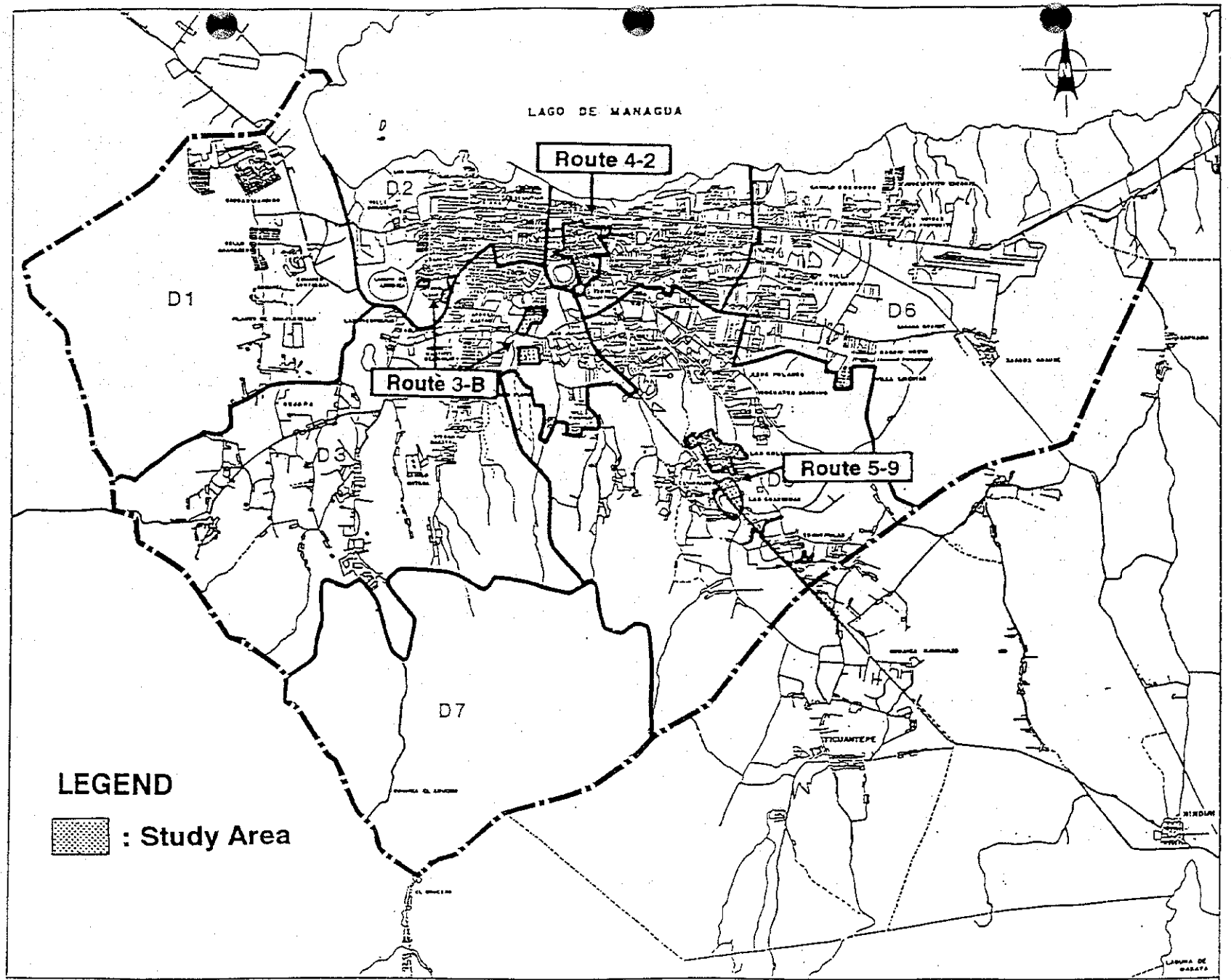
* : Waste amount was estimated as follows;
*1 : 15 m3 x 0.28 = 4.20 ton 0.28 = ASG of waste in market
0.9 = Rate of operation of vehicle (ROV)
*2 : 15 m^3 x 0.28 x 0.9 = 3.78 ton
*3 : 15 m^3 x 0.20 = 3.00 ton 0.20 = ASG of industrial waste

Table E.5.4b(6) Data of Time and Motion Survey (6/6)

Date : 21th, May, 1994
Type of waste : Market waste/Illegal dumping waste
Collection Area : Oriental Market/Villa progreso
Municipality or Private Contractor : Municipality
Crew : 9 persons (1 operator, 8 drivers)
Type of collection vehicle : Wheel Loader, 7 Dump trucks
Loading capacity (m^3) : 7 m3 (7 dump trucks) 14 m3 (1 dump truck)
Vehicle No. (year of fabrication) :
Working hours : 05:49 to 12:00 (6 hr. 11 min.)
Number of Trips : 1st point: 15, 2nd. point: 21; 3rd point: 6, Total : 42
Waste amount : 1st point 30.0 ton, 2nd point 36.2 ton, 3rd point 11.0 ton, Total 77.2 ton

Time (from-to)	Time required (min.)	Distance (Km)	Activity	Number of collection point	Waste amount (ton)
05:49-06:09	20	-	Inspection, Preparation		
06:09-06:32	23	7.4	Garage to 1st to collection point		
06:32-07:32	60	0	Waste collection work Total 15 trips		*1 30.0
07:32-07:56	24	6.3	1st collection point to 2nd collection point		
07:56-10:15	139	0	Waste collection work* Total 21 trips		*2 36.2
10:15-10:20	5	0.3	2nd collection point to 3rd collection point		
10:20-10:55	35	0	Total 6 trips		*3 11.0
10:55-10:31	36	10.5	3rd collection point to garage		
10:31-12:00	29	-	Filling up, washing		

*1 : (13 vehicles x 7 m^3 + 2 vehicles x 14 m^3) x 0.28 x 0.9 = 30.0 ton
*2 : (19 vehicles x 7 m^3 + 2 vehicles x 14 m^3) x 0.25 x 0.9 = 36.2 ton
*3 : (5 vehicles x 7 m^3 + 1 vehicle x 14 m^3) x 0.25 x 0.9 = 11.0 ton
0.28 : ASG of waste in market
0.25 : ASG of waste in low income area
0.90 : Rate of operation vehicle (ROV)



THE STUDY ON THE IMPROVEMENT OF THE SOLID WASTE MANAGEMENT SYSTEM FOR THE CITY OF MANAGUA

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure E.5.4a Study Areas of the Time and Motion Survey

E.6 Installation and Operation of Truck Scale

E.6.1 Installation

In order to determine the disposal amount at the present Acahualinca disposal site, a load cell type truck scale was installed at the entrance of the site. The location of the truck scale was decided by the officers of the Managua Municipality and is shown in Figure E.6.1a.

An inspection building was constructed and a truck scale was installed at the present Acahualinca disposal site according to the following work assignment:

Task	Organization in charge
procurement of a truck scale	JICA
design of the truck scale and supervision of installation	supplier of the truck scale
construction of an inspection building (about $20m^2$) and foundation work for truck scale	Nicaraguan side (Municipality of Managua)
installation of the truck scale	Nicaraguan side
development of operation program for truck scale	Study Team

The plans for the foundation of the truck scale and inspection building are shown in Figure E.6.1b and E.6.1c

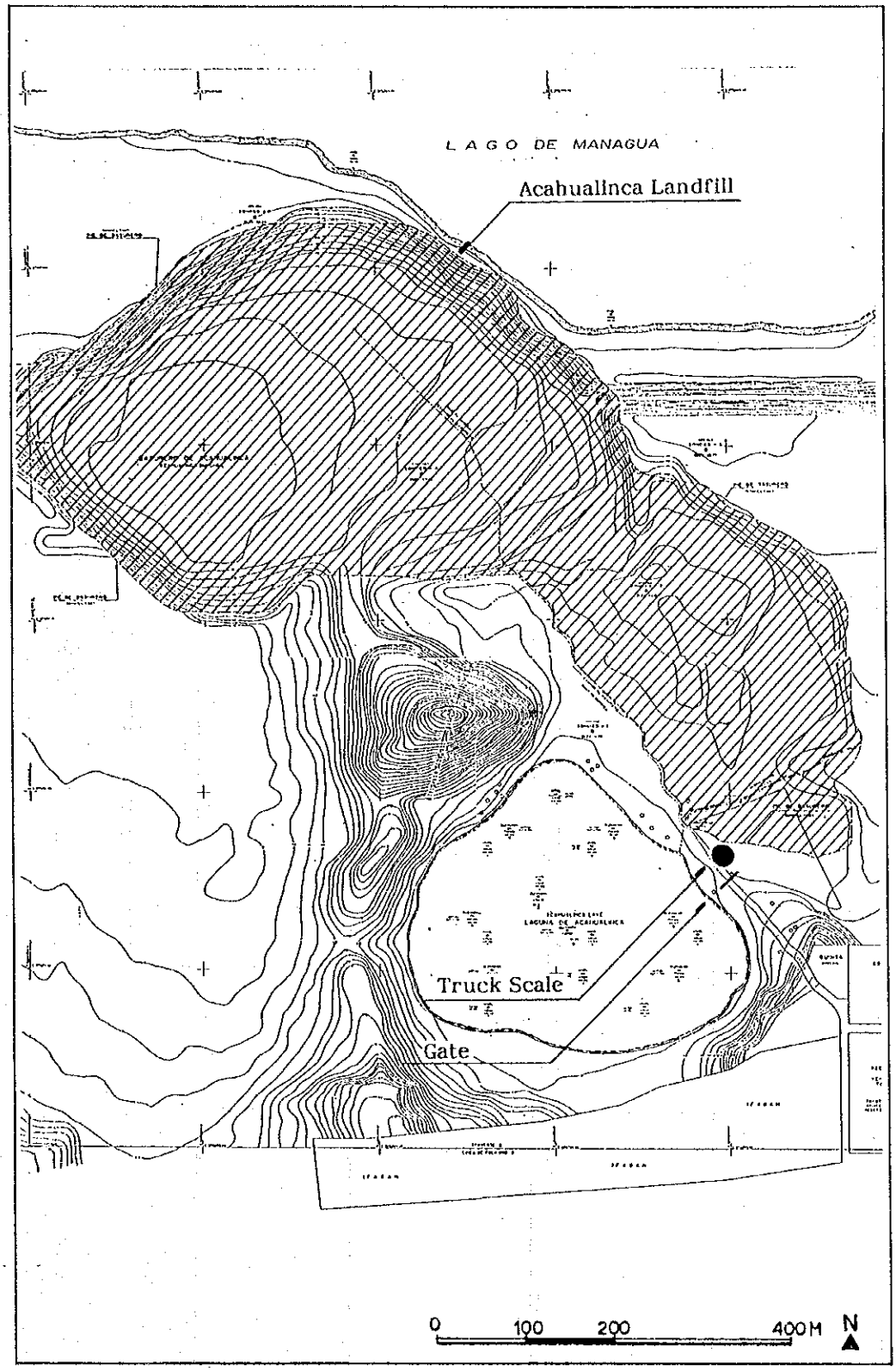


Figure E.6.1a Location of Truck Scale

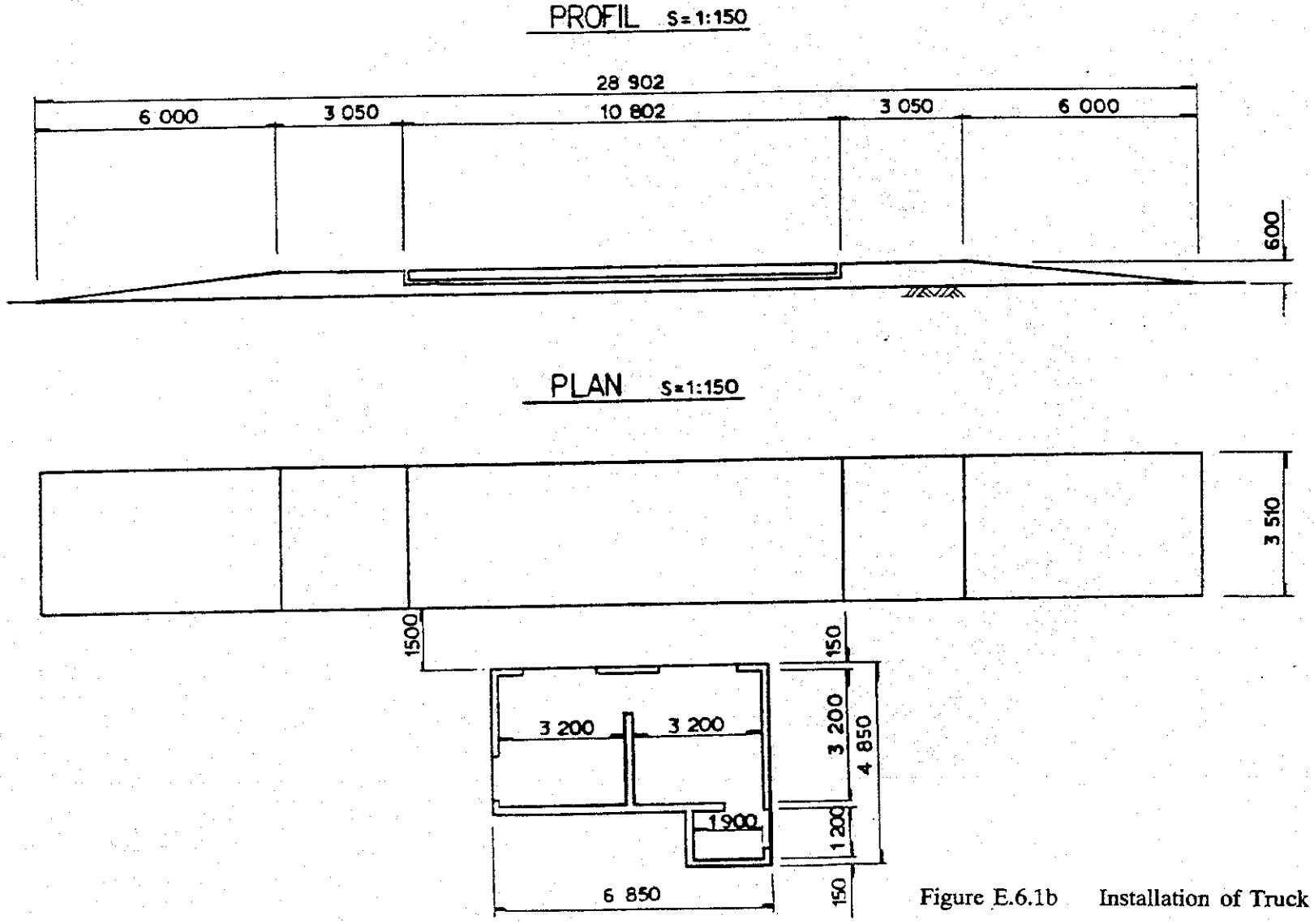


Figure E.6.1b Installation of Truck Scale

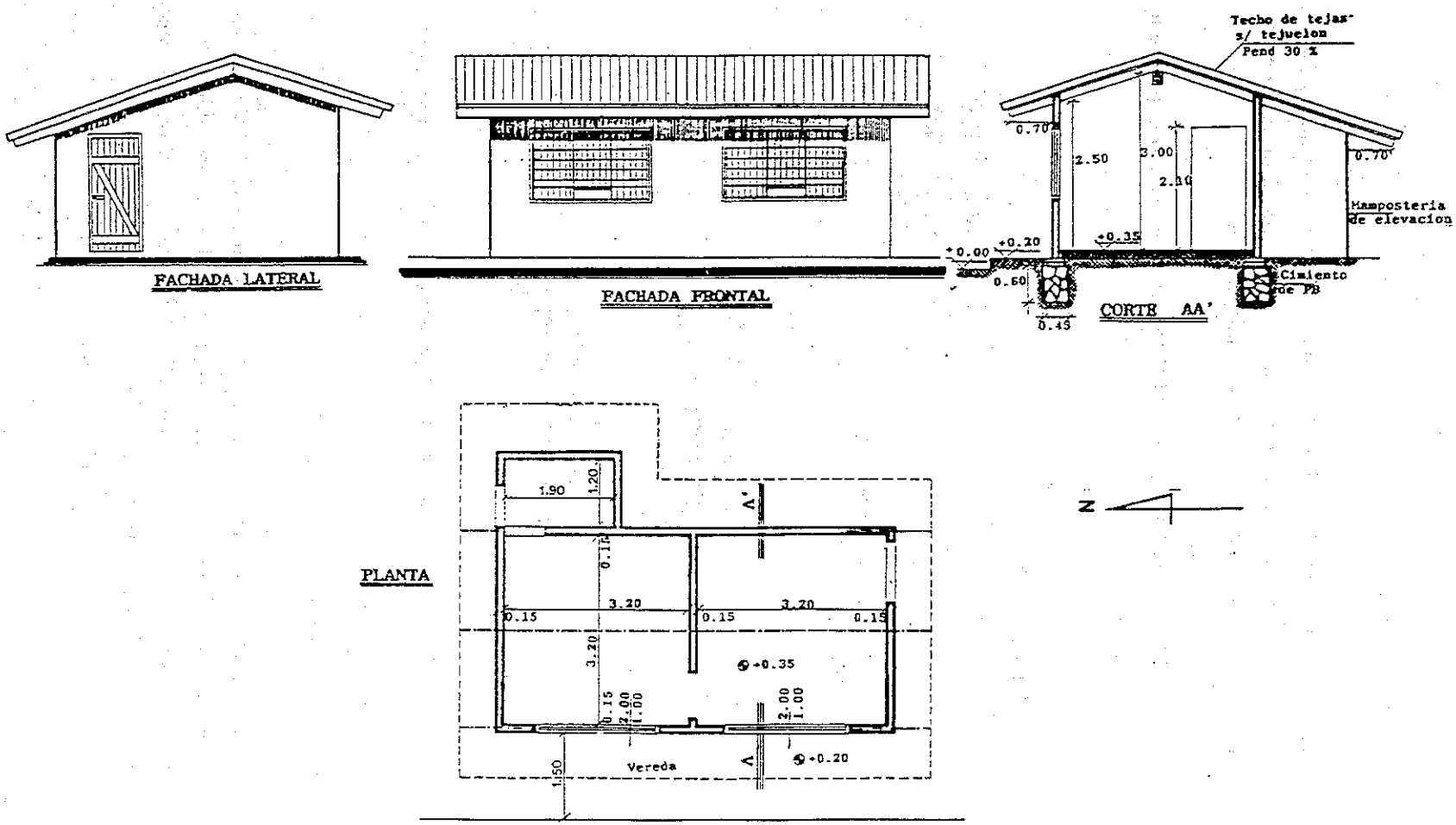


Figure E.6.1c Plan of Inspection Building

E.6.2 Development of Operation Programs

a. Flow Chart

A maximum of about 30 – 50 vehicle units enter the Acahualinca disposal site on an hourly basis everyday, including sundays. The operation program of the truck scale was developed taking this number into account.

The flow chart of the development of the truck scale operation program is shown in Figure E.6.2a.

