

f. DF Scope

Within the DF scope, the following basic concepts should be emphasized.

f.1 Statute from the Government of the Federal District

- The GDF statute has been recently issued. Due to this situation it voids some of previous precepts.
- It assigns to the central organs (such as the DGSU) planning, organizational, normative, control, evaluation and operational functions related to:
 - ◆ provision or concession of public services which provide general coverage to the city; as well as those which have inter-delegation impacts with high technical specialty.
 - ◆ determination of Delegations participation systems with respect to the provision of public services with general characteristics such as waste collection in primary roads.
- It assigns to central organs (DGSU) the provision of public services which cover the whole city or which can have a multi-delegation impacts.
- It allows attributions mentioned previously, such as those with technical-operative characteristics, to be assigned to decentralized organs which are not the Delegations.
- It assigns to the Delegations their functions established in DF Organic Law, as well as those attributed to them through an agreement with the Governor - under any hypothesis, attention should be paid to the following basic principles:
 - ◆ to provide services taking into account the particular characteristics of each Delegation.
 - ◆ to provide opinion on service concession which has effects on the Delegations.
 - ◆ to issue and to revoke licenses, permits, and authorizations.
 - ◆ to provide services executed by or affecting more than one delegation.

f.2 Internal Regulation

The internal regulation assigns the following attributions to the DGSU.

- To establish, in coordination with concerned authorities, technical criteria and standard for the activities related to waste minimization and management.
- To undertake studies, projects, construction, conservation and maintenance of infrastructure works for SWM (e.g., transfer stations, S/P, final disposal sites, and final disposal sites restoration).
- To organize and execute transfer stations, treatment and final disposal.
- To establish solid waste recycling and treatment systems.

f.3 Organic Law of Public Administration of the Federal District

- The urban cleansing service is a public service and is for a public benefit. Therefore the law gives the authorities enough power to decree expropriation, limit domination, and use and temporarily occupy goods which are required to provide the service;
- The service concessionaire should provide it uniformly and continuously to every person who requests it. As a result, the concessionaire should cover the costs. On the other hand, the corresponding authority should fix and modify the corresponding fee and supervise whether the service is provided satisfactorily.

f.4 DF Environmental Law

This law has decisive importance related to the broad administration of waste, given that it establishes the scope of work of the SMA and the DGSU as well as obligations and responsibilities of solid waste generators/ holders. The following items should be highlighted.

- **Competency of the SMA in the DF**
 - ◆ To evaluate the environmental impact and risk and, depending on the case, to issue an authorization for works or activities (public or private) which might affect the environment. Also to supervise to ensure that related directives are satisfied (for the cases that are not assigned to the Federation, i.e., the case of non-hazardous waste disposal).
 - ◆ To regulate, prevent and control all hazardous environmental activities not assigned to the Federation.
- **Competency of the SMA, in Coordination with the DGSU, in the DF**
 - ◆ To prevent and control soil contamination, including that originated from the generation and management of non-hazardous solid waste.
 - ◆ To establish or authorize the establishment of sites which are destined for non-hazardous solid waste, as well as to propose an investigation on mandates in order to regulate their management (observing the official standards).
- **Citizens' Obligation**
 - ◆ To prevent or, in case that is not possible, to minimize waste generation by way of recycling or reusing generated waste.
 - ◆ To haul treated (or processed) waste to the final disposal site with the purpose of eliminating or reducing their hazardous level or volume (or quantity), whenever waste can not be recycled or reused.
- **Responsible for Any Damage or Negative Effect Caused by Waste**

It is assumed that, unless proven to be contrary, those responsible for any damage or negative effect caused by waste are:

- ◆ Waste owners, i.e. those who manage waste while waste is under their custody or responsibility.
- ◆ The Public Administration of the Federal District, for the non-hazardous waste collected by the cleansing service.

Important items can be summarized as follows, from what were stated above.

- i. Facilities and activities related to non-hazardous SW management are under the jurisdiction of the SMA in coordination with the DGSU.
- ii. Natural and artificial persons have the responsibility of waste from the generation to the disposal activities.
- iii. Final disposal methods for wastes (non-recyclable or non-reusable) should, implicitly, involve a process to minimize hazardous level and volume (amount). In other words, a *correct sanitary landfill* should receive SW that has been treated previously (to minimize hazardous level) and processed (to minimize volume).
- iv. Waste generators and holders, although transitory, are responsible for damages and negative effects caused by waste.
- v. The GDF is responsible for damages and negative effects caused by non-hazardous waste collected - either directly by the GDF or by sub-contractors or concessionaires and, consequently the future effects produced by the waste.

This summary of main points obviously asserts that responsibilities should be defined (with corresponding costs) for all those who participate in waste management; either under contract, under concession or under a simple permit issued by the GDF - represented by the DGSU and the Delegations.

f.5 Regulation for Urban Cleansing System Services in the DF

This regulation was approved by DF representative assembly, and it defines the following:

- Urban cleansing services consist of:

Task-I: street sweeping.

Task-II: SW collection.

Task-III: design, equipment and operation of storage, haulage, reuse, treatment and final disposal.

- Task-I corresponds to the Delegations, except primary roads which should be serviced by the DGSU.
 - Task-II corresponds to Delegations, except waste accumulated in public roads.
 - Task-III corresponds to the DGSU.
- Collection service will be offered "free", if generation amount does not exceed 200 kg/day/user (working days).

According to this last point, only major generators should pay directly (such as, commerce, industries and services). On the other hand, payment of other generators

should be disguised as other tax forms. It is important to note that this point will justify the informal payment from residents which is called "propina" or "finca".

f.6 The Financial Code and the (Annual) Law of Revenues and Expenditure Budget of the DF

This legislation and the entities which are part of the billing and collection system in the DF (Delegations and Finance Secretariat) will have the most important role when the GDF makes a decision on a more formal payment manner (direct payment by the citizens) for cleansing services - either to a concessionaire or to the GDF. Cadaster register and Tax payer listing will be used as a data base required to produce an adequate fee system.

Issues that should be pointed out from the current legislation are as follows.

- **Circulation Bill** charges DF contributors for public roads, monuments, parks, public markets maintenance, etc. Although this is the closest fee related to cleansing services, it does not refer directly to them.
- With a **land use** concept, charge of an amount related to SW generated could be added, depending on the contributor's activity.
- **DF's Financial Code** establishes quota related to waste collected or delivered to the GDF facilities, but it is a fixed amount which does not take into account inflation or other factors.

C.6.2.3 Other Influential Legal Norms and Practices

a. Labor Legislation

Labor legislation that rules over the GDF employees is divided into three groups. The first one works with full loyalty, is provided with highest payment and various benefits (such as bonus, gifts, medical insurance and life insurance), and is placed on trust administrative position. The second one is granted with all benefits (bonus, gifts, medical services, vocational allowance, food, coupon, SAR, etc.), and total work stability, but with low paying jobs. Finally, the last one is composed for "eventual workers" who do not have the guarantee of work stability, no benefit with low paying jobs (less than 6 months contact).

Undoubtedly, labor instability hinders the appropriate planning in the long run for both parties, and this situation also leads to the rotation of temporary workers, affecting their professional progress and increasing the GDF's administrative costs.

The second group with total stability and "trust" compromises with the Administration is strengthened by joining an Union; they acquire political power and complement their salaries with informal income coming from the population as "propinas" and "fincas". Their power is increased by bringing additional personnel close to each one, such as family members and friends. These persons help with the task assigned to the employee as "volunteers" who do not have any labor link. These "volunteers" as "eventual workers", turn out to be the employees' subordinate, and this situation is maintained as they share the informal incomes.

This labor regime reduces the influence that "trust" administrators can exert over stable employees or volunteers; this is true also for eventual workers (even though it seems different). On the other hand, this situation increases the influence of the unionized group. As a result, the informal structure is strengthened.

It can be assumed that a vindicative action for the workers' right will serve well to the Justice. It would be favorable for *eventual* workers who are contracted for the less than six months and for *volunteers* who have no formal ties, but work openly for GDF for long and continuous terms.

b. Contract of Services

The private sector widely participates in the activities carried out by the DGSU, given the fact that in 1996, 70% of operative budget was executed by private enterprises, and in 1997 the percentage increased to more than 80%.

The Political Constitution (art. 134) establishes that "acquisitions, renting, or alienation of any type of goods, provision of services of any nature and contract of works to be done, should be awarded or done through public bidding".

The Law of Acquisition and Public Works, published in the Official Gazette of the Federation on December 30, 1993, rules this matter.

It has been determined that 80% of amount derived from contracts should be consequence of "public bidding". On the other hand, the other 20% should be obtained as a consequence of "restricted invitations" for three or more providers or by "exemption of bidding". Obviously, the last two methods are a smoother path than the first one, and they are applied in urgent or very special situations.

There is no legal restriction regarding *duration* of contracts for services, but in order to surpass the current exercise, a prior authorization from the Finance Secretariat is necessary.

