

## PART B

### PRIMARY COLLECTION AND STORAGE IN K-WEST WARD, BOMBAY

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## **B-1 INTRODUCTION**

This part discusses the management of solid waste until the stage when it is loaded into a vehicle to be transported to the disposal site. It is concerned with sweeping, drain cleaning and storage, and, to a lesser extent, public toilets.

## **B-2 PRIMARY COLLECTION AND STORAGE OF SOLID WASTE IN K-WEST WARD**

### **B-2.1 ORGANISATION**

The organisational set up of the Solid Waste Management Department (SWMD) in K-West Ward has already been described in Section A-2.2.

Street sweeping, drain cleaning, cleaning of public latrines and urinals, and maintaining cleanliness around the community storage facilities provided by the SWMD are together classified as *conservancy services*. With regard to these services, K-West Ward is divided into two administrative zones (northern and southern). These zones are further divided in 13 SWM districts (five in the northern and eight in the southern zone). One Junior Overseer (JO) is assigned to each district to organise the work of the conservancy staff of the SWMD. The organisational set up of the conservancy section in Ward K-West is shown in Table B-2.1 below.

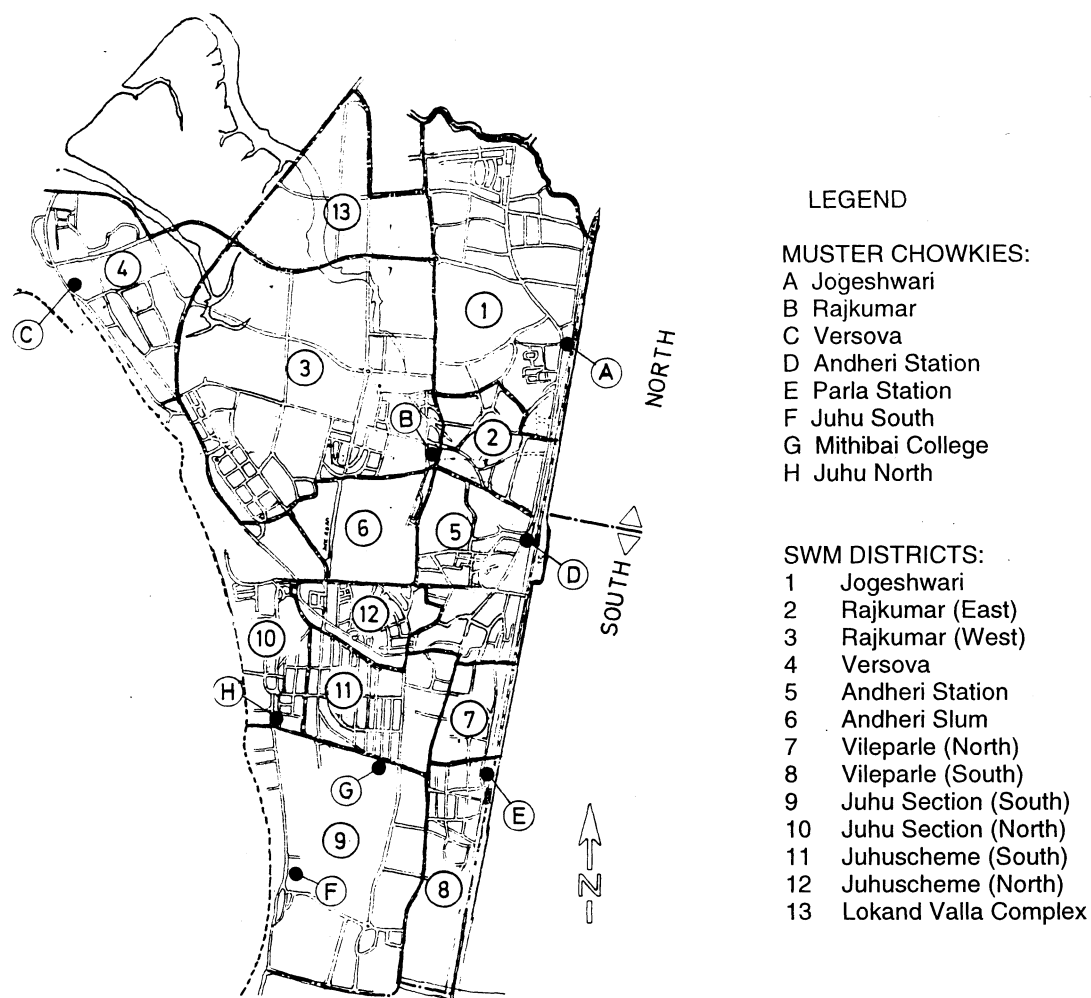
**Table B-2.1: Organisation Chart of the Conservancy Section**

One Assistant Head Supervisor (head of SWMD in Ward K-West including conservancy services)		
Two Supervisors (one supervisor per zone, responsible for SWM including conservancy services)		
13 Junior Overseers (in charge of organisation and supervision of conservancy services in the 13 SWM districts)	Junior Overseers (Motor loaders)	
33 Mukadams (foremen of conservancy staff, supervision of labour twice daily, between 2 and 3 mukadams per JO)	Mukadams for motor loaders	
662 Labourers (about 20 labourers per mukadam)	147 motor loaders	
498 sweepers (sweeping roads cleaning lanes in public areas and government slums)	29 drain cleaners (cleaning of roads and small drains in public areas and government slums)	135 halalkhores (cleaning of public toilets removal of faeces from public areas and in government slums)

Conservancy services are carried out seven days per week. The official working hours are from 6.30 am to 1.30 pm (seven hours per day including a tea break from 10.30 to 11.00). Labourers work six days per week and have one day off (in turn).

For the day to day organisation of work there are eight muster chowkies (Junior Overseer Offices) in Ward K-West as shown in Figure B-2.1.

**Figure B-2.1: SWM Districts and Muster Chowkies in Ward K-West**



Municipal sweepers, drain cleaners, halalkhores and mukadams meet at these chowkies at 6.30 in the morning. Attendance is taken by the JO and particular tasks are assigned to the labourers before they leave the chowki to start their work. Each SWM district is further divided into beats for street sweeping and street sweepers are permanently assigned to these beats. The total number of beats in Ward K-West is about 262.

Depending on the time taken to walk from the muster chowki to the places of work, the staff actually start working between 7.00 am and 7.15 am.

Towards the end of the working day attendance is again taken at the muster chowki (at about 1.15 pm). In order to reach the muster chowki in time, labourers have to leave their places of work between 12.45 and 1.00 pm.

Considering that there is a tea break from 10.30 to 11.00 the effective working time of labour is between 5 and 5½ hours per day. It will be shown in section B-3, *Operations in Jogeshwari SWM District*, that the actual working time of labour is even lower than the values mentioned above.

It is shown in Figure B-2.1 that there are only eight muster chowkies in the ward compared with 13 SWM districts. For instance the muster chowki at Rajkumar has to accommodate 3 JO's and the chowkies at Parla Station, Mithibai College and Andheri Station accommodate 2 JO's each. Consequently, about 150 labourers meet at the Rajkumar chowki in the morning and about 100 in the other three chowkies mentioned above.

Although organisation of the day-to-day duties may be possible, the distances that the labourers must walk to arrive at their places of work are excessive. In the worst case labourers are required to walk about eight kilometres, twice daily (for morning and noon attendance). Therefore the effective working time of labour, which is already very short (between 5 and 5½ hours per day), is further reduced in these areas.

**SUGGESTION:** It is therefore proposed to provide one muster chowki for each of the SWM districts (i.e. five additional muster chowkies in Ward K-West). Further investigations are required to identify suitable locations for these chowkies. As shown in Figure B-2.1 some of the existing muster chowkies are located at the fringe of the SWM districts. To ensure that the walking distances from the chowkies to the places of work are kept to a minimum, it would be highly desirable to locate muster chowkies near the centres of the SWM districts.

## **B-2.2 CONSERVANCY SERVICES IN K-WEST WARD**

The services provided by the public sector in Ward K-West are described briefly in this section. This includes street sweeping in (i), drain cleaning in (ii) and cleaning of public latrines in (iii). Some more general considerations are suggested in this context. More detailed observations are presented in sections B-3 and B-4.

### **(i) Street sweeping**

As already mentioned above, the ward is divided into SWM districts which are further split into beats (about 262 in K-West). Within the SWM districts sweepers are assigned permanently to particular beats. According to information obtained from the Chief Engineer SWM (CE/SWM) the average area of roads and lanes within one beat is between 3,000 and 5,000 square metres in busy areas (e.g. along main roads), and 5000 to 10,000 square metres in quieter areas (e.g. along secondary roads).

One pair of sweepers is assigned to each beat for sweeping and cleaning the roadside and the areas surrounding the community containers. It has been observed that, of the two sweepers in a team, only one of the sweepers sweeps along the roadsides and in the lanes. He forms small heaps of sweepings along the kerb and it is the second sweeper's task to load these piles into his handcart and carry them to the nearest community container. The central section of the road is not swept and there is no need to do so because dust and litter are blown by moving traffic towards the side.

This arrangement is analysed in detail in section B-3.3. However, some general observations are noted here.

### **SUGGESTIONS**

- Information obtained from officers of other municipal corporations in India suggests that it is quite unusual to require sweepers to work in pairs. Further observations should be made to compare the system of sweeping in pairs with the more common single sweeper system (see Section B-3.3).
- It has also been suggested that a night shift should be introduced for street sweeping in very busy streets. This proposal aroused different views when discussed by the groups and further investigations are suggested to investigate the need of this measure as well as suitable measures for implementing such a service. One outcome that was foreseen was that municipal staff, supported by the Unions, would probably demand 100% higher wages for working at night.

- Within this context the pros and cons of small mechanical sweepers have been discussed. Although this may avoid the need to sweep busy roads during the peak traffic hours, this type of machinery is not available in India and severe repair and maintenance problems are anticipated. However, further investigations are required and should include exchange of experience with other large municipal corporations regarding mechanical sweepers as well as a market research on suitable equipment. In any case small scale pilot projects are suggested before such systems may be introduced on a larger scale.

### **(ii) Drain cleaning**

Drain cleaning in residential localities and along small roads is carried out by the 29 drain cleaners (DC's) in K-West Ward. However, according to information obtained from the SWMD, the Maintenance Department is responsible for cleaning and maintenance of large drains. It was mentioned that all drains larger than six inches (0.15 metres) are under the responsibility of the maintenance department. It was also mentioned that street sweepers become responsible for the cleaning of small drains along the roads and lanes when the drains are dry.

During drain cleaning by staff of the conservancy section silt heaps are formed along the drains and left to dry for a period of time. The heaps are then loaded into wheel barrows and carried to the closest community storage facility.

However, it has been observed that drains in Ward K-West are not cleaned regularly and that they are often used for refuse disposal by the public. Particularly in low-income areas, drains are clogged, causing flooding and unhygienic conditions. This will be further elaborated in section B-4, *Investigations in Slum Areas*. Some more general suggestions are set out below.

The arrangements regarding drain cleaning are considered inadequate. Responsibilities seem to be not clearly defined and different departments are involved in this sector. Considering that only 29 drain cleaners are employed by the conservancy section in K-West Ward, these personnel seem hardly sufficient to cope with all the work.

## **SUGGESTIONS**

- Further investigations are proposed to identify suitable solutions in this sector. They should aim at providing a clear responsibility structure for drain cleaning services. Because of the fact that drain cleaning and street sweeping are interrelated, it may prove advantageous if the SWMD were to become responsible for *all* drain cleaning services in the ward. It may be most suitable to assign cleaning of the small drains to sweepers, i.e. drains in a particular beat should be cleaned by the street sweepers in charge of the area. However, cleaning of large drains will require separate crews who are equipped with appropriate implements. The assignment of labour to particular main drains may be the most promising arrangement, together with regular monitoring and supervision.
- Public awareness campaigns are considered crucial to discourage the depositing of refuse in the drains by the public (see Section A-3.5). This may further include the provision of additional community storage facilities in the areas concerned.

### **(iii) Cleaning of public toilets**

Public toilets are the most commonly used in low income and slum areas in Bombay. Latrines on public land are cleaned by the conservancy staff of the SWMD (135 halalkhores). According to information obtained from the Ward Officer, certain private slums are served by private contractors (including the cleaning of public toilets).

Services performed by the municipal workers (halalkhores) include cleaning and disinfection of public toilets and removal of faeces from public areas. It has been observed, however, that public toilets are not properly cleaned and maintained and that children in particular are commonly seen defecating in front of the toilets and in areas adjacent to community refuse bins. This issue is discussed in more detail in section B-4, *Investigations in Slum Areas*. Results of a household survey (see Section B-4.4) indicate that the people in slum areas consider the cleaning of public toilets to be the most neglected service in their communities.

## **SUGGESTIONS**

- The people in slum areas are not satisfied with the cleanliness of public toilets. Further investigations are required to identify suitable arrangements for toilet cleaning. Consideration should be given to increasing the involvement of the private sector in this field. Experience gained by the New Delhi Municipal Committee indicates that it may be suitable to employ private contractors for construction, operation and maintenance of public toilets.
- Public awareness campaigns are considered crucial to avoid indiscriminate defecation in public areas (see section B-4).

### **(iv) The role of private sweepers**

Conservancy services undertaken by the public sector are generally not provided in private areas (which include 46 private slums and a large number of private residential complexes). However, according to information obtained from the Ward Officer, all of the large private residential areas as well six private slums are covered by sweepers on a private contract basis within pilot projects. It has been further mentioned that these projects are very successful and that another eight private slum areas will be included, beginning in 1993.

According to information obtained in one of the private slum areas (Bauder Ville), the monthly salary of private sweepers is Rs 535. Considering that the salary of municipal sweepers ranges between Rs 865 and Rs 1,057, the private sector is capable of providing sweeping services at a considerably lower cost.

**SUGGESTION:** As already mentioned in Section A-4, it is suggested that the private sector becomes more and more involved in primary collection of refuse, including street sweeping and drain cleaning activities in private and public areas. This may be the most promising way to reduce the expenditure involved in this sector and to extend and improve services at affordable cost. At present a large number of private slum areas remain without street sweeping services and therefore an extension of services might concentrate on these areas.

However, supervision of private sweepers could cause problems because these personnel may contribute to crude dumping of waste in the localities. Hence, provided that sufficient community storage facilities will become available, strict supervision would be required to ensure that private sweepers use these facilities properly.

## **B-2.3 PRIMARY COLLECTION OF REFUSE**

The existing system of primary collection in high-rise and multi-storey buildings is described in section (i) below. In slum areas primary collection is usually carried out by the residents who carry their household waste to communal storage facilities or crude dumping areas in the locality. However, in some slum areas private refuse collectors, sometimes called private sweepers, are employed by the residents for house-to-house collection of refuse and to transport it to community containers [ section (ii)].