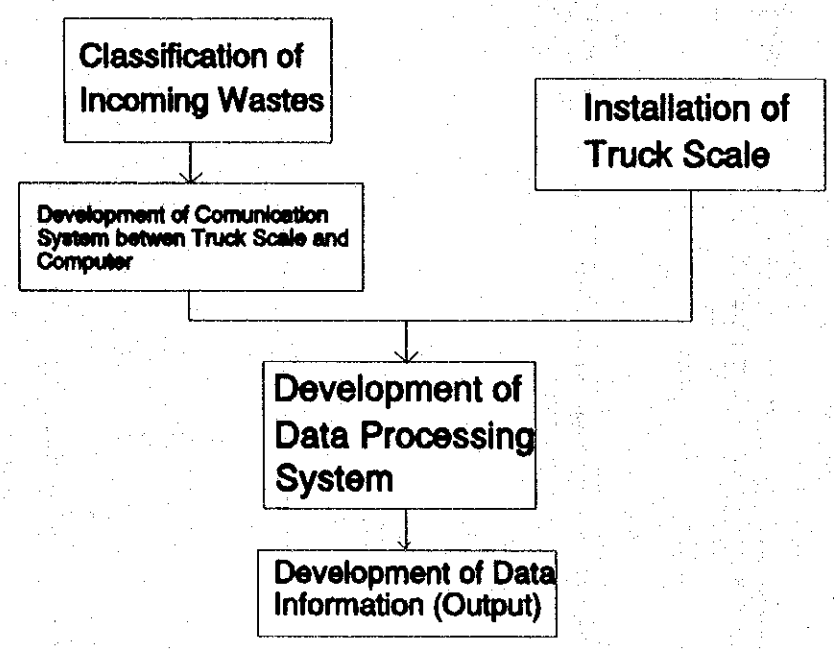


Figure E.6.2a Flow Chart of Development of Truck Scale Operation Program

b. Classification of Incoming Wastes

A truck scale will be installed to determine the disposal amount of each waste category, categories decided upon holding a discussion with the officers of the Managua Municipality. The Acahualinca disposal site incoming wastes were classified as shown in Table E.6.2a.

Table E.6.2a Classification of Acahualinca Disposal Site Incoming Waste

Type of Waste	Responsible Organization	Generation Source		Code No.
MSW	Public Cleansing Office	Household	D1	10
			D2	20
			D3	30
			D4	40
			D5	50
			D6	60
			D7	70
		Market, Commercial Area and Institution		80
		Hospital		100
		RIDS		110
	District Coordination Office	Street Sweeping		120
	Beautification Office	Park and Green Area		130
	Direct Haulage by Private Sector	Bulky Waste	Household	140
			Office, Shop, Others	141
		Garden Waste	Household	142
			Office, Shop, Others	143
		Construction Waste	Household	144
			Office, Shop, Others	145
		Other Wastes	Household	146
			Office, Shop, Others	147
ISW	Public Cleansing Office	Factory		200
	Direct Haulage by Private Sector	Type of Waste Hauled	Paper	210
			Construction Waste	211
			Food Waste	212
			Metal	213
			Plastic	214
			Glass and Ceramic	215
			Textile	216
			Leather and Rubber	217
			Others	218
Soil				300
Recyclable				310
Others				320

RIDS: Registered Illegal Dump Site

c. Development of Communication System

The truck scale installed at the entrance of the Acahualinca disposal site is connected to a computer programmed with a scale system DATA BASE (FOXPRO). The weight of an incoming vehicle measured by the load cell unit of the truck scale is transmitted to an indicator with a printer. Data from the indicator is transmitted to the computer by a serial port which relays a signal to the computer. In order to decode the received signal (gross weight), a program is developed in FOXPRO, where a license plate number is entered to verify the vehicle file. The process is illustrated below.

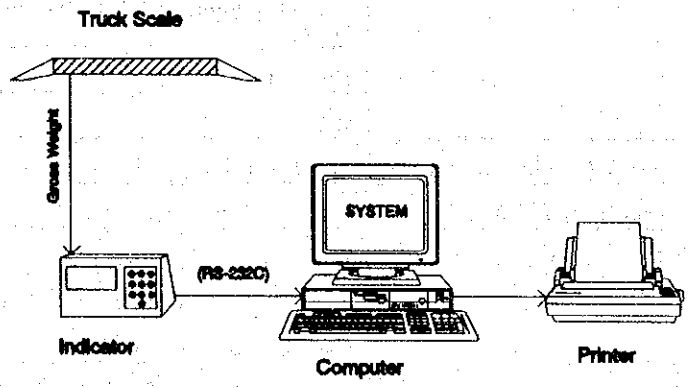


Figure E.6.2b Communication System between Truck Scale and Computer

d. Development of Data Processing System

The main program was developed in FOXPRO. The weight of the truck measured in the truck scale (gross weight) is entered in the computer by the serial port, where the program decodes the received signal. The license plate number is then entered in the computer to verify the vehicle files. The data processing system is explained as follows:

da. For Non-registered Vehicles

If the vehicle is not registered, the following data processing systems are applied:

Step 1 The following data are entered:
- Plate number of the vehicle
- Type of vehicle
- Vehicle brand
- Model
- Year
- Capacity
- Tare (this figure is not entered manually)

Step 2 The classification code, which is shown in Table E.6.2a, is entered with the following data:
- Type of waste
- Generation area
- Responsible organization
- Generation category

Step 3 The operator code is entered.

Step 4 A partial ticket is printed as a control measure.

Step 5 Then the truck enters the disposal site and at the exit it is weighed again. This time the is entered in the computer and saved in the vehicle file into which the truck has been registered. The net weight is calculated (NET weight = gross weight – tare), and all the data are saved in the movement file. A final ticket is printed and presented to the driver.

db. For Registered Vehicles

If the vehicle is already registered, the data processing system shown below is applied:

Step 1 only the plate number is entered
Step 2 same as the 2nd step above–mentioned
Step 3 same as the 3rd step above–mentioned
Step 4 The ticket with the required data is printed and given to the driver
Step 5 The truck is not weighed again at the exit (tare already on file)

dc. Movement File

Since the movement file accumulates data daily, the design shall be made as small as possible. The data for the movement file is coded and the detailed information of each code are filed separately in the computer as shown in Figure E.6.2c.

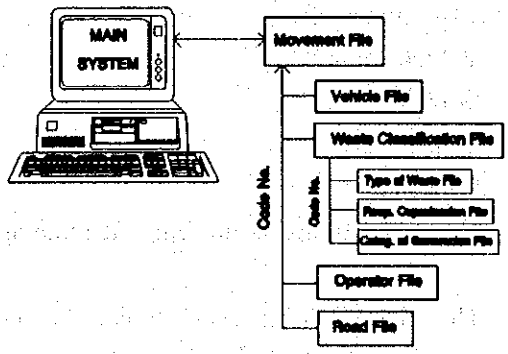


Figure E.6.2c File Management System

A movement file contains the following data:

- License plate of the vehicle
- Classification code
- Entrance date
- Time of entrance
- Net weight
- Operator code

e. Development of Data (Output)

Various data (outputs) were developed using processed data in the movement file. The data (outputs) is available in the computer installed at the truck scale at Acahualinca (output to printer), which unfortunately is only accessible from 6:00 AM to 18:00 PM everyday. A file copy of the data is then made for Excel, Lotus, Text, etc. The file output is processed by a computer in the office. Data information system is illustrated in Figure E.6.2d.

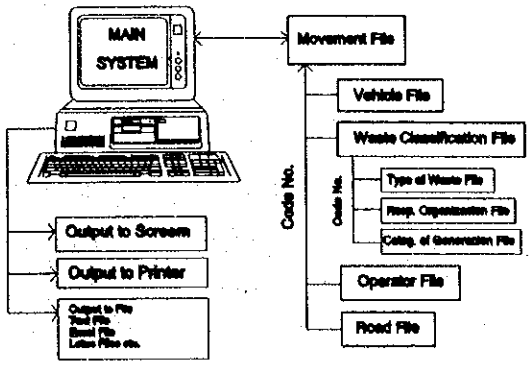


Figure E.6.2d Data Output System

With the file data converted, the data is processed and analyzed by the computer in the office using conventional data processing systems such as EXCEL, LOTUS, Quattoro-Pro, etc..

E.6.3 Output of Operation Program

a. Output

As described above, various files of different computer systems were made from the data obtained by the main system. Consequently, the data in the file is processed and analyzed in the computer of the Study Team using the EXCEL system. The following output is presented.

i. List of registered vehicles in accordance with the classification of incoming wastes

ii. Daily, weekly and monthly number of incoming vehicles in accordance with:
- classification of incoming wastes,
- categories of generation source,
- responsible organization for collection and haulage,
- types of wastes hauled directly.

iii. Daily, weekly and monthly disposal amount according to the above-mentioned categories.

The output of data obtained within a 4-month observation period is presented below.

Table E.6.3a Number of Incoming Vehicles

unit:number of vehicles

Items	August	September	October	November	Average
Month	4,418	4,291	4,623	4,596	4,482
Day	143	143	149	153	147

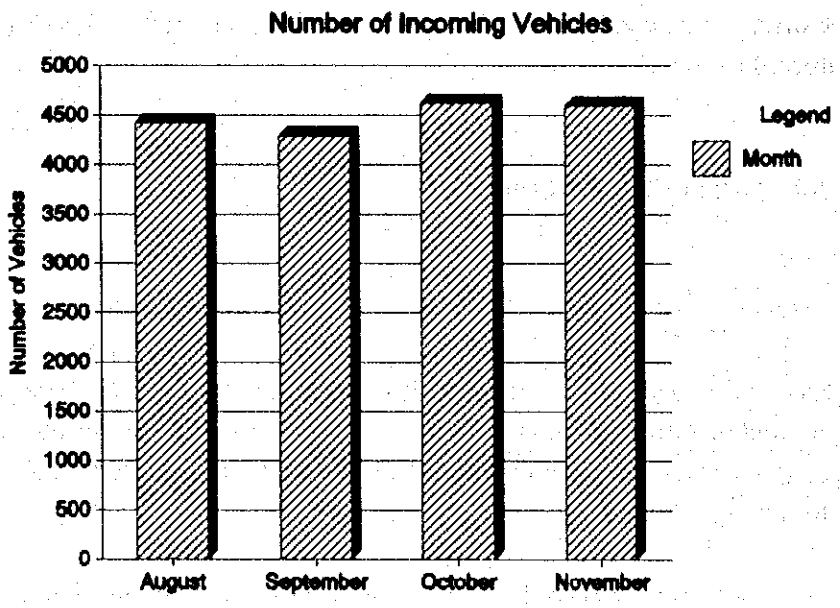


Table E.6.3b Monthly Incoming Waste Amount

unit:ton

Items	August	September	October	November	Average
Month	18,337.6	20,074.3	22,081.3	20,719.4	20,303.2
Day	591.5	669.1	712.3	690.6	665.9

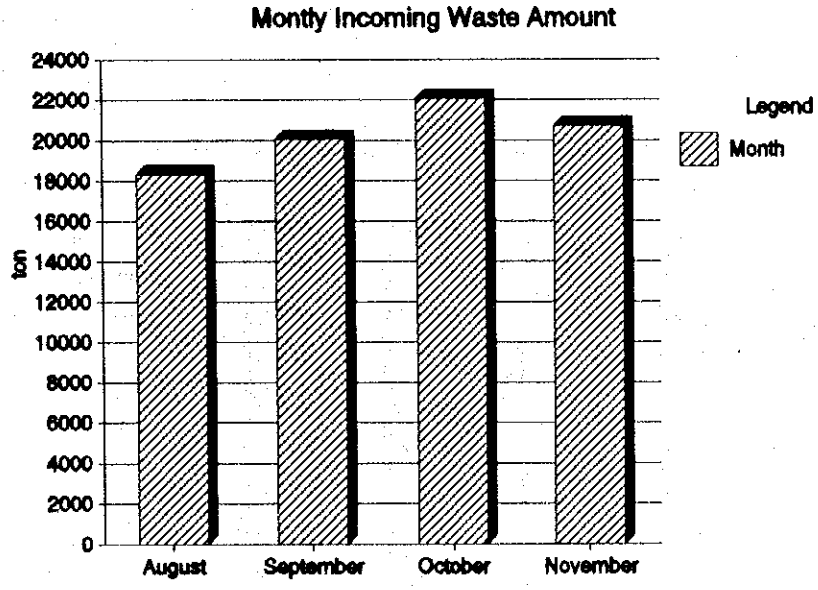


Table E.6.3c Number of Incoming MSW Vehicles

unit:number of vehicles

Items	August	September	October	November	Average
MSW	4,204	4,145	4,439	4,442	4,308
ISW	214	146	184	154	175
TOTAL	4,418	4,292	4,623	4,596	4,482

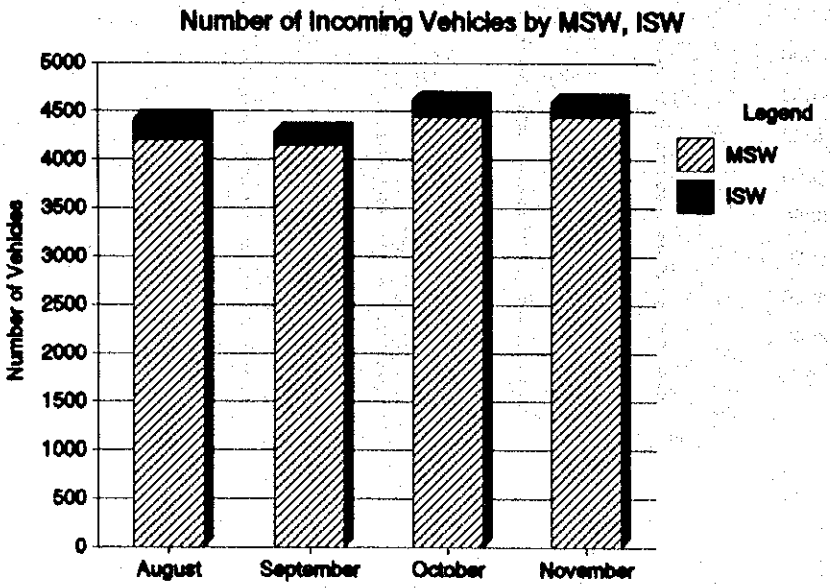


Table E.6.3d Monthly Incoming MSW, ISW Amount

unit:ton

Items	August	September	October	November	Average
MSW	17,876.3	19,691.7	21,645.6	20,285.5	19,874.8
ISW	461.3	382.6	435.8	433.9	428.4
TOTAL	18,337.6	20,074.3	22,081.4	20,718.9	20,303.0

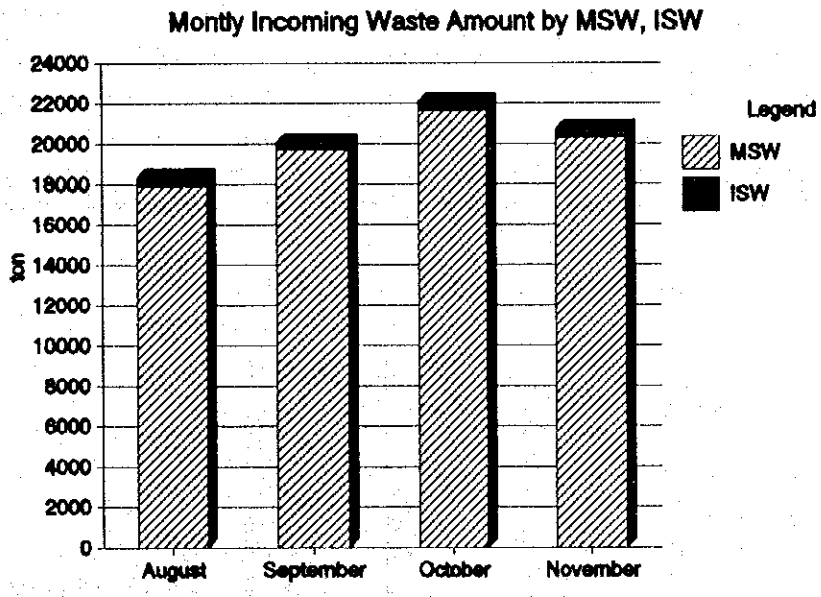


Table E.6.3e Number of Incoming Vehicles by Category

unit:number of vehicles

	Items	August	September	October	November	Average
MSW	Household	1,610	1,453	1,661	1,650	1,594
	Market,Commercial Area and Institution	114	114	151	155	134
	Hospital	51	37	29	34	38
	RIDS	1,056	1,315	1,367	1,374	1,278
	Street Sweeping	143	125	135	175	145
	Park and Green Area	28	41	34	15	30
	Directly Hauled MSW	1,202	1,060	1,062	1,039	1,091
	SUB-TOTAL	4,204	4,145	4,439	4,442	4,308
ISW	Factory	47	50	52	59	52
	Directly Hauled ISW	167	96	132	95	123
	SUBTOTAL	214	146	184	154	175
	TOTAL	4,418	4,291	4,623	4,596	4,482

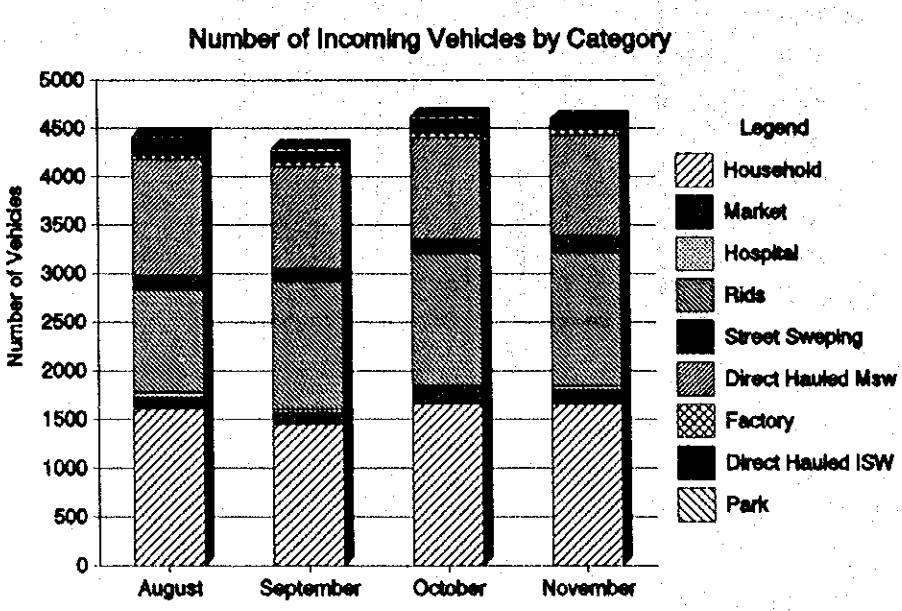


Table E.6.3f Monthly Incoming MSW Amount by Category

unit:ton

	Items	August	September	October	November	Average
MSW	Household	9,813.7	9,129.5	10,866.7	10,524.3	10,083.5
	Market, Commercial Area and Institution	815.3	745.1	919.7	874.5	838.6
	Hospital	218.1	175.1	174.8	198.9	191.7
	RIDS	5,522.3	8,110.2	8,037.4	7,027.4	7,174.3
	Street Sweeping	485.1	539.5	543.2	613.0	545.2
	Park and Green Area	0.0	0.0	0.0	0.0	0.0
	Directly Hauled MSW	1,021.8	992.4	1,103.8	1,047.0	1,041.2
	SUB-TOTAL	17,876.3	19,691.7	21,645.6	20,285.1	19,874.7
ISW	Factory	230.0	261.4	300.3	293.7	271.4
	Directly Hauled ISW	231.3	121.2	135.5	140.2	157.0
	SUB-TOTAL	461.3	382.6	435.8	433.9	428.4
	TOTAL	18,337.6	20,074.3	22,081.4	20,718.9	20,303.0