Probably for the reason mentioned previously, almost all the DGSU contracts are done for a short term, between three to six months, or sometimes even less. This is a comfortable advantage, but it causes a number of disadvantages, such as the ones to be mentioned below (among many others):

- The bidder will not invest on new or specialized equipment when he/she signs a contract, which does not ensure repayment for the lifespan of that equipment;
- The GDF has to invest to acquire equipment; and then contract out their operation. Short term contracts do not make it feasible for the contractor to acquire this equipment.
- Maintenance can not be provided with due attention as a consequence of the GDF's short term operation equipment contract which lasts between two to four months usually.
- Contractor can not hire high-level specialized personnel when the contract is short term.

- All expense which includes costs of short term contract will be very high; unless the bidder assumes that contract will be renewed.
- Costs of bids are high, for both the GDF and bidders, and these costs are included in proposed prices and administrative costs.

It is recommended to award contracts with long term which correspond to the lifespan of equipment involved and to the requirements for expert personnel well trained for the assignments.

In order to save useless administrative costs, it is also recommended to have turn-key contracts; in other words, the contractor should judge possibility of sub-contracts and the DGSU should refrain from taking part in small and diversified contracts which might result in administrative loads and high costs.

C.6.2.4 Informal Entities in SWM

From the description detailed in items C.5.1 and C.5.2, the following is commented:

- Sweepers, sweepers' "voluntary" helpers and formal collectors' "voluntary" helpers informally intervene in the sweeping and collection process, spurred by the distribution of tips and *fincas* and, in the second place, by the distribution of the revenues from the selling of recyclable products.
- On the streets, other people conduct "pre-scavenging" activities, picking recyclable products from the wastes before the collectors arrive;
- At each S/P, productive operations including separation, internal haulage and pre-processing, and the storage and trading of materials, are activities conducted by the waste pickers' Association, that have a permission from the GDF.
- At the Santa Catarina landfill, discharged wastes are left open-air for waste picking by the waste-pickers of the local association, under an informal agreement reached with the GDF (on the next day, these wastes are disposed of at the landfill).
- Several hundreds of informal "collection centers" (centros de acopio) informally receive and trade the recyclable products provided by the collectors and pre-scavengers;
- Trading of recyclable products is mostly informal among the aforementioned persons and the retail purchasers; which could be reviewed during the market research for recyclable products.

Regularization of this framework would be obviously traumatic or unfeasible. However, this can be done partially and step by step.

For a regular commercialization, appropriate fiscal and tax measures are required under the economic and social interest of material recycling. A political decision in this regard will imply the reviewing of the corresponding financial legislation.

To regulate the remaining activities, it is primarily required the institutionalization of the persons involved into juridically empowered entities which will execute the activities.

C.6.2.5 Assessment of the Resulting System in Mexico City

The legislative and institutional structure targeted for SWM is well elaborated and appropriate. Some points regulated in the past by the Cleaning Code (Reglamento del Servicio de Limpia) must be reviewed in regards to the existing legal basis.

Some administrative policies and practices, such as staffing and service hiring, must be deeply reconsidered.

Contracts must be more economic and less complicated for the GDF and the contractors, in accordance with the critique and suggestions from section C.6.2.3. Contracts will become more forcible when the GDF develops a policy of contracting out collection services and other services, which imply greater investments in equipment and labor. In this moment, not only will the contract period and contents be the appropriate; also, an insurance for the performance of the service to be submitted on the contract day will be convenient for both parties.

Yet the modalities allowed by the law are not changed, labor relations should also be reviewed, in the search of justice for both parties, with rights and obligations perfectly outlined and controlled. However, a radical change will only be feasible in the long run, for a total overcome of the informal structure that the SWM is currently bearing.

The weak points of labor legislation helped enhancing or creating the dominant informal structure in the SWM system, which seems to have origin in a traditional political system that helps politically well commanded groups; and economic support of "no charge" status established in the Cleaning Code (Reglamento de Limpieza); and on the other hand, the fair acknowledgment by the citizen that the service is being rendered to them.

There is no doubt that the citizen pays to the servant for the effective service rendered and at a negotiated or agreed price. This fact is very important, and must be the basis for any transformation or upgrading of SWM. It can be said that the informal system fostered the "culture of payment" with a high degree of social justice. The culture of payment will allow gradual formalization of the system towards a legal **concession** of the residential collection service; however, the formalization of the payment system will demand a well elaborated fee plan, based on cadasters and on a careful social-economic survey, along with a research of the current payments (tips and *fincas*). Meanwhile, it is necessary to accept that the formalization of the payment as a tax would be disastrous in economic terms, and would destroy most of the achievements of the informal system.

Back to the institutional and legal structure affecting the SWM system, the urgent need to regulate the DF's Environmental and Organic Law should be emphasized again. The regulation must be compatible with the SWM system M/P and amended *before* the new political-administrative institutionalization of the DF (i.e.

the direct election of delegation executives), establishing fair and consistent concepts that will not derogate nor void the work done. After this regulation and based on the Organic Law, the Treasury Law and the Financial Code (*Ley de Hacienda y Código Financiero*) should be reviewed, and therefore the Income and Expenditure Budget Law of the DF.

It is worth mentioning that the aforesaid hypothesis of specialized and strictly formal Inter-delegational Sub-system will require SWM rules for contracted entities and concessionaires, as well as the citizens such as the duties, rights and sanctions. These rules would be specialized.

To end with, the convenience and justice of integrating in the SWM system the informal persons and entities (that are currently accepted by means of tolerance and irregular concessions) is observed. To do so, they must become legally valid entities that will have their corresponding rights and obligations.

C.6.3 Social Aspects

a. The Community and Solid Wastes

The economic and "plural" socio-cultural features of the population of the DF have a significant impact both on the amount and quality of generated wastes and on their participation to the management of the municipal solid wastes. In effect, if efficiency and efficacy goals are kept for an integral management of public cleansing service, the aforementioned plurality requires that the authorities know how to correctly manage these characteristics.

Among these features, we have the following:

- The high-income sectors of the DF generate more wastes per capita with a greater incorporated value than those generated by lower income sectors.
- The organic wastes ratio is the most significant among solid wastes in every socio-economic sector.
- In general terms, solid waste management culture at the generation source has not yet developed. People deposit wastes in containers of various types and capacity. However, better management and storage is being observed nowadays in plastic bags - at middle and high socio-economic levels.
- It must be acknowledged, however, that from ancient times, there has always been the will to keep houses and the surroundings clean, although this objective is not always achieved. This attitude is confirmed at lower income sectors where the population sweeps their roads and organizes themselves to clean clandestine dumping sites in ravines and public areas.

a.1 Attitude towards the Minimization of Wastes

- As a result of the increase of the per capita income (although it is slow), the consumption of goods in the DF has increased too, thus turning the city into a larger generator of wastes. This is shown by the increase in per capita production in the last 10 years.

- The community is not properly informed - and therefore scarcely motivated - to participate in the reduction of wastes production, nor in the solid wastes separation programs at the generation source.
- Minimum achievements have been reached in an effort to implement programs and actions aimed at the separation of wastes at the generation source, sponsored by the INARE, ecological organizations and some neighbor groups in the DF.
- A probably successful exception is the DGSU's solid wastes pilot separation program being carried out in some public buildings, a housing complex and a preschool educational center, involving around 8,500 persons. However, it must be recognized that, like many pilot programs, the success of the program is a result of financial support by the DGSU for all necessary tasks. Similar and even greater financial backup would be required for the feasibility of a massive and long-term coverage of this program in the DF.
- The proposals to minimize the waste generation form packing and crating in the manufacturing industry are weak, as well as the those to simplify and minimize packages.

a.2 Culture of Payment for the Collection Service Rendered

- Domestic recipients of the collection service directly pay the sweepers or collectors a "voluntary fee" or "tip" every time they bring their waste containers for their collection. The amount of the tips varies according to the amount of solid wastes collected and the socio-economic level of the zone. It is estimated that almost every family pays this "tip".
- Commercial stores, offices and other small, medium or big business entities also pay a fixed "voluntary fee" known as *finca*. The amount goes from 5 pesos to 100 pesos, according to the amount of solid wastes collected, which in turn depends on the size of the establishment. All the business entities with the collection service pay these *fincas*.
- The population of the DF has the culture of payment for the service rendered, which has been established informally as time passes by, satisfying those who receive the payment and also people that pay.
- Besides, equity of the payment has been reached without even planned so: those who generate more, pay more and those at the higher socio-economic levels also pay more.
- The delay of payment has also been reduced to almost zero, as there are no service debtors.
- The informal commercial system works efficiently. According to comments of the population, if fees were imposed by the GDF delegations, the system would not function because the population would not pay. The society perceives the garbage collection service as an obligation of the government and that is included within their taxes, although they pay "voluntary" fees (tips and *fincas*) to those who really operate the service.