### (i) Primary collection of refuse in high-rise flats

Most of the middle and high income groups in Bombay live in high-rise buildings. Housing societies usually employ private refuse collectors (also called private scavengers or private sweepers) for daily collection of refuse from the flats and carrying it to the nearest community container.

Some people in high and middle income groups were asked about the situation in their household

Q-2: Who is responsible for taking out refuse from your house?

	Mother	Father	Children	Servant	Private sweeper
High income	0	0	0	9	6
Middle income	3	1	0	1	5

The answers confirm that refuse collection from high income groups is almost exclusively carried out by private collectors or house servants. It is further shown that this seems to be slightly different in the middle income bracket. However, the questionnaire was carried out in blocks with only three storeys and therefore a different situation is considered likely in high-rise buildings.

In addition some of the private collectors were interviewed. In one case two persons are employed by the housing society to collect the refuse from 150 flats in five different blocks. Refuse is collected door-to-door seven days per week.

Plastic bins with a capacity of about 60 litres are used by the collectors for storage and transport of domestic refuse. According to information provided, the daily working time is about 6 hours and the salary is Rs 500 per collector per month. This is equal to about Rs 7 per flat per month. It has been further observed that the private collectors gain some additional income by recycling items that they separate from the refuse they collect. Recycling takes place at the community storage facilities before unwanted material is deposited in them. Recyclables are sold to hawkers and recycling shops.

In another case four private collectors were employed by a housing society to serve about 270 flats in 9 blocks. The salary of these people was only Rs 225 per month per collector (Rs 100 per block or about Rs 3.50 per flat).

Replies to a small questionnaire survey indicate that the residents are satisfied with the existing refuse collection service that is provided by private collectors.

The existing system of primary collection by private collectors is functioning well and works independently of the public sector. Although there may be possibilities of changing the present system (i.e. by providing refuse chutes in high rise buildings), this is not considered desirable as long as the people are satisfied with the present arrangements. The monthly charges of about Rs 3.50 to 7 per flat seem to be affordable and the people are willing to pay for this service. Due to the fact that there is a large number of private collectors employed in Bombay this system also helps to create employment for the urban poor. Considering these factors no changes seem to be required.

### (ii) Primary collection in slum areas

In several slum areas and single storey residential areas it has been observed that some of the residents employ private collectors to collect refuse from their households and take it to community storage facilities or crude dumping areas. According to the residents, the charges are about Rs 8 per house per month. The opinions of these residents about refuse collection in slum areas is further discussed in Section B-4. Some general conclusions and suggestions are set out below.



As is the case with high-rise flats, primary collection by private sweepers is considered to be the only possibility for providing house-to-house collection to low income groups. It would not be economically feasible for the public sector to provide such services. The system of private sweepers allows for flexible arrangements, i.e. the people can choose whether they want to pay for a more convenient house-to-house service or whether they prefer to carry their refuse themselves.

However, due to the fact that there is a lack of community storage facilities in slum areas, residents and private collectors commonly use crude dumping areas near where they live. Therefore the provision of sufficient community storage facilities in these areas is a pre requisite to achieving more sanitary conditions in these areas (see Section B-4). The introduction of more containers should be accompanied by public awareness campaigns and tight control of private collectors to ensure that these facilities are used properly.

#### **B-2.4 IMPLEMENTS AND PROTECTIVE CLOTHING**

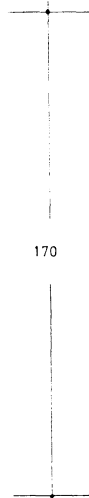
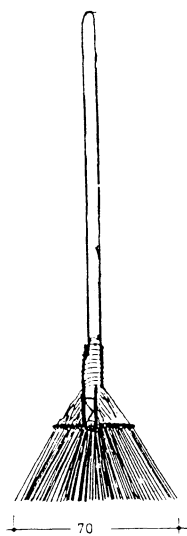
Sweepers, drain cleaners and halalkhores are the cutting edge functionaries of the conservancy unit. Therefore it is of utmost importance to provide them with adequate equipment to enable them to work efficiently and with minimal health and safety risks. The different types of equipment used at present are discussed in this section. They include (i) brooms, (ii) different types of handcarts and baskets as well as wheel barrows and (iii) protective clothing.

##### **(i) Brooms**

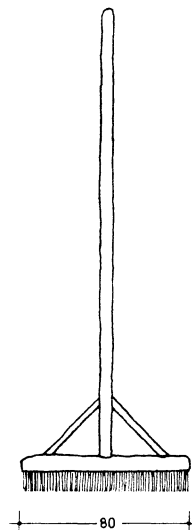
Each pair of sweepers is equipped with a standard broom as shown in Figure B-2.2.(a). When the brooms wear out they are repaired by the sweepers using the spares for broom repairs kept at the muster chowki. This type of broom is versatile regarding sweeping on rough and paved surfaces. Based on discussions with sweepers they like the design and handling of the standard broom.

A wide based long handle type of broom has been suggested for sweeping long stretches along main roads (see Figure B-2.2.(b)). However, this type of is more expensive than the

**Figure B-2.2: a) Standard broom**



**b) Wide base broom**

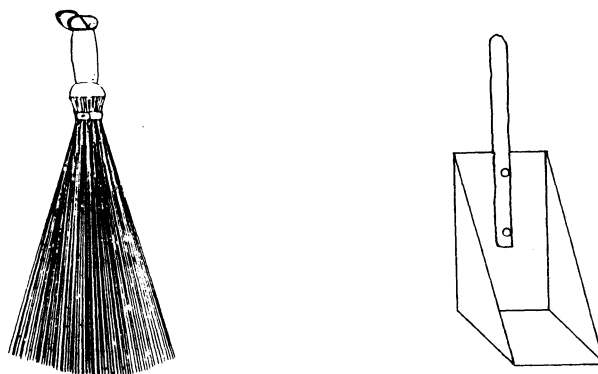


standard type and more difficult to repair. In addition this broom cannot be used in areas with a rough surface. It may prove suitable, however, to introduce the wide based type in beats which involve sweeping of large, paved areas.

For loading of the sweepings two small wooden boards (with dimensions of about 20 cm by 30 cm) are kept by the sweepers who are responsible for loading. One of the boards is held in each hand and the sweepings are squeezed between the boards for lifting and loading into the handcart. It has been observed that the sweepers are very skilful in handling the boards and that even sandy particles are lifted in no time. Although these boards are not provided by the SWMD each of the sweeper crews that was observed had equipped themselves with a pair. Some of boards were almost worn out, which indicates that they had been used for a long time and were considered to be a valuable tool.

It has been suggested that kerosene cans in conjunction with a small broom should be tried as an alternative, as shown in Figure B-2.3. However, there appears to be no real need to change the present system.

**Figure B-2.3: Kerosene can and small broom for loading sweepings**



**SUGGESTION:** Standard brooms are considered suitable for sweeping purposes. A wide base broom could be introduced on a pilot basis in beats which involve the sweeping of large, paved areas. Monitoring of the system is suggested to find out whether this will allow an improvement in the efficiency of the sweepers. A trial to investigate the benefits of introducing a modified loading system for street sweepings - as shown in Figure B-2.3 - might be worthwhile.

Due to time constraints the group did not observe the equipment used by drain cleaners and halalkhores. Further observations would be required to assess these implements.

#### **(ii) Handcarts and baskets**

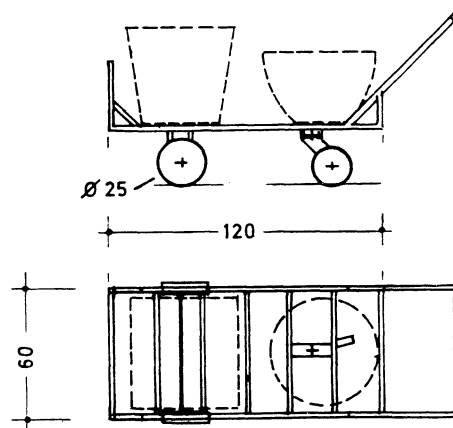
There are two main types of handcarts used in K-West Ward as shown in Figure B-2.4 and B-2.5. Both are equipped with baskets as described below. In addition there are some wheel barrow type handcarts as shown in Figure B-2.6. The number of handcarts employed in K-West Ward in relation to the conservancy staff is shown in Table B-2.2 below.

The table indicates that there seems to be a shortage of handcarts in K-West Ward. Considering that some spare carts are also required, (about 10 % may be sufficient), to allow for repair and maintenance, the number of handcarts required would be about 375, whereas the existing number of handcarts is only 312.

**Table B-2.2: Handcart requirements in Ward K-West**

<b>Existing handcarts</b>			
	Type A, 3 wheeled	see Figure B-2.4	156
	Type B, 2 wheeled	see Figure B-2.5	138
	Type C, wheel barrow	see Figure B2.6	18
	<b>Total existing</b>		<b>312</b>
<b>Required handcarts</b>			
	For street sweeping	about 262 beats	262
	For drain cleaning	about 14 crews	14
	For toilet cleaning	about 64 crews	64
	<b>Total required</b>		<b>340</b>

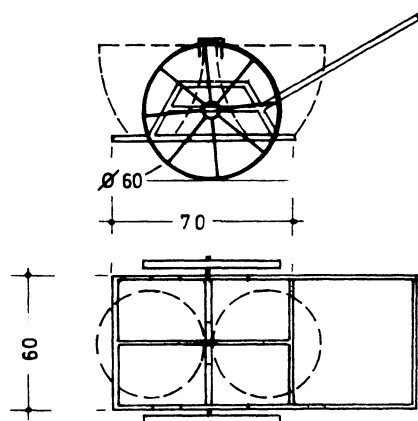
**Figure B-2.4: Type A handcart**



This cart is equipped with two fixed wheels and one pivoting wheel at the handle end. It is shown that small diameter wheels are used, therefore movement on unpaved areas is hardly possible. However, the cart is easy to push and manoeuvre on paved roads and lanes. Since sweeping is almost exclusively carried out along paved roads the design of the type A cart is considered appropriate for this purpose. It is simple, cheap and durable.

The cart is equipped with two baskets, made from cane or bamboo, each having a capacity of between 40 and 70 litres. Assuming that the density of street sweepings may be about  $350 \text{ kg/m}^3$  and two 70 litre baskets are used, this handcart may carry up to 50 kg per load. The smaller cane baskets would allow a load of only about 30 kg.

**Figure B-2.5: Type B handcart**

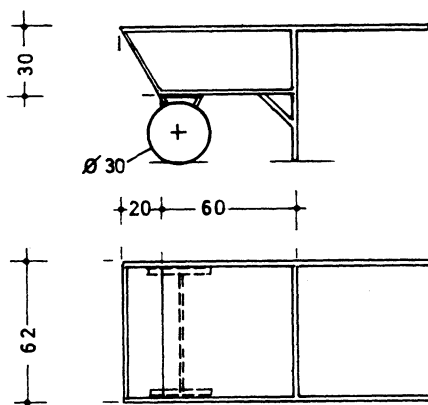


The Figure shows the two wheeled type B cart. There is also a three wheeled version similar to the type A cart - i.e. with a small rotating wheel fitted at the handle side of the cart. It is shown that large diameter steel wheels are fitted to this cart, to facilitate pushing and manoeuvring operations on paved and uneven surfaces.

It has been observed, however, that the bearings of these carts wear out quickly. All of these carts were very old and so poor maintenance and probably inadequate design are the likely causes of the problem. The sweepers did not indicate a preference regarding the number of wheels (i.e. two or three).

As with type A carts, only two baskets of various capacities (40 to 70 litres) are loaded on this type of cart, therefore the weight carried is between 30 and 50 kg per load.

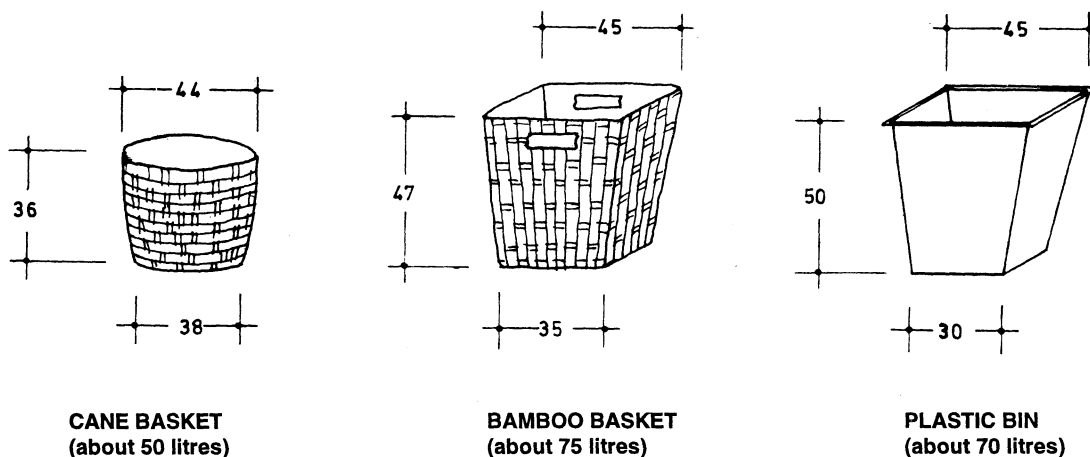
**Figure B-2.6: Wheel barrow type cart**



The wheel barrow type handcart is used for collection of street sweepings and for toilet cleaning. This cart provides a capacity of at least 130 litres (loaded level) and around 175 litres if fully loaded. A rubber rim is fitted to the small wheels and pushing and manoeuvring along paved roads and lanes is reasonably easy. If used for street sweeping a load of up to 60 kg could be carried and if faeces are carried the weight of a levelled load may be about 100 kg. Emptying into community storage facilities always involves double handling, i.e. tipping onto the ground and manual loading. Bin type carts are therefore more suitable and should be preferred.

Different types of baskets which are used on the handcarts described are shown in Figure B-2.7 below.

**Figure B-2.7: Baskets and bins (used on handcarts)**



It is shown in the figure that there is no standard design for baskets. The capacity ranges between 45 litres and 75 litres, some of the baskets are square, others round, most are made of cane and some of bamboo.

At present 50 litre cane baskets are primarily used. It has been reported that the life span of these baskets is only between two and three months and that they cost about Rs 150 per basket. Spare baskets are kept in the muster chowkies.