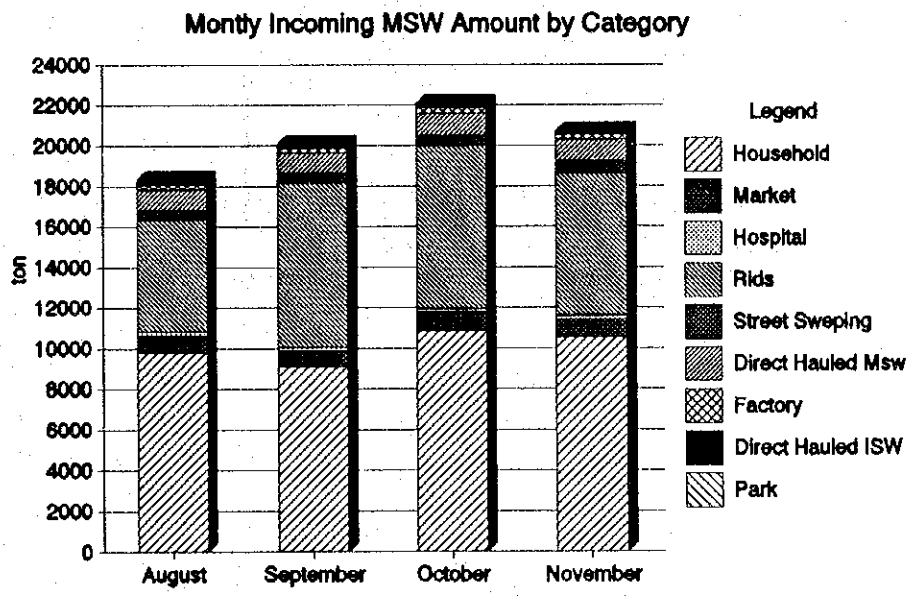


Table E.6.3g Number of Incoming Vehicles from Each Office and of Direct Haulage Services

unit:number of vehicles

Items	August	September	October	November	Average
Public Cleansing Office	2,878	2,969	3,260	3,272	3,095
District Coordination office	143	125	135	175	145
Beautification office	28	41	34	15	30
Direct haulage by Private Sector	1,369	1,156	1,194	1,134	1,213
TOTAL	4,418	4,291	4,623	4,596	4,482

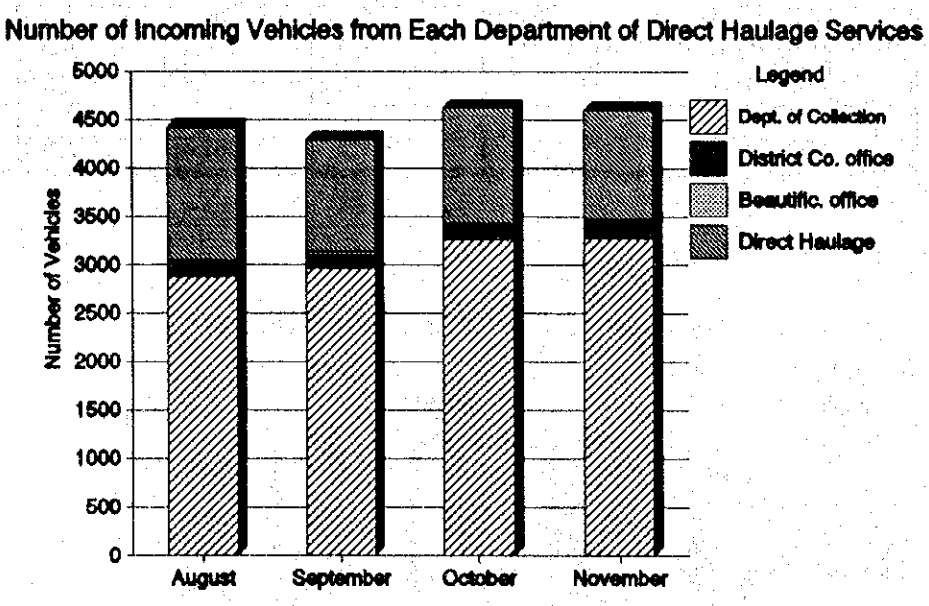


Table E.6.3h Monthly Incoming Waste Amount from Each Office and Directly Hauled Amount

unit:ton

Items	August	September	October	November	Average
Public Cleansing Office	16,599.5	18,421.2	20,298.9	18,918.8	18,559.6
District Coordination Office	452.5	481.9	486.2	587.8	502.1
Beautification Head Office	32.6	57.6	58.7	25.6	43.6
Direct Haulage by Private Sector	1,253.1	1,113.6	1,237.5	1,187.2	1,197.8
TOTAL	18,337.7	20,074.3	22,081.3	20,719.4	20,303.2

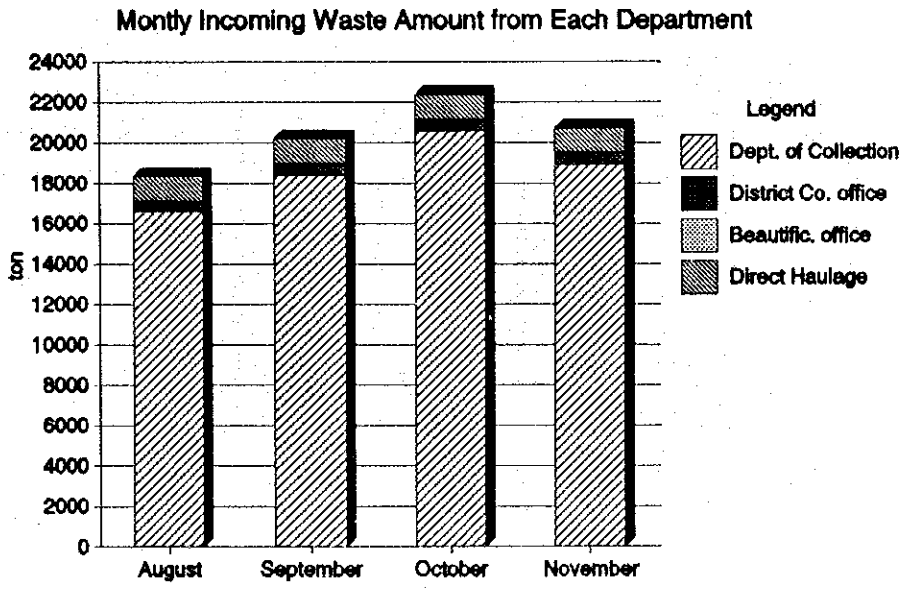


Table E.6.3i Number of Incoming Vehicles of the Private Sector (MSW)

unit:number of vehicles

Items	August	September	October	November	Average
BULKY	101	79	80	105	91
GARDEN	314	281	291	272	290
CONSTRU	102	75	81	81	85
OTHERS	685	625	610	581	625
TOTAL	1,202	1,060	1,063	1,040	1,092

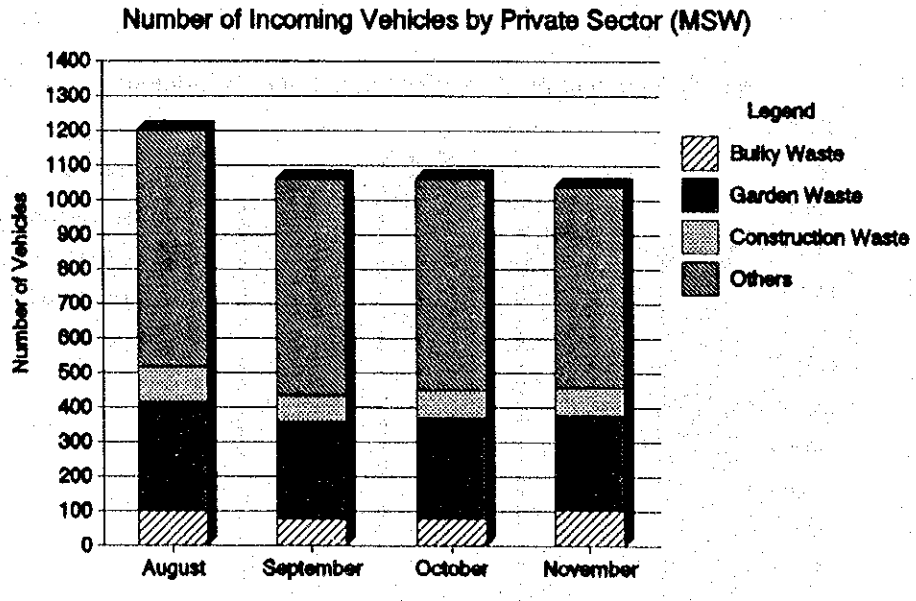


Table E.6.3j Monthly Incoming Waste by Private Sector (MSW)

unit:ton

Items	August	September	October	November	Average
BULKY	73.9	40.3	66.5	80.0	65.2
GARDEN	227.4	231.2	198.9	228.6	221.0
CONSTRU	209.4	219.7	228.1	226.4	220.9
OTHERS	511.1	501.2	608.5	512.1	533.2
TOTAL	1,021.8	992.4	1,103.8	1,047.0	1,041.2

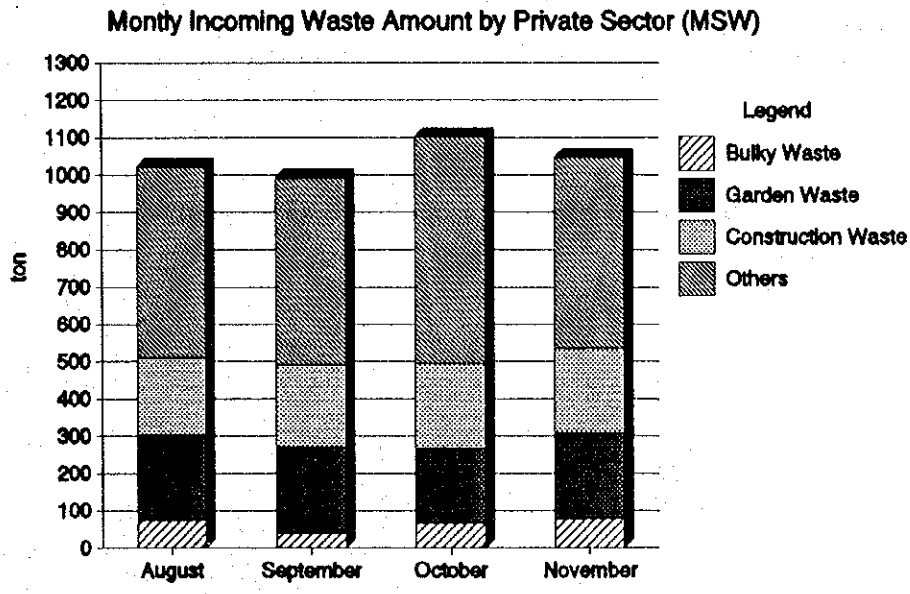


Table E.6.3k Number of Incoming Vehicles of the Private Sector (ISW)

unit:number of vehicles

Items	August	September	October	November	Average
PAPER	24	12	4	5	11
CONSTRU	12	3	6	12	8
FOOD	62	39	92	53	62
METAL	5	7	1	0	3
PLASTIC	5	9	0	1	4
GLASS	0	2	4	1	2
TEXTILE	4	2	1	0	2
LEATHER	0	0	2	2	1
OTHERS	55	22	22	21	30
TOTAL	167	96	132	95	123

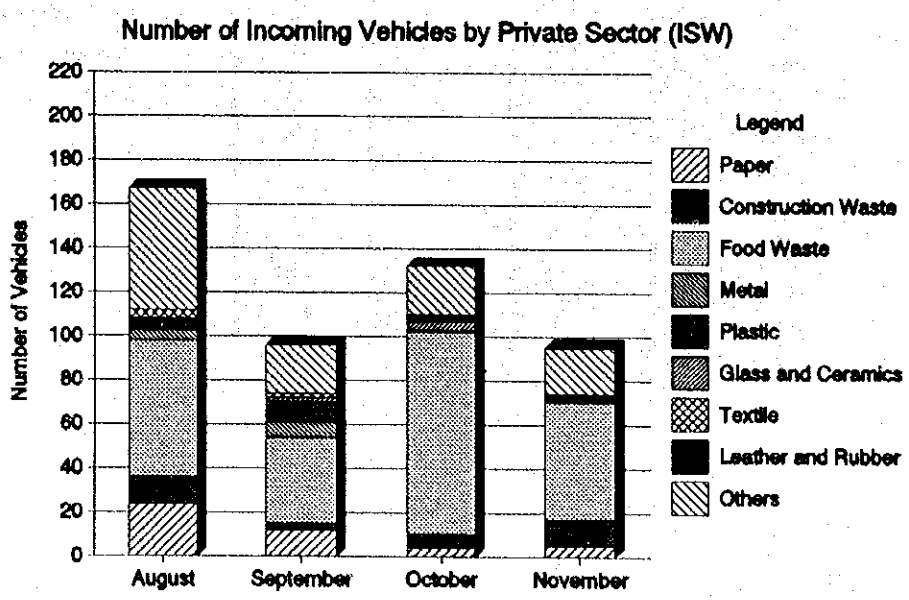
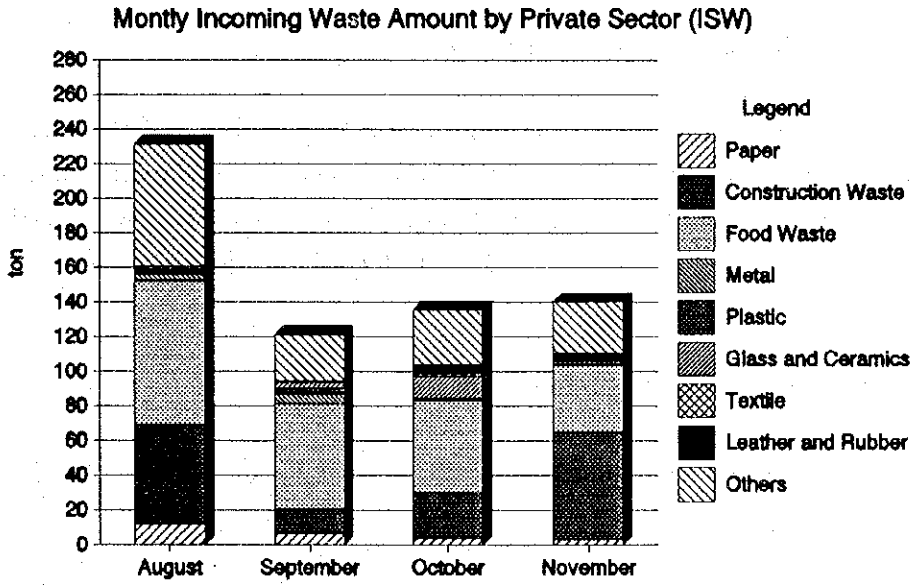


Table E.6.31 Monthly Incoming Waste Amount by Private Sector (ISW)

unit:ton

Items	August	September	October	November	Average
PAPER	12.2	6.5	4.0	3.2	6.5
CONSTRU	56.7	14.4	26.2	61.8	39.8
FOOD	83.3	60.3	53.0	38.7	58.8
METAL	4.1	5.8	1.0	0.0	2.7
PLASTIC	2.7	3.4	0.0	0.6	1.7
GLASS	0.0	3.4	13.0	1.8	4.5
TEXTILE	1.4	1.0	1.6	0.0	1.0
LEATHER	0.0	0.0	5.2	4.3	2.4
OTHERS	70.9	26.5	31.6	29.9	39.7
TOTAL	231.3	121.2	135.5	140.2	157.0



E.6.4 Findings

a.General

aa. Operation System

A local system engineer was engaged not only for the development of the operation program but also to instruct the operation method to the operators of Managua Municipality. In addition, a Spanish edition of the truck scale operation manual was formulated. The daily operation of the scale was established.

ab. Inspection System of Incoming Vehicles

The truck scale has been functioning well, registering 1,081 vehicles within 4 months since the onset of the operation. Conclusively, the inspection system of incoming vehicles is established.

ac. Utilization of Collected Data

The collection of data on waste disposal is very important for a sound solid waste management. Since disposal data in accordance with classification of incoming vehicles (see Table E.6.2a) can be totaled every day, week, month and year, data should be used for proper operation of collection vehicles, etc..

b. Number of Incoming Vehicles

The following figures are the salient features of the four month-observation period.

Table E.6.4a Salient Features Observed within a 4 Month Period on Incoming Vehicles

(August to November, 1994)

Items	Unit	Number	Date
Maximum Number	units/day	269	24/10/1994
Minimum Number	units/day	0	5 days
Average Number	units/day	147	16/12/1993
Total Number for 4 Months	units	17,928	-
Monthly Maximum	units/month	4,623	Oct. 1994
Monthly Minimum	units/month	4,291	Sep. 1994

bb. Fluctuation by Classification

i. The daily number of incoming vehicles to Acahualinca disposal site averaged 147 units within 4 months. The maximum number was 269 units and the minimum was 0 unit per day.

ii. The monthly number of incoming vehicles to Acahualinca disposal site almost always amounted to around 4,500 units.

iii. The percentage of incoming vehicles transporting household, RIDS and directly hauled MSW was approximately 36%, 29% and 24%, respectively.

iv. The percentage of incoming vehicles from Public Cleansing Office, Direct Coordination Office, Beautification Office and direct haulage by private sectors was 69%, 3%, 1% and 27% of the total incoming vehicles, respectively.

c. Incoming Waste Amount

The salient features observed within a 4 month period on incoming waste amount are shown below:

Table E.6.4b Salient Features Observed within a 4 Month Period on Incoming Waste Amount

(August to November, 1994)

Items	Unit	Quantity	Date
Maximum Daily Incoming Waste Amount	ton/day	1,390.2	24/10/94
Minimum Daily Incoming Waste Amount	ton/day	0	5 days
Average Daily Incoming Waste Amount	ton/day	665.9	———
Total Incoming Waste Amount for 4 Months	ton	81,212.2	———
Maximum Monthly Incoming Waste Amount	ton/month	22,081.4	October 1994
Minimum Monthly Incoming Waste Amount	ton/month	18,337.6	August 1994
Average Incoming Waste Amount per Vehicle of Codes 10 to 70 (Household Waste)	ton/unit	6.3	———
Average Incoming Waste Amount per Vehicle of Code 80 (Market, Commercial and Institutional Wastes)	ton/unit	6.3	———
Average Incoming Waste Amount per Vehicle of Code 100 (Hospital Waste)	ton/unit	5.1	———
Average Incoming Waste Amount per Vehicle of Code 110 (RIDS)	ton/unit	5.6	———
Average Incoming Waste Amount per Vehicle of Code 120 (Street Sweeping Waste)	ton/unit	3.5	
Average Incoming Waste Amount per Vehicle of Code 130 (Park and Green Area Waste)	ton/unit	1.5	

i. The daily average of incoming waste to Acahualinca disposal site was 665.9 tons for four months. The maximum incoming waste amount was 1,390.2 tons and the minimum was 0 ton per day.

ii. The monthly incoming waste amount ranged from about 18,500 to 22,100 tons.

iii. Approximately 98% of the total incoming waste amount was MSW and 2% was ISW.

iv. The incoming percentage of household, RIDS and directly hauled MSW was approximately 50%, 35% and 5%, respectively.

v. The percentage of incoming waste collected and transported by the Public Cleansing Office, District Coordination Office, Beautification Office and

directly hauled by private sectors was about 91%, 2%, 1% and 6%, respectively.

d. Examination of Collection Route

The collection services of the Public Cleansing Office have 86 collection routes. Using the output of the operation program, it is possible to examine the work efficiency of each route.

The inspection of the collection routes should not only consider collection amount but the route condition assigned to each vehicle and the time required for each trip as well.

e. Industrial Solid Waste (ISW)

The salient feature of ISW disposal is as follows:

Table 3.4.1c Salient Features Observed within a 4 Month Period on ISW (August to November, 1994)

Items	Units	Quantity	Remarks
Maximum Daily Incoming Waste Amount	ton/day	60.0	16/08/'94
Average Daily Incoming Waste Amount	ton/day	14.1	———
Total Incoming Waste Amount for 4 Months	ton	1713.6	———
Share of ISW in Total Incoming Waste Amount	%		Total disposal 71,213 tons
Monthly Incoming Waste Amount (Max.)	ton/month	461.3	August 1994
Monthly Incoming Waste Amount (Min.)	ton/month	382.6	September 1994

ISW transported to the Acahualinca disposal site averaged 14.1 tons daily.