a.3 Citizens Information and Education

- The society as a whole knows very little about the problem represented by solid wastes, and its participation is limited only to bring the wastes and to pay tips and *fincas*. The overprotective position of the government has fostered this behavior and a lack of interest from the population.
- It is accepted that the population is not deeply involved in the management of solid wastes, due to a lack of transparent information and an access to it. Besides, the general public should also be informed of the problem caused by the management of solid wastes, as well as the functions of the GDF's diverse organizations and cleansing service levels. The diffusion of the information on the separation of solid wastes is a good example of what should be done.
- A hindrance for the population to voluntarily join a solid wastes management participation program, whose central objective is public health, the preservation of the environment and the provision of the service, is the declined environmental culture. It does not allow them to assess the negative impacts of solid wastes on health or the environment (water, air and soil). This educational restriction is critical in adult population, who has received general data on this topic during the last few years only.
- For the recent years, issues related to the protection of the environment have been gradually included in educational programs. Although the educational plan proposes that there should be the integrity and continuance of these issues during the primary levels, the efforts to raise a child with the knowledge to properly manage solid wastes are useless if these topics are taught theoretically during only one year without practices or visits to public cleansing services, S/Ps, transfer stations and sanitary landfills. The attitude of the DF population towards solid wastes should be changed so that children are raised to behave as expected when they grow up.
- There is scarce or no information at all to the GDF's cleansing service staff; private contractors of transfer stations, S/Ps, transportation and sanitary landfills; *pепенadores* (waste-pickers) and informal sweeping and collection workers with regards to their health, environmental protection, and industrial safety.

b. Social Aspects in Collection

- The relations between the population and the GDF' sweepers and collectors are acceptable in general terms, and there are no difficulties or conflicts among them. There exists a symbiosis between the service recipients and the workers, and they benefit from each other: the former pay a "voluntary fee" and the latter render a reasonably acceptable waste collection service.
- The relations between the sweeping and collection workers, as they all are registered as a member of the Section 1 Union, do not present conflicts either:
 - ◆ There exists a good relation among sweepers, as the routes are well defined and they respect each other.

- ◆ The relation with the *cabos* (who are supervising the sweepers' work in each sector) is a co-live for convenience. It means both comply with the informal code encompassed by economic obligations.
 - ◆ The relation between the sweepers and the truck drivers is somehow distant, as the sweepers protest when the quota charged on them to discharge the wastes to the truck are increased.
 - ◆ The relation between the truck driver and his collection staff is not conflictive, as the former has all power and is regarded as the owner of the business.
 - ◆ The relation between the formal and informal (volunteer) workers has no social problems due to the difference in positions; volunteers earn no salary and totally depend on the driver's decisions. Besides, the volunteers are relatives or friends of the driver in most cases.
- The relation between the service recipients and the GDF is indifferent, and population participation in the management of solid wastes is weak so far. Nevertheless, due to this indifference, the population does not demand for better services, resulting in some social problems:
 - ◆ Some population sectors (peripheral zones, squatter settlements, sites difficult to access) with deficient collection services or no service at all. These sectors, yet not very big, represent a social problem.
 - ◆ Customs of the population (the family members leave the house early, before handing their solid wastes to the collector). Nevertheless, people has not asked for a change of collection schedule.
 - ◆ There are people who litter wastes on public roads, although the number of them has been reduced.
 - ◆ As a consequence of the above points, the GDF has to collect almost 800 tons of solid wastes every night from 996 clandestine dumping sites in 301 colonias in 12 delegations, which do not include lower economic level delegations as Cuajimalpa, M. Contreras, Milpa Alta and Tlahuac. Obviously, at these colonias, wastes are dumped at ravines and public areas, and the neighbors pick these wastes through cleaning campaigns with the help of the corresponding delegations.
 - ◆ In summary, there exist some DF zones with deficient, sporadic or no collection service, yet this is a small portion and in peripheral zones.
 - The most unbearable social problem during the collection process is that the volunteers, sweepers and collectors are informal personnel without salary, social welfare, health insurance, and not even working devices or uniforms. This is a severe problem, because there are almost 7,500 informal sweepers and collection workers.
- c. Social Aspects of Wastes Selection
- The waste-pickers groups control the S/Ps, at the high expense of the GDF with regards to financing the investments, current operation and maintenance cost of the plants, as well as other benefits for the waste-pickers. There is no doubt that former waste-pickers (*ex-pepenadores*) are in much better socio-economic conditions than they were when they segregated garbage at open dumping sites 15 years ago. The subsidies paid by the GDF for the S/Ps are in fact being

paid by the population of the DF, because part of the taxes levied by the government are allocated to the payment of this service, instead of using these funds to other social benefit projects.

- The waste-pickers groups of the three S/Ps are not legally recognized yet as business associations, although this is being analyzed. Currently, they are organizations that seem to operate as cooperatives, but they are not such, because the waste-pickers (*ex-pepenadores*) do not receive the benefits like cooperative members. Instead, they are private informal enterprises.
- At the San Juan de Aragon S/P, a very small number of workers dedicate to the conditioning of selected wastes and add value to them. They are controlled and paid by the leader. At the Santa Catarina and the Bordo Poniente plants, the same job is done by the private companies with permission by the leaders. In the case of the San Juan de Aragon plant, the salary they earn is unknown, but it is assumed that it is just like or less than the minimum legal wage. They are not provided with the social benefits by law either. Obviously, the socio-economic situation of this group is poorer than those of selectors. Hiring of these formally paid workers may have an intention of "freezing" or even "reducing" the number of the alleged waste-pickers "members".
- Currently, the waste-pickers groups do not give information on how resources are allocated, nor how much their revenues are. However, one of the critical issues arises definitely from the fact that this distribution seems to be unfair and affects those who really works; the former waste-pickers (*ex-pepenadores*).
- The recovered amount of the wastes of the total processed is low (4%-7%), yet it is estimated that the manual selection method currently in place is appropriate. It may be fair to say that solid wastes that enter the plants are "poor", because they have been probably undergone a "pre-scavenging" process during collection.
- The first objective of the selection plants was to eliminate the existence of waste-pickers at open dumping sites. This objective has been achieved mostly in the DF, with the exception of the Santa Catarina sanitary landfill, which still has waste-pickers, who are headed by the same person as the S/P.
- S/Ps' operation and maintenance is contracted to private sector companies, and the costs for those and energy are high, which imposes a considerable expense on the GDF. The security of the working staff of the contractors must be guaranteed with all social benefits and with necessary equipment to carry out their activity. Transparent contracts and supervision for the compliance with the contract clauses for the benefit of the workers are required.

d. **Social Aspects at Other Stages of the Service**

- Operation, maintenance and technical control of the 13 transfer stations and the final disposal site are contracted to a great number of small and medium enterprises, that hire in turn 2,000 workers and whose labor relations are directly with the contracted private companies. On the other hand, the DGSU has supervising staff at the transfer stations (80 persons). Additionally, the

delegations have personnel at the transfer stations (maybe more than 300 people), whose specific function is not very clear.

- Besides, for urban cleansing at main roads (freeways, avenues, highway accesses and secondary avenues) the DGSU hires contractors.
- Social aspects at these stages are the following:
 - ◆ Insufficient compliance of contracted enterprises with labor obligations for their workers (welfare and complementary benefits).
 - ◆ The possibility of labor conflicts within the contracted companies, which would lead to strikes and demonstrations solutions of these must appear in the contracts for the protection of the service and the GDF.
 - ◆ Lack of staff training and information diffusion to the workers on health and safety within the work places.
 - ◆ Very short-term costly contracts, resulting in instability of the workers and demanding higher training costs for the new staff.
 - ◆ Necessity for more strict and effective control and supervision by the GDF to execute the contracts (which should be as transparent as possible) entered between the GDF and private companies.

e. Conclusions on Social Aspects: Strength and Critical Points

Although the SWM service in the DF does not currently show conflictive social problems, it does present critical underlying points which block the improvements of the system. This situation could affect Master Plan implementation if these points are not solved or at least mitigated during the period until 2010.

Among those underlying critical social points, we can name the following:

- There are a large number of informal workers without being protected by the labor law.
- Social costs: subsidies for SWM granted by GDF are transferred to the society. As a result, taxes are directed to finance these subsidies instead of going to other broader social benefit projects.
- It is unknown whether there is an equitable distribution of profits among ex-waste-pickers proceeding from revenue of traded recovered materials from S/P.
- Sta. Catarina landfill still operates with waste-pickers.
- In small proportion, there are peripheral areas in the DF where there is a deficient or sporadic collection service.
- Indifference is found in the relationship between service recipients and GDF cleansing staff.
- Weak supervision to enforce labor legislation, social security, and health of workers group of the contracted enterprise.

Table C-42 summarizes the conclusions on strengths and critical points for social aspects within the current situation of SWM in the DF.