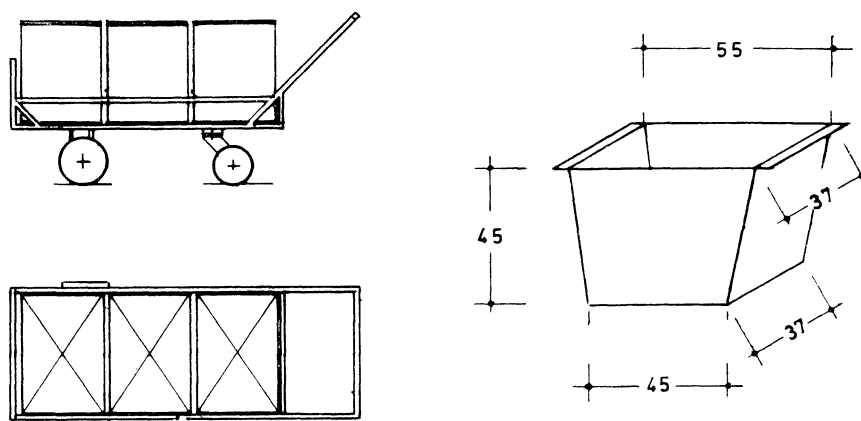
Some of the sweepers mentioned that bamboo baskets are far more durable than cane baskets. Figure B-2.7 shows a the design of a bamboo basket which is equipped with openings for easy handling.

Recently plastic bins have been introduced in some areas of K-West Ward. These bins have a capacity of 70 litres and cost about Rs 700 per bin. According to information obtained in the SWMD it is expected that these bins are more economical than cane or bamboo baskets due to their longer life span. Although these bins are not equipped with handles the projecting lip allows for handling to some extent. However, openings like the bamboo type would probably ease handling of these bins.

### SUGGESTIONS

- As shown in Table B-2.2 above there seems to be a shortage of handcarts in K-West Ward. It is therefore suggested that further investigations be carried out in individual muster chowkies to identify the number of additional carts required. In Section B-3 the situation in Jogeshwari muster chowki is analysed in more detail.
- To avoid double handling it is suggested that the wheelbarrow type cart should be phased out as soon as possible. This type should be replaced by a handcart-bin system. In paved areas the type A handcart is considered appropriate, in areas with unpaved surfaces and slopes, carts with larger wheels are more suitable.
- It is further suggested handcarts, baskets and bins should be standardised. This may involve the introduction of different handcart designs on a pilot basis; the different types should be monitored in close co-operation with the sweepers and halalkhores. To achieve a more efficient handcart system the present capacity of between 30 and 50 kilograms should be increased considerably. Some suggestions are shown in Figure B-2.8 and B-2.9 below.

**Figure B-2.8: Type A handcart with three plastic bins**

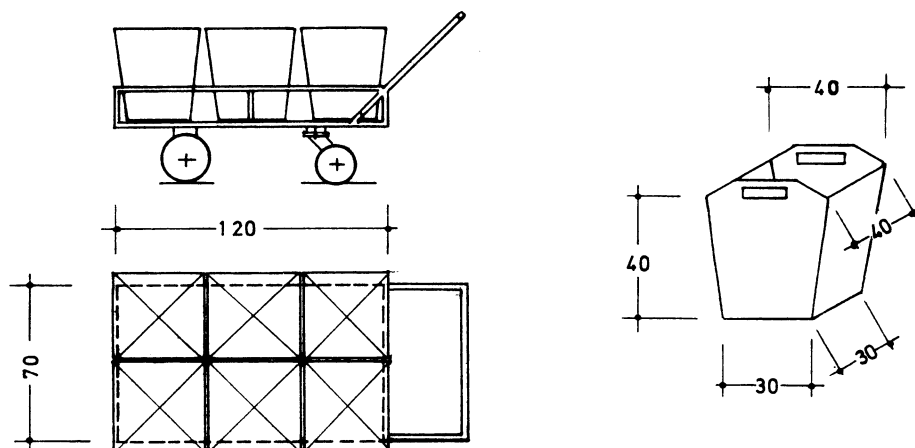


Results of the present pilot project with plastic bins may be used to decide on the most suitable material. It should be remembered, however, that plastic bins avoid spillage of dust and that they are suitable for transport of wet material like drain cleanings and faeces.

Three bins, with a capacity of about 70 litres each, would enable a cart to carry about 75 kg. This would increase the efficiency of handcarts considerably.

As a more long term objective it is considered desirable to introduce smaller bins which are easier to handle. Since there are many female sweepers, the total weight of a full bin should not exceed about 20 kg to allow convenient lifting and tipping into community storage facilities. Figure B-2.9 shows an arrangement of a slightly larger Type A handcart which is designed to carry six bins which have a capacity of about 50 litres each.

**Figure B-2.9: Enlarged Type A handcart with six bins**



This type of handcart would allow for loading at least 100 kg of street sweepings (which is more than twice as much as in the present system). In non paved areas the cart should be equipped with larger diameter wheels.

### (iii) Protective clothing

As already mentioned in Part A, conservancy workers are not equipped with gloves, and no boots are provided to drain cleaners and halalkhores. Uniforms are considered important in an unhealthy working environment. They allow for some publicity and also ease supervision of labour. At present a new uniform is issued to the conservancy staff every second year. However, it has been observed in the Jogeshwari muster chowki that less than 50 % of the employees wear their uniforms while they are on duty. Reasons include that the present practice of providing only one uniform per person does not allow for washing and repair.

In addition there are no arrangements for regular medical check-ups. However, some sweepers mentioned that they arranged their own annual medical examinations.

### SUGGESTIONS

- As already suggested in Section A-3.3, section (iv), conservancy staff should be provided with adequate protective clothing. Gloves could be cotton, woollen, leather, rubber or plastic. Keeping hygiene in mind, cotton and woollen gloves are ruled out. Rubber and plastic gloves are very warm and therefore resined or leather gloves may prove suitable. In addition long rubber boots should be provided to drain cleaners and halalkhores.
- It is further suggested that a thorough annual medical check-up should become provided for conservancy workers at no charge.
- To allow for washing and repair, it is suggested that two sets of uniforms should be provided to conservancy staff. This would make it possible to enforce the wearing of uniforms during official working hours.

## B-2.5 COMMUNITY STORAGE FACILITIES

Solid wastes from households, commercial enterprises and institutions are deposited in the community storage facilities provided by the SWMD. In addition street sweepers, drain cleaners and halalkhores use these facilities for disposal of solid waste. The storage capacity provided in K-West Ward is analysed in (i) below and the different types of storage facilities are described in section (ii). Some aspects regarding the impacts of rag picking on the cleanliness of these locations are mentioned in (iii).

### (i) Storage capacity of community facilities

The storage capacity of community facilities, based on information obtained in the SWMD is summarised in Table B-2.3.

**Table B-2.3: Existing capacity of community storage facilities in K-West Ward**

Type of facility	Capacity [m <sup>3</sup> ]	Number	Total capacity [m <sup>3</sup> ]	Emptying frequency [per day]	Storage capacity [m <sup>3</sup> ]
Steel pipe sections	about 0.7	203	142	once	142
Compactor trolleys	1.0	69	69	50% once, 50% twice	103
Masonry facilities	about 5	8	40	once	40
Refuse sheds	about 5	2	10	once	10
<b>Total storage capacity in K-West Ward</b>			<b>261</b>		<b>295</b>

Table B-2.4 provides an order-of-magnitude estimate of the present solid waste generation in K-West Ward.

**Table B-2.4: Estimated solid waste generation in K-West Ward**

Population	Solid waste generation	Solid waste density	Total solid waste generation	
5,80,000	0.40 kg/cap.d [1]	375 kg/m <sup>3</sup> [2]	230 tons/day	620 m <sup>3</sup> /day

#### Notes

- 1) Assumed value including commercial waste, street sweeping, drain cleaning and institutional waste
- 2) Based on results of Group C (see Part C.)

Using the values obtained in Table B-2.4 the required capacity of community storage facilities is estimated in Table B-2.5.

**Table B-2.5: Solid waste storage capacity in K-West Ward**

Amount of solid waste collected at present	Estimated solid waste generation	Present collection rate	Required storage capacity for [4]	
			present collection	total generation
170 tons/day [1]	230 tons/day [2]	74% [3]	600 m <sup>3</sup> /day [5]	815 m <sup>3</sup> /day [6]

#### Notes

- [1] Based on information obtained in the SWMD
- [2] See Table B-2.3 above
- [3]  $170 / 230 = 0,74$
- [4] Refuse density 375 kg/cum (see Section C-...), provision of 33% excess storage capacity.
- [5]  $170 \text{ tons per day} / 0,375 \text{ kg per cum} \times 1,33 = \text{about } 600 \text{ cum/day}$
- [6]  $230 \text{ tons per day} / 0,375 \text{ kg per cum} \times 1,33 = \text{about } 820 \text{ cum/day}$

The table indicates that about 75 % of the solid waste generated in K-West Ward is collected by the present SWM system. Recycling activities reduce the amount of waste and therefore the actual collection rate may be slightly higher. Considering that there are no services provided to most of the private slum areas and that drains and open plots are used for refuse disposal to some extent a collection rate of about 75 % seems to be realistic.

Although the calculations carried out in the tables above cannot be regarded as precise because they are based on a approximate data, they show clearly that the present storage

capacity of community facilities in Ward K-West is totally insufficient. The estimated shortfall in storage capacity in K-West Ward is shown in table B-2.6.

**Table B-2.6: Estimated storage deficiency in K-West Ward**

Existing storage capacity	Estimated storage requirements for	
	present collection rate	total generation rate
295 m <sup>3</sup> /day (36%)	600 m <sup>3</sup> /day (74%)	820 m <sup>3</sup> /day (100%)

**SUGGESTION:** Table B-2.6 indicates that the present capacity of community storage facilities is only sufficient for storage of about 36% of the total amount of refuse generated in K-West Ward. It is therefore suggested that a strategy be developed for increasing the storage capacity until sufficient capacity is available to cater for the present amount of waste collected by the SWMD. Storage deficiencies should be determined in each of the SWM districts of K-West Ward and priority areas identified.

The provision of adequate storage capacity is considered essential to the improvement of the cleanliness in K-West Ward and it is a necessary pre-requisite to the implementation of legislation regarding litter control.

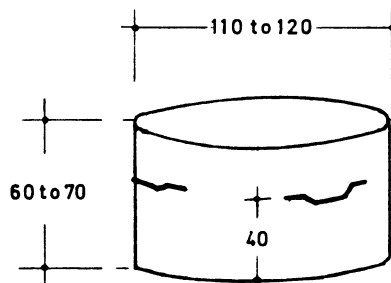
Considering that nearly twice the existing capacity is required this problem should become a priority measure for the improvement of refuse collection improvements. Regular monitoring of community storage facilities including their filling rate is required, and crude dumping areas (including drains and canals) need to be identified before a strategy for the elimination of crude dumping of refuse can be developed. The Junior Overseers may be the best people to collect the necessary data. This will further require major support by the Central Office including the allocation of funds and suitable strategies regarding the type of storage facilities and collection vehicles (see (ii) below).

**(i) Types of community storage facilities**

The five different types of community storage facilities in Ward K-West are shown in figures B-2.10 to B-2.13.

About 203 out of 282 storage containers are made from large diameter steel pipes as shown in figure B-2.10. The bins are primarily provided along secondary roads and in residential colonies including slum areas.

**Figure B-2.10: Refuse bins made from steel pipe sections**



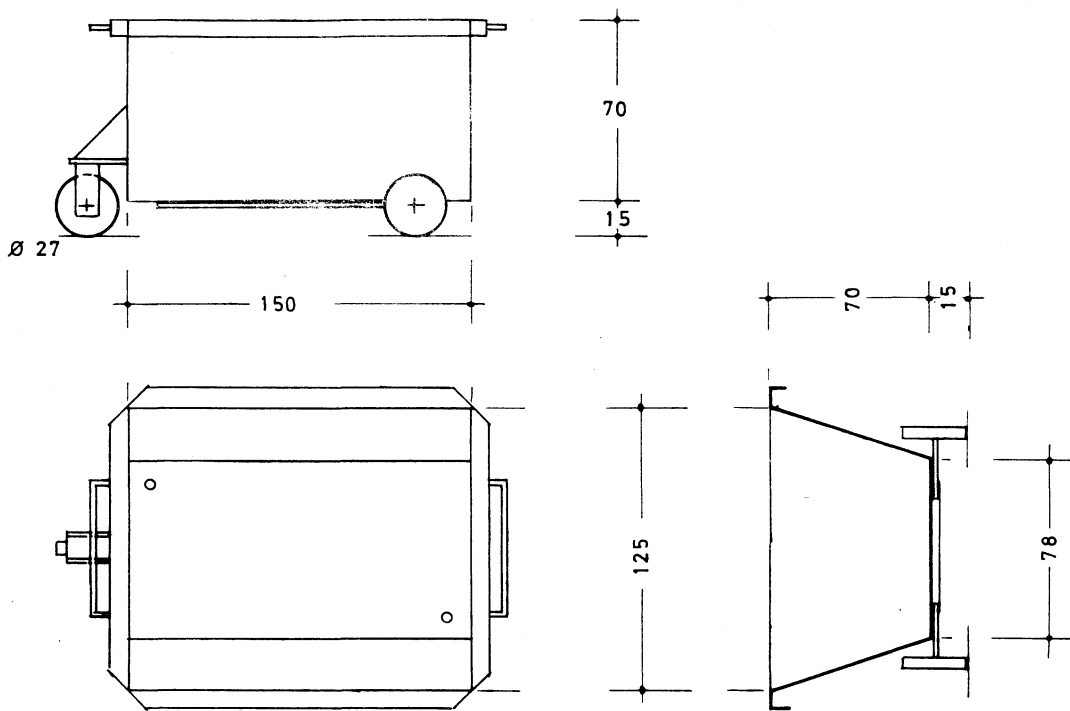
This bins are made from spare or used pipe sections of the water supply network in Bombay. The dimensions vary slightly, providing a capacity between about 0.6 and 0.8 m<sup>3</sup>. The bins are painted yellow and equipped with three handles, made from metal bars, as shown in the figure. Since the bins have no floors or bases, emptying involves tipping the bins over and manual loading into open trucks (usually contractors' vehicles).



Advantages:	Disadvantages:
<p>Very cheap. Waste is confined by the bin (avoidance of littering). Suitable capacity for medium density residential areas. No special purpose vehicles required for emptying (can be used in conjunction with contractors' vehicles). Convenient height for emptying household containers and bins from handcarts. Little maintenance and repair is required. Durable (life span more than 5 years).</p>	<p>Difficult to handle (weight about 150 kg, a crew of at least four loaders is required to tip the bin for loading). Loading is labour intensive and very time consuming (inefficient use of trucks). Unhygienic conditions for loaders. Fly maggots burrow into soil through open bottom and develop in the soil. Littering during loading (so that cleanliness of locations is difficult to maintain).</p>

Figure B-2.11 shows refuse containers which are used in conjunction with compactor trucks (also called compactor trolleys). These containers are located along the main roads and in high and multi-storey housing areas.