Of the 14.1 tons of ISW, the Municipality collected 8.9 tons (code Nº 200)and private sectors carrying out direct haulage collected 5.2 tons (code Nº 210 ~ 218).

According to the codes classified by waste type, 37% of the total amount of ISW hauled to Acahualinca is food waste, which averages 1.5 tons daily. Construction waste covers 25% of the total ISW amount, and averages 1.3 tons daily.

E.7 Disposal Waste Amount Survey

E.7.1 The Objective of the Survey

The Disposal Waste Amount Survey (DWAS) was carried out at Acahualinca disposal site in order to clarify the following points:

- to properly classify the present incoming waste prior to installation of the truck scale
- to understand the present disposal waste amount
- to observe the actual disposal of medical and industrial waste and the type of industrial waste

E.7.2 The Method of the Survey

Type of waste, responsible organization, generation source and number of incoming waste vehicles were continuously recorded for 7 days at the Acahualinca disposal site.

The final disposal waste volume obtained by the measured number of vehicles were converted to weight as shown in Table E.7.2a.

At the same period, type and volume of recyclable materials hauled out from the disposal site was observed.

Table E.7.2a Haulage Weight of Waste by Type of Vehicle

Type of Collection Vehicle	Capacity (m^3)	Compaction Type	Haulage Weight of Waste
Screw Type Collection Truck (M.BENZ)	16.0	x	16.0 x a *1 x 0.9*2
Screw Type Collection Truck (LIAZ)	22.0	x	22.0 x a x 0.9
Compactor Truck (NISSAN)	15.3	o	15.3 x 2.0*3 x a x 0.9
Compactor Truck (INTERNATIONAL)	15.0	o	15.0 x 2.0 x a x 0.9
Compactor Truck (IVECO)	14.0	o	14.0 x 2.0 x a x 0.9
Dump Truck (MAZ)	7.0	x	7.0 x a x 0.9
Dump Truck (KAMAZ)	7.0	x	7.0 x a x 0.9
Tractor Truck/Dump Body (KRAZ)	14.0	x	14.0 x a x 0.9
Roll-on Roll-off Truck (MACK)	15.0	x	15.0 x a x 0.9
Cart Tractor (BELARUS)	7.0	x	7.0 x a x 0.9

Note: *1 : a = Apparent Specific Gravity (ASG) obtained by WACS
*2 : 0.9 = Rate of operation of vehicle
*3 : 2.0 = Compaction Ratio

Type of Waste	ASG	Source
Household Waste	0.22	WACS
Hospital Waste	0.22	According to ASG of household waste
Commercial and Market Waste	0.28	WACS (ASG of market waste)
Industrial Waste	0.22	According to ASG of household waste
Street Sweeping Waste	0.19	WACS
Park Waste	0.19	According to ASG of street sweeping waste
Directly Hauled Waste	0.22	According to ASG of household waste
Illegally Dumped Waste	0.22	According to ASG of household waste

E.7.3 Results of the Survey

a. Classification of Incoming Waste

The survey was carried out for 7 days; the number of vehicles carrying waste to the disposal site, type, responsible organization and the generation source of incoming wastes were observed. The results are summarized in Table E.7.3a.

The total number of vehicles carrying waste to Acahualinca disposal site was approximately 180 vehicles per day, including Sundays. Almost 60 percent of the vehicles carried municipal solid waste and the remaining 40 percent were carrying out direct haulage of waste from factories, etc.

The public cleansing office hauled waste form residential areas, commercial ares, hospitals, markets and rids. Wastes resulting from street sweeping activities and in parks and green areas were hauled by the district coordination office and the ornamentation head office, respectively.

Table E.7.3a Type of Waste, Responsible Organization, Generation Source and Number of incoming Vehicles

Type of Waste	Responsible Organi-zation	Generation Source	Number of Vehicles	
			Total	Ave./day
Municipal Solid Waste (MSW)	Public Cleansing Office	Residential Areas	391	56
		Hospitals	6	1
		Commercial Areas, Markets and Institutions	83	12
		Registered il-legal Dumping Sites	267	38
	District Coordination Office	Street Sweeping	2	0.3
	Beautification Office	Parks and Green Areas	7	1
Industrial Solid Waste	Public Cleansing Office	Factories	13	2
Direct Haulage by Private Sector			512	73
Total			1,281	183.3

b. Disposal Waste Amount

The results of Disposal Waste Amount Survey is shown in Table 4.11.3b and Figure 4.11.3a. Amount of waste disposal was estimated at approximately 460 tons per day.

The amount of waste disposal by the Municipality and the waste amount directly hauled were 87% (420.1 tons) and 13% (60.4 tons) respectively. The percentage and amount of each type of waste carried into the disposal site are shown below:

- Household waste collected through curb collection system	63.3%	(304.3 ton)
- Hospital waste	0.8%	(3.8 ton)
- Commercial market and institutional waste	8.4%	(40.6 ton)
- Industrial waste collected by the Municipality	2.0%	(9.7 ton)
- Registered illegal dumping site waste (household and street sweeping waste)	12.6%	(60.4 ton)
- Street sweeping waste collected by the District Office	0.1%	(0.3 ton)
- Parks and green area waste	0.2%	(1.0 ton)
- Directly hauled waste	12.6%	(60.4 ton)
TOTAL	100%	(480.5 ton)

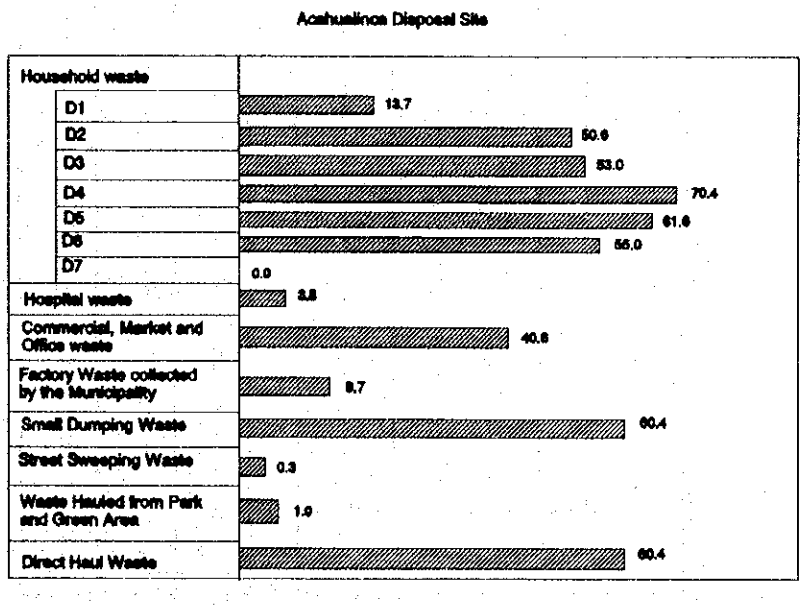


Figure E.7.3a Disposal Amount to Acahualinca Disposal Site (Unit: t/d)

Table E.7.3b Results of the Disposal Amount Survey at the Acahualinca Disposal Site

(14th May 1994 – 20th May 1994)

Type of Waste	14th May (Sat.)		15th May (Sun.)		16th May (Mon.)		17th May (Tue.)		18th May (Wed.)		19th May (Thu.)		20th May (Fri.)		Average	
	Time	ton	Time	ton	Time	ton	Time	ton	Time	ton	Time	ton	Time	ton	Time	ton
Household Waste	57	324.1	0	0.0	86	456.8	70	387.6	62	330.0	48	260.4	68	370.1	55.9	304.3
D1	3	17.1	0	0.0	5	24.6	4	23.2	2	8.7	1	6.1	3	15.3	2.6	13.7
D2	4	24.2	0	0.0	17	96.6	6	31.1	16	85.4	4	24.2	17	92.0	9.1	50.6
D3	0	0.0	0	0.0	27	139.5	3	17.2	17	83.1	4	24.1	20	106.9	10.1	53.0
D4	10	60.0	0	0.0	23	132.0	8	48.2	19	107.8	7	42.1	19	102.6	12.3	70.4
D5	19	111.0	0	0.0	8	33.4	23	136.1	5	29.8	15	83.9	6	35.8	10.9	61.6
D6	21	110.3	0	0.0	6	30.7	26	131.8	3	14.7	17	80.0	3	17.5	10.9	55.0
D7	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
Hospital Waste	1	4.4	0	0.0	1	4.4	1	4.4	1	4.4	1	4.4	1	4.4	0.9	3.8
Commercial, Market and Office waste	19	54.6	0	0.0	27	77.1	8	33.8	10	39.6	9	37.5	10	39.6	11.9	40.6
Factory Waste collected by the Municipality	2	12.1	0	0.0	0	0.0	5	28.6	2	7.4	2	12.1	2	7.4	1.9	9.7
Registered Illegal Dumping Site Waste	56	89.5	0	0.0	48	77.0	74	112.1	23	39.8	17	29.9	49	74.3	38.1	60.4
Street Sweeping Waste	0	0.0	0	0.0	2	2.4	0	0.0	0	0.0	0	0.0	0	0.0	0.3	0.3
Waste Hauled from Parks and Green Areas	0	0.0	0	0.0	6	6.2	1	0.9	0	0.0	0	0.0	0	0.0	1.0	1.0
Directly Hauled Waste	80	41.2	20	15.7	80	73.0	60	23.4	80	57.0	89	89.4	103	122.8	73.1	60.4
Total	215	525.9	20	15.7	250	696.9	219	590.8	178	478.2	166	433.7	233	618.6	183	480.5

c. Hospital and Industrial Waste Disposal

Non-infectious waste discharged from hospitals is collected by the Municipality and hauled to the Acahualinca disposal site. One fixed collection vehicle is assigned for the collection of hospital waste six times a week except on Sundays. Average amount of hospital waste hauled to the disposal site was 3.8 tons per day, including Sundays.

Some factories have entered into an agreement with the Municipality regarding the collection of their waste. The Municipality has three routes for industrial waste collection. The average industrial waste amount hauled to the disposal site by the Municipality is 9.7 tons per day.

Other factories or private sectors, i.e. households, offices and shops, not under any binding agreement with the Acahualinca disposal site. The number of vehicles directly hauling waste is 73/day.

d. Recyclable Materials Transported out from Disposal Site

The type and volume of recyclable materials hauled out from the disposal site is shown in Table E.7.3c.

Small scale recycling businesses are carried out by scavengers; reusable materials were carried out bay hand, push carts and bicycles. The main recyclable materials removed were plastic, aluminum and iron.

Table E.7.3c Results of the Recycling Survey at the Acahualinca Disposal Site

(14th May 1994 – 20th May 1994)

Type of Recyclable Material	14th May (Sat.)	15th May (Sun.)	16th May (Mon.)	17th May (Tue)	18th May (Wed.)	19th May (Thu.)	20th May (Fri.)	Total	Weight (kg)
Meat	3 barrels 2 sacks	0	0	0	4 sacks	5 sacks	4 sacks	3 barrels 15 sacks	2,000
Plastic	9 sacks	1 sack	3 sacks	9 sacks	3 sacks	11 sacks	5 sacks	41 sacks	164
Aluminum	18 sacks	10 sacks	15 sacks	0	0	0	0	43 sacks	161
Bottle	3 sacks	4 sacks	8 sacks	0	0	0	2 sacks	17 sacks	425
Wood	2 sacks	3 sacks	0	0	1 sack	7 sacks	0	13 sacks	390
Cardboard	2 sacks	1 sack	2 sacks	2 sacks	2 sacks	12 sacks	0	21 sacks	252
Iron	62 quintals	31 sacks	3 sacks	5 sacks	0	5 sacks	5 quintals	44 sacks 67 quintals	6,600
Paper	0	0	0	0	1 sack	0	0	1 sack	6,700
Leather	0	0	0	0	1 sack	3 sacks	0	4 sacks	17
Cotton	1 sack	0	2 sacks	1 sack	1 sack	0	2 sacks	7 sacks	63
Total	–	–	–	–	–	–	–	–	16,840

E.8 Operation and Maintenance of Equipment

E.8.1 Introduction

Information and data about the vehicles and its maintenance was obtained through visits to the Public Cleansing Head Office, District Coordination Office and the Administration of Maintenance and Recovery of Equipment. With the latter institution, visits were made to the "Los Cocos" and to the "Central" workshops.

The heads of the Public Cleansing Office, District Coordination Office and Workshops were very cooperative in providing the necessary information.

In the different locations, the Study Team was on the look out for information about vehicles used for waste collection and street sweeping, equipment used in the sanitary landfill, and equipment used within the workshop for repairs and preventive maintenance.

The vehicles used in waste collection and equipment used in the landfill are under the responsibility of the Public Cleansing Head Office, while the vehicles used in street sweeping are under the several sections of the District Coordination Office.

In this chapter, the operation as well as the maintenance of the equipment will be discussed.

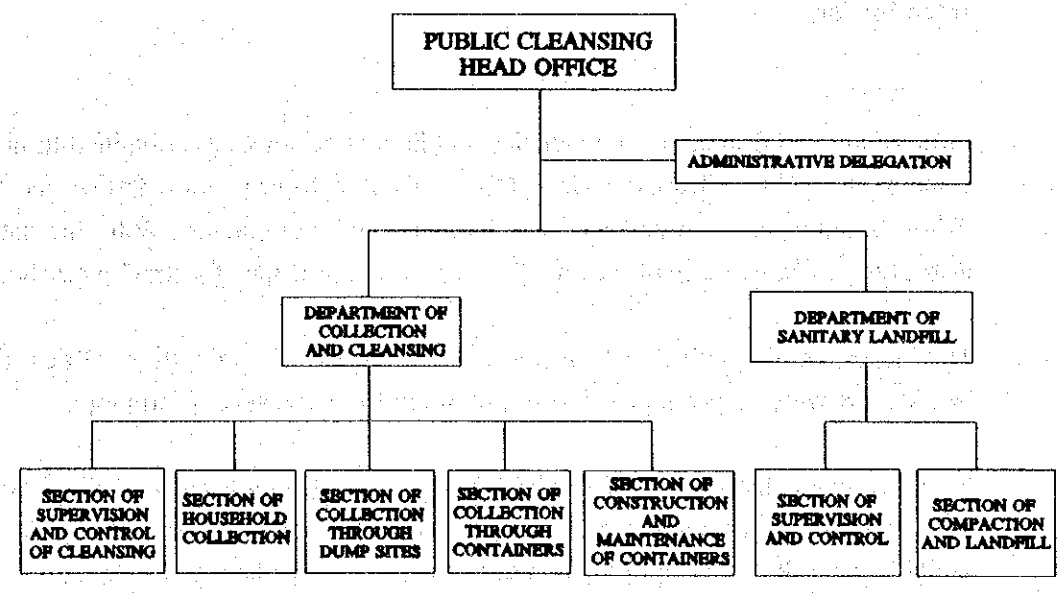
E.8.2 Operation and Maintenance at the Municipality

a. Equipment Operation

The Public Cleansing Head Office is subordinated to the Municipal Works and Services Head Office. This Department is responsible for the operation of the vehicles used in waste collection through two departments:

- The Department of Collection and Cleansing, and
- The Department of Sanitary Landfill

The organizational chart of the Public Cleansing Head Office is presented below:



The Department of Collection and Cleansing has five sections:

- Supervision and control
- Household collection
- Collection through dump sites
- Collection through containers
- Container construction and maintenance

The Sanitary Landfill Department has two sections:

- Supervision and control
- Compaction and landfill

The vehicles and equipment used in the garbage collection and street cleansing activities are subordinated to three sections:

- Household collection
- Collection through dump sites
- Collection through containers

The table presented ahead shows a listing of the vehicles used in each section:

Household waste collection using compactor trucks

-	M.Benz 1513	8.4 m^3	6
-	Liaz 110820	16 m^3	7
-	International 1850B	15.3 m^3	2
-	Nissan CPC 14	15.3 m^3	27
-	Iveco 135-17	14 m^3	20

Household waste collection using pulling cart tractors and dump carts

-	Belarus MTZ80	6 (Tractors)
-	IFA HW6011	21 (Carts)

Collection through dump sites

-	Kraz BI258	Tractor Trucks	2
-	Taimo	Dump Trailers (14 m^3)	3
-	Kamaz 5511	Dump Trucks (7 m^3)	5
-	Maz 5549	Dump Trucks (7 m^3)	7
-	Kamaz 55111	Dump Trucks (7 m^3)	3
-	ZTC UNC200	Wheel Loaders	2
-	Fiat Hitachi FR 130	Wheel Loader	2

Collection through containers (15 m^3)

-	Western Star	Roll-on-Roll-off Trucks	1
-	Mack R6858	Roll-on-Roll-off Trucks	3

The equipment used for the sanitary landfill are subordinated to the Compaction and Landfill Section, and is as follows:

Equipment actually being used in the Acahualinca Landfill:

-	Compactor tractor Caterpillar 816-B	2
-	Bulldozer Caterpillar D6H	2
-	Compactor tractor Benati BC250	2
-	Water Tank Truck M.Benz 1513	1
-	Water Tank Truck Nissan CMF87F	1

Equipment not being used because of being outdated or due to malfunction:

- Bulldozer Komatsu D50A 1
- Bulldozer Caterpillar D6D 1
- Bulldozer Uruaz DZ 130 2

aa. Cleansing Supervision and Control Section

This section is located within the Acahualinca landfill site. There are four employees working in pairs at the entrance gate, recording the following data:

- entrance time
- exit time
- truck type
- waste characteristics
- amount of waste (m^3)

ab. Household Collection Section

The Household Collection Section is located in the same offices as the other collection sections (container and dump sites). The dimension of this room is 6m x 4m, and it is situated close to the gate control and the Public Cleansing Head Office.

This section controls the collection trucks for household waste collection, and compactor trucks for the 0.83 m^3 containers and 4 m^3 tractor pulled carts. The drivers in charge of the above equipment are also subordinated to this section.

This section dispatches 38 vehicles and 5 tractor pulled carts daily, i.e. Monday to Saturday, with their drivers; work usually starts from six in the morning until noon.

The various daily services are assigned and listed in a form named "Daily Control of Entrance and Exit of Equipments".

In this form, the following items are registered:

- vehicle identification code
- driver's name
- service routing
- number of helpers
- exit time
- entrance time

The entrance and exit time are recorded at the entrance gate.

The section handles driver allocations so that each driver has a "specific" vehicle to manage every day and to ensure the assignment of drivers to vehicles and equipment they are well acquainted with, especially regarding familiarity with any faults and specific handling requirements.

Each driver receives daily a " Routing Sheet" already filled in by the section with the following information:

- Type and identification number of the vehicle
- Name and identification number of the driver
- Helpers
- Routing code
- Name and signature of the responsible officer and signature

In the back of the "Routing sheet" is an "operator daily record" with the following data:

- type and identification number of the vehicle
- name and Identification of the Driver
- date
- production data: distance travelled, volume transported in m^3, number of trips to the landfill and working time.
- technical condition of the vehicle
- amount of combustibles
- work time during loading, maintenance, breakdowns, absence of driver and others
- extra time
- signature of driver

Each route has an estimated production in m^3. When the driver, at the end of his shift, presents a collection amount larger than the estimated one, he gets a bonusbased on the amount of 1 hour over time for every 5 m^3 of excess load. The volume of waste carried is measured by eye.

Extra pay is given for overtime, however, it is only granted with the director's approval.

These "awards for high productivity" encourages the drivers to take care of the vehicles.

The "Routing Sheets" are handed to the drivers, every monday, for the whole week.

In this section there is also a vehicle key display, where all the keys for the Household Collection trucks are located.