Table C-42: Conclusions on Social Aspects: Strengths and Critical Points on SWM in the DF

Components	Strengths	Critical Points
<ul style="list-style-type: none"> Source Separation and Minimization of Solid Waste 	<ul style="list-style-type: none"> The DGSU undertook successfully a demonstration project of waste source separation which could be extended. Almost natural separation at the source (markets, parks, public offices, schools, others) is implemented where an immediate separation program could begin immediately. Educational programs on the environment and health already established in primary schools. 	<ul style="list-style-type: none"> General citizens does not practice waste separation. Inefficient packing and crating minimization done by industry. Little information to the public on benefits derived from separation. There is no culture on waste management at the source.
<ul style="list-style-type: none"> Information and Education 		<ul style="list-style-type: none"> Little information on negative effects on health and the environment derived from an inadequate SWM. Limited involvement of society into SWM. Training given to cleansing personnel is weak. No information to informal workers. Environmental culture of the private sector is limited. Relations among the GDF, residents associations and NGOs are weak.
<ul style="list-style-type: none"> Willingness to pay for services 	<ul style="list-style-type: none"> There is a culture of spontaneous willingness to pay which is difficult to achieve in other cities. Equity: Those who generate more pay more. Simplicity: Payment is derived from direct calculation of solid waste quantity generated by clients. Redistribution: Those who have more, pay more Collection efficiency: zero delinquency. 	<ul style="list-style-type: none"> GDF regulation on payment exemption to those who generate less than 200 kilograms per day. Current informal payment system.
<ul style="list-style-type: none"> Collection and street sweeping 	<ul style="list-style-type: none"> Good relations for mutual benefit (symbiosis) between the community and those who provide the service (collectors and sweepers). Finance from the GDF is limited regarding current expenditure for sweeping and collection services. Efficient operation by the informal collection system within the GDF. Low probabilities that service might be stopped or affected by strikes derived from labor conflicts. Jobs for a large number of persons who are otherwise unemployed and not-qualified. 	<ul style="list-style-type: none"> Informal operation by, practically, an autonomous entrepreneurial organization within a state structure and organization. Unfavorable working conditions for 7,500 volunteers (collectors and sweepers), without basic remuneration or social benefits. Small peripheral areas, irregular settlements, and sites with difficult access which have irregular or no collection services. Material selection is done on public areas without paying any attention to aesthetics or sanitation. Weak accidents prevention.

Components	Strengths	Critical Points
<ul style="list-style-type: none"> Transfer Stations (T/S) 	<ul style="list-style-type: none"> Impact derived from eventual strikes by workers from contracted enterprises is minimal, as a result of the number and size of them. 	<ul style="list-style-type: none"> Difficult to supervise the large number of small and medium size private contractors. Little fulfillment of existing regulations to protect workers' health and prevent occupational accidents. Short term contracts which create worker instability and higher costs to the DF and consequently to the society.
<ul style="list-style-type: none"> Transportation (between T/Ss, S/P and final disposal sites) 	<ul style="list-style-type: none"> Reduced impact of strikes and standstill. Possibility of continuous transportation is guaranteed by insurance policies. 	<ul style="list-style-type: none"> Complicated supervision for the execution of contracts by with a large number of enterprises. This supervision includes the following aspects: technology, administration, operation and fulfillment of regulations which protect workers' health and prevent occupational accidents.
<ul style="list-style-type: none"> Selection Plant (S/P) 	<ul style="list-style-type: none"> The social-economic conditions of ex-waste-pickers was improved. Incentive is given (the more material recovered, the more paid). 	<ul style="list-style-type: none"> The objective of operating landfills without waste-pickers has not been yet reached (Sta. Catarina). Waste-pickers organizations which receive high subsidies from the GDF (capital cost, current cost and other economic benefits) are informal; these organizations do not pay taxes, nor social charges; additionally, they do not inform about revenue redistribution among their members. Economic burden on the GDF which is finally paid by the society of the DF is excessive. Personnel hired by waste-pickers organizations has unfavorable working conditions. Recovered waste amount is between 4 to 7% of the amount processed; this figure is not meaningful regarding the minimization objectives.
<ul style="list-style-type: none"> Final Disposal 	<ul style="list-style-type: none"> Contracting several enterprises reduce impact of eventual strikes or standstill. Possibility of continuous transportation is guaranteed by insurance policies. 	<ul style="list-style-type: none"> Complicated supervision for the execution of contracts with a large number of enterprises. This supervision includes the following aspects: technology, administration, operation and fulfillment of regulations which protect workers' health and prevent occupational accidents. Short term contracts cause the instability of workers and higher costs for training new personnel. Furthermore, higher costs to the DF and consequently to the society is imposed.

C.6.4 Organizational System

The diagrams of item C.5.2 showed the functional structures of the diverse SWM services. It is noted that these services are distributed in accordance with legal precepts: local ones are under the responsibility of the delegations - residential sweeping and collection - those precepts involving several delegations or very specialized tasks are under the jurisdiction of the DGSU - sweeping of primary road network, cleaning of monuments and walls, transfer, separation of recyclable products and final disposal.

It is also observed that all the services are shared by several enterprises and/or third parties to the GDF, as informal structures. This brings as a result small and simple formal organizations, within the delegations and in the DGSU.

The lack of a maintenance and control organization (with respect to supplying of spares) of the collection teams is quite remarkable, which is overcome thanks to the cooperation of informal beneficiaries. This lack is also present in regards to other equipment, but this lack is overcome by contracting operation and maintenance. Meanwhile, more attention to these aspects is recommended, because they may lead to a decrease of productivity and increasing costs, since these equipment are specialized and most of them are imported, which in turn will result in a delay to obtain spare parts or even to modify them. It is also true that service contracting or concession, including necessary equipment, can also be a good solution.

Planning and control of residential collection and street cleaning services are empirical and the informal structure is in charge of them, with the exception of specialized services.

A regulation for service execution and another for public procedure regarding urban cleaning and wastes should be created, including their corresponding sanctions. Likewise, permanent communication with neighbors is necessary such as providing them with information and paying attention to their claims, which would represent a good tool to monitor the services.

Some transfer stations have a certain number of staff from the delegations where these facilities are located, and this number of staff would be reduced, because the services are contracted and supervised by the DGSU.

In order to review the aforementioned topics, the following would be recommended:

- To establish a consistent monitoring system of the waste amounts handled and of the services developed at Transfer Stations (including haulage), at S/Ps and at Sanitary Landfills. Since the operations are contracted out and must keep that way, the control by each enterprise on its corresponding work is independent from the monitoring carried out by the DGSU. This monitoring must be fed with data from the companies, but only with the information selected in order to integrate a managerial and superior information system that may be interesting to the contract client (DGSU). This system must be integrated by data chosen as assessment parameters for the total destination operative flow of collection-to-destination, preferably *on-line* information (so that it remains reliable); which will generate indexes and graphics for a quick and consistent assessment.

- The monitoring system would supply the necessary information to the Sub-direction in charge of supervising the contract and the more concise and consolidated information necessary for the Direction and by the General Direction.
- A system for distribution, operation, maintenance and cost control of vehicle and machinery owned by the GDF and assigned to the SWM system should be organized and implemented. This system would encompass directly operated equipment and, through chosen parameters, equipment operated under a contract or concession.
- For directly operated vehicles and equipment, it is necessary to organize a physical and exclusive system for the cleansing sector, which includes garages (basic maintenance) and a central workshop (spare parts and accessories warehouse) for major maintenance. Even though this maintenance is contracted to private workshops, it might be convenient to have a stock with the most common spare parts and with pieces that may be difficult to acquire (because they are imported).
- The DGSU's structure as regards to the SWM system should also be reviewed, if the suggestions on the vehicle and machinery control and maintenance were accepted. In this reviewing, Directions of Transfer, Final Disposal and Construction-Maintenance would be adapted better.
- Garages and basic maintenance as the use control would be supervised by the delegations where the corresponding vehicles and machinery are located.

C.6.5 Ascertainment of Aggregate Unit Cost of Solid Waste Management in DF, 1998

C.6.5.1 Preface

Whereas financial accountancy emphasizes the relationship of the entities to outsiders an owners (or tax payers in the case of public business undertakings), management accounting is concerned with providing information for planning, control and decision making. Of the management accounting system, cost accounting, or simply putting it as "costing", would facilitate the establishment of past costs of products, either in the forms of goods or services, and functions, thus leading to aid management people in short-term control and long-term decision making. By definition, "cost" is a monetary measure of value consumed or acquired, and "cost objective" is the purpose for which costs are measured. While the term "cost" may represent different ideas to different cohorts of people, "cost" to be ascertained and cost objective to be considered in financial analysis would include, among others, expense paid, unit cost, function (cost centers), sensitivity of cost with regard to change in other factors, and/or efficiency in performance of cost centers (standard). Cost comprises expenditure incurred for costing purposes, vis-à-vis, materials, labor,

and expenses, with further sub-classification of these elements into direct and indirect.⁶

With the basic proposition as noted above, this section is provided to briefly ascertain the unit cost of solid waste service currently in place in DF with a view to articulating part of the financial issues attributed to the cost efficiency in operations. The structure of the section is as follows. Following the opening remarks, the model configuration and the assumptive parameters used are given such that the accounting view of "cost ascertainment" regarding the DF's SWM service as a whole be elucidated. Subsequently, the estimated unit costs of public service per annum as per 1998 price are given, with the alternatives of (i) that inclusive of all of the cost centers within the service, and (ii) that excluding costs attributed to disposition of illegal dumping and sweeping and cleaning of major roads in DF. Costs accrued to collection and transportation of garbage under the responsibility of Delegation are also considered in due course of the ascertainment of unit cost and included thereof.