**Figure B-2.11: Standard refuse containers (trolleys)**

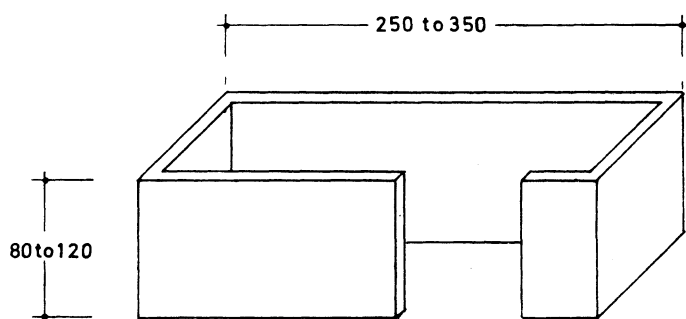


The trolley type containers provide a storage capacity of  $1.0 \text{ m}^3$ . Lifting and emptying these standardised containers requires special purpose vehicles like rear loading compactor trucks, which are equipped with a hydraulic lifting devices.

<p><b>Advantages:</b></p> <p>Rapid loading (efficient use of trucks). No manual handling of waste, therefore minimum health hazards for loaders. Loading less labour intensive (about three loaders are able to handle the containers). Direct loading of containers avoids littering. Less need of cleaning of container locations. Suitable capacity for medium density residential areas. Convenient height for emptying household facilities and bins from handcarts.</p>	<p><b>Disadvantages:</b></p> <p>Only possible in conjunction with special purpose vehicles. Containers should be located on paved areas. Present system of private contracting is not suitable for using this type of facility. Relatively costly (compared with pipe bins). Regular maintenance is required. Life span may be less than five years.</p>
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Although they have mostly been replaced by pipe bins and trolleys, there is a small number of permanent structures used for community storage of refuse in slum areas and markets, known as refuse sheds and masonry enclosures. Refuse sheds consist of an masonry building including a simple roof (see figure B-6.3 below). A typical masonry enclosure is shown in figure B-2.12.

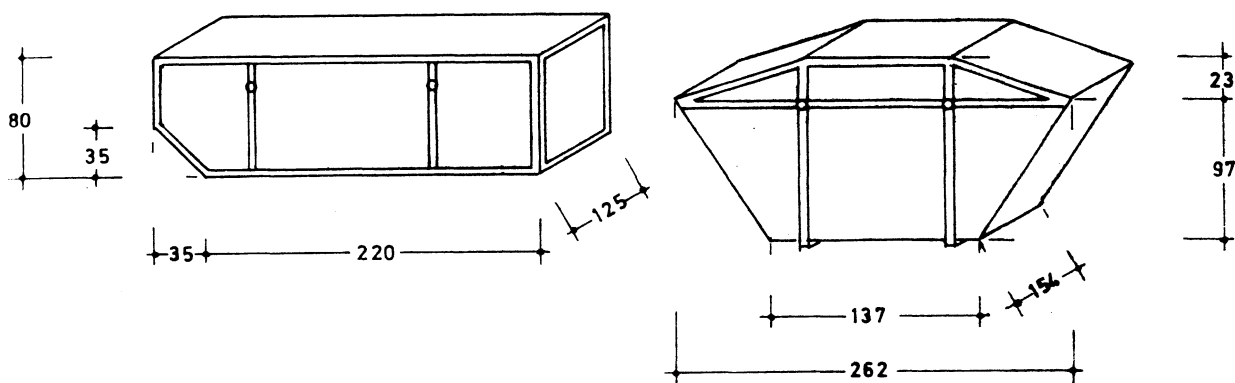
**Figure B-2.12: Masonry enclosure (masonry bin)**



<p><b>Advantages:</b></p> <p>Very cheap. Waste is partially confined to the enclosure. No special-purpose vehicles required for emptying (can be used in conjunction with contractors' vehicles). Little maintenance and repair is required. Durable - life span more than 5 years.</p>	<p><b>Disadvantages:</b></p> <p>Loading from them is very difficult and extremely unhygienic. Ineffective litter control. Loading is labour intensive and very time consuming ⇒ inefficient use of trucks. Fly and odour nuisance due to large surface area. Cleanliness of surrounding areas virtually impossible, therefore unhygienic and inconvenient for users.</p>
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In addition to the facilities described above figure B-2.13 shows skip containers which are commonly used in the city centre of Bombay.

**Figure B-2.13: Skip type containers**



The larger skips with a capacity of about 3.7 m<sup>3</sup> are used by the MCGB in conjunction with skip trucks (dumper placers). Refuse collected by these vehicles is transferred to large capacity bulk transport vehicles at a solid waste transfer station.

A smaller skip with a capacity of about 2.5 m<sup>3</sup> has been observed at the landfill site and was used by a private deliverer in conjunction with a small TATA truck (type 407, GVW 5.3 tons).

<b>Advantages:</b>	<b>Disadvantages:</b>
<p>Very rapid loading. No manual handling of waste, therefore minimum health hazards for loaders. Operation without loaders is possible, but one loader may be useful for connecting the lifting chains to the containers. Direct loading of containers avoids littering. Little cleaning of container locations is required. Suitable capacity for high density residential areas.</p>	<p>Only possible in conjunction with special purpose vehicles and probably a solid waste transfer station (for bulk transport). Present system of private contracting does not allow for using this type of containers. Lower costs than compactor trolleys. Some maintenance required. Life span may be about five years. Depending on the design the height for emptying household containers may cause problems, in particular for children.</p>

### **SUGGESTIONS**

- In an effort to achieve more hygienic conditions the present strategy of phasing out masonry bins and refuse sheds should be continued.
- In addition the present emptying frequency of once daily (seven days per week) is considered most appropriate because it allows costs for storage facilities to be minimised. Further investigations are required to evaluate whether introducing an emptying frequency of twice daily would be appropriate in high density housing areas. Considering the comparison of different storage facilities set out above it is thought desirable to gradually replace pipe bins by trolley type containers (in medium density areas) and probably skip type containers (in high density areas including slums). This strategy would:
  - avoid manual loading of refuse (a more healthy working environment for loaders);
  - reduce the labour costs for loading considerably;
  - utilise trucks more effectively;
  - achieve litter control and cleanliness of container locations;
  - introduce rapid unloading at the disposal site.

However, the implementation of this strategy is very difficult because the vehicles of the private contractors are unsuitable for handling containerised refuse collection systems. Measures to support the use of special purpose vehicles by the private sector have been discussed in Section A-4. They include a modified bidding procedure for contracts by giving preference to closed vehicles with mechanical container handling and unloading arrangements. This may be achieved by extending the contract period from two years to about five years and probably allowing an extension of contracts for a further five years under certain conditions.

- As a means of increasing the storage capacity to the requirements as set out in table B-2.6 above, it is suggested that additional pipe bins should be provided until the private sector is able to offer special-purpose vehicles and containerised systems.

Additional trolley type containers and probably skip systems may be introduced by the public sector when new vehicles become available. However, as already discussed in Section A-4, it is considered far more economic to increase the involvement of the private sector in refuse collection and transport. Therefore the strategy should aim at increasing the involvement of private contractors rather than providing additional vehicles operated by the public sector.

### **B-3 OPERATIONS IN JOGESHWARI SWM-DISTRICT**

The location of Jogeshwari SWM district is shown in figure B-2.1 above. There are different residential colonies in Jogeshwari including all income groups (high, middle and low), high rise buildings and slums. It is further shown in figure B-2.1 that this district has a muster chowki which is only responsible for organising conservancy services in Jogeshwari SWM district (see section B-2.1).

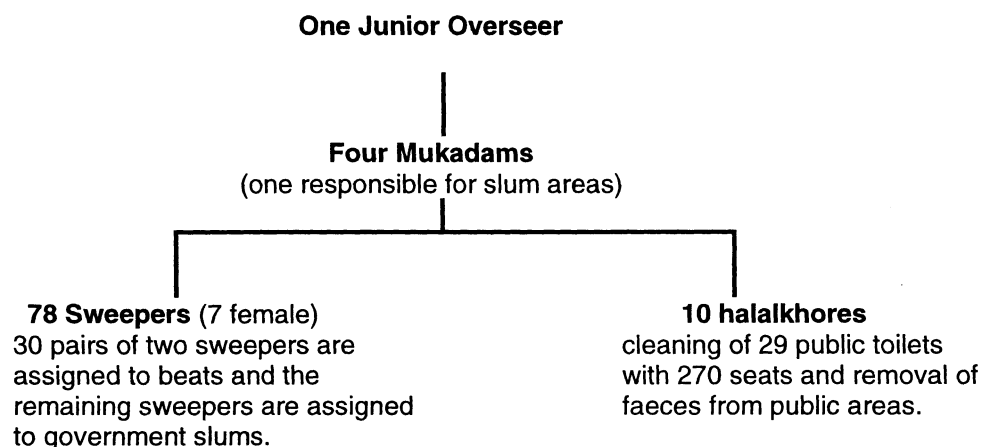
#### **B-3.1 ORGANISATION, MANPOWER AND SUPERVISION**

The organisation and manpower for carrying out conservancy services in Jogeshwari SWM District are set out in section (i). This is followed by a description of existing record keeping systems in (ii). Observations regarding the organisation of daily work as well as the supervision of conservancy staff at district level are outlined in section (iii).

##### **(i) Organisation and manpower in Jogeshwari district**

The organisational chart and manpower in the Jogeshwari SWM district is shown in figure B-3.1.

**Figure B-3.1: Organisation Chart of the Jogeshwari Muster Chowki**



It is shown in the chart that there are no drain cleaners assigned to this muster chowki. However, the JO explained that street sweepers carry out some drain cleaning activities in small drains (provided that the drains are dry).

Because the services are carried out 7 days per week, additional labour is required to allow one day off per labourer each week. A very clever system is employed by the SWMD to allow for the weekly day off for permanent employees. About 15 workers turn up at the morning attendance and are employed according to the particular daily requirements on a daily wage basis. For example on 1 December 1992 the following situation was observed:

Out of 88 permanent employees 68 were present in the morning - 15 employees had their weekly day off and 5 were absent for unknown reasons. To cope with the shortage 4 additional workers were employed on a daily wage basis.

**COMMENT:** The organisation of conservancy services seems clearly defined at the different levels and so is considered satisfactory. In particular the arrangements regarding the employment of labour on a daily wage basis seems very suitable because it allows for flexibility without employment of permanent labour.

#### **(ii) Records**

A muster roll on daily attendance is checked by the JO in the morning and at the end of the working day. The following records are kept by the JO:

- Date, name of employee, attendance, reason for non attendance (i.e. regular weekly off, annual leave, casual leave).
- Names of workers employed on daily wage basis including names of permanent employees replaced by these workers.

A second record book is kept in the muster chowki regarding beats, public toilets, community bins and assignment of labour, i.e.:

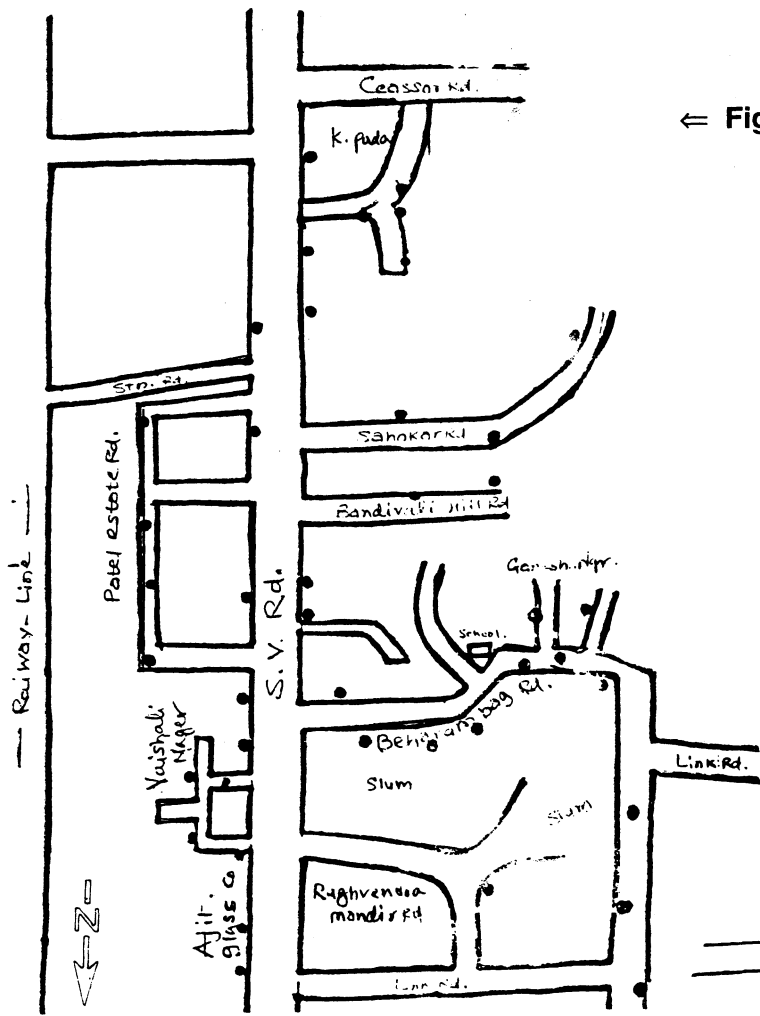
- Areas of beats are defined by mentioning the streets to be swept in each particular beat (total 30 beats).
- Names of the two sweepers assigned to each beat.
- Locations of community bins are described, i.e. name of street, junction or particular buildings (total 53 community bins).
- Location and name of public toilets (total 29 public toilets, 270 seats).
- Names of halalkhores assigned to particular toilets.

Although the records kept in the muster chowki have not been analysed fully, they appear to be complete and regularly updated by the JO.

In addition to the records kept at the muster chowki, two different sets of maps were provided by the SWM Office / K-West Ward. One type of map indicates community bin locations in each particular SWM district, and the other type shows the beats and assignment of sweepers in each district. A complete set of these maps, designed in 1990, was available in the SWM Office. Figure B-3.2 shows the sheet regarding bin locations in Jogeshwari SWM district.