This section has also a time registration clock, but the drivers do not use it since they are not subject to carrying a daily registration card (the drivers of the other collection sections – dump sites and containers, and the maintenance personnel, use the daily registration card). The reasoning behind this conduct is due to the difficulty in making the drivers register their time of departure, which results in delays in commencing the works.

The section daily records the condition of each vehicle on a special form according to the following classification:

- E : spare
- A : active
- R : under repair

A check list is being made only for the new Nissan trucks. There is a form for each vehicle with its code and the name of the driver. The main components under observation are:

- starter
- radiator cap
- oil tank cap
- windshield
- battery
- lights
- mirrors
- doors
- bumpers
- tires

When a problem arises with any of the trucks, the inspector in charge notifies the manager (head of the section) who in turn charges the driver the cost of the repair.

The inspection is followed by a night watchman, who remains responsible for the trucks until the next morning, when the truck is handed to its driver.

ac. Collection through Dump Sites Section

This section is responsible for the trucks and the following equipment used to clean up the dump sites:

–	dump trucks	15
–	tractor trucks and trailers	2 and 3
–	wheel loaders	4
–	excavator	1
–	water tank trucks	2

The personnel in this section is made up of the following:

–	drivers	19
–	operators	3
–	inspectors	4

The regular daily shift goes from 6:00 to 12:00, but if necessary extra time is made with the approval of the management.

All the employees in this section are subject to the "Daily Registration Card" control registering their entrance and exit by punching the time card. Besides this individual control, the overseer records the daily attendance of each employee in another form.

Six districts are served by this section, each one twice a week. The employees are grouped in teams for each truck, according to the wheel loaders in working condition. At the time of the visit to the shop, only one wheel loader was in operation.

All the vehicles and equipment are controlled by a routing sheet.

ad. Collection through Containers Section

This section handles the trucks for the collection of containers of 15 m^3 and are of the roll-on-roll-off type.

There are ten trucks in the section but only two are working at present.

This section employs are drivers and five helpers who work in a shift of eight hours a day; these drivers are paid higher than the drivers of the trucks for household waste collection.

The operation of this section is controlled through a chart which lists the number of containers and daily collection points.

Maintenance and breakdowns are registered in the routing sheets. Requests for repair are made based on the data extracted from the Routing Sheets of each section. At this moment there are no request forms available, thus a simple memorandum is made. With this memorandum, the vehicle is directed to the shops in order to be repaired.

When the vehicle is repaired, the head of the section and the driver go to the shop in order to check whether and how reparation was conducted. Once the repair work is approved, the vehicle is brought back to the section.

ae. Container Construction and Maintenance Section

In this section the 15 m^3 and the 0.83 m^3 containers are repaired. Metallic parts and other items for vehicles or for civil works are also made in this section. This section carries out the following repair services:

- truck body repair
- bumpers
- stairs
- doors, windows and large doors
- air Conditioning stand and screen
- mechanical parts repair

The headman of this section directs the following staff:

- Secretary	1
- Welders	3
- Painters	2
- Assistants	2

The following equipment is not used by this section due to a different voltage. The voltage of the equipment is 220V three phases as opposed to the supplied voltage of 220V single phase.

- air compressor	1
- hydraulic shearing machine	1
- high-speed abrasive cut-off machine	1
- point welding machine	1
- bending roller	1
- power type circle shear	1

These machines were previously at the Batahola workshop and were moved to the Los Cocos workshop. The electrical outlets will be adjusted after INE – Nicaraguan Energy Institute carries out the necessary connecting works.

Currently, only the following machines and tools are in working condition:

–	welding machine 225 A	2
–	welding machine 250 A	1
–	oxy-acetylene welding	1
–	bench electric grinder*	2
–	hydraulic press	1
–	metallic bench	3
–	machinist vise	3
–	iron anvil	1
–	cabinet tools	2
–	tank for container washing	1

* one inoperative due to lack of grinding wheel

This section is located in a shed (140m^2) with low wall partitions for painting, welding, iron works and for housing the machines. There is also a set of lockers for the employees.

The following containers were being repaired the day we visited the shop (10/05/94):

15 m^3 containers:	on rail repair	8
	on door repair	5
	repaired	3
0.83 m^3 containers:	waiting for repair	447
	being repaired	11

Reparation is conducted through a "repair request", where works to be done is described. If the job is to be done on an equipment or vehicle, its code number, plate number and model should be inscribed in the request form.

With the repair is request a "service order" which is filled with the day, the description of the services, personnel employed and the hours spent in the repair. In the back of this form is the list of materials used and the costs; the cost of materials and manpower are added up for the total repair cost.

An "Activities Control" panel fills up a form daily recording the names of the laborers, the activities made, the number of service orders being carried out and the time spent in the works. At the end of the week a report is made with a listing of all the service orders concluded and the corresponding costs. This report also generally registered other activities, absences, relevant problems and observations.

At the end of each month a monthly report is made listing all the requested repairs and works, materials applied and manpower employed, and giving the total monthly direct cost of this section.

The weekly and monthly reports are forwarded to the Public Cleansing Head Office.

Every year, in October, a listing of all the materials and parts needed for the coming year is prepared . The materials are requested monthly, according to the approved budget. This particular year, however, until now, only 3% of the budgeted and approved material has arrived at the shop. This situation is causing difficulties to the repair works and is the reason why there are so many containers waiting to be repaired.

The containers repaired are removed from the shop under a release order issued by the section.

af. Compaction and Landfill Section

The section of compaction and landfill is responsible for the operation of the Acahualinca landfill.

This section has the following equipment:

-	bulldozer caterpillar D6-H	2
-	compactor tractor caterpillar 816B	2
-	compactor tractor benati BC 250	2
-	water tank truck Nissan CMF 87F	1
-	water tank truck M.Benz 1513	1

From time to time, this section borrows the equipment of other municipal institutions for excavation and dirty transport for the maintenance of the access ways. At the day of the visit to the landfill, the following machines not belonging to the compaction and landfill section were at work:

- wheel loader Trojan 1900 1
- dump truck KAMAZ 55111 2

Both the compactor tractors, Benati BC 250, were inoperative in all the visits made to the landfill due to the preference of the employees for the compactor tractor Caterpillar 816B.

ag. Fuel Supply in Los Cocos

There is a fuel station in the Los Cocos workshop located near the gate control. This service is under the Directory of Maintenance and Recovery of Equipments.

Fueling control is made through a form named " daily fuel supply". One form is used for gasoline powered vehicles and motorcycles while another one is used for diesel oil powered trucks, machines, pick-ups, mobile fuel tank truck and equipment in general.

The name of the equipment manufacturer, its identification number, the name of the driver, the amount of fuel supplied and the hour of the day are all recorded.

The controller of this station receives a coupon from the driver which conforms with the amount of fuel to be delivered. At the end of the day he sends all the coupons to the Equipment Recovery Directory, together with the filled forms "daily fuel supply", for control purposes.

ah. Infrastructure in Los Cocos

Gate control:

The gate control is manned by 13 employees grouped in two teams, each one working alternately for 24 hours, from 7:00 am.

The entrance and exit hours of each vehicle is recorded at the gate at the routing sheet and on the daily control of the entrance and exit of vehicles and equipments

Items and objects carried by the vehicles are also checked at the gate. When the driver carries something (parts, equipment, supplies etc.) with him, he is required to have an authorization, a copy of which is kept at the gate.

Rest rooms:

The rest room is located close to the gate control room and is equipped with 6

showers and 9 toilets – the rest room measures 14m X 4m.

Locker rooms:

Each employee has a locker . The locker room is located beside the rest room and measures 12m X 4m.

Auditorium:

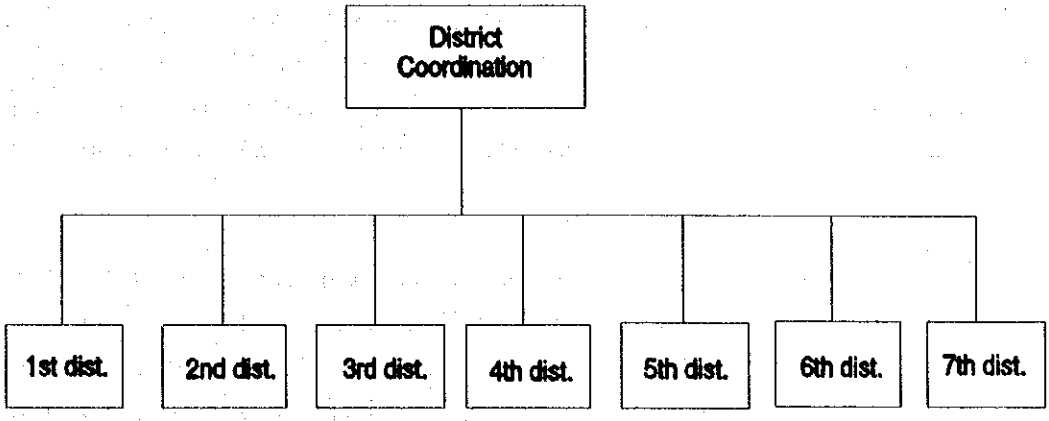
Alongside the locker room is a room measuring 18m x 6m which is used for meetings and for entertainment of the employees. There are two ping-pong tables in this room.

Canteen:

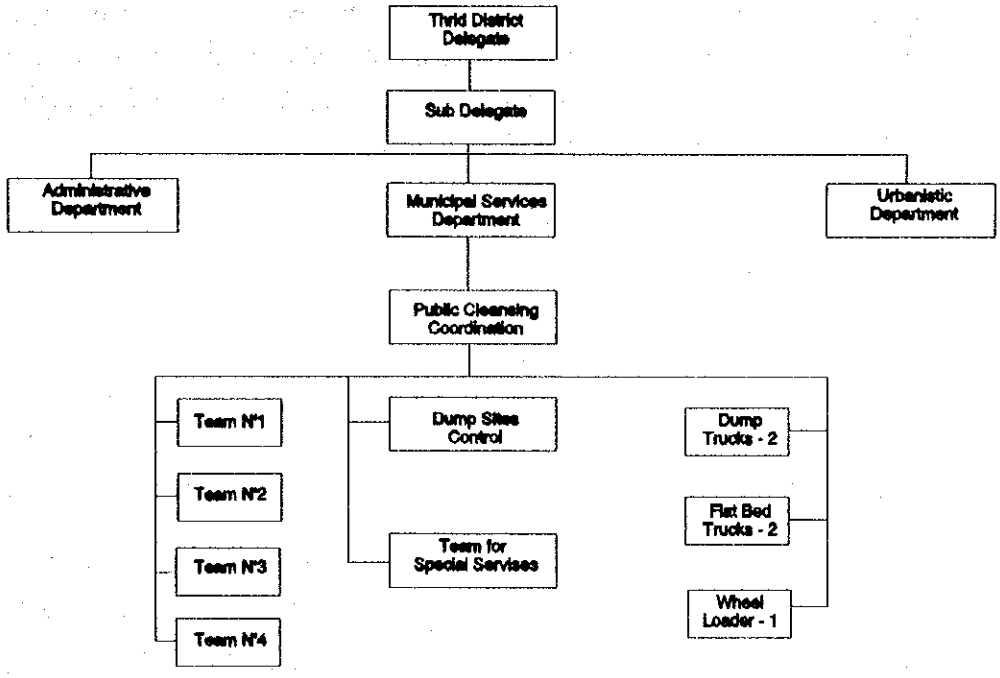
There is a private canteen occupying an area of 10m X 6m beside the meeting room.

ai. Street Sweeping

The street sweeping services are carried out by seven municipal districts, all under the Districts Coordination Office.



A visit was made to the third district, where the chief of the Municipal Services is Mr. Hugh Kain Hodgson.
The administrative structure of the third district is the following:



The cleansing operational system is made up of four teams for routine services and one team for special services.

The teams for routine services use wooden carts to remove street sweeping wastes

and take them to the several small dump sites scattered in the city, in district 3. These carts are 0.20 m^3 big and are used to transport wastes to one of these 52 dump sites – the vehicles of the Collection Through Dump Sites Section collect the refuse from 25 of these dump sites, while district trucks remove waste from the remaining 27. For this task, the districts use dump trucks and wheel loaders of the Bob–Cat type.

The assignment of trucks is carried out on an daily basis for each of the 27 dump sites, priority being given to the landfills located near the main routes, when vehicles or wheel loaders are not available. Negatilations and all carried out verbally and truck inspections are made just by looking. Everything is recorded.

The teams work from 6:00 to 12:00.

There is a transport foreman in charge of controlling the use of the trucks and wheel loader. The maintenance services are made in the Central Workshop. The problems to be repaired are described in a memorandum. Oil exchange, greasing and washing are carried out every three months in the Central Workshop.

The districts have a budget which allows them to send their vehicles needing small repairs to private shops. Tire repair services, for example, are made in a private shop close to districts. For these services a fast bidding process is required, among, at least three dealers. At the time of our visit, the section had maintenance problems on the following trucks:

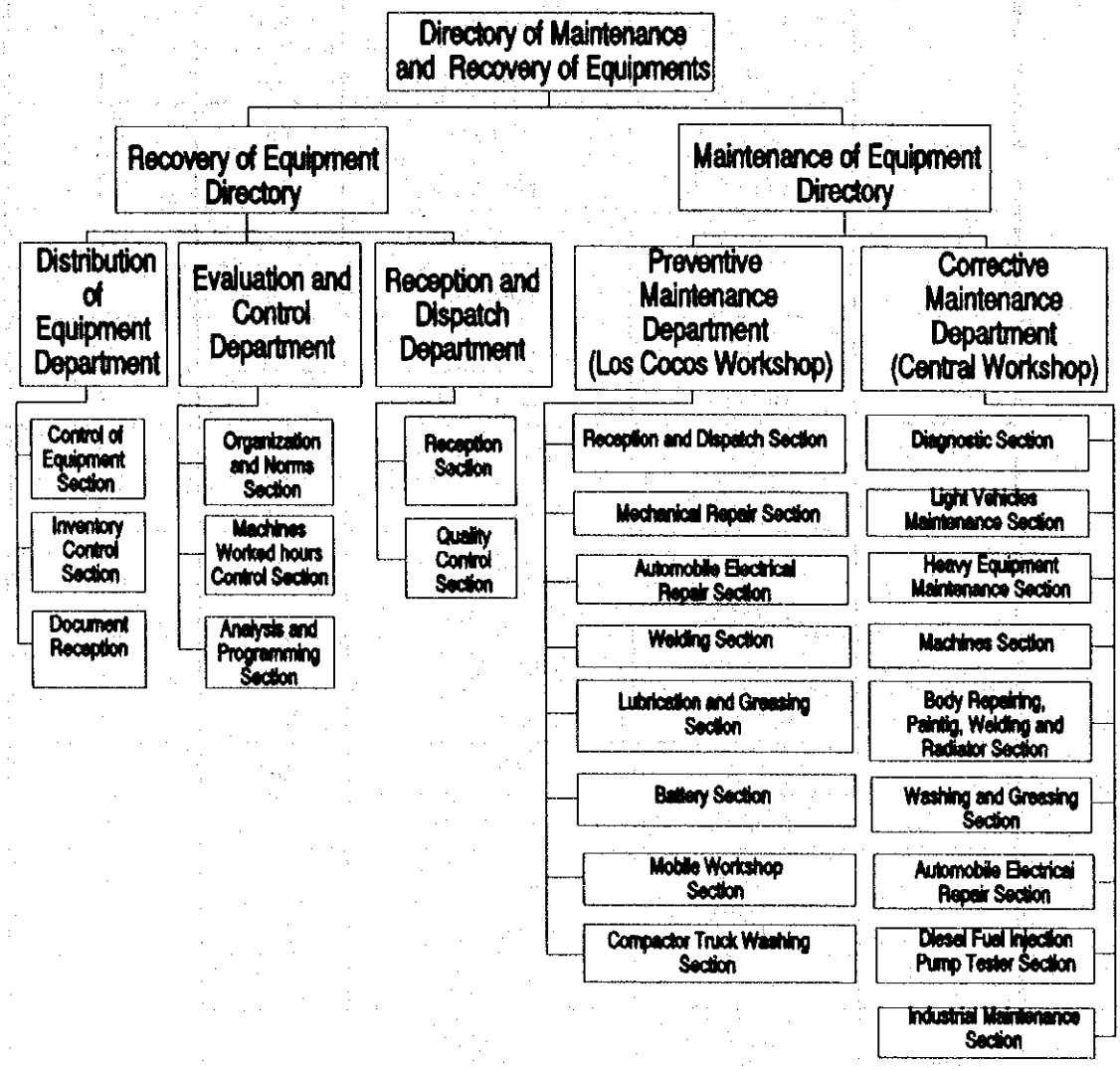
- MA flat bed truck 6 m^3 1
- KAMAZ dump truck 7 m^3 1

The following is a list of all the equipment used in each district:

EQUIPMENT USED IN THE DISTRICTS				
District	Manufacturer	Type	Capac.	Number
1	MAZ-3	dump truck	$7m^3$	1
	KAMAZ	dump truck	$7m^3$	1
	IFA	flat bed	$6m^3$	1
	MAZ-3	flat bed	$6m^3$	1
	Bob-Cat	wheel loader	-	1
2	MAZ	flat bed	$6m^3$	1
	MAZ	dump truck	$7m^3$	1
	KAMAZ	dump truck	$7m^3$	1
	Bob-Cat	wheel loader	-	1
3	MAZ	dump truck	$7m^3$	1
	MAZ	flat bed	$6m^3$	1
	IFA	flat bed	$6m^3$	1
	KAMAZ	dump truck	$7m^3$	1
	Bob-Cat	wheel loader	-	1
4	KAMAZ	dump truck	$7m^3$	2
	IFA	flat bed	$6m^3$	2
	Bob-Cat	wheel loader	-	1
5	MAZ	dump truck	$7m^3$	1
	KAMAZ	dump truck	$7m^3$	1
	MAZ	flat bed	$6m^3$	1
	Bob-Cat	wheel loader	-	1
6	MAZ	flat bed	$6m^3$	1
	MAZ	dump truck	$7m^3$	1
	KAMAZ	dump truck	$7m_3$	1
	Bob-Cat	wheel loader	-	1
7	IFA	flat bed	$6m^3$	1
	MAZ	dump truck	$7m^3$	1
	BELARUS	cart tractor	-	1

b. Equipment Maintenance

The Direction of Maintenance and Recovery of Equipments is responsible for the maintenance of all the vehicles and equipment of the Managua Municipality. The organizational chart of this directory shown below:



The above structure is the official organizational structure of the Directly. However, the directory is actually involved in the following:

- The Recovery of Equipment Directory is not an operational but an administrative office in charge of the control and the operational distribution of the vehicles and equipment.

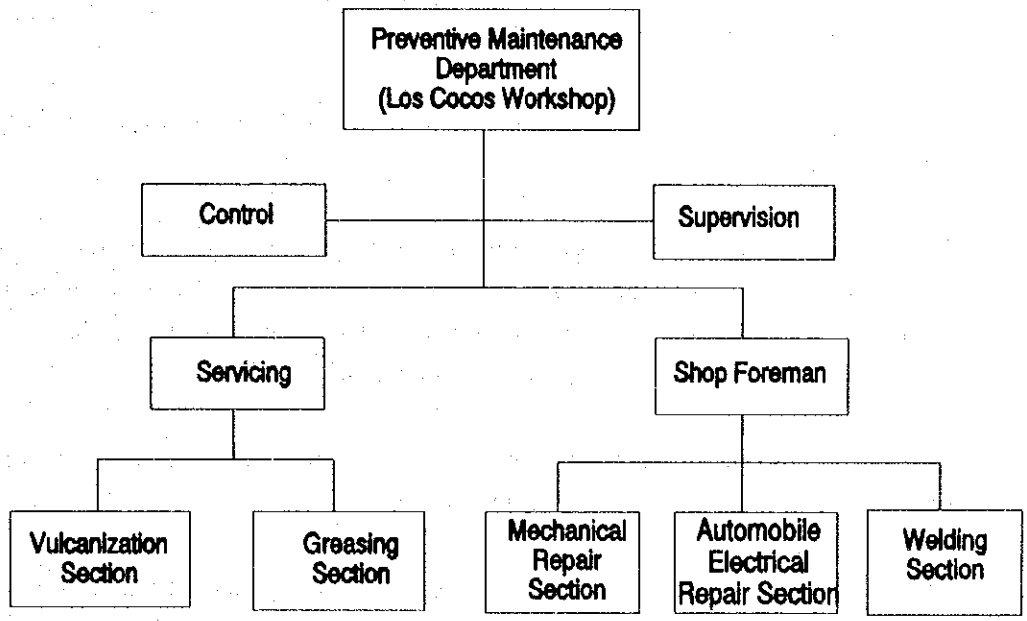
- Its three departments and eight sections are staffed by only four

employees performing the following tasks:

- evaluation and control
- inventory control
- work reception
- control of equipments

ba. Preventive Maintenance Department - Los Cocos Workshop

The administrative structure of this department is shown below.