In the meantime, the fundamental concepts of accounting as borne out in the face of the current analysis included "going concern", "accruals", "consistency", and "prudence". Each of which are being suggested in Statements of Standard Accounting Practices as "entities will continue in operation for the foreseeable future", "revenues and costs are recognized as they are earned or incurred in the profit and loss account of the period to which they relate, not as money is received or paid", "consistency of treatment of like items within each accounting period and from one period to the next", and "profits and loss are recognized only when the ultimate cash realization could be assessed with reasonable certainty", in that order. Nonetheless, due to a paucity of relevancy and consistency with the aforementioned accounting principles in the numerical information obtained during the survey period, not a least part of the analysis had been undertaken subject to the presumptions and parameters intuitively set forth within a margin by the mission members.

C.6.5.2 Model Configuration, Methodology, and Assumptive Parameters Used

In pursuance of the team's endeavors to figure out the indicative unit cost for the management of solid waste in DF as per 1998 price, the following model configuration and the assumptive parameters have duly been applied. While the deliverable of the investigation comes appear in the last part of the section, it should be noted that those "aggregate unit costs" elucidate the summation of the "unit cost" accrued to each phase of processing for solid waste management currently in place, vis-à-vis, capital investments, recurrent costs, and hidden costs.

a. Model Configuration

In line with accounting definition, the cost components and the associated cost centers considered in the estimation of unit cost attributed to the solid waste management service in DF as per 1998 price include the followings.

- (1) Annuitized capital investments in recycling plants, transfer stations, and final disposal sites;

⁶ References: Lee J. Seidler & D. R. Carmichael (Eds), *Accountants' Handbook, Vol. 2*, chapters 33, 37, and 44, Ronald Press, 1981, Wilfred Hingley, *Accounting*, Heinemann Professional Publishing, 1989

- (2) Recurrent Costs associated with collection, transfer, transfer stations, selection plants (S/Ps), final disposal sites, deposition of illegal dumping, and sweeping and cleaning of major roads; and
- (3) Hidden Costs, or social costs, in the form of "Tips" and "Fincas"⁷

b. Methodology

Considering the cost (marginal costs) of services rendered annually by the existing plants and facilities in Bordo Poniente, Santa Catarina, and San Juan de Aragon, as well as those auxiliaries, the most commonly used variant of the theoretical concept in welfare economics and its applied segment of investment decision theory is a levelized annuity cost plus recurrent cost over a fixed period of time. This is the cost of advancing one unit supply of SWM services in concern, being annuitized over the expected economic life of the plants and facilities. To be specified in estimation, capital recovery factor (CRF) which is a function of (social) discount rate of capital (denoted by i) and economic life (n) to estimate the levelized annuity cost.⁸

Thus, a numerical expression will be:

Annual Costs of Capital Investment Accrued (MC) = TC * CRF(i, n) + annual recurrent cost,

where TC denotes the total capital investment cost, while CRF is depicted as:

$$CRF^9 \equiv \frac{i(1+i)^n}{(1+i)^n - 1}$$

Capital investment costs have initially been placed while referring to the 1993 feasibility study reports of those plants on the aforementioned three sites, thereby sequentially being annualized as per 1998 price. Recurrent costs have been estimated on the basis of information currently of avail and cost data on operation and maintenance, further divided by quantities of factors of relevance to draw the unit cost of service. Coupled with brief interview of people in DF and discussions with the sociologists deeply involved in the issues for a period, review of the materials in the past has been of great help for the mission to draw the frequency and amount of "tips" and "fincas" currently in place in DF within a certain range of confidence interval.¹⁰

⁷ "Tips" is understood as a kind of pecuniary contribution "occasionally" and "voluntarily" given to waste collectors by households, whereas "Fincas" as that paid by entities on rather periodic occasions.

⁸ Another variant of MC widely used is the Long Run Average Incremental Cost (LRAIC) with its short accessibility to the relevant information and data. In theoretical terms it may not be correct nonetheless it is useful as an approximation. Mathematically it is expressed as LRAIC =

$\left\{ \sum_t \left(I_t \times (1+i)^{-t} \right) \right\} / \left\{ \sum_t \left(Q_t \times (1+i)^{-t} \right) \right\}$ where t is a year in a project period ($t=1,2,\dots,n$), whereas i , I and Q denote a discount rate, an incremental investment and an incremental supply, respectively.

⁹ CRF is defined as a summation of depreciation (represented by a sinking fund factor) and opportunity cost of capital (or inflation rate), which is mathematically depicted as follows:

$$\frac{i(1+i)^n}{(1+i)^n - 1} = \frac{i(1+i)^n + i - i}{(1+i)^n - 1} = \frac{i[(1+i)^n - 1] + i}{(1+i)^n - 1} = \frac{i}{(1+i)^n - 1} + i$$

¹⁰ References: Departamento del Distrito Federal, "Estudio de Analisis Economico de Los Sistemas de Tratamiento de Residuos Solidos de Santa Catarina, San Juan de Aragon, y Bordo Poniente", 1993, DDF, Metas del Ambito Delegacional para el Presupuesto de Egresos 1996, Interview Survey

To be noted that the outcomes of the public opinion survey (POS) deliberately undertaken by the JICA team during the mission to Mexico in summer 1998 have duly been taken into account. Of these, for instance, the average amount of tips paid by each of the household in Mexico City are presumably set at 28.3 peso per month (equivalent to 7.0 peso per week), with the ratio of "voluntary" tip payers to the total households being fixed at 0.81. Talking turkey, it has been intuitively assumed that the average of the sample taken up this time of POS is set within a confidence interval of that for the population.

In the meantime, it would further be noted that the social costs, notably, "tips" and "fincas", drawn in the current analysis would furnish different views and opinions on its intuitiveness while depending on perceptions and status of people who read the report.

c. Assumptive Parameters

1. Capital Investment

(1) Incremental Investment, San Juan de Aragon, Peso million, 1993	40.2
(2) Incremental Investment, Bordo Poniente, Peso million, 93	25.9
(3) Incremental Investment, Santa Catarina, Peso million, 93	41.4
(4) Ann Ave Inflation 93-94	8.0%
(5) Exchange Rate, P/\$, 1993	3.12
(6) Solid Waste ton/day/1993	9,500
(7) Solid Waste ton/year/1993	3,467,500
(8) Economic Life (years)	15
(9) Interest Rate (cetes), 1993	15.5%
(10) Annual Average Inflation Rate, 1995-98	27.3%
(11) Social Discount Rate, 1993	7.5%
(12) Unit Cost, Transfer Station, Peso million 1995	4.4
(13) Unit Cost of Truck, US\$, 1998	80,000
(15) Unit Cost of Trailer, US\$, 1998	200,000
(16) # of Truck	1,800
(17) # of Trailer	200
(18) Landfill Capacities at Bordo Poniente (ton)	34,000,000
(19) Landfill Capacities at SANTA CATARINA (ton)	34,000,000
(20) Land Acquisition Total C. Bordo Poniente (US\$ million)	0.2
(21) Construction Total C. at Bordo Poniente (US\$ million)	4.4
(22) Equipment Total C. at Bordo Poniente (US\$ million)	3.2
(23) Ratio of Cost at Santa Catarina in terms of Bordo Poniente	1.337

2. Recurrent Costs

(1) Waste Collection (1996, million ton)	5.8
(2) Cost of Collection (1996, P million)	483.8
(3) Unit Cost of Collection (1998, US\$/t/year)	10.6
(4) Transfer Station Handling Quantity (t/year)	1,584,197
(5) Transfer Station Unit Cost (P./t, 1996)	63.9
(6) S/P Handling Quantity, Bordo Poniente (t/year)	618,858
(7) S/P Handling Quantity, Santa Catarina (t/year) 1/	234,771
(8) S/P Handling Quantity, San Juan de Aragon (t/year)	627,399
(9) S/P O&M Unit Cost, Bordo Poniente (P./ton, 1996)	35.60
(10) S/P O&M Unit Cost, Santa Catarina (P./ton, 1996)	26.17
(11) S/P O&M Unit Cost, San Juan de Aragon (P./ton, 96)	40.22
(12) Dumping Quantity, Bordo Poniente (ton/day)	8,500
(13) Dumping Quantity, Santa Catarina (ton/day)	2,500

undertaken by JICA team during mission, and GDF, *Asignacion Original del Subprograma Control de Residuos Solidos*, 1998