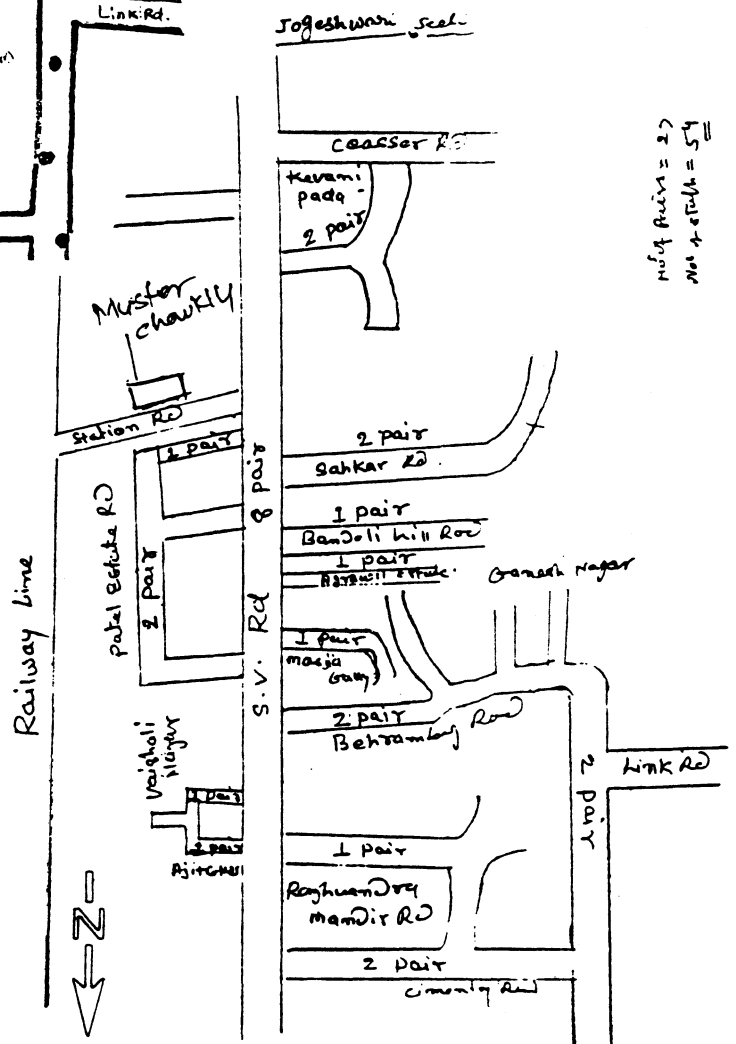
However, this map was not available in the Jogeshwari muster chowki. It was also observed that the JO had considerable problems in reading the map and no updating had been carried out since 1990 (only 43 out of the 53 community bins had been marked on it). Although the map is based on a rough sketch it appeared suitable for showing the locations of the bins. More detailed observations in section B-3.3-(i) show that the locations of the storage facilities marked on the map seem to be mainly correct and that it is possible to identify the locations in the area, using the map.

A second map of Jogeshwari SWM district indicates the location of beats as well as the assignment of sweepers, and is as shown in figure B-3.3.



← Figure B-3.2:  
Locations of community bins in Jogeshwari

⇒ Figure B-3.3:  
Beats and assignment of sweepers in Jogeshwari



The names of pairs of sweepers were written on the reverse of this map. Again, the map was not available in the mustar chowki and not up to date (27 beats out of 30 were indicated, as were only 54 sweepers instead of 60).

**SUGGESTION:** The existing system of record keeping in Jogeshwari muster chowki is impressive, up to date, well designed and well functioning. However, it may be more appropriate to use maps for indicating beats, bin locations, public toilets and the assignment of labour. Although this system is already used by the SWM Office there seems to be a lack of co-operation between the muster chowkies and the SWM Office. Based on these observations, it is considered desirable to introduce a single system, using maps rather than records, and to assign the updating of this map to the JO's. However, this seems difficult because JO's may have problems working with maps because they find them difficult to understand. It is therefore suggested that junior overseers should be trained to interpret and use maps before the duties of updating the maps are assigned to these personnel.

**(iii) Organisation of daily work and supervision**

The organisation of the day to day street sweeping activities are set out below:

Attendance/assignment of labour .....	6.30 to 6.45 am
Walking to beats, toilets etc.....	6.45 to 7.00 am (7.15 for very distant beats)
Working period .....	7.00/7.30 to 10.30 am
Tea break.....	10.30 to 11.00 am
Working period .....	11.00 to 1.00 pm (12.45 for very distant beats)
Walking to muster chowki.....	1.00/12.45 to 1.15 pm
Attendance at muster chowki.....	1.15 to 1.30 pm

The timetable above shows that the working period on the job is between 5 and 5½ hours daily (see also section B-2.1). However, observations in Jogeshwari indicate that the actual working time on the job ends with the tea break at about 10.30 am. During a visit to six different beats between 11.30 and 11.45 am not a single sweeper was observed on duty. More than 15 workers were been observed at the muster chowki at about 12.30. These observations indicate that the actual working time on the job is only between 3 and 3½ hours daily.

Although the duties of mukadams include supervision of their crews by carrying out two inspection rounds daily this seems to have little effect on the actual work carried out by labourers after the tea break.

Reasons may include that the JO's cannot punish the workers directly. The normal procedure involves writing a note regarding complaints to the supervisor. However, it has been reported that measures for punishment are very difficult to enforce because of the Labour Union's militancy and politicisation of strikes.

**SUGGESTION:** As already mentioned in section A-3.3, suitable measures to improve the supervision of labour and to increase the effective working period should be identified and enforced. This could include possibilities for JO's themselves to administer penalties to labour, such as deductions from salaries and rotation within the ward. It is considered totally unacceptable that employees, who obtain a comparatively good salary, cannot be forced to work during normal working hours. Measures aimed at increasing the output of the labour force are outlined in section B-3.5 below. In addition privatisation of conservancy services may prove a suitable way of reducing the labour costs involved in this sector.

**B-3.2 PROVISION OF IMPLEMENTS TO CONSERVANCY STAFF**

The type of equipment used by conservancy staff has already been discussed in section B-2.4, and aspects regarding protective clothing and uniforms as well as the need of regular medical checks have been dealt with in section B-2.4 above.

The Jogeshwari muster chowki consists of a well constructed building which is located at one of the main road junctions in Jogeshwari (see figure B-3.2). The dimensions of the building are about eight metres by three metres, divided into an office and a store room, both of similar size. Chairs and a table are provided, as well as water supply and electricity, including a fan. However, there is no telephone in the JO office. The store room is used for keeping a stock of about 40 baskets, cane for repair of brooms and some bags of disinfectant and insecticide.

Regarding handcarts, the following situation was observed:

AVAILABILITY OF HANDCARTS		HANDCART REQUIREMENTS		SHORTAGE OF HANDCARTS
total number	in working condition	for sweepers	for halalkhores	
20	8	30	5	15 plus 12 awaiting repair

According to the junior overseer, repair of handcarts is carried out by the central workshop. Although requests for repair had been addressed more than two months previously, nine of the broken carts were still at the chowki and there was no sign of action being taken to repair them. Because of the lack of handcarts, sweepers were using single cane baskets, which they pulled along the ground using a rope.

### SUGGESTIONS

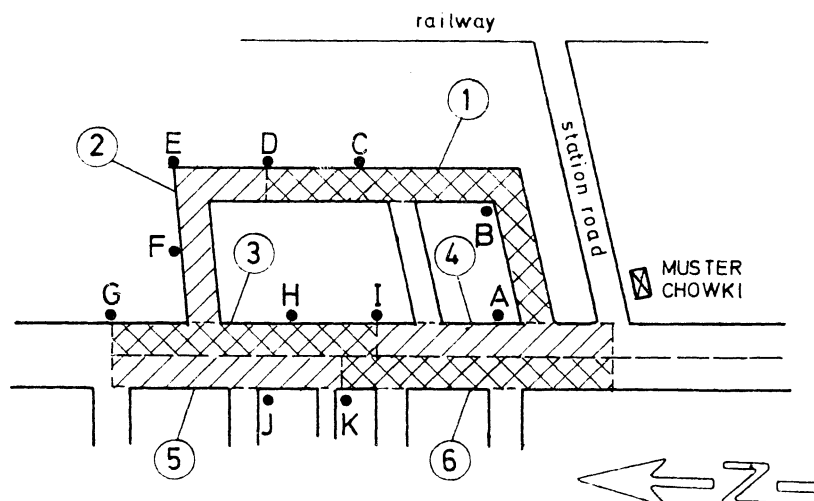
- The muster chowki is well designed, properly equipped and centrally located. However, to allow for better communication between the central, ward and district levels, it would be desirable to provide a telephone to the chowki.
- Regarding handcarts there seemed to be a total lack of co-ordination and support by the SWMD. Despite the general shortage of handcarts the arrangements for repair seemed to be totally inadequate. Instead of using the central municipal workshop it may be far more suitable to employ local workshops for maintenance and repair of simple equipment. It is therefore suggested that the AHS should be provided with sufficient funds for minor repairs of handcarts and containers as well as for petty cash purchases and minor maintenance.
- For more difficult handcart repairs and for mending storage containers it may be most appropriate to introduce mobile repair and maintenance crews, based at the central workshops. Another option could be the assignment of one mechanic, probably assisted by one helper, to each of the two supervisors for repair of equipment in the SWM districts.
- In an effort to provide sufficient handcarts to the conservancy staff it is suggested that the situation in all SWM districts should be evaluated as soon as possible. The handcart deficiency should be made good immediately, including the provision of sufficient standby carts (say 10 %) to allow for repair without causing a shortage of carts in the districts. This should include replacement of very old and broken carts according to the strategy suggested in section B-2.4 (ii) above and include the provision of adequate baskets.

### B-3.3 WORK EFFICIENCY STUDIES

The area chosen for carrying out work efficiency studies of sweepers is shown in figure B-3.4.



**Figure B-3.4: Study area for work efficiency studies**



As shown in the figure, the area covers six beats, each assigned to one pair of sweepers. The beats are marked 1 to 6 and the eleven community bin locations in the area are marked A to K.

The division of beats and the assignment of sweepers in the study area is discussed in (i) and followed by more detailed observations regarding performance of sweepers in (ii). Section (iii) deals with community storage facilities in the study area and the impacts of rag pickers on littering are outlined in (iv).

**(i) Division of beats and assignment of sweepers**

It is shown in figure B-3.4 that in small roads (width about 12 metres) one pair of sweepers is responsible for sweeping both sides of the road (beats 1 and 2), whereas along the main road (width about 24 metres) one pair of sweepers is assigned to each side of the road (beats 3 to 6). Table B-3.2 provides a summary of the main features regarding street sweeping in the study area.

**Table B-3.2: Assignment of sweepers in the study area**

	----- secondary road -----					----- main road -----					----- main road -----					
BIN LOCATION	A	B	C	D	E	F	G	H	I	A	(G)	J	K	(A)		
DISTANCE [m]	150	150	250	150	210	250	180	180	150	150	250	80	180	150		
PAIR NUMBER	.....1.....				.....2.....				.....3.....		.....4.....		.....			
	5.....		6.....													
METRES/PAIR	550				610				360		300		330		330	
BINS/PAIR	4				4				3		2		2		1	

Based on the data shown in table B-3.2 some general comments are set out below:

- The average length of beats along main roads is 330 metres, ranging between 300 and 360 metres (sweeping is carried out by one crew along each side of these roads). In secondary roads about 580 metres are assigned to one pair of sweepers (responsible for sweeping along both sides of the road). According to information obtained from the CE/SWM, the average area of roads and lanes within one beat is between 3,000 and 5,000 square metres in busy areas (e.g. along main roads) and 5,000 to 10,000 square meters in quiet areas (e.g. suburbs).

- In the study area about 4,000 square metres (330 x 12) are assigned to the sweepers along the main roads and 7,000 square metres (580 x 12) to sweepers along secondary roads; therefore the division of beats in Jogeshwari seems to be very well arranged.
- Regarding the distribution of community bins for sweepers, the average distance between the storage facilities is about 180 metres, ranging between 80 and 250 metres.
- Along the secondary road each pair of sweepers was using 4 bins for disposal of street sweepings whereas along the main road between 1 and 3 bins are available per pair of sweepers.
- In case of pairs 5 and 6, the sweepers were forced to cross the busy main road to reach the containers G and A.
- The map of community storage locations which was provided by the SWMD proved almost correct. Only the bin location F is missing and some of the locations are marked on the wrong side of the road (namely B and D).

The division of beats in Jogeshwari seems to be very well arranged. The work load is equally distributed between the sweeping crews. Some suggestions are discussed below and others in section (ii), *performance of sweepers*, which follows.

### SUGGESTIONS

- Due to the small amount of street sweepings in secondary roads it is suggested to reduce the frequency of sweeping in some of the secondary roads to every other day. Further investigations are suggested to review the frequency of sweeping in secondary roads.
- Although a more equal spacing between storage facilities would be desirable it is suggested to provide the containers according to the refuse generation at central locations, to allow for some variation between the facilities (see ii below).
- In order to avoid accidents the sweepers should not be required to cross main roads (as do pair 5 and 6 in table B-3.2). Therefore additional containers should be provided on the opposite side of the road in the area of the containers A and G (see figure B-3.4).

#### (ii) Performance of sweepers

The following implements were being used by the six pairs of sweepers in the study area:

**Table B-3.3 Equipment used by the sweepers who were observed**

Team	Method of transport	Other equipment
Pair 1	No handcart. 60 litre basket with rope	One broom, wooden boards
Pair 2	Only one sweeper on duty. Type A handcart in good condition. Cart was not used (locked at lighting post, key of the lock was kept by the other sweeper who did not report for work that day).	One broom, wooden boards
Pair 3	No handcart. 60 litre basket with rope	One broom, wooden boards
Pair 4	No handcart. 70 litre basket, carried by loader.	One broom, wooden boards
Pair 5	Wheel barrow type cart in good condition	One broom, wooden boards
Pair 6	Type B handcart in good condition, two baskets (capacity about 75 and 60 litres)	One broom, wooden boards

Considering the shortage of handcarts observed in Jogeshwari district it is not surprising that only three out of the six crews shown in the table were equipped with handcarts. It is further shown that only one broom is provided per crew. Therefore one of the sweepers is responsible for sweeping whereas the other is responsible for loading the street sweepings and transporting them to the nearest community container.

Estimates of the performances of three pairs of sweepers, based on observations and interviews with the crews, are presented in table B-3.4.

**Table B-3.4: Performance of sweepers**

	Basket/handcart capacity [litres]	Estimated density [kg/l]	Weight of filled basket/handcart [kg]	Loads per time interval [no.]	Time interval [min.]	Performance of the pairs [kg/h]
Pair 1	about 60	0.35	21	2	45	56
Pair 5	about 175	0.35	61	3	180	61
Pair 6	about 135	0.35	47	4	195	58
<b>Average performance of sweepers about 58 kg/hour per pair, equal to about 200 kg/day [1]</b>						

Note [1] Considering an effective working time of 3.5 hours per day, see Section B-3.1-iii.