This workshop also conducts lubrication and oil exchange.

The type of works that are done at Los Cocos workshop and at the Central workshop are the same and there is no criteria that determine which workshop should carry what service.

Presently, the Los Cocos workshop has the following sections:

- vulcanization
- greasing
- mechanical repair
- automobile, electricity
- welding

Services at the shops starts after receiving a "repair request" from the operational section where the vehicle is assigned to the moment there are no special forms for this request, and repair services are requested through a memo.

Based on the repair request, a "service order" is issued. This service order describes all the services to be done and assigns the employees in charge of it. Also the time spent repairing the vehicle or equipment is recorded. On the back of this form is the list of the materials employed.

The materials needed are requested by the employees in charge of the repairs through a material request form signed also by the chief of the section and forwarded to the Head of the Department. After his approval, the employee goes to the warehouse to receive the materials.

All the repair orders go to the Directory of Equipment Recovery every week, along with a weekly report.

For tire repair services, the "Service Order for Repairs and Replacement of Tires" should be filled up. It is sent to the "Public Cleansing Head Office" to allow them to control the collection services and to determine the number of extra hours spent by the collection crew due to the tire repair works.

A weekly report on lubricants, tires and batteries is made and sent to the Directory of Maintenance and Recovery of Equipments.

The fueling control of the field fueling vehicles is made through a form – "Refueling order for grease and fuel". The identification of the equipment or vehicle and the amount and type of lubricants delivered are listed in the form.

Three copies are made of this form, each one directed to:

- the Recovery of Equipment Directory
- the Public Cleansing Head Office
- the workshop

There is also a lubricant services control. Each type of lubricant has a record to keep an inventory of the material used. This control measure is basically for accounting purposes; one record sheet is kept in the Los Cocos workshop while a copy is handed over to the recovery of equipment directory.

baa. Vulcanization Section

This section is located in a shed of 175 m^2. Part of this area is separated by a wire fence.

The machines and tools used in this section are:

-	hot patch clamp	3
-	air compressor	1
-	portable Hydraulic Jack (20t)	5
-	portable Hydraulic Jack (50t)	1
-	hand tools	various

There are also some spare tires for the vehicles

The place is out of order and some tire tubes are placed on the floor waiting for repairs. There are also many tires and tire rims in the section.

The section is staffed with five persons working in shifts: three from 6:00 am to 12:00 and two from 12:00 to 6:00 pm.

Most of the repair services are made during the morning shift because this section does not operate during the night and the tires are checked only in the morning by the driver. A daily average of 10 tires are repaired in the morning and 6 in the afternoon.

bab. Greasing Section

This section occupies an area of 7.30m x 7.15m and is located in the same shed that houses the vulcanization section. This section has a pit for maintenance services.

This section carries out oil exchange services as well as lubrication for all the vehicles belonging to the "Los Cocos" Workshop.

This section has the following equipment:

-	compressed air outlet	1
-	high pressure grease pump	1
-	hand oil pump	1

This section does not perform washing services.

This section has five employees and two drivers, who work with the two mobile oil tank trucks which are presently in bad shape.

The greasing section conducts a lubrication program organized by the department for the compaction equipment, SHIN MAYA, assembled on the NISSAN trucks. These services are available from Monday to Friday for the 27 vehicles.

The following parts are lubricated:

- guide rail of the ejector panel
- bushing and pins of the tailgate
- bushing and pins of the hydraulic cylinders
- lock of the tailgate

This section also cleans air filters.

Lubrication Program

Day of the Week	Quantity	Identification Nº of the Vehicle		
Monday	4	04-K-76	04-K-77	04-K-78
		04-K-79		
Tuesday	5	04-K-80	04-K-81	04-K-82
		04-K-83	04-K-84	
Wednesday	5	04-K-85	04-K-86	04-K-87
		04-K-88	04-K-89	
Thursday	6	04-K-90	04-K-91	04-K-92
		04-K-93	04-K-94	04-K-95
Friday	7	04-K-96	04-K-97	04-K-98
		04-K-99	04-K-100	04-K-101
		04-K-102		

Since the workshop offers no washing services, the NISSAN vehicles are cleaned and washed in the open yard by their own drivers and helpers, using the water tank and pump provided.

The daily washing of the vehicles prevents corrosion and keeps the vehicles clean.

On the other hand, greasing should be done more frequently. This practice also causes corrosion in the brakes and wheels.

An evidence of this situation is the lubrication problems with the pins and bushings of the hydraulic cylinders which led to the modification of the original design.

The chassis of the NISSAN trucks are not lubricated in this section. The trucks are brought over for lubrication and oil change to the central workshop every 4,000 km.

All the other trucks and machines are lubricated and have their oil changed in this section, but they are not washed.

bac. Mechanical Repair Sections

In this section all the trucks belonging to the Public Cleansing Head Office are maintained and repaired and are parked in the yard. The yard is not paved and the work conditions are not so good. This section provides the following repair services:

- brakes
- springs and axles repair
- clutches
- belts
- butt – joint

The overhaul of injection pumps, injection nozzles and engines are made in the central workshop.

There are two mechanics A, two mechanics B, and four helpers in the first shift and two mechanics A, two mechanics B and three helpers in the second shift.

Machines and Tools

The machines and tools existing in this section are also used in the welding section.

-	welding machine	2 (one in bad conditions)
-	bench electric grinder	1
-	bench	1
-	metallic bench	1
-	machinist vise	2

- oxy-acetylene welding 1
- tool box 8

On the day of our visit (May-5th-1994) the following trucks and equipment where undergoing repair:

09-K-53 Hydraulic valve of the body equipment

07-C-01 Clutch-the overhaul of the clutch disc is made in a private shop

04-K-96 Generator and Tire repair

04-K-97 Oil leakage in the engine. The mechanics are removing the puller. This service required the welding of a nut; there was no eye protection for the welder. This service should be done at the Central Workshop.

04-V-158 Over heating - radiator removed and sent to the Central Workshop.

04-V-160 Clutch and battery. The overhaul of the clutch disc was made in a private shop.

06-C-29 Hydraulic system and over heating - radiator removed and sent to the Central Workshop.

04-OK-49 Butt - Joint

04-V-143 Water pump - injection pump sent to Central Workshop for adjustment services. The tires are in recap.

bad. Automobile Electrical Repair Section

This section is housed in an area of 7.15 m x 3.45 m, in the same shed housing the other sections. The place is out of order with many parts and with various tube tires lying around. The section has some starter engines and generators.

Machines and Tools

- battery charger 1
- metallic bench 1
- machinist vise 1

There are two electricians working in the first shift and another two in the second shift. This section only handles small repairs on starter engines and generators. The starter engine overhaul and generator overhaul are made in the Central Workshop.

bae. Welding Section

It is located in the same open shed where other sections are, and it occupies an area of 7.15 m x 10.70 m.

This section only welds trucks or parts of trucks and equipment and does not handle repair and refitting of trucks, equipment and machines. The repair services are made in the container construction and maintenance section.

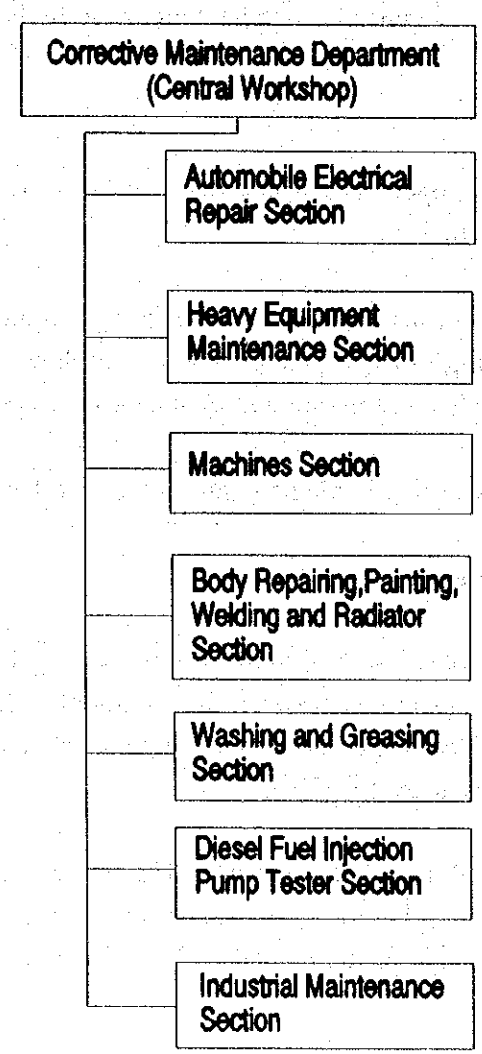
There are two welders working in the first shift and one welder in the second shift.

baf. General Comments

The total number of employees in all these sections is 42. There is no bathroom in the shed. There is a cloakroom between the automobile electricity section and the welding section divided by partitions made of wood and another one beside the Vulcanization Section near to the office.

Several trucks are parked in the yard, but they will not be overhauled because the cost is very expensive and due to the unavailability of spare parts in Nicaragua. Most of the trucks are made in Russia and Czecho-Slovakia.

bb. Corrective Maintenance Department–Central workshop



This workshop carries out corrective maintenance services for all the municipal vehicles as well as preventive maintenance such as oil change and lubrication. This department has catalogs of several equipment.

Periodic inspection and maintenance plans have been prepared for the following equipments:

- compactor truck Nissan CPC 14 FHL
- compactor truck Iveco 135–17 Turbo
- compactor truck M.Benz 1513
- compactor truck Liaz
- dump truck Kamaz

- tractor truck Mack/Autocar/Western Star
- dump / Flat Bed Kraz/Maz
- motor grader baukema
- bulldozer Caterpillar D6H
- compactor tractor Caterpillar 816B
- compactor tractor Benati BC250
- tractor truck Kamaz/Kraz
- excavator Bel/Guria
- bulldozer Komatsu
- wheel loader ZTS UNC200
- wheel loader Fiat Hitachi

At this moment the maintenance department is careful with the Nissan Trucks which were attached with the compactor equipment, Shin Maywa Town Pac GC16-4 (15.3 m^3), donated by the Japanese Government, and with the Iveco 135-17 turbo trucks which were attached with the compactor equipment, Farid Titanomatic 14 (14 m^3) donated by the Italian Government.

Maintenance of the New Trucks

	Tools Donated	Training	Services (Manual)	Shop (Manual)	Spare Parts for the Truck	Spare Parts for the Body
Nissan Truck attached with the Shin-Maywa (15.3 m^3) compactor	Numerous	Little	Yes	Yes	Numerous	Few
Iveco Truck attached with the Farid Titanomatic (14 m^3) compactor	Few	None	Yes	None	Numerous	Numerous

This workshop has the following sections:

- automobile electrical repair section
- heavy equipment maintenance section
- machine section
- body repairing, painting, welding and radiator section
- washing and greasing section
- diesel fuel injection pump tester section
- industrial maintenance section

During our visit in May 12th, 94, the following were undergoing repair in the

Central Workshop:

Ident Nº	Type	Manufacturer	Model	Arrived at
04C21	Roll-on-Roll-off	Autocar	-	06-24-92
04C23	Roll-on-Roll-off	Mack	R6858	09-02-93
04C26	Roll-on-Roll-off	Mack	R6858	04-13-94
04C27	Roll-on-Roll-off	Mack	R6858	01-03-94
04C28	Roll-on-Roll-off	Mack	R6858	08-19-93
04C29	Roll-on-Roll-off	Mack	R6858	11-29-93
04C30	Roll-on-Roll-off	Mack	R6858	06-01-93
04K16	Compactor Truck	M.Benz	1513	02-03-94
04K56	Compactor Truck	Steyr	68191	03-29-93
04K73	Compactor Truck	International	1850B	09-04-92
04K74	Compactor Truck	International	1850B	02-18-93
04K75	Compactor Truck	International	1850B	06-29-93
04V158	Dump Truck	Maz	5549	01-31-94
04V167	Dump Truck	Maz	5549	06-28-93
04V215	Dump Truck	Kamaz	55111	05-10-94
06-028	Wheel Loader	ZTS	UNC 200	09-25-93
06-029	Wheel Loader	ZTS	UNC 200	03-07-94
07-A-26	Pulling Cart Tractor	Belarus	MTZ-80	01-31-94
07-A-29	Pulling Cart Tractor	Belarus	MTZ-80	08-02-93

The sections of the central workshop carries out repair according to the "Repair Request Order". The vehicles or the components needing repair are delivered to the Central Workshop with a letter specifying the services required. The "Repair Request Order" form is opened and addressed to the corresponding section where the services will be made.

In each section is a foreman who assigns which employee should be in charge of such service, and records it in the Repair Order form. There is a blank space where the services made and duration of time spent is recorded. In the back of the form is a list of the materials used in the repair.

When the material is not available at the section a "Supply Request" is made by the requesting employee. With the approval of the section foreman and the Department Chief, the employee goes to the storehouse with a copy of the Request Order.

The requested material is usually supplied, although the two procedures are possible:

- If the value of the material or the parts is under C$2,000.00, a direct purchase is made (provided that there are funds in the central administration treasury cash box).

- If the value is over C$ 2,000.00 a "Purchase Request" shall be made to the storehouse.

There are always problems in the supply of spare parts and for this reason many vehicles remain parked in the yard, waiting to be serviced.

When the service is concluded and the Repair Orders are closed, they are sent to the Department Chief which in turn send them to the Directory of Equipment Recovery.

The control on the equipment repairs through the Repair Orders are made only for accounting purposes based on the costs of materials and labor employed. There are no files which contain records on the history of repairs carried out on vehicles or equipment.

The regular work shift is from 7:00 to 12:00 am and from 1:00 to 5:30 pm, but when there is a need for extra work, permission for overtime work either during the weekdays or on the weekends is requested by the department head and approved by the Director.

bba. Automobile Electrical Repair Section

This section is located in an area of 9 m x 6 m, in a new shed constructed and donated by the Italian Government. The area is walled with a barber wire on top, is well ventilated and lightened. This section repairs; starter engines, generators, light systems and wiring. This section does not handle amateur repair works.

There are four electricians and two helpers, not receiving payment, in this section. Mr. Carlos Alejandro Espiñoza is the foreman in charge of supervising the four employees and the helpers.

Machines and Tools

- table for the foreman 1
- bench 4

-	machinist vise	6
-	bench electric grinder	1
-	tool box	4
-	electric soldering Iron	1
-	amperemeter / voltmeter	1
-	OHM meter	1
-	compressed air outlet	1
-	washing tank (water)	1
-	washing tank (solvent)	1

There is a repaired starter engine and a generator, and many electrical parts to use as spare parts. There are also several starters that could be repaired and used as spare units if the required parts were available.

In the same section is a battery shop which is placed beside the radiator repair part of the section measuring 7 m x 4 m. This shop either repairs or charges up some batteries.

Machines and Tools

-	battery charger	2
-	bench	1
-	machinist vise	7
-	oxy-acetylene welding	7
-	air drill	7
-	compressed air outlet	1
-	voltmeter	1

Only one employee works in this shop.

bbb. Heavy Equipment Maintenance Section

This section is in charge of the maintenance of all trucks and machines belonging to the municipality of Managua.

It is located in the new shed and is divided in two areas:

The heaviest services occupies an area of 60 m x 12 m and the adjustment and assembling 40 m x 5.5 m .

The fenced area carries out repair services on engines, gear box, differential and hydraulic components. The other area services trucks, such as, brakes, spring

leaves, axles repair, coupling hose change, etc.

This section has one foreman, Mr. Wayne Taylor, who supervises the following employees:

- mechanics A - 7
- mechanics B - 11
- helpers - 1

All the mechanics work in both areas of the section.

Crankshaft grinding, brake services and overhaul, are made in private shops.

Machines and Tools

- gear box and differential repair area

. transmission jack	1
. push puller	various
. garage jack	6
. machinist vise Nº 10	2
. machinist vise Nº 6	1
. transmission jack (high lift type)	1
. hand press	1
. universal drilling machine	1
. bench electric grinder	1
. tools box	1 (Good Condition)
. tools box	2 (Bad Condition)
. tool cabinet	1
. compressed air outlet	3

- engine repair area

. engine positioner	2
. bench	2
. machinist vise	1
. universal drilling machine	1
. bench electric grinder	1
. hydraulic press - 25 ton	1
. tank for parts washing	1
. compressed air outlet	2
. puller set	1
. tool box (big)	1

.	torque wrench	1
-	truck repair area	
.	universal drilling machine	1 (bad condition)
.	bench (small)	4
.	bench	1
.	tool cabinet	1
.	metallic bench	1
.	compressed air outlet	1
.	pit for maintenance	1
.	overhead crane - 5ton	1

bbc. machines section

This section is sites in a closed shed besides the storehouse occupying an area of 26 m x 18.5 m. It manufactures parts, in general, for the workshop and for the vehicles and machines.

The foreman of this section is Mr. Omar Rugama. The employees in this section are as follows:

-	lathe operator A	3
-	milling operator B	1
-	helper	2

Machines and Tools

-	engine lathe	4
-	milling machine	1
-	complex drilling and milling machine	1
-	surface grinder	1
-	shaping machine	1
-	universal drilling machine	1
-	hack sawing machine	2 (one in bad condition)
-	broaching machine	1
-	bench electric grinder	1
-	bench electric drill	1
-	machinist vise	5
-	bench	6
-	hydraulic press	1
-	valve refacer	1
-	electric polisher	1

-	air polisher	1
-	compressed air outlet	5
-	welding machine	1
-	electrical heater 1200 °C	1
-	outside micrometer	various
-	caliper	various
-	V.block	various

bbd. Body Repairing, Painting, Welding and Radiator Section

This section is in the shed beside the used parts storehouse. It carries out body repair and painting services for vehicles and machines. Welding services are carried out in the shed for the heavy equipment maintenance section and involves repair and refitting of trucks, equipment and machines. The radiator repair shop is between the battery shop and the washing and greasing section in an area of 7 m x 4 m.

Mr. Francisco Gonzáles is the foreman in charge of this section and supervises the following employees:

-	body repairing and painting workers	3
-	welders	3
-	radiator repair worker	1
-	helpers	2

There is an office for the foreman with a table and a cabinet with tools and some materials which are being used.

An area of 15 m x 6 m enables the simultaneous repair of vehicles.