(14) Unit Cost for 11,000 ton, Bordo Poniente (US\$/ton)	3.0
(15) Unit Cost for 11,000 ton, Santa Catarina (US\$/ton)	4.0
(16) O&M Cost, Cell Production, Bordo Poniente (US\$ million)	9.69
(17) O&M Cost, Labor, Bordo Poniente (US\$ million)	0.2
(18) O&M Cost, Material, Bordo Poniente (US\$ million)	0.3
(19) Inflation in 1997	15.7%
(20) Inflation in 1998	14.0%
(21) Illegal Dumping (t/year)	84,391.2
(22) Unit C of Disposition of Ill. Dumps (P./A,96)	143.3
(23) Unit C of Manual Cleaning (P./km)	223.0
(24) Unit C of Mechanical Cleaning (P./km)	157.3

1/ Based on actual operation of 0.42 year days in 1996

3. Hidden Costs (Tips, 1998)

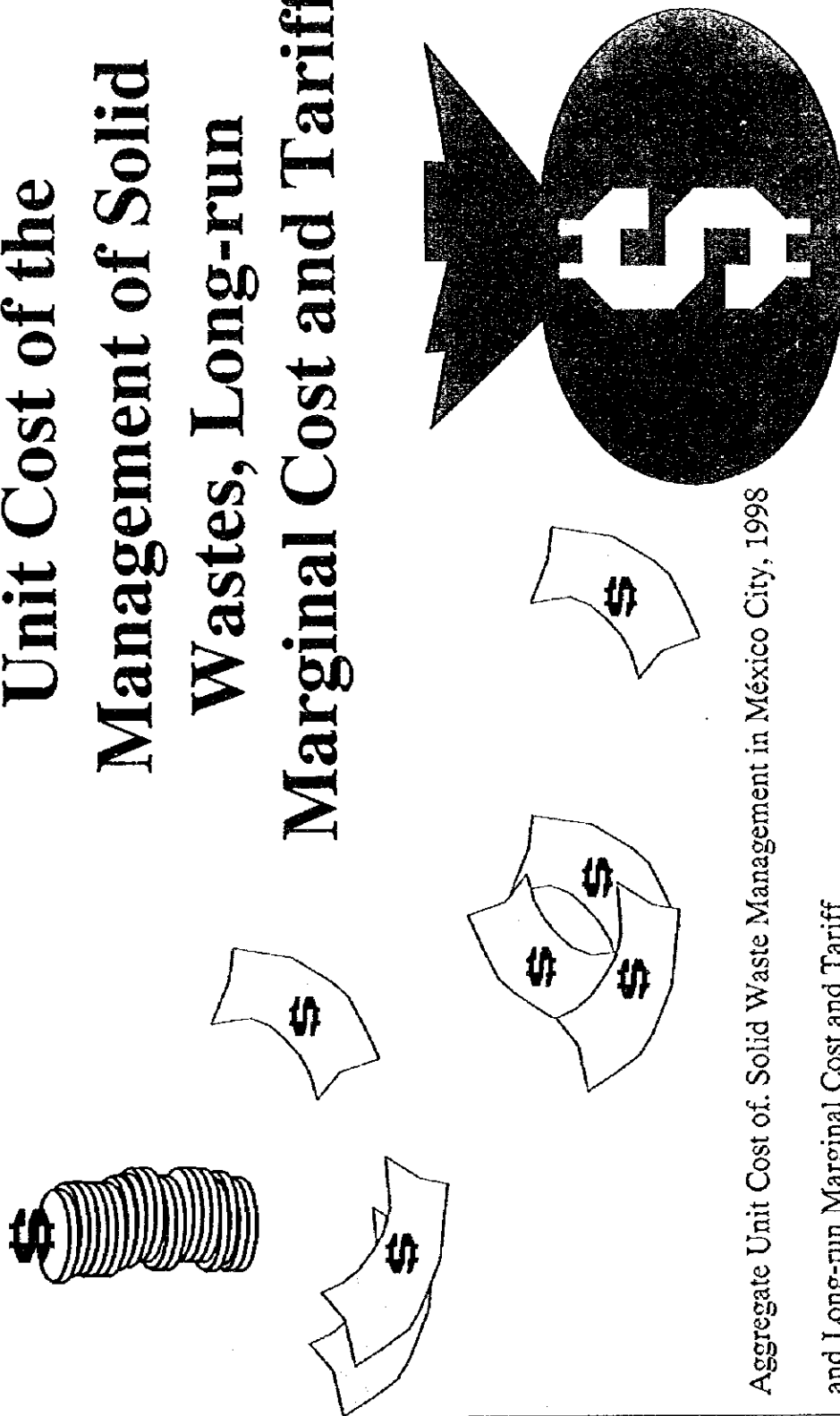
(1) Tip Household per week (peso)	7.0
(2) Tip Household per year (peso)	336.0
(3) population	8,500,000
(4) Household ratio	0.7
(5) Household population	5,950,000
(6) Household members	5.5
(7) # Household	1,081,818
(8) Ratio of "Voluntary" Tip Payers	0.81
(9) tip Household per month (Peso million)	30.0
(10) tip Household per year (Peso million)	294.9
(11) # Entities (93)	314,292
(12) # Entities (98, est, 5% annual increase)	330,007
(13) % Share of Large Entities (94)	1.0
(14) % Share of Medium Entities	5.0
(15) % Share of Small Entities	94.0
(16) # Large Entities	3,300
(17) # Medium Entities	16,500
(18) # Small Entities	310,206
(19) Fincas, Large (Peso/week)	500.0
(20) Fincas, Medium (Peso/week)	150.0
(21) Fincas, Small (Peso/week)	50.0
(22) Fincas Total, 1998, P. million/year	942.5
(23) Exchange Rate P/US\$ (1998)	9.1
(24) Solid Waste (1998, ton/day)	11,000
(25) Solid Waste (1999, million ton/year)	4.015

C.6.5.3 Indicative Figures of Aggregate Unit Cost of Solid Waste Management

In line with the model configuration and the assumptive parameters as noted in the foregoing, the "aggregate unit costs" of capital investments on collection, the 13 units of transfer stations, recycling plants, final disposal sites in place being levelized in each of the years up to 2010, as well as the recurrent costs associated with these cost centers, and the hidden costs in the form of "tips" and "fincas" are figured out at respective of US\$ 16.9, US\$ 37.8, and US\$ 33.9 per ton per annum, thus aggregating to a total of US\$ 88.6 as per 1998 price. In lieu of the alternative as reflected above, the unit cost is envisaged to stand as high as at US\$ 107.4 per annum per year, with the recurrent costs accrued to the disposition of illegal dumping and cleaning of major roads in view. Numerically expressed, capital costs, recurrent costs, and hidden costs worked out US\$ 16.9, US\$ 56.7, and US\$ 33.9, respectively. Summarized table giving the estimates is provided below.

1. Capital Investment	
1.1 Recycling Plant	2.7
1.2 Collection and Transfer Stations (13 units) *1	13.6
1.3 Final Disposal Site	0.5
Sub-Total	<u>16.8</u>
2. Recurrent Costs	
2.1 Collection	16.1
2.2 Transfer Station (13 units)	13.9
2.3 Selection Plants (3 units)	4.6
2.4 Final Disposal Sites (3 sites)	3.2
2.5 Disposition of Illegal Dumping	18.2
2.6 Major Road Cleaning	0.7
Sub-Total (2.1 – 2.4)	<u>37.8</u>
Sub-Total (2.1 – 2.6)	<u>56.7</u>
3. Hidden Costs (Tips)	
3.1 Household <i>Tips</i>	8.1
3.2 Entities <i>Fincas</i>	25.8
Sub-Total	<u>33.9</u>
"AGGREGATE UNIT COST" OF SWM, US\$/ton/year/98 price	
Alternative 1: without Illegal Dumping & Major Road Cleaning	<u>88.6</u>
Alternative 2: including All Cost Factors	<u>107.5</u>
(*1 Inclusive of tracks and trailers in service)	

Unit Cost of the Management of Solid Wastes, Long-run Marginal Cost and Tariff



Aggregate Unit Cost of. Solid Waste Management in México City, 1998
and Long-run Marginal Cost and Tariff

Figure C-26: Aggregate Unit Cost of Solid Waste Management (1)