Although observations on a larger scale would be necessary to obtain more reliable data the values shown in the table above may provide an idea about the present distribution of work within the pair system.

It is shown that the performance of the three pairs does not vary considerably. This may be surprising because pair 1 was not equipped with a handcart and pair 5 was using a wheel barrow type cart which involves double handling. However, it has been observed that only about 2 minutes are required to transfer the wheel barrow load into a trolley container (the load is tipped to the ground beside the trolley and loaded manually).

The results are very uniform because the work load within the pair system is very imbalanced. As will be shown in the following section, the person in charge of loading and transporting the sweepings has plenty of time and therefore the impact of poor transportation equipment on the performance of the pairs is negligible.

It has been observed that the pairs manage to sweep their beats within 3 to 3½ hours. The amount of sweeping per beat is estimated as:

In main roads: about 200 kg/day from 4,000 m<sup>2</sup> (one road side, length of the kerb about 330 metres).

In secondary roads: about 200 kg/day per 7,000 m<sup>2</sup> (both sides of the road, length of road 580 metres, kerb length about 2 x 580 metres = 1060 metres).

The activities of Pair 1 have been observed in more detail to assess the effective working time of each person within the pair system. Results of the work efficiency study are shown in Table B-3.5.

**Table B-3.5: Effective working time of sweepers**

Time scale in minutes	0	20	40	60
Activities of SWEEPER	S	S S S S S S S	S S S S S S S R	R S S S S S S S S S S S
Activities of LOADER		-----L T-----	L--T-----L	T-----

Legend: S (sweeping), R (repair of broom), L (loading), - (non productive), T (transport)

It is shown in the table that the person who is sweeping may be productive for up to 60 minutes per hour whereas the person loading and pulling the basket to the container works for only about 17 minutes per hour. Therefore the use of well-designed handcarts would only reduce the working time of the loading and transport person to less than 17 minutes per hour. Hence, without changing the present sweeping system any investment in handcarts and baskets would be a total waste of funds.

Considering that the actual working time on the job is less than 3½ hours per day, the person who loads and transports the street sweepings receives a full salary for working less than one hour per day.

It has been reported *off the record* that it is not uncommon to find a couple who share the work. Only one of the two is present to do the job and the other person only reports twice daily for attendance at the muster chowki.

There are two main shortcomings observed regarding the performance of sweepers:

- Although the official working time on the job is between 5 and 5½ hours per day, the actual time spent on the job is only 3 to 3½ hours.
- The workload within the pairs of sweepers is very unevenly distributed. The person responsible for loading and transport remains idle for almost ¾ of his working time.

**SUGGESTION:** two different possibilities for improving the present situation:

- Improvements of the pair system such that both persons of the pair are equipped with a broom for sweeping. This would increase the effective working time of the crew considerably.
- The second option is to assign only one sweeper to each beat (an arrangement that is common in other municipalities in India).

Table B-3.6 further indicates the potential performance of sweepers by adjusting the sweeping period to the official working hours.

**Table B-3.6: Comparison of different sweeping arrangements**

	Present pair system		Improved pair system		One sweeper per beat	
	3 to 3½	5 to 5½	3 to 3½	5 to 5½	3 to 3½	5 to 5½
Period working [hours per day]						
Performance along main roads [m <sup>2</sup> ]	4 000 (1)	6 500 (2)	5 700 (3)	9 200 (2)	2 850 (4)	4 600 (2)
Performance along secondary roads [m <sup>2</sup> ]	7 000 (1)	11 300 (2)	10 000 (3)	16 100 (2)	5 000 (4)	8 050 (2)

**Notes**

- 1) According to (i) above.
- 2) Ratio 5.25 / 3.25 = 1.61 used here.
- 3) Each person spends 17 min/hour for loading and transport and 43 min/hour for sweeping. Effective sweeping period per pair is 2 x 43 = 86 min instead of 60 min at present. This allows to increase the performance of the pair by 83/60 = 1.43.
- 4) The person spends 17 min/hour for loading and transport and 43 min/hour for sweeping. One sweeper would achieve 43/60 = 72 % of the performance of the present pair system.

Both options shown in the table would allow for improving the efficiency of sweepers by at least 42 %. The provision of adequate handcarts [see section B-2.4-(ii)] would allow a further increase in the performance by reducing the transport and transfer time.

Although there were no small drains in the study area, it may be most suitable to assign cleaning of the small drains to sweepers, i.e. drains in a particular beat should be cleaned by sweepers in charge of the area [see section B-2.2 (ii)].

**(iii) Locations and filling rates of community bins**

Community containers in the study area (see figure B-3.4) were closely observed during the studies in Jogeshwari. The capacity of refuse in the containers was recorded (as a percentage of the total container capacity) as well as the condition of the facilities and cleanliness of the locations. The results are summarised in table B-3.7.

**Table B-3.7: Monitoring of community storage facilities**

Location	Type of container	Capacity m <sup>3</sup>	Condition	Percent full (8am -9am)	Frequency of emptying	Percent full (noon - 1pm)	Cleanliness of location
A	trolley	1.00	wheel broken	50	twice/day	>100	good, paved
B	pipe bin	0.70	good	75	once/day	>100	bad, unpaved
C	pipe bin	0.64	good	30	once/day	100	bad, unpaved
D	pipe bin	0.62	bad	30	once/day	>100	bad, unpaved
Comment: Slum dwellers dump refuse in an open drain close to bin D							
E	pipe bin	1.50	very bad (1)	10	once/day	30	bad/unpaved
F	pipe bin	0.68	good	20	once/day	50	good, paved
Comment: Private collectors dump refuse over a wide area on adjacent private property							
G	trolley	1.00	good	75	twice/day	90	good, paved
H	trolley	1.00	good	75	twice/day	>100	good, paved
I	trolley	1.00	good	60	twice/day	100	good, paved
J	trolley	1.00	good	20 (2)	twice/day	60	good, paved
K	trolley	1.00	wheel missing	20 (2)	twice/day	70	good, paved

**Note**

- 1) Very old steel bin, diameter 1.5 metres, height 0.6 metres.
- 2) These trolleys had already been emptied that the morning.

Some general comments on storage, based on the observations summarised in table B-3.7, are set out below:

- Trolley type containers are placed along the main road and allow for proper cleanliness of the locations. (It is duty of sweepers to keep these areas clean.) An emptying frequency of twice daily seems to be of help in keeping these areas clean. Rag pickers were observed at all trolley locations. They did not cause severe problems regarding cleanliness around the trolley containers.
- Steel pipe bins are located along secondary roads; the cleanliness of the surroundings of the bins was unsatisfactory in most cases. Reasons include that the locations were not paved and therefore very difficult for the sweepers to clean and inconvenient for the public.
- Monitoring of the filling rate of the community bins shows that six out of eleven facilities were already full or overflowing by lunch time. This indicates a general lack of storage capacity, as discussed in section B-2.5 (i).
- There seems to be a maintenance problem regarding compactor trolleys. Two out of five trolleys needed repair (broken or missing wheels). In addition cleaning and repainting of containers was not carried out regularly.
- There were a number of crude dumping areas used by the public in the immediate vicinity of storage facilities.

**SUGGESTIONS**

- The presence or absence of a paved area around community storage facilities pavement seems very to have a big influence on the cleanliness of the sites. It is therefore suggested that all community storage facilities should be paved.
- To avoid overflowing containers and bins, a regular monitoring of filling rates is suggested. The mukadams and the JO's should become responsible for carrying out this monitoring. The results should be collected by the supervisors and passed on to the Central Office in order to decide on the provision of additional storage facilities according to the requirements identified. This would probably allow a reduction in the distance between storage facilities to less than 150 metres.
- An adequate system for organising the maintenance and repair of storage facilities seems to be required. Monitoring of the facilities regarding maintenance and repair could be carried out either by collection crews or by JO's of SWM districts. Since the vehicle crews are directly affected by missing wheels etc. it may be more suitable to

assign this duty to the mukadams of collection vehicles. A mobile repair and maintenance team may be most appropriate for carrying out maintenance and repair of trolley containers (and handcarts, see section B-3.2). It may be sufficient to base one mobile team at each central workshop.

- To prevent dumping of refuse in drains and open areas, additional storage should be provided at places where indiscriminate dumping is practised. This is particularly difficult in private residential areas because the SWMD is not responsible for cleaning on private property. However, adequate legislation and enforcement, coupled with co-operation between the SWMD and housing boards, may help to develop suitable arrangements.
- Public awareness campaigns are certainly required to reduce crude dumping of refuse. Section A 3.5 (ii) discusses this subject in more detail.

#### **(iv) Littering by rag pickers**

Recycling of saleable material is carried out at the community storage facilities by rag pickers and private collectors. Private sweepers tip the refuse bins into the containers and pick out anything of value, which is placed into the empty bin. It was observed that this procedure did not cause littering around the storage containers (provided that the facilities were not overfilled).

Scavenging by rag pickers involves far more extensive digging in the storage facilities. Some pickers place the materials on several heaps at the locality, whilst others remove parts of the contents to an area beside the facilities to allow scavenging in deeper layers within the trolley containers. Although refuse is sometimes replaced in the containers in this type of situation, it has been reported (and observed at other localities) that rag pickers are one of the main causes of littering around the community facilities.

#### **SUGGESTIONS**

- Littering by rag pickers and private refuse collectors is certainly more extensive if community containers are overfilled. Therefore the provision of adequate storage capacity is a pre-requisite for reducing littering at storage sites.
- Paved locations for community bins and trolleys may further help to reduce littering because they allow more convenient access, good conditions for sweeping and better working conditions for rag pickers.
- Another suggestion that might minimise the nuisance caused by rag pickers requires the provision of two storage containers at one location. Instead of depositing refuse outside the containers, rag pickers could transfer refuse from one container to the other as they look for items they can sell.
- Finally, some punitive measures are suggested to avoid littering by rag pickers. Possibilities could include the banning from scavenging in the district of those who cause most nuisance, or alternatively, the confiscation of material that they have collected.

### **B-4 INVESTIGATIONS IN SLUM AREAS**

According to the SWMD, the total number of slum areas in K-West Ward is 93 (45 on private land, 35 on government land, 9 on municipal land and 4 on land belonging to housing boards). Records at the ward office show that 68 of these slum areas are declared slums (15 on government land, 7 on municipal land and 46 on private land).

Public sector conservancy services are only provided to declared government and municipal slums. Conservancy services for the remaining categories are either non-existent or

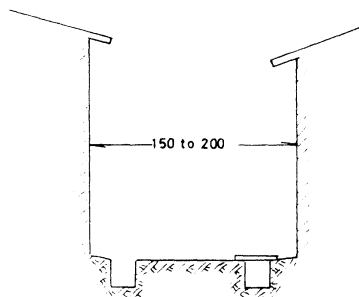
provided on a private contract basis; adjacent main roads are sometimes cleaned by the public sector. According to the WO, six of these slums are already served on a private contract basis within pilot projects. It was also mentioned that these projects had been very successful and that another eight private slum areas would be included in the year 1993.

Investigations have been carried out in three different slums, namely in the government slum Gilbert Hill (section B-4.1) and in two private slums - Bauder Ville (section B-4.2) and Behram Bagh (section B-4.3). Bauder Ville is on a hilly site whilst Behram Bagh is on flat land. The studies are based on field visits and on results of a household questionnaire survey which is discussed in section B-4.4.

#### **B-4.1 GILBERT HILL SLUM**

Gilbert Hill consists of about 8,000 buildings with around 48,000 inhabitants. The people live in single storey masonry buildings, and two-storey buildings with shops on the ground floor are common along main lanes. Access is via a few main roads with some paving, and along narrow sloping lanes with concrete surfacing. Open drains, located at one or both sides of the lanes, are used for sullage disposal and drainage, as shown in figure B-4.1.

**Figure B-4.1: Typical lane in Gilbert Hill**



Dwellings on government property are provided with municipal services by the SWMD. They include sweeping of lanes and roads, removal of refuse from the area, and cleaning of drains and public toilets.

Storage facilities for domestic refuse include 19 community bins (pipe section type) and 3 masonry enclosures. The municipal work force of 45 persons consists of 13 sweepers, 12 halalkhores, 18 drain cleaners and two mukadams. Services are provided 6 days per week (Sunday is a holiday).

Houses are usually without sanitary facilities; there are 25 public toilets with around 20 seats each.

##### **(i) Public toilets**

Observations in two public toilets indicated that cleaning was unsatisfactory and that some of the toilets were blocked. The residents complained that these latrines were not cleaned regularly by the municipal staff. Children were frequently observed defecating in front of the toilets and close to the community bins.

##### **(ii) Primary collection and storage of refuse**

As with the slum areas on public land it has been observed that refuse was being deposited into drains and that the existing storage facilities were overflowing. To estimate the storage deficiency in Gilbert Hill the storage needs are compared with the existing capacity of community bins in table B-4.1.

**Table B-4.1: Refuse storage in Gilbert Hill**

Existing storage capacity m <sup>3</sup> (1)	Estimated refuse generation		Estimated storage requirement m <sup>3</sup> (4)
	kg/day (2)	m <sup>3</sup> (3)	
23.3	16,800	42.0	about 56

**Notes**

- 1) 19 pipe sections, 0.7 m<sup>3</sup> each = 13,3 m<sup>3</sup>. 2 masonry facilities, about 5.0 m<sup>3</sup> = 10,0 m<sup>3</sup>
- 2) Assuming 48,000 people x 0.35 kg/cap.d (in low income communities) = 16,800 kg/day.
- 3) Assuming a density of about 400 kg/m<sup>3</sup> (in low income communities) = 16,800 / 400 = 42.0 m<sup>3</sup>.
- 4) Considering daily emptying (7 days per week) and the provision of 33% excess storage capacity.

It is shown in table B-4.1 that the present capacity of the community bins allows for storage of less than 50% of the amount of refuse generated in Gilbert Hill. This may be one of the main reasons for the overflowing containers and crude dumping of refuse. This idea is reinforced by the responses to Questions 6 and 7.

**(iii) Street sweeping and drain cleaning**

According to the JO, sweeping of roads and lanes was being carried out on alternate days; the small drains were being cleaned once a week according to a fixed programme. It was also mentioned that the public sector did not cover the entire area and that some private sweepers were employed by the residents in some parts of Gilbert Hill.

As shown in figure B-4.1 the many of the lanes are concreted and open drains have been provided for drainage of the area. Although the concrete surface allows for convenient sweeping, it is very difficult to prevent the sweepings entering the drains. It was observed that a considerable amount of waste was accumulating in these drains and that blockage was common. This may be caused by residents who dump their waste in the drains or by waste not being properly contained in storage sites and subsequently carried to the drains. The drains are used for sullage disposal and so refuse in them becomes wet and difficult to remove. During dry weather peak flow in the drains occurs in the morning (water is supplied from 6 am to 10 am), causing flooding in areas with blocked drains.