Machines and Tools

-	body repairing and painting shop		
	.	bench	4
	.	machinist vise	1
	.	compressed air outlet	3
	.	hand tools	various
	.	welding machine	1
	.	oxy-acetylene welding	1
	.	air drill	1
	.	spray gun	1

- welding services shop
  - . pit 1
  - . bending roller 1
  - . bench 2
  - . metallic bench 3
  - . iron anvil 1
  - . machinist vise 3
  - . welding machine 3
  - . universal drilling machine 2 (one in bad condition)
  - . bench electric grinder 1 (without grinding wheel)
  - . rivet forge 1 (in bad condition)
  - . compressed air outlet 1
  - . hand tools various

- radiator repair shop
  - . bench 1
  - . machinist vise 1
  - . water tank for radiator tester 1
  - . gas torch 1
  - . compressed air outlet 1

bbe. Washing and Greasing Section

This section is located in a roofed area of 22 m x 14 m, beside a shed of 8 m x 7 m.

In this place the vehicles and equipment are washed as well as greased and lubricated (including oil change). Used oil is collected and put in metal barrels. There isn't a place to wash parts and filters.

Machines and Tools

- tn roof area
  - . high pressure water pump 1 (small)
  - . high pressure grease pump 1
  - . pit 1
  - . compressed air outlet 1

- in shed area
  - . hand oil pump 1
  - . hydraulic jack 1
  - . hot water high pressure car washer 1

(not used because there isn't enough
water to carry out this service)

bbf. Diesel Fuel Injection Pump Tester Section

This section is located in the new shed which has two rooms occupying an area of 5.50 m x 5.50 m for one and 4 m x 5.50 m, respectively. This section is responsible for adjustment services for all the rotative diesel fuel injection pumps and injection nozzles of the equipment of the Managua Municipality.

They can't make adjustment services in flow diesel fuel injections pumps because of the inavailability of the accessories needed for such service.

This section cannot particularly service a Cumins engine diesel fuel injection pump.

This section does not have specific tools for some services and service manuals for the fuel injection pumps of American trucks like:

- international
- mack
- western Star
- autocar

There are two employees in this section and one has been trained in a private shop for adjustment services for:

- Kamaz engine diesel fuel injection pump
- IFA engine diesel fuel injection pump

This section is well organized, well lightened with one air conditioner.

There are many fuel injection pumps waiting to be serviced because they don't have spare parts.

Machines and Tools

- diesel fuel injection pump tester hartridge 2500 (from England)	1
- injection nozzle tester	1
- pressurized nozzle cleaner	1
- metallic bench	2
- bench electric grinder	1

- compressed air outlet 2
- tool cabinet 1
- injection nozzle reconditioning machine 1
- nozzle reseating machine 1
- bench 1
- machinist vise Nº 6 1

These machines were removed from a technical school for the central workshop. All the installations and tools were donated by the Italian Government.

bbg. Industrial Maintenance Section

This section is located in the new shed, occupying an area of 8 m x 5.5 m . It is responsible for the maintenance services of the following equipment of the Managua Municipality:

- electricity power plant
- two centrals of compressed air
- substation
- machines from the workshop
- machines of the managua municipality (welding machines, air compressor, etc.)
- over head crane
- armature repair

Mr. Rafael Espinoza is the foreman in charge and supervises three electricians.

Machines and Tools

- bench 2
- machinist vise 2
- bench electric drill 1
- bench electric grinder 1
- tool box 4
- compressed air outlet 1

At the time of our visit the following machines where in the section for repair:

- welding machines 4
- armature various
- field coil of fan various

The place was organized when we were there. This section has a small storehouse for the storage of some materials and the repair of some parts.

bbh. Tools Shop

This shop is located in the new shed, occupying an area of 8 m x 5.5m, beside the industrial maintenance section. It has assorted tools which are borrowed by the mechanics, electricians, welders, etc. Lending or borrowing is made by filling up a form.

Main Tools

-	combination wrench	various
-	open end wrench (double hand)	1
-	torque wrench	1
-	air impact wrench	1
-	socket wrench set 1/2	various
-	socket wrench set 3/4	various
-	adjustable pipe wrench	3
-	hydraulic jack	various
-	double offset box wrench	various
-	pressure gauge 600 psi	1
-	valve lifter	1
-	hexagon wrench set	1
-	drills	various
-	plier	various
-	ball peen hammer	various
-	adjustable wrench	2
-	screw driver	various
-	outside micrometer set	1
-	diesel compression gauge	1
-	brake wrench set	1
-	puller set	1

bc. Recovery of Equipment Directory

Although the name suggests an operational organ for equipment repair, this directory is only in charge of the administration services for the production and control of the vehicles. This directory has the following sections:

- evaluation and control department

- inventory control section
- reception section
- equipment control section

bca. Evaluation and Control Department

This department receives, the listings containing all the Repair Orders and the maintenance control sent by the Central Workshop and the Los Cocos workshop every week. This section checks these Service Orders and then sends them to the accounting section.

This section does not analyze information on repairs or maintenance services made contrary to what its name suggests. These information are sent to the accounting section.

bcb. Inventory Control Section

This is the section where equipment listing is made.

This section prepares an inventory based on time and consumption (fuel) and a monthly inventory of the costs of fuel and lubricants per equipment or vehicle and the operational hours of each equipment or vehicle.

bcc. Reception Section

This is the section that receives all the Service Request Orders for maintenance or for repairs and sends the equipment or the component to the workshop department.

The personnel working in the section has only administrative knowledge, not being able to evaluate the technical issues related to the request.

bcd. Equipment Control Section

This is the section in charge of preparing the fuel coupons for each one of the vehicles. These coupons are sent to the Public Cleansing Head Office which gives them to the drivers according to the services programmed. This section receives from the fueling section a daily report listing all the fueled vehicles and the used coupons spent each day.

Finally, a fuel consumption report is made and sent to the Directory, then to the Municipal Works and Services Head Office.

bd. Light Vehicles Preventive and Corrective Maintenance Section

In this section all the light vehicles belonging to the Municipality of Managua are maintained and repaired.

This section is directly under the Maintenance of Equipment Directory.

It is located in a small new shed, also constructed and donated by the Italian Government, near the administration office, occupying an area of 20 m x 6 m and is without walls or fences.

All the maintenance services are made in this section, including electrical repairs in generators and starters. Engine crankshaft grinding is made in private workshops.

Due to the great diversity of vehicles and the lack of adequate special tools, the services are difficult to perform.

The personnel of this section are quite experienced, but they need some training to get acquainted with the new vehicles and equipment, which are now mostly made in Japan as opposed to the cars then made in America, Russia and Czecho-slovakia.

Machines and Tools

–	tool box	2 (in bad condition)
–	bench	4
–	machinist vise	3 (one in bad condition)
–	welding machine	1
–	hydraulic hanger	1
–	air compressor	1
–	garage jack	1
–	racks	various
–	metallic bench	1
–	bench electric grinder	1 (in bad condition)

There are four mechanics, three helpers and one electrician in this section. Mr. Victor Conrado is the foreman in charge and supervises the five employees and the helpers.

be. Infrastructure in the Central Workshop

Gate Control

The entrance (admission) and exit of vehicle, equipment and people are controlled at the gate.

Rest room and locker room

There is a rest room close to the entrance which is used as a locker room as well. This rest room has 6 toilets, urinals and several lockers. There is no shower in this rest room.

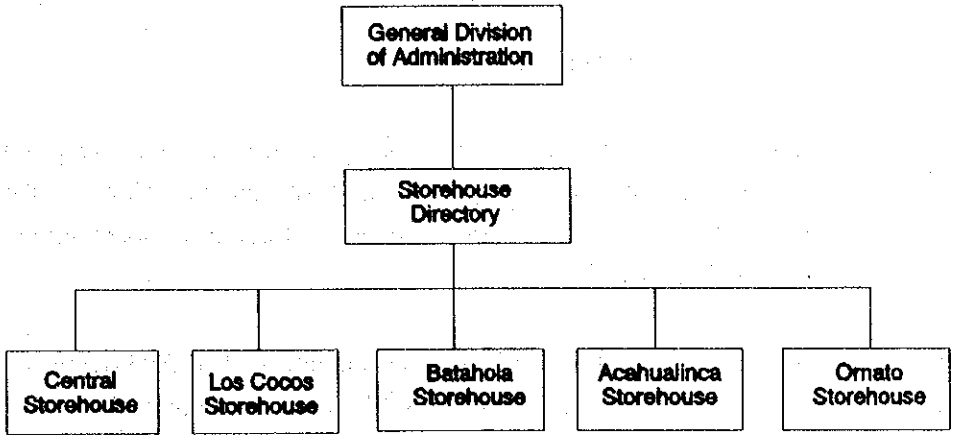
There is another rest room close to the canteen, which is used by the personnel of the machine section. This rest room does not also have a shower.

Another is located at the body repairing and painting section, with toilets showers and urinals. The rest room in the washing and greasing section also has a shower.

Canteen

There is a canteen, operated privately, in the administration building close to the machines section. This canteen allows employees to bring their own food and eat it inside.

bf. Material Administration



The supply of materials for the various operational sections is kept in the above outlined storehouses which are under the General Division of Administration.

The visit to the Storehouse Directory was made with its chief, Lic. Ortiz. The Central Storehouse host was Mr. Edgard Lopez.

The spare parts supply system operates in the following way:

a) The Workshop Department prepares a Service Request and send it to the storehouse,who upon receipt informs the workshop department so that they may issue a supply request for the release of the requested materials or parts.

b) If the material is not in stock, the storehouse issues a purchase request signed by its chief and sent to the Purchase Delegate.

c) The Purchase Delegate, who belongs to the General Procurement Division, informs his chief and starts the required process for procurement. The procurement process requires at least three steps.

d) After some bureaucratic dealings, the material is purchased and handed to the storehouse.

e) From the storehouse the material is handed to the petitioner, through a Parts Supply Request form.

f) For purchases of value up to C$ 2,000, the Purchase Delegate is allowed to directly purchase the request using funds from the treasury of the Workshop Department.

Storehouse in Central Workshop

This storehouse only holds spare parts for type of equipment repaired and maintained at the central workshop. There is one storehouse in each plant like; Los Cocos, Batahola, Acahualinca y Ornato. The other storehouses have some spare parts and construction material.

In April 30, 1994 the central workshop storehouse had 13,293 items costing 14,746,783.76 córdobas, or US$ 2,268,735.8. They are stored in shelves according to the manufacturer of the equipment.

The storehouse occupies an area of about 630 m^2, for new spare parts and tools and an area of about 300 m^2 for used spare parts.

For stock control purposes, requests and releases are registered in a Kardex type file. The section needs a computer to facilitate data control.

There are also some spare components in the roofed area of 35 m x 10 m, such as Iveco engine, gear box for Iveco truck, transmissions for Iveco truck, spring leaves for Iveco truck, cylinders for farid compactor equipment, cylinders for Shin Maywa compactor equipment, etc..

The oils used for equipment is stocked in drums.

Listed in the Kardex control are the following items:

- Miscellaneous
- Nissan
- Case
- Guria
- Ebro
- Kamaz
- Mercedes Benz
- IFA
- Bel Robur
- Isuzu
- Warran
- Lada
- Bob Cat
- UNC 200
- Caterpillar
- Iveco
- Toyota
- Nissan – Light Vehicle
- Datsun
- Subaru
- Golden Kiri
- Ifa – Motoricle
- Used Spare Parts

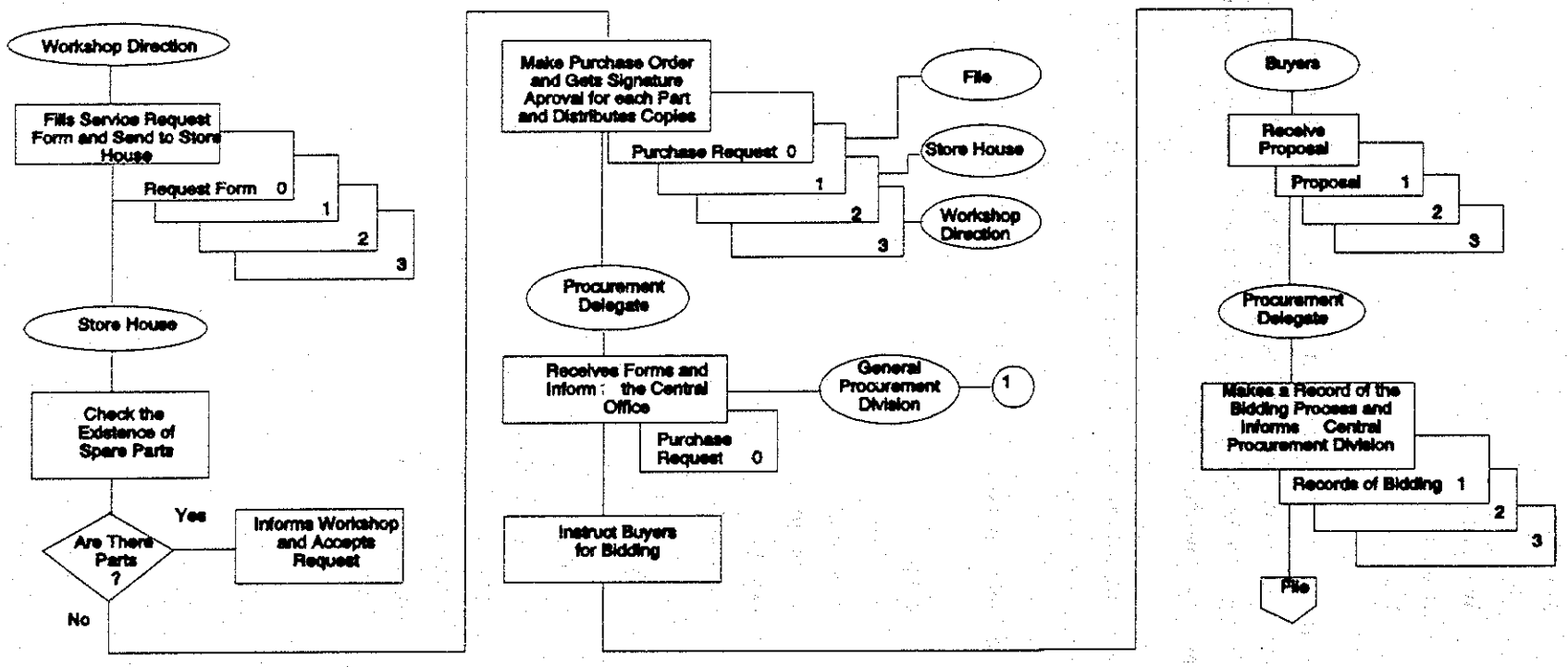
- Mack
- Komatsu
- Maz 3
- Liaz
- Was Jeep
- Baukema
- Belarus

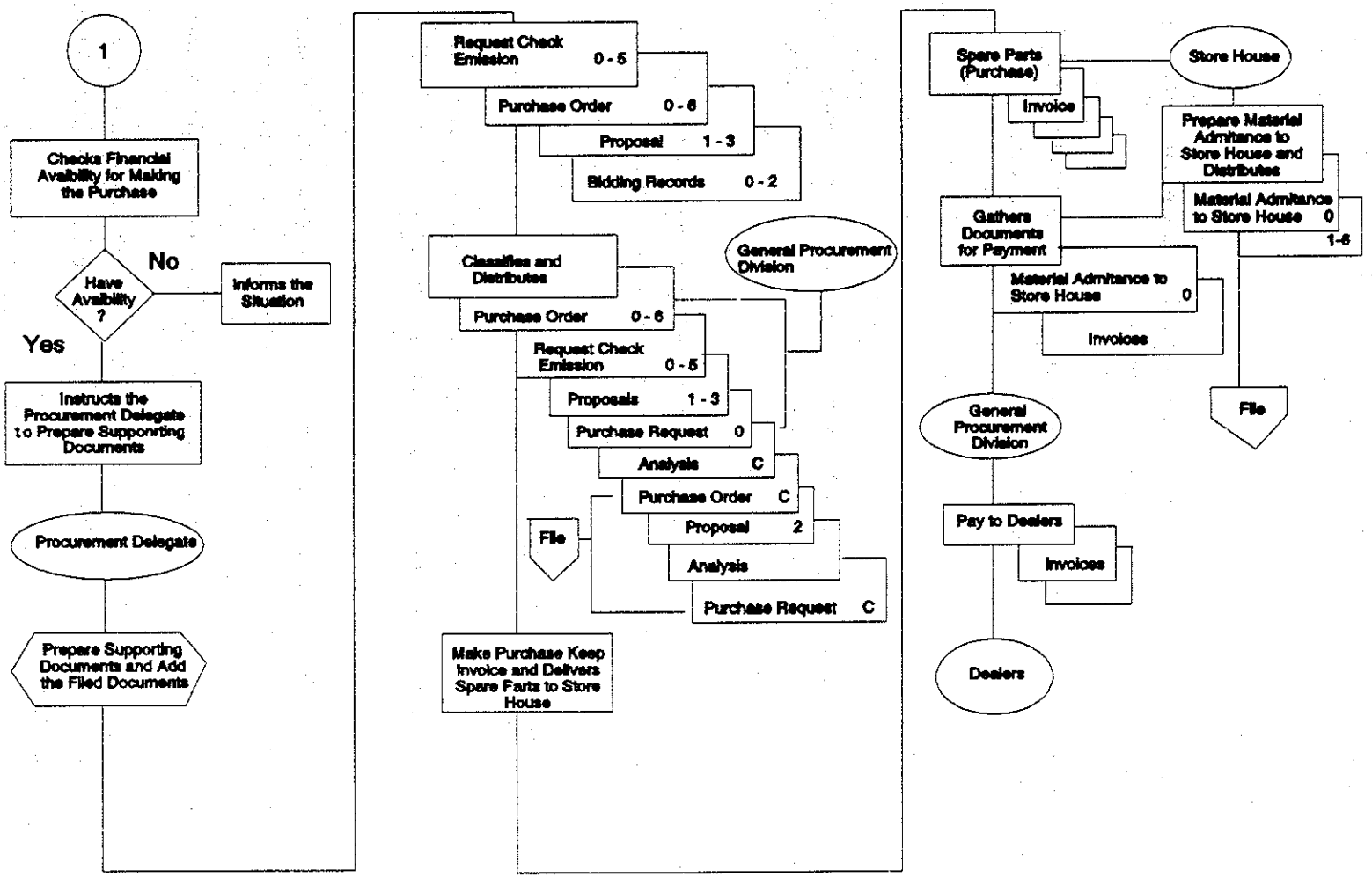
There are many spare parts for the Mercedes Benz trucks, Ifa, Caterpillar, Baukema, Iveco, Nissan and miscellaneous. The equipment manufactured by Mercedes Benz and Ifa, however, are now few compared to those of Kamaz which has very few spare parts.

There are 486 filters that cannot be used and they don't have the filters they need for other equipment.

The following were seen in the used spare parts storehouse:

- engine
- gear box
- generator
- starter engine
- bearing
- crankshaft
- water pump
- brake drum
- rear axle
- front axle
- hydraulic cylinder
- clutch
- injection pump
- air compressor
- sir tank


Workshop Direction
Fills Service Request Form and Send to Store House
Request Form 0
1
2
3
Store House
Check the Existence of Spare Parts
Are There Parts ?
Yes
Informs Workshop and Accepts Request
No
Make Purchase Order and Gets Signature Aproval for each Part and Distributes Copies
Purchase Request 0
1
2
3
File
Store House
Workshop Direction
Procurement Delegate
Receives Forms and Inform the Central Office
General Procurement Division
1
Purchase Request 0
Instruct Buyers for Bidding
Buyers
Receive Proposal
Proposal 1
2
3
Procurement Delegate
Makes a Record of the Bidding Process and Informs Central Procurement Division
Records of Bidding 1
2
3
File


1
Checks Financial Availability for Making the Purchase
Have Availability ?
No
Informs the Situation
Yes
Instructs the Procurement Delegate to Prepare Supporting Documents
Procurement Delegate
Prepare Supporting Documents and Add the Filed Documents
Request Check Emission 0 - 5
Purchase Order 0 - 6
Proposal 1 - 3
Bidding Records 0 - 2
Classifies and Distributes
General Procurement Division
Purchase Order 0 - 6
Request Check Emission 0 - 5
Proposals 1 - 3
Purchase Request 0
Analysis C
Purchase Order C
Proposal 2
Analysis
Purchase Request C
File
Make Purchase Keep Invoice and Delivers Spare Parts to Store House
Spare Parts (Purchase)
Store House
Invoice
Prepare Material Admitance to Store House and Distributes
Material Admitance to Store House 0
1-6
Gathers Documents for Payment
Material Admitance to Store House 0
Invoices
File
General Procurement Division
Pay to Dealers
Invoices
Dealers

E.8.3 Comments about problems found in the daily of operation and maintenance of equipment

a. Personnel

Almost all the mechanics, electricians, welders, smiths, body repair workers, etc., do not have any technical or professional knowledge.