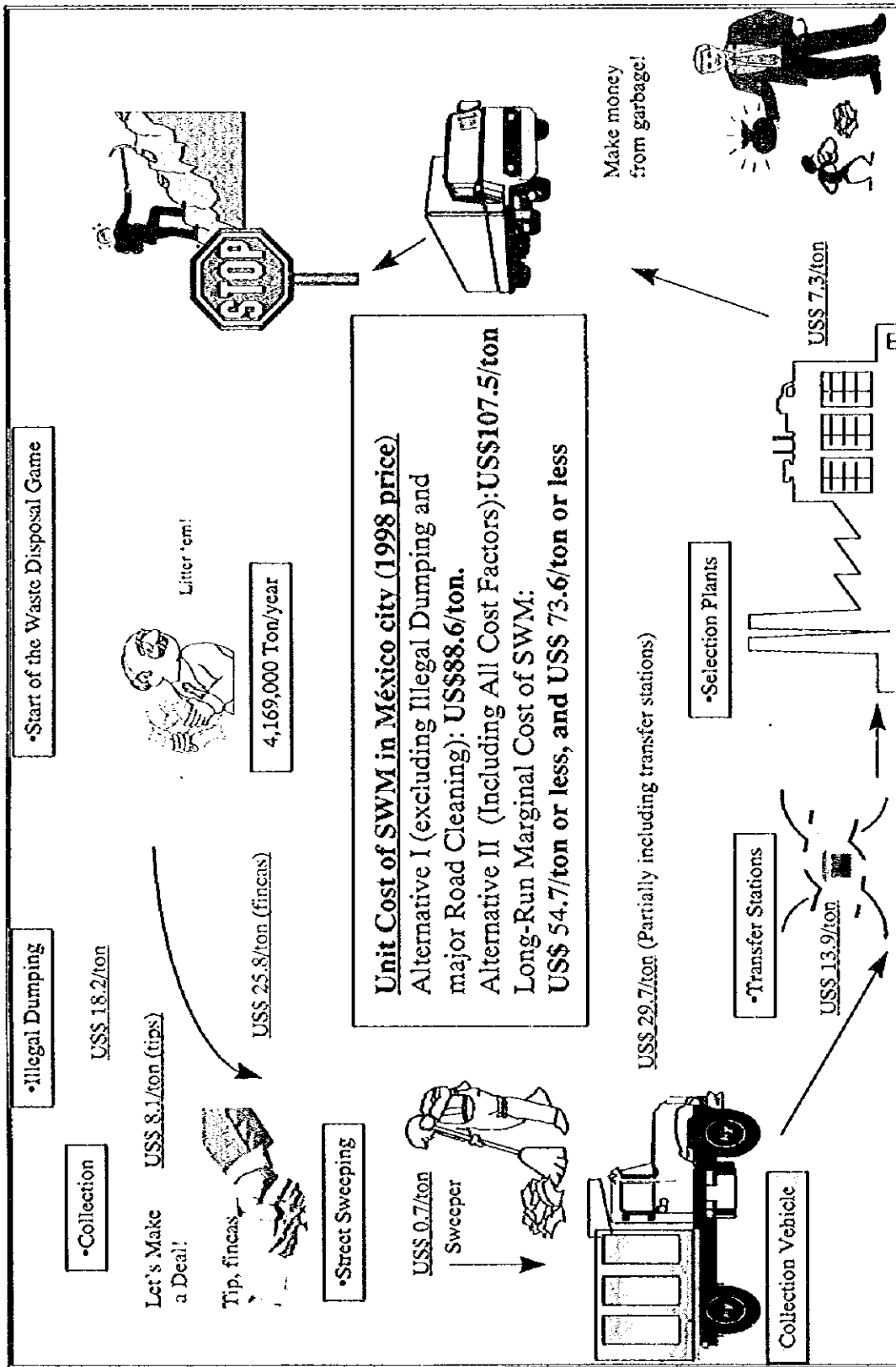


Figure C-27: Aggregate Unit Cost of Solid Waste Management (2)

Annex D

Comparative Evaluation of Candidate Sites for Final Disposal of Solid Waste

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D Comparative Evaluation of Candidate Sites for Final Disposal of Solid Waste

D.1 Background

Wastes to be disposed of in the target year 2010 amounts to as much as 3.3 million tons in a year, although annual disposal amount will be declined as a result of the M/P. Remaining service life of the present Bordo Poniente Etapa IV lasts merely until January 2001. Vertical expansion is to be employed there, but the total extended service life is anticipated to be only several years and the method requires a moratorium period about two years for each vertical expansion of about eight meters height to allow landfill settlement every 2-3 years operation. Consequently, it is obvious that there is a strong need to find a land for a new final disposal site.

Under such background, the DGSU presented four candidates for a new landfill: one in Naucalpan de Juarez, one in Huixquilucan, one in Ixtapaluca and the other in Texcoco (or to be called Bordo Poniente Etapa V). All of these are located in the State of Mexico. They are presented briefly as follows.

a. Naucalpan de Juarez Site

The Naucalpan site is on the local road which is deviated from the state road No.3. The distance from the border of the DF and the State of Mexico is about 10 km and the nearest DF delegation is Azcapotzalco. The coordinates are 19° 30'40" north and 99° 15'50" west at the elevation of 2,600 - 2,650 m above sea level.

b. Huixquilucan

The Huixquilucan site is just off the toll road called Autopista Naucalpan Cuajimalpa. The interconnection of this toll road and the Federal Road No.130 is about 1 km north of the site. The distance from the DF border to the site is about 5 km and the nearest delegations are Miguel Hidalgo and Cuajimalpa. The coordinates are 19° 25' to 19° 26' north and 99° 18' west at the elevation of 2,732m.

c. Ixtapaluca

The Ixtapaluca site is on the right side of Carretera Mexico Puebla, which connects the DF and the State of Puebla, and about 12km to west from the Santa Catarina S/P site. The nearest delegations are Ixtapalapa and Thahuac and the coordinates are 19° 18'53" to 19° 19' 53" north and 98° 47' 30" to 98° 49'00" west. The elevation is about 3,000m.

d. Bordo Poniente Etapa V (BP-V)

The BP-V site is about 6km from the existing Bordo Poniente Etapa IV. Its elevation is about 2,250m.

D.2 Evaluation Criteria and Method

The development of a final disposal site is land-intensive work because of its scale and possible risk associated with its operation, and could impose severe "hardship" on the recipient environment, either natural or socio-economic. Although technical countermeasures are available for a certain problems and uncertainties, they could be unacceptably costly for the society and can not be perfect. Considering that an environmental effect is a result of the interaction of the causal activities and the recipient's characters, it is worth considering first the latter, or in other words, to what extent the recipient environment is susceptible or resistant to impacts presumably caused by the proposed project. It should be emphasized here that the term, environment, refers to natural, social, and economic environment. It also should be reminded that the mitigation of negative effects always must be pursued, the ultimate mitigation measure is the avoidance of the effects, and rational site selection is one of the most practical and effective tools toward avoidance.

On the other hand, such initial evaluation has to be as systematic, objective and efficient as possible. Accordingly, several criteria are required to compare the candidates.

The Mexican Official Norm, MON-083-ECOL-1996, gives a good guide for the criteria selection process. The norm describes the requirements for a final disposal site to meet in the following aspects:

- Ecology or nature conservation.
- Other public works nearby, if any.
- Hydrology or surface water.
- Geology.
- Hydrogeology.

Empirically speaking, there are some other criteria to be added to these. They are as follows.

- Possibility of land acquisition.

Due to a great demand for land in the urbanized city and in its periphery, land acquisition is becoming highly difficult. Therefore, it is inevitable to have a perspective of land acquisition possibility.

- Possibility of neighborhood acceptance

A NIMBY (not in my back yard) syndrome is unavoidable in most countries when a new final disposal site is planned and Mexico is not an exception. The most obvious and common solution for this is to avoid any unnecessary conflicts with people at the early stage of project planning. For this reason, the prior examination of the existing and estimated residential patterns near the site and the access road is essential.

- Environmental acceptability

The criteria given by the norm and listed above, except the second one, are concerning environmental acceptability. As stated above, however, environment should be taken into account in the broader sense. Therefore,

environment in the social context is also to be considered. The second criterion of the norm would be one of such elements.

- Economic feasibility

As far as the lives of the people are based on the consumption of goods, they can by no means eliminate wastes, and society is obliged to manage the wastes. The expense for this is, unfortunately, not small but should be small enough for society to bear. Although detailed economic feasibility can not be investigated at this stage, primary economic evaluation still should be tried and is possible.

Under the understanding of these, the comparative evaluation was conducted as below.

D.3 Site Evaluation

D.3.1 Possibility of Land Acquisition

Possibility of land acquisition largely depends on the current land use, land ownership and the necessity of compensation to obtain the land. These are summarized for all candidate sites as shown in Table D-1.

Table D-1: Evaluation of Possibility of Land Acquisition

Naucalpan	Huixquilucan	Ixtapaluca	BP-V
Present Land Use			
Formerly used for corn agriculture and later for extraction of construction material.	Currently used for extraction of construction material.	Currently used for maguey agriculture in the east half and for extraction of construction material in the west half.	Currently used for livestock farming.
Land Ownership			
Ejidatarios.	Private.	Ejidatarios.	Federal Government.
Necessity of Compensation			
Yes.	Yes.	Yes.	No. (But specific agreement with the CNA required.)

The definitive difficulty of land acquisition is not seen at every site. The impact given by the land use conversion on economic activity of the construction materials extraction should be minimum because extraction can continue with providing landfill covering soil beside the on-going waste disposal site.

Care should be given to the necessity of compensation, which must be found in the cases of Naucalpan, Huixquilucan and Ixtapaluca. Considering the fact that the 1992 amendment to the Constitution allows the privatization of *ejido* (communal land), all the three sites are, in fact, private, thus the authority should be well prepared for possibly high compensation and prolonged negotiation.