It was also observed that refuse disposal to a large drain inside the area leads to considerable risk of severe flooding. Due to limited access cleaning is very labour intensive. These drains are occasionally cleaned by a private contractor. One of the cleaning crews was seen dumping drain cleanings behind a community bin and it appeared that this material was never removed.

**B-4.2 BAUDER VILLE SLUM**

Bauder Ville slum is located on private land in the north-east part of K-West Ward. About 9,000 people live in Bauder Ville, in 1,500 simple single storey buildings. The community is located on a small hill and access is provided via an asphalt road, ending at the boundary of the area. However, an unpaved road in good condition continues to the centre of the community on top of the hill.

Services provided by the MCGB include one public standpost, toilet facilities and a refuse bin. These facilities are grouped at the boundary of the community, along the main access road.

**(i) Public toilets**

The public latrine was dirty and rarely attended by municipal staff.



### **(ii) Primary collection and storage of refuse**

The existing refuse bin is primarily used by the street sweepers responsible for cleaning the public roads in the vicinity of Bauder Ville. Domestic refuse from the community had been dumped at various locations on the slopes of the hill but never removed by a collection crew and so it had been washed downhill during the monsoon season. This created very unhygienic conditions in the community and also contributed to blocking of the drains further down the hill, and flooding.

### **(iii) Street sweeping and drain cleaning**

According to information obtained locally, street sweeping in the community had been carried out by a private contractor. The contract had been terminated in September 1992 (two to three months before this study) and there were no services provided at the time of the survey. The residents had been satisfied with the service and they hoped that a new contract would be agreed with effect from January 1993.

The contract included the provision of four workers for daily street sweeping at a cost of Rs 535 per worker ( to cover an area in which about 9,000 people were living).

There was an obvious need for drain cleaning services. It was observed that the drains along the main access road had not been cleaned for a long period and that refuse disposal to the drains caused flooding of public areas. Drain cleaning by the maintenance department seemed to be inadequate or non-existent in this area.

## **B-4.3 BEHRAM BAGH SLUM**

Behram Bagh is located on private property in a relatively flat area. Based on information obtained locally there are about 10,000 dwelling units with a population of around 60,000. Housing consists of single storey masonry buildings, usually without direct access for vehicles. Small lanes, partially concreted, are connected to the few asphalt roads in the area.

Although the public sector is usually not involved in the provision of conservancy services in private slums, some services were being provided in this case. These included the provision of about 15 community bins (steel pipe sections) as well as sweeping of the asphalt roads inside the slum area by municipal sweepers; 8 sweepers had been deployed for this purpose with 4 handcarts. However, some of these bins were located on public ground at the boundary of Behram Bagh and the sweepers were also responsible for sweeping public roads around the areas.

As in Bauder Ville, some community members were asked for their opinions regarding conservancy services. However, due to time constraints, only nine questionnaires were completed, which is certainly insufficient for a valid assessment. Therefore only a few results are presented in this section and comments are primarily based on the observations carried out in the locality.

### **(i) Public toilets**

As in Bauder Ville, maintenance and cleaning of public toilets is inadequate and was considered by five out of nine community members to be the most significant problem. This had been recognised by the local authorities and a new 'Sulabh System' toilet was under construction at the boundary of Behram Bagh.

### **(ii) Primary collection and storage of refuse**

Applying the estimated refuse generation rate and density according to table B-4.1 above, the total waste generation in Behram Bagh was estimated to be about 21 tons per day, which is equivalent to about 53 m<sup>3</sup> per day. Hence, the present storage capacity of community bins of only about 10 m<sup>3</sup> is totally inadequate.

This was confirmed during the studies in the locality. Most of the people were using open spaces and marshy land in the vicinity of the housing areas for refuse disposal (including a large area which is used for silt and debris disposal by the SWMD).

When interviewed, some householders explained that they employed private sweepers for cleaning the lanes and collection of domestic waste. However, because of the lack of storage facilities, only a small proportion of refuse was being deposited into the community bins provided. It appeared that the bins were not emptied regularly and that waste remained for up to one week in the facilities.

According to the JO, the refuse which accumulated in areas which were accessible for vehicles was being removed three or four times yearly.

**COMMENT:** The provision of sufficient storage facilities and regular removal of refuse is considered the main shortcoming in Behram Bagh. Refuse collection could either remain within the responsibility of the public sector or be handed over to a private contractor, as was done in Bauder Ville.

### **SUGGESTIONS**

- Further investigations are required to identify suitable locations for community facilities. Limited access to the area will probably lead to relatively long distances between the containers. Therefore larger capacity storage facilities like skips would be more appropriate than trolleys or pipe bins (see section B- 2.5-(ii)). However, since the public sector is usually not required to provide services to residential areas located on private property it may be more suitable to hand over the duties of providing storage facilities and refuse transport to the private sector. Pipe sections, probably arranged on paved areas in groups of two or three, would produce a considerable improvement in the present situation .
- In addition, publicity and awareness campaigns - including cleanup campaigns - are considered crucial in helping the residents to change their present dumping practices and use the facilities properly. (Only one out of the nine residents interviewed had ever been advised on cleanliness and public health issues). This would require support by the public sector including the WO and the SWMD (see section A-3.5).

### **(iii) Street sweeping and drain cleaning**

The main cause of littering in Behram Bagh is the accumulation of refuse in virtually all larger open spaces in the community. Because the waste is not confined to containers, it is totally accessible to scavenging animals, children and wind, and therefore is soon scattered around the dumping areas. This could be reduced considerably by implementing the improvements suggested in the previous section. This would also reduce the need of sweeping and cleaning of roads and open spaces.

It has been observed that the people of Behram Bagh clean the lanes and small yards in front of their houses regularly.

### **SUGGESTIONS**

- The present sweeping system along main roads is considered adequate and residents should be encouraged to continue sweeping the other areas.

- Although few problems have been observed regarding surface water drainage in the area, it is suggested that street sweepers should become responsible for drain cleaning along the main roads, whereas cleaning of drains in small lanes should remain the responsibility of residents.
- Drain cleaning, street sweeping and the provision and emptying of refuse storage facilities should be carried out by a single authority, either public or private.

#### B-4.4 RESULTS OF QUESTIONNAIRE SURVEYS AND RELATED SUGGESTIONS

In order to have first-hand information regarding the most neglected services in slum and other areas, and about the opinions, needs and aspirations of the residents, and to learn more about the current systems of sweeping and storage, a questionnaire comprising twenty questions was prepared for government and private slums. (Questionnaires were also prepared for other areas - single-storey houses, and multi-storey flats; the replies from these areas are discussed briefly in section B-5, and in Part D where they refer to resource recovery.) A survey of 43 houses in Gilbert Hill government slum, 40 houses in Bauder Ville private slum and 9 houses in Behram Bagh private slum was carried out with the help of enumerators from the All India Institute of Local Self Government. (Time did not permit a sufficiently large sample to be questioned in Behram Bagh so any results from that area have been mentioned in section B-4 3 and are not included here.)

The following problems were encountered in conducting the survey:

- At the time of survey - during working hours - the male members of the households some information could not be obtained.
- There were no lady enumerators; it would have been better if female enumerators had been available to talk with female residents.
- People complained that such surveys were often made but no action was ever taken to solve their problems.
- The enumerators had received no training in solid waste management and so were not much aware of the background of the subject. They were also not very familiar with the areas being surveyed.

These problems should be considered when planning future surveys.

Some of the questions that were asked and a summary of the replies are reproduced below, together with comments on the responses, and observations and suggestions that relate directly to the issues under consideration

**Q-1: Please rank neglected services in your locality in order of importance.**

<b>GILBERT HILL</b>	Water supply	Toilets	Flooding	Refuse	Roads	Electricity
First priority	2	22 [52%]	3	9	7	0
Second priority	6	8	16 [38%]	8	4	2
Third priority	1	10	10	19 [44%]	3	0

<b>BAUDER VILLE</b>	Water supply	Toilets	Flooding	Refuse	Roads	Electricity
First priority	5	27 [68%]	3	3	2	0
Second priority	10 [25%]	4	10 [25%]	8	6	2
Third priority	7	7	11 [26%]	8	4	3

The answers showed that residents consider toilets to be the most neglected service in their community.

In **Gilbert Hill** the next priorities were flooding and refuse collection. Although water was being supplied only between 6 am and 10 am, this was considered to be an acceptable service by most of the people and the improvement of roads was ranked higher than water supply. Finally, electricity was regarded as reliable and was not considered to be a problem. Flooding by blocked drains is commonly caused by uncollected refuse. Therefore improvements of the refuse collection system would help to avoid flooding to some extent.

In **Bauder Ville** the second priority was divided between water supply and flooding. Although refuse did not rank very high it should be considered that flooding by blocked drains is commonly caused by uncollected refuse. Hence, when considering flooding and refuse collection as a combined issue the ranking would become similar to water supply.

**COMMENT:** This document does not intend to analyse all the different services in more detail. The cleaning of public toilets, drain cleaning and refuse collection will be discussed in more detail below.

**Q-2: Please think about the public toilet in your area and choose the most serious problem:**

	Poorly maintained	Place very dirty	Place far away	Lack of water
<b>Gilbert Hill</b>	9 [21%]	29 [67%]	5 [12%]	0
<b>Bauder Ville</b>	13 [33%]	22 [55%]	3 [7%]	2 [5%]

The answers indicate that a clear majority of the people considered poor cleaning and maintenance of toilets to be the main reason for the unsatisfactory situation.

Question 3 was based on the observation that children in slum areas often defecate in front of public toilets.

**Q-3: Why do you think many children do not use these toilets?**

	Parents do not like these places	Difficult for children to use	Others
<b>Gilbert Hill</b>	8 [19%]	26 [60%]	9 (no opinion)
<b>Bauder Ville</b>	13 [32%]	25 [63%]	2 [5%]

The answers indicate that toilets are difficult to use for children. Another reason may be that parents do not show their children how to use the toilets properly (probably because they do not want them to go there). Children may feel very uncomfortable because the toilets are very dark. Others have mentioned that children do use the toilets.

Faeces around the toilets are removed by the halalkhores using wooden boards and a wheel barrow type cart. In the case observed, the worker did not use gloves and the cart was emptied on the ground behind a community bin. It seemed to be standard practice to dump drain cleanings and faeces at this locality. The material was not removed by municipal trucks and so was accumulating. There were many children playing and scavenging at this locality so this practice was certainly contributing to the spread of disease.

## **SUGGESTIONS**

- Although the public sector provides cleaning and maintenance services for the toilets, they seemed to be not properly arranged. Possible improvement measures might include a scheduled cleaning service by halalkhores of the SWMD including strict supervision.

- However, observations in all slum areas visited during the studies suggested that this option is not very promising. It has been suggested that *private* agencies should be entrusted with construction, maintenance and cleaning of public toilets. Regarding existing public toilets, similar arrangements may be feasible. This could include selling off the structures to a private agency which would become responsible for maintenance, operation and revenue collection.
- Consideration should be given to fostering the involvement of the community in toilet cleaning and maintenance. It may be possible to encourage community leaders to take the responsibility and to arrange for cleaning and maintenance within the community. Charging a small fee from users of toilets may be appropriate rather than providing a cost-free service.
- However, further investigations are considered necessary regarding cleaning and maintenance of public toilets. Private agencies could be entrusted with construction, maintenance and cleaning of public toilets. In Delhi, for instance, this has been introduced successfully. The contract with the agency (Sulabh International) includes construction, maintenance and cleaning of toilets as well as the collection of user charges by a user card system. All male community members are issued with a card at Rs 10 per month for using the toilets whereas women and children use the toilets free of charge. It has been observed that one of these toilets is under construction at the boundary of Behram Bagh slum.
- The present practice of dumping human faeces beside community bins is by no means acceptable. Training and supervision of halalkhores is suggested to ensure that all material collected is deposited within the community containers and removed daily. To avoid double handling it is proposed to replace wheelbarrows by handcarts with large diameter wheels and plastic bins.

**Q-6: Please think about the place where most people in your locality bring their refuse and choose the most serious problem:**

	Refuse is not removed	Place is very dirty	Place is far away
<b>Gilbert Hill</b>	16 [37%]	19 [44%]	7 [16%]
<b>Bauder Ville</b>	17 [43%]	17 [43%]	6 [15%]

**Q-7: Is refuse from your house brought to this place?**

	Yes	No
<b>Gilbert Hill</b>	40 [93%]	3 [7%]
<b>Bauder Ville</b>	36 [90%]	4 [10%]

Replies to Question 7 indicate that the majority of people were using the existing storage facilities (in Gilbert Hill) or open areas where refuse was dumped (in Gilbert Hill and Bauder Ville) for refuse disposal. It should also be mentioned that a considerable amount of refuse was finding its way into the small and larger drains in the locality.

Replies to question 8 indicate a healthy attitude towards the use of community bins or designated dumping/transfer areas.

**Q-8: Provided that this place is cleaned regularly would you be willing to bring your refuse to this place?**

	Yes	No
<b>Gilbert Hill</b>	40 [93%]	3 [7%]
<b>Bauder Ville</b>	40 [100%]	0 [0%]

Questions 9 to 11 were asked to determine the residents' opinions regarding different refuse collection services.

**Q-9: What would you think about the idea of sharing a community bin with several families if this bin is emptied daily?**

	Good	Fair	Bad
<b>Gilbert Hill</b>	36 [84%]	2 [5%]	5 [12%]
<b>Bauder Ville</b>	38 [95%]	1 [3%]	0 [0%]

**Q-10: What do you think about the idea of having a scavenger collect refuse from your house every day?**

	Good	Fair	Bad
<b>Gilbert Hill</b>	40 [93%]	3 [7%]	0 [0%]
<b>Bauder Ville</b>	30 [75%]	5 [13%]	4 [10%]

**How should this scavenger collect the refuse?**

	Knock on door	Blow a whistle	Take refuse from roadside
<b>Gilbert Hill</b>	27 [63%]	6 [14%]	10 [23%]

**Q-11. Would you be willing to pay a fee for this service?**

	Yes	No
<b>Gilbert Hill</b>	39 [91%]	4 [9%]
<b>Bauder Ville</b>	28 [70%]	12 [30%]

The answers show that the majority (around 90%) would be satisfied to share community storage facilities. Most would also be happy with a house-to-house collection services, but the reasons why ten percent of the Bauder Ville sample were opposed to such a service should be investigated. It is significant that a clear majority would be willing to pay for this service. The reasons for this willingness to pay may include that the road conditions in the Gilbert Hill area are such that there are relatively long distances between community containers. For instance the distance between bins along the main access road was about 120 metres on average (90, 40, 120, 80 and 250 metres). At present the people in some areas of Gilbert Hill have to walk up to 300 metres to the nearest community bin.