There is an Italian training team teaching the personnel of the Central Workshop. However, there are still some segments where training is necessary.

b. Landfill

Regardless of the new equipment and a source for covering material nearby, a large amount of the wastes are not covered daily and a place for the parking of trucks has not been prepared yet.

During the rainy season, very often the vehicles get stuck and have to be removed with the help of bulldozers. This operation often harm the vehicles.

c. Equipment and Vehicles

The vehicles fleet, as well as the equipment, are very diversified. This situation demands a great amount of different tools and special parts from different manufacturers.

The lack of guidelines poses many difficulties in the maintenance services and the existence of many vehicles and equipment beyond their economic life span.

The donation of the Nissan and Iveco trucks has improved the collection of waste.

The same can be said of the Acahualinca landfill, where the situation improved a lot with the arrival of the bulldozers and the compactors Caterpillar and the compactors Benati.

There has been many problems with the compactor trucks equipped with the 0.83 m^3 container lifting device due to inavailability of spare parts. The container collection system is therefore facing many problems, because the new trucks do not carry the lifting system.

The roll-on roll-off trucks are also very old and pretty difficult to operate and maintain now.

d. Control

There are too many documents and forms to fill up for the operational and maintenance services. Nevertheless the activities are not properly controlled. Only the accounting record of the materials used in the operation and in the repairs is made.

There is no maintenance control and there is no record of the services done to each vehicle or equipment.

e. Organizational Structure

The Public Cleansing Head Office is under the Municipal Works and Services Head Office.

The Street Sweeping Services is under the District Coordination Office. This organizational structure also hampers the effective management of the operational services.

The workshops - Los Cocos Workshop and Central Workshop - belong to the Directory of Maintenance and Recovery of Equipment, that is under the Municipal Works and Services Head Office, and is therefore considered appropriate.

The Storehouse Directory is under the General Division of Administration and the Purchasing System is under the General Division for Buying.

The distribution of these different interrelated services under different divisions or head offices hampers the effective conduct of maintenance and repair services.

ea. Los Cocos Workshop

The working conditions at the different sections of the workshop in general, aren't good, what harms the development of the maintenance services.

The lack of a washing and greasing section, and the lack of a shed for the mechanic section seriously affects the repair and maintenance services.

eb. Central Workshop

The work in the different sections of the workshop were observed to be in normal conditions.

The new installations and machines donated are very good, but some sections are out of order and a lot of scrap and junk material can be seen in the open yard.

The personnel are not prepared in using some of the machines and tools.

In both workshops, the condition of the restrooms is not good.

f. Spare Parts

Many problems are usually encountered when the maintenance services are in need of spare parts. Most of the materials stored in the storehouse are of no use. For example, there is a large stock of parts for the IFA trucks and for the Mercedes-Benz trucks although IFA trucks are no longer operational and only six Mercedes-Benz are working.

The majority of the spare parts is acquired at the moment they are needed. This procedure generates long delays for getting the parts and as a consequence, trucks stay idle for many days creating problems in the public cleansing system.

There is much bureaucracy in the purchasing system and the services are not able to solve all the needs for the maintenance services of the workshops.

The lack of financial resources for buying spare parts is also a permanent problem which usually results in stranded vehicles waiting to be repaired up to 24 months.

E.8.4 Specification of the collection vehicles.

The economic situation of the country in the recent years, has not allowed the municipality of Managua to acquire new equipments for the Solid Waste Management services.

For many years the fleet of collection trucks are being replaced, thanks to the donation of equipment from various countries.

The last trucks actually bought by the government were those in the seventies (Somoza government), when only Mercedes-Benz trucks were purchased.

During the eighties, most of the resources were poured into the civil war, leaving the solid waste system to become a minor priority, without any possibility of investments.

Services were maintained using the remaining fleet purchased during the seventies, in addition to several equipment donated by Eastern European countries, mostly from Russia, Czecho-Slovakia and Eastern Germany.

The Liaz trucks, equipped with compaction bodies and 0.83^3 container lifting arms, as well as containers, were introduced in this period.

All the fleet donated during the revolution period, are in poor condition, without maintenance and without spare parts.

Many other donations have been received in this decade from other countries, mainly Japan and Italy: in 1993, Japan donated 27 Nissan trucks with Shin-Maywa collection equipment and in 1994, 20 Iveco trucks were donated by the Italian government.

These two recent donations have improved the efficiency of the collection system.

Nevertheless, the administrative division of the collection services is worried because one of their most important collection systems, container collection, is facing a collapse since only 4 out of the 18 trucks assigned to this job are operating. In addition, these trucks do not have spare parts in Nicaragua, and importing it is bothersome and expensive.

This situation will be very difficult to overcome, regardless of the surplus in collection vehicles, because the new vehicles (Nissan and Iveco) are not constructed in a manner that would enable them to lift containers.

Donations are usually made, with the recipient country not being able to determine which equipment it wants to receive.

Nevertheless, if a technical study were made beforehand, the specifications for the equipment may have been different and the technical questions and problems may be properly solved.

E.8.5 Part Dealers and Factories Representatives

A questionnaire to be distributed among the vehicle and equipment (of the brands existing in the Managua municipality) representatives, as well as part dealers for trucks and equipment has been prepared. They were particularly distributed to the representatives of the vehicles and equipments with the highest participation in the Municipal fleet.

The questionnaire asked information about the dealer's representative workshop, the technical personnel in charge of maintenance operations, machines and tools, vehicle repair services, number and type of parts and availability of technical and operational training.

The following factories representing the following were surveyed:

Trucks:

- MAZ
- KAMAZ
- FORD
- TOYOTA
- MERCEDES-BENZ
- NISSAN
- INTERNATIONAL
- MACK
- HINO

Equipment

CATTERPILLAR	Bulldozer, Wheel Loader, Motor grader and Compactor
KOMATSU	Bulldozer and Motor-Grader
UNC	Wheel Loader

The questionnaires did not include equipment like IVECO and FIAT-HITACHI, because they are not popular in Nicaragua.

The questionnaires were handed personally to the representatives and dealers, together with a letter from the Managuan municipality explaining the objectives of the survey and the importance of the data being inquired for. Regardless, it has been very difficult to get the forms filled.

The person responsible for the firm "Multiservicios Sevilla", which gives assistance

to the IVECO trucks and FARID collector equipment, informed us that it would take 10 to 15 days for him to answer the questionnaire because he had too many things to do. Through visual inspection, however, we found that this firm does not have technical resources as well as machines and tools required to carry out good services. The lack of technical and material conditions therefore might have been the reason why the representative was so uncooperative with the survey.

The parts shop MANTICA, a representative of the ISUZU trucks, refused to answer the form after receiving it for a week. This attitude was considered very strange, since this is a well known firm and there is no reason why they should not cooperate with an inquiry backed by the municipality.

The firm NIMAC, representative of the CATTERPILLAR equipment and INTERNATIONAL trucks, also refused to answer the questionnaire. By visual inspection though, the company was observed to have good technical and equipment resources needed to perform good services.

On the other hand, the questionnaires distributed to the factories representing the trucks and equipment were fully and properly answered.

These representatives present, in general, fair to good conditions, according to the answered forms, some of them with a stock of spare parts around 65% of the total number of items.

Delay in the importation of parts not in stock usually takes 7 to 90 days.

The following parts dealers with the best commercial standards were selected for the survey:

ENICONS
TRACTOSA
CORTASA
AUTOTADA
REY-TRACK

Of the companies, only the firm TRACTOSA refused to fill up the questionnaire.

Based on the answers given by the other firms, it is possible to have a good picture of the situation: these firms have stocks of spare parts.

Also, the questionnaires, indicate that the importation of parts not available in the parts dealer's shops in Nicaragua takes 3 days (as in the case of the Mack trucks)

to 15 days. In extreme situations though, importation can take up to six months.

There is actually a great variety of imported equipment and vehicles from different countries in Nicaragua. The parts of all these brands are marketed in the country. This market however sells parts not only manufactured by factories that supply parts for the assembling factories, but also by factories that produce parts only to the parts market, without a license or endorsement from the assembling companies.

E.8.6 Inventory of Equipment in December 1994

The inventory lists of vehicles, machines, and tools in Los Cocos Workshop are shown in the next pages.

a. Collection

Ident.	Type	Manufacturer	Model	Year	Condition	Body Manufacturer	Capac. (m^3)	Condition
04-K-047	Compactor	Liaz	110820	1989	Regular	BOBR 16.2	16	Regular
04-K-049	Compactor	Liaz	110820	1989	Regular	BOBR 16.2	16	Regular
04-K-053	Compactor	Liaz	110820	1989	Regular	BOBR 16.2	16	Regular
04-K-059	Compactor	Liaz	110820	1990	Maintenance	BOBR 16.2	16	Bad
04-K-065	Compactor	Liaz	110820	1990	Maintenance	BOBR 16.2	16	Regular
04-K-067	Compactor	Liaz	110820	1990	Regular	BOBR 16.2	16	Regular
04-K-076	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-077	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-078	Compactor	Nissan	CPC14FHL	1993	Maintenance	Shin Maywa GC16-4	15.3	Good
04-K-079	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-080	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-081	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-082	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-083	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-084	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-085	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-086	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-087	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-088	Compactor	Nissan	CPC14FHL	1993	Maintenance	Shin Maywa GC16-4	15.3	Good
04-K-089	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-090	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-091	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-092	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-093	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-094	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-095	Compactor	Nissan	CPC14FHL	1993	Maintenance[1)]	Shin Maywa GC16-4	15.3	Good
04-K-096	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good

Ident.	Type	Manufacturer	Model	Year	Condition	Body Manufacturer	Capac. (m^3)	Condition
04-K-047	Compactor	Liaz	110820	1989	Regular	BOBR 16.2	16	Regular
04-K-097	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-098	Compactor	Nissan	CPC14FHL	1993	Maintenance[2]	Shin Maywa GC16-4	15.3	Good
04-K-099	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-100	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-101	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-102	Compactor	Nissan	CPC14FHL	1993	Good	Shin Maywa GC16-4	15.3	Good
04-K-103	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-104	Compactor	Iveco	135-17A	1994	Maintenance[3]	Farid Titano-matic 14	14	Good
04-K-105	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-106	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-107	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-108	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-109	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-110	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-111	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-112	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-113	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-114	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-115	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-116	Compactor	Iveco	135-17A	1994	Maintenance[4]	Farid Titano-matic 14	14	Good
04-K-117	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-118	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-119	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-120	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
04-K-121	Compactor	Iveco	135-17A	1994	Maintenance[2]	Farid Titano-matic 14	14	Good

Ident.	Type	Manufacturer	Model	Year	Condition	Body Manufacturer	Capac. (m^3)	Condition
04-K-047	Compactor	Liaz	110820	1989	Regular	BOBR 16.2	16	Regular
04-K-122	Compactor	Iveco	135-17A	1994	Good	Farid Titano-matic 14	14	Good
07-A-024	Pulling Cart Tractor	Belarus	MTZ 80	1988	Maintenance	-	-	-
07-A-025	Pulling Cart Tractor	Belarus	MTZ 80	1988	Good	-	-	-
07-A-027	Pulling Cart Tractor	Belarus	MTZ 80	1988	Regular	-	-	-
07-A-034	Pulling Cart Tractor	Belarus	MTZ 80	1993	Good	-	-	-
07-A-035	Pulling Cart Tractor	Belarus	MTZ 80	1993	Good	-	-	-
04-C-019	Tractor Truck	Kraz	B1258	1983	Maintenance	-	-	-
04-C-020	Tractor Truck	Kraz	B1258	1983	Regular	-	-	-
04-C-021	Roll-on	Auto Car	-	-	Maintenance	Open Container	15	-
04-C-022	Roll-on	Western Star	-	1980	Regular	Open Container	15	-
04-C-023	Roll-on	Mack	R6858	1977	Regular	Open Container	15	-
04-C-024	Roll-on	Mack	R6858	1977	Regular	Open Container	15	-
04-C-025	Roll-on	Mack	R6858	1978	Maintenance	Open Container	15	-
04-C-026	Roll-on	Mack	R6858	1979	Maintenance	Open Container	15	-
04-C-027	Roll-on	Mack	R6858	1972	Maintenance	Open Container	15	-
04-C-028	Roll-on	Mack	R6858	1979	Maintenance	Open Container	15	-
04-C-029	Roll-on	Mack	R6858	1979	Regular	Open Container	15	-
04-C-030	Roll-on	Mack	R6858	1978	Maintenance	Open Container	15	-
04-V-129	Dump	Kamaz	5511	1986	Maintenance[2)]	-	7	Regular
04-V-137	Dump	Kamaz	5511	1987	Maintenance	-	7	Regular
04-V-143	Dump	Kamaz	5511	1988	Maintenance	-	7	Regular
04-V-149	Dump	Kamaz	5511	1988	Maintenance	-	7	Regular
04-V-157	Dump	Maz	5549	1988	Maintenance	-	7	Regular
04-V-158	Dump	Maz	5549	1988	Regular	-	7	Regular
04-V-163	Dump	Maz	5549	1988	Regular	-	7	Regular
04-V-168	Dump	Maz	5549	1988	Maintenance	-	7	Regular
04-V-169	Dump	Maz	5549	1988	Regular	-	7	Regular
04-V-215	Dump	Kamaz	55111	1991	Good	-	7	Good
04-V-216	Dump	Kamaz	55111	1991	Maintenance[4)]	-	7	Good
04-V-217	Dump	Kamaz	55111	1991	Good	-	7	Good
06-36	Wheel Loader	Fiat Hitachi	FR-130	1994	Good	-	-	-
06-37	Wheel Loader	Fiat Hitachi	FR-130	1994	Maintenance[5)]	-	-	-

Note: 1) Waiting Tires and Starter Engine
2) Waiting tires
3) Gear Box
4) The truck is idle, waiting to be repaired due to a collision
5) Waiting for repair in the brake system

b. Street Sweeping

Type	Manufacturer	Capacity	Quantity
Dump Truck	Maz - 3	7 m^3	6
Dump Truck	Kamaz	7 m^3	7 2 in Maintenance
Flat Bed Truck	Maz - 3	6 m^3	5 4 in Maintenance
Flat Bed Truck	Ifa	6 m^3	4 2 in Maintenance
Small Wheel Loader	Bob Cat		6 4 in Maintenance
Pulling Cart Tractor	Belarus		1
Wheel Loader	Massey Fergunson	1 m^3	1

c. Disposal

Ident.	Type	Manufacturer	Model	Year	Condition
07-B-024	Bulldozer	Caterpillar	D6H	1993	Good
07-B-025	Bulldozer	Caterpillar	D6H	1993	Good
07-TC-001	Compactor Tractor	Caterpillar	816B	1993	Good
07-TC-002	Compactor Tractor	Caterpillar	816B	1993	in Maintenance
07-TC-003	Compactor Tractor	Benati	BC250	1994	Good
07-TC-004	Compactor Tractor	Benati	BC250	1994	Good
04-PA-07	Water Tank	M.Benz	1513	1980	Regular
04-PA-38	Water Tank	Nissan	CMF87F	1993	Good

d. The Inventory List of Machines and Tools in Los Cocos

Machines and Tools		Labor	
CONTAINER CONSTRUCTION AND MAINTENANCE SECTION			
Air Compressor	1[1)]		
Hydraulic Shearing Machine	1[1)]		
Power Type Circle Shear	1[1)]		
High-Speed Abrasive Cut-Off Machine	1[1)]		
Point Welding Machine	1[1)]		
Bending Roller	1[1)]		
Welding Machine 225 A	2		
Welding Machine 250 A	1		
Oxy-Acetylene Welding	1		
Bench Electric Grinder (one in repair)	2	Welders Painters Helpers	2 2 2
Hydraulic Press	1		
Metallic Bench	3		
Machinist Vise	3		
Iron Anvil	1		
Cabinet Tools	2		
Tank for Container Washing	1		
Electric Drill 1/2"	1		
Portable Hydraulic Jack 20T	1		
Welding Shield (in bad condition)	3		
Spray Gun (in bad condition)	3		
VULCANIZATION SECTION			
Hot Patch Clamp	3		
Air Compressor (in bad condition)	1[2)]		
Portable Hydraulic Jack (20T)	5	Workers	6
Portable Hydraulic Jack (50T)	1		
Hand Tools	various		

Machines and Tools		Labor	
GREASING SECTION			
Compressed Air Outlet	2	Workers Drivers	4 2
High Pressure Grease Pump	1		
Hand Oil Pump	1		
Lubrication and Fuelling Truck	1		
MECHANIC SECTION			
Tool Box	8	Foreman Mechanics A Mechanics B Helpers	1 4 4 8
AUTOMOBILE ELECTRICAL REPAIR			
Battery Charger	1	Electricians	4
Metallic Bench	1		
Machinist Vise	1		
WELDING SECTION			
Welding Machine	2	Welders	3
Bench Electric Grinder	1		
Bench	1		
Metallic Bench	1		
Machinist Vise	2		
Oxi-Acetylene Welding	1		

Note: 1) Inoperative because the equipment voltage is 220 V three phases while the power supply is 220 V single phase.

2) The section is operating with one air compressor lent by another section

Data to Evaluate the Representative

Vehicle, Machine or Equipment represented:_____

_____

_____

Name of the Company:_____

Address:_____

Subsidiary:_____

	Subsidiary 1	Subsidiary 2	Subsidiary 3
1. Workshop – Constructed Area (m^2) – Yard Area (m^2)			
2. Personnel – Mechanical Engineer – Maintenance Technician – Maintenance Technician – Service Inspector – Mechanic – Electrician – Welder – Other			
3. Machines and Tools – Dynamometers – Test bench – Injection pump overhaul quipment – Welding Machine – Press – Servicing ditch – Torquemeter – Manual Tools – Other			
4. Service Vehicles – Towing Vehicle – Field Vehicles – Training Vehicles			
5. Parts – Constructed Area (m^2) – Nº of items in the parts catalogue – Nº of items in stock – Personnel – Time for delivering imported parts			
6. Training – Has technical school? – Has instructors for technical training? – Has instructors for operational training?			

Data to Evaluate Part Dealers

Vehicles, Machines or Equipments with spare parts_____

_____

Name of the Company_____

Address_____

Subsidiary_____

Constructed Area (m^2)_____

Personnel_____

- Spare Parts for the Manufacturer_____
- Genuine parts or not_____
- Nº of Items of Parts Catalogue_____
- Nº of Items in Stock_____
- Period of Time to Import Parts_____

- Spare Parts for the Manufacturer_____
- Genuine origin or _____
- Nº of Items of Parts Catalogue_____
- Nº of Items in Stock_____
- Period of Time to Import Parts_____

- Spare Parts for the Manufacturer_____
- Genuine origin or not _____
- Nº of Items of Parts Catalogue_____
- Nº of Items in Stock_____
- Period of Time to Import Parts_____
- Spare Parts for the Manufacturer_____
- Genuine parts or not_____
- Nº of Items of Parts Catalogue_____
- Nº of Items in Stock_____
- Period of Time to Import Parts_____