Regular removal of refuse from the community was felt to be a basic requirement to improve the hygienic conditions in Bauder Ville. Plans to improve the situation should include a suitable means for refuse storage at the present areas used for crude dumping of refuse.

## **SUGGESTIONS**

- The lack of sufficient storage facilities and regular removal of refuse is considered the main shortcoming in refuse collection in Gilbert Hill. Further investigations are required to identify additional locations for community facilities. The strategy should aim at spacing the facilities as close as possible. However, due to limited access to the area long distances between the containers cannot be avoided in some cases.

- Considering that there seems to be a healthy attitude regarding the use of community bins it is suggested that the public sector should not offer a two-stage collection system. Those who want a more convenient system should employ private contractors to collect the refuse from their households and transport it to community bins.
- The masonry enclosures at Gilbert Hill are in very poor condition and should be replaced by community bins or containers. Because the number of possible locations for community storage facilities is severely limited, larger capacity facilities like skips would be more appropriate than trolleys or pipe bins (see section B- 2.5 (ii)).

The answers indicate that there seems to be no urgent need to consider house to house collection because few complained about the distance to the storage points and almost all were willing to use the community facilities. Therefore the provision of community storage facilities appears to be the most promising approach to improving the present situation.

**SUGGESTION: (Bauder Ville)** Due to the fact that the public sector is not entitled to provide services in settlements on private property refuse collection by private contractors is considered the only feasible solution. Contracts should include the provision of storage facilities in the community, the regular emptying of these facilities, and the transport of the collected waste to the disposal site. Based on the results of the household questionnaire it is considered possible to introduce a small charge for refuse collection services. Refuse collection, street sweeping and drain cleaning should be combined in a single contract.

**Q-12. Have you ever been advised by a person how keeping your neighbourhood clean can improve people's health**

	Yes	No
<b>Gilbert Hill</b>	3 [7%]	40 [93%]
<b>Bauder Ville</b>	23 [58%]	17 [42%]

**SUGGESTION:** It is suggested that public agencies should become involved in carrying out publicity and awareness campaigns in the community. The answers to question 12 indicate that there had been a total lack of publicity campaigns and public health education in Gilbert Hill but that some efforts have been made in Bauder Ville. Possible activities have been suggested in section A-3.5.

Flooding and stagnant water in the drains contribute greatly to mosquito breeding. The influence of disease vectors is addressed in question 13:

**Q-13: Please select the most significant nuisance in your locality from the following: flies, mosquitoes or rats.**

	Flies	Mosquitoes	Rats
<b>Gilbert Hill</b>	1 [2%]	33 [77%]	9 [21%]
<b>Bauder Ville</b>	4 [10%]	30 [75%]	5 [13%]

The answers show clearly that mosquitoes were considered the most significant nuisance.

### **SUGGESTIONS**

- Considering the fact that sweeping of lanes and drain cleaning are closely interrelated it is suggested that both duties should be combined and that (in government slums such as Gilbert Hill) municipal workers should be assigned (as pairs or individuals) to particular areas for sweeping and cleaning of drains. Adequate handcarts should be provided to these personnel including plastic bins and gloves. Training and strict supervision is

suggested to ensure that all waste collected is deposited in community containers and removed regularly.

- In private slums, where municipal agencies have no responsibilities, drain cleaning, street sweeping and the provision and emptying of refuse storage facilities should be combined in a single contract. An important reason for this arrangement is that these services are interrelated. (For example, without adequate removal of refuse, littering is likely to increase, so that the burden on street sweepers will increase and they may tend to use drains for disposal of street sweepings. This is likely to cause flooding of public areas, hence cleaning becomes virtually impossible.) The provision of adequate storage facilities and regular emptying of these facilities is considered the most important and should be given priority. Provided that awareness and education campaigns are conducted, it is considered possible to reduce street sweeping and drain cleaning very substantially.

Covering the drains would prevent blockage of drains by refuse and litter. However, this would only be beneficial if *all* drains in an area are covered. Partial covering is likely to increase the problem of blocked and overflowing drains (litter and refuse may still enter the drains but cleaning becomes far more difficult). Due to the cost involved in covering drains this may be considered a medium term objective in case the measures described above prove insufficient.

## **B-5 OBSERVATIONS IN OTHER HOUSING AREAS**

### **B-5.1 GENERAL COMMENTS**

Attempts were made to collect information by means of questionnaires in housing areas that were not slums. The aims were to ascertain opinions and priorities regarding solid waste management and waste recycling.

The results of the survey for middle and high income multi-storey flats indicated that most residents felt that the most neglected service in their area was water supply, followed by stormwater drainage and then refuse. There was often an arrangement whereby private sweepers would collect garbage from houses and dump it in the nearest municipal container. This system does not require any modification

It was further felt that a more elaborate and representative survey is needed to know the requirements, difficulties and aspirations of a broader section of society in these areas. More enumerators would be required to be involved in this exercise and they should be briefed properly before undertaking the survey. The main survey should follow the appraisal of a brief trial survey.

Some results from the survey amongst residents in single-storey flats, apparently in the middle income range, are presented below.

### **B-5.2 MIDDLE INCOME GROUP: SINGLE-STOREY FLATS (DN Nagar, Andheri)**

The analysis of responses regarding the most neglected or inadequate services is given below:



	Water supply	Toilets	Stormwater drainage	Refuse	Roads	Electricity
First priority	7 [58%]	1	1	2	1	0
Second priority	2	4 [28%]	3	4 [28%]	2	0
Third priority	1	1	5 [35%]	4	1	2

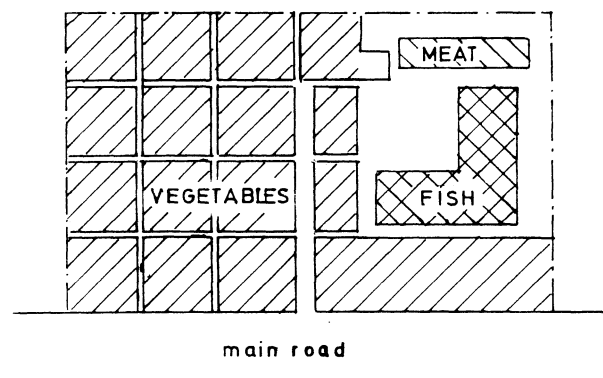
This sample indicates that inadequate water supply is seen as the most serious problem in this locality, followed by toilets, refuse and stormwater drainage. Most of the people expressed the opinion that the toilets were very dusty. It was also learned that the refuse was taken to the community collection point either by the father or a house servant.

Most of the people said that flooding of drains was a serious problem. It appears that drain cleaners were not functioning properly in this area.

## **B-6 MANAGEMENT OF MARKET WASTES**

The collection of market waste from the Andheri Municipal Market was studied. This market is the largest of the five markets in K-West Ward - two of the markets are municipal and three are private. There are 401 small stalls in Andheri market including a large vegetable and fruits section (105 stalls), hardware and hosiery shops. The meat and fish section of Andheri Market is located in large sheds. Access by vehicles is only possible along one larger lane in the centre of the area. The remaining lanes are narrow and designed for pedestrians only. Figure B-6.1 shows a very approximate layout of the market.

**Figure B-6.1: Approximate layout of Andheri Market**



Andheri Market including all facilities and structures is owned by MCGB.

### **B-6.1 ORGANISATION AND MANPOWER**

The Market Superintendent, in the Market Section of the Ward Office, is responsible for management and supervision of the markets.

One market supervisor and four market inspectors are permanently assigned to Andheri Market. Their tasks include supervision of ten sweepers who are responsible for refuse collection, sweeping of lanes, and cleaning the fish and meat market. In addition two lavatory cleaners are assigned to the market. Primary collection and storage of market waste is under the responsibility of the market section.

Sweeping and market waste collection were carried out in two shifts. Seven sweepers worked in the morning shift (7 am to 2 pm) and the remaining three sweepers worked in the

afternoon shift (3 pm to 11 pm). According to the Market Inspector the area is cleaned twice daily, 7 days per week. The waste collected in the market is stored in one refuse shed (see ii below). Transport of market waste is carried out by a contractor's vehicle for the SWMD (starting daily at about 6.30 am).

The charges for market waste collection and sweeping varied according to the size of the stalls, ranging between Rs 30 and Rs 100 per stall monthly. Another Rs 30 to Rs 100 was charged as rent for the stalls.

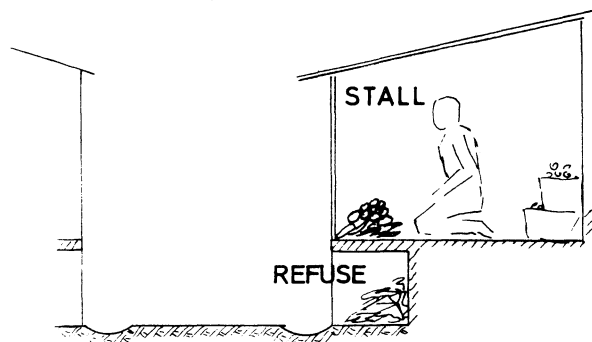
**COMMENT:** The present system seems to be functioning well and no problems regarding co-operation between the Market Section and the SWMD were reported.

## B-6.2 PRIMARY COLLECTION OF WASTE FROM STALLS

Market waste from stalls was collected twice daily by the sweepers. The crews were equipped with brooms for sweeping the lanes and wooden boards for loading the waste into handcarts. Equipment was stored at the market chowki and issued to the sweepers daily.

According to the market supervisor between 3 and 4 tons of waste were generated in Andheri Market per day (including the fish and the meat section).

**Figure B-6.2: Typical lane in Andheri Market**



As shown in the figure vegetable waste was usually stored below the stalls and must be loaded manually into the handcarts. Hence, removal of vegetable waste and cleaning of these locations is difficult and labour intensive. Transport of market waste was carried out using two type A handcarts (see figure B-2.4). Each cart was equipped with two cane baskets with a capacity of up to 70 litres each. Considering that the refuse density may be about 0.5 kg/litre the handcart load would be only 70 kg. However, it was observed that the cart was very difficult to push in lanes with uneven surfaces and that the sweeper pushing the cart needed help from a second person pulling a rope which was fixed to the cart.

### SUGGESTIONS

- To improve storage and loading of market waste from the stalls it is suggested that adequate storage facilities should be introduced. Interviews with some of the stall owners showed that the majority would be willing to co-operate with the market department regarding more adequate means for storage of refuse. Cane baskets or plastic bins are considered appropriate and should be provided by the individual stallholders. It was observed that larger shops along the main road already kept bins or baskets for storage of refuse.
- Regarding handcarts, it is suggested that their capacity should be increased according to the concept described in section B-2.4 above. The provision of plastic bins would be far more suitable for storage of vegetable, fish and meat waste. In addition, the carts should

be equipped with larger diameter wheels to allow for handling by a single person on uneven surfaces.

The measures described would probably allow a reduction in the labour force for market waste collection in Andheri Market.

### **B-6.3 COLLECTION OF WASTE IN THE FISH AND MEAT SECTION**

Waste from the fish and meat section is highly objectionable and therefore requires careful consideration. The stalls usually dumped their fish waste on the ground and the small heaps were either brought to the shed-type storage facility of Andheri Market or hosed down the drains twice daily. At the time of the study there are no bins or bags used in the fish market.

The drainage system in the fish market consisted of a network of open drains which were connected to manholes and sewers. Apart from the nuisance caused by foul smells, the practice of discharging waste to the drains is likely to cause other problems, especially the blockage of sewers, and flooding during the monsoon season.

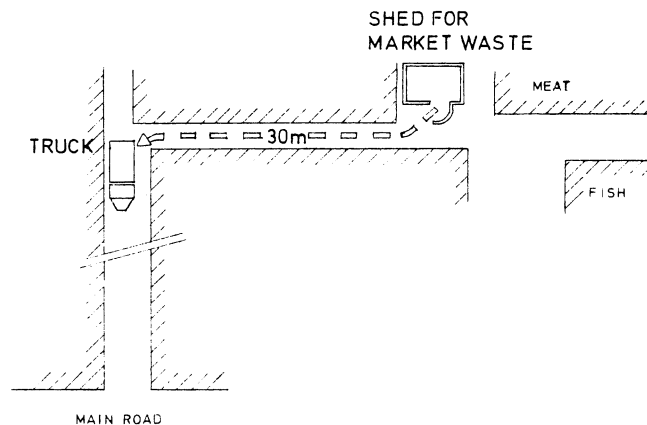
#### **SUGGESTIONS**

- Being aware of the problem, the Market Section was planning to introduce plastic bags for storage of waste in the fish market. It was planned to charge about Rs 2 per stall daily for the provision of bags. Considering that this would add up to another Rs 60 per stall each month, this option may be not economically feasible.
- Another option may be the provision of several plastic bins (with lids) which could be used by groups of stalls (say about ten). Provided that these groups could be made responsible for cleaning and keeping the bins overnight this option may be more reliable and far cheaper than the provision of plastic bags. The bins could be kept outside the shed to allow for easy emptying by the sweepers.
- In addition it would be desirable to cover open drains in this area and to provide screens at the inlets to manholes. If screens are provided it is essential that they be cleaned regularly, otherwise the small and flooding nuisance would be even worse.

## B-6.4 SECONDARY STORAGE AND COLLECTION OF MARKET WASTE

As already mentioned above one refuse shed is used for storage of market waste from Andheri Market. A ground plan of this masonry structure is shown in Figure B-6.3.

**Figure B-6.3: Refuse shed for storage of market waste**



Market waste is tipped to the floor of the building and has to be loaded manually into the refuse collection vehicle. It is shown in the figure that there is no direct access for the vehicle and therefore the loaders have to carry waste some distance from the shed to the collection vehicle.

**COMMENT:** The existing storage practice is considered very unhygienic. Waste accumulates on the floor of the building, inviting flies and creating bad smells in close proximity to the stalls. In addition the location is considered very unsuitable because it does not allow for direct access for the collection vehicle.

### SUGGESTIONS

- It is therefore suggested that the shed should be removed and containerised facilities should be provided instead. For instance, a refuse skip, provided with lids and placed at a location close to the main road, is considered suitable. However, because the skip system had not yet been introduced to K-West Ward, trolley type containers could be used for an interim period. Twice daily emptying would allow the numbers of containers to be kept to the minimum and reduce the development of bad smells. Storage facilities in markets are primarily used by staff of the market section; provided that these personnel were trained and supervised so that they always replaced the lids of containers, this would improve the hygiene status of the markets considerably.
- The provision of containerised storage facilities to markets is considered a priority measure and further investigations are suggested to assess the situation.