D.3.2 Possibility of Neighborhood Acceptance

This criteria is further made up of three items, namely neighboring inhabitants, distance to nearest house and residents along the access road. Table D-2 presents the main points of each of these.

Table D-2: Evaluation of Possibility of Neighborhood Acceptance

Naucalpan	Huixquilucan	Ixtapaluca	BP-V
Neighboring Inhabitants			
There is a residential area called Rincon Verde five km east of the site.	Nearest residential area is about one km away to northeast.	The nearest residential area called La Cañada is about three km east from the site. There are other residential areas about three km west from the site.	The residential area called "Colonia el Sol" is one and half km to the south of the site.
Distance to Nearest House			
About 800m.	About 1 km.	About 2 km.	About 1.5 km.
Residents along the Access Road			
No residents near the site but populated areas along the road at a certain distance from the site.	Because of the nature of the access road which is an express highway, houses next to the road are very few. Impact on the people along the road, thus, would be small.	There are no populated areas along the access road near the site.	There are no residential areas along the access road near the site.

The distance from the proposed site to the nearest residential area of all candidates will be acceptable. In terms of the distance to the nearest house, however, the two sites at Naucalpan and Huixquilucan may be problematic.

The situation of residential pattern along the access road could be fatal for the Naucalpan site. The access road there passes through the urban fringe about 5-6 km from the site where houses and small shops are standing on the both sides. This section of the road is paved, but the width is not enough to let large trailers pass in both directions, thus the road width expansion would be necessary. Consequently, not a few houses should be relocated. For the other three sites, any major residential areas are not found along each access road. At a distance of about 2-3 km from the Huixquilucan and Ixtapaluca sites, however, newly developed housing complexes are found. Therefore, due attention should be paid to the direction of urbanization in areas surrounding those two sites.

It can be assumed that the BP-V site is not subject to opposition by the neighborhood.

D.3.3 Environmental Acceptability

As already stated earlier, the aspect of environmental acceptability can be assessed from viewpoints of ecology, hydrology, geology, hydrogeology and social environment. It is common that the issues of residents and land ownership are considered as part of social environment, but in the present case, they are regarded being independent and were, in fact, already discussed above. Hence, social environment is to cover such aspects as culture, traffic, and other public facilities.

Table D-3 presents the summary of the evaluation.

Table D-3: Evaluation of Environmental Acceptability

Naucalpan	Huixquilucan	Ixtapaluca	BP-V
Ecology			
Since the site was developed by mining activity, any important species of fauna or flora might not be identified in the site itself. There might be some ecologically important area near the site.	Express highway and residential development are near the site, but forest area around the site might be a habit of some important species.	There might be no particularly important species of fauna nor flora at the site. The Zoquiapa Mexico-Puebla National Park is a protected area with 19,418 ha, but located at considerable distance from the site.	There might be some important plants and birds to be protected.
Hydrology			
The region is of high hydrological importance in the country in terms of the volume of surface runoff. A stream El Muerto flows the proposed site.	A stream Agua Caliente flows 200 m away from the site. The bed is permeable and water quality is good. The region is not susceptible to inundation.	There are no permanent rivers due to the high permeability, hence a flood risk should be small.	Extensive hydrological work has been implemented by the CNA.
Geology and Hydrogeology			
The area is on the Tarango Formation, geologically formed by volcanic rock, namely surface layer of tuff and volcanic breccia below. An aquifer is found at the depth of 200 m. The nearest well is found in San Mateo Nopala, 5 km east from the site. The piezometric level of this well is at least 40 m deep from the ground level. A boring test at the site showed that the subsurface layer is clay with a depth of two meters which overlies a strata of sand and silt with gravel. Overall permeability is at the order of 10^{-6} cm/sec.	The area is on the Tarango Formation, geologically formed by volcanic rock. An aquifer is from 75 to 115 m depth. A boring test at the lowest point in the proposed site indicated the depth of aquifer to be 91.5 m. Permeability is found to be in a range of 3.2×10^{-6} to 6.7×10^{-4} cm/sec down to the depth of 30m and the site is rich in the granules/poroneous material with a permeability of middle level. Runoff coefficient of the site is 5 to 10 %.	Geologically, the area is volcanic origin. Volcanic breccia and tuff are dominant and andesite is found in limited part. Permeability ranges from 3.6×10^{-3} to 1.8×10^{-8} . Together with the facts that an aquifer at the site is not very deep (the depth is estimated to be about 40 - 60 m) and that groundwater has good quality for human consumption and irrigation, considerable care should be given to the design of groundwater protection.	The geology is lacustrine, but there is a bedrock at the depth of about 300 m with high solidity. A superficial aquifer is 1.5 m deep. The water has high salinity with a concentration of sodium carbonate at 5 to 6 %. There is a considerably deep clay subsurface formation (could be more than 50 m) and its permeability is found to be 3.5×10^{-8} in a vertical direction and 3.8×10^{-8} in a horizontal direction. A further deep aquifer lies at the depth of 80 m.
Social Environment			
There is a solid waste disposal site in Rincon Verde, 5 km from the site along the same access road. Local transportation will be affected by increased number of vehicles.	There is a small power generation plant about 2 km from the site. Local transportation will be affected by increased number of vehicles.	There are not found any particular public facilities near the site. Local transportation will be affected by increased number of vehicles.	There are an international Benito Juarez Mexico City Airport at 5 km distance.

a. Ecology

Adverse impacts on ecology by a landfill project might be potentially found in four candidates sites and no preference for any sites can be concluded at this moment. Further examination would be necessary.

b. Hydrology

In the Naucalpan site flows an intermittent stream El Muerto, and there are other several permanent rivers (Hondo, San Mateo, Los Remedios, San Javier, Tlalnepantla and Tepatlaxco) and intermittent streams (Blanca, Caliente, Chiluca, and Sifon). In fact, the region is of high hydrological importance in the country in terms of the volume of surface runoff. Besides, it should be noted that because of the excessive human activities, the land does not have much capacity to retain surface runoff.

A permanent river Agua Caliente flows near the Huixquilucan site. Its depth fluctuates between a few centimeters and one meter throughout the year. Therefore, although it is permanent, it will not have any major significance to the regional hydrological system.

The Ixtapaluca site presents an interesting hydrological feature: although its elevation is high, there are neither rivers nor streams around the site. This is largely because of the high permeability of the area.

The ex Lake Texcoco area, in which the BP-V is located, was susceptible to flooding historically, but because of this, extensive hydrological work has been implemented and well managed by the CNA.

c. Geology and Hydrogeology

In the area of the Naucalpan site, an aquifer is very deep. The nearest well is found 5 km east from the site. Besides, several water springs are found, for example in Mazatla (3 km northwest), Santiago Tepallazco (3 km southwest), and San Mateo (2 km southeast). Together with the hydrological character of the area stated above, the aquifer underneath will be a rich water body to be protected, although the present actual hydrological use is limited and only found at a distance. Although there is a superficial clay layer with a depth of about 2 m, the overall permeability is not very low, hence environmental effects on the aquifer should draw attention.

Relatively low permeability is also an anxiety for the Huixquilucan site. The low runoff coefficient also suggests relatively high infiltration of water into the soil, and higher risk of groundwater or soil contamination as a consequence. Moreover, the nearest well is located at 5 km away from the site and the direction of its flow is estimated to be northeast. The hydrogeological feature of strata below the depth of 30m is not yet known, but because it is reported that the quality of groundwater is good enough for any purpose of water use, site development should be planed with prudent precaution.

The proposed area in Ixtapaluca can be divided into five from the hydrogeological point of view, but two of these predominate in terms of surface area. One of them has permeability of 1.0×10^{-6} - 1.8×10^{-8} while the other 3.6×10^{-3} to 9.7×10^{-7} cm/sec. The large range of permeability at this site is brought by the variation of underground gravel sizes. Considering that the water always seeks the most permeable path by its

nature, the most highest value, i.e. an order of 10^{-3} , should be taken into account. It is presumed, however, that the low permeability is mainly attributed to gravel near the surface which is now extracted as construction materials.

Hydrogeology of Bordo Poniente differs significantly from that of the other three. First, there is a superficial aquifer which contains very high salinity and limits the commercial value of the site. Secondly, a subsurface formation of clay with a depth of 50 m or more lies under the superficial aquifer. Permeability could be at the order of 10^{-5} when fissures exist, but it is generally as low as 10^{-8} cm/sec. Therefore the likelihood of groundwater contamination in the aquifer further down to 80 m should be very small.

d. Social Environment

There are neither historical places nor cultural properties near every site. All the candidates but the Naucalpan site do not have public facilities which are within an influential distance.

Near the proposed Naucalpan site, there exists a Rincon Verde disposal site which is used by the municipalities of Naucalpan de Juarez and Jilotzingo and this fact may result in serious consequences. If the new Naucalpan disposal site were constructed independently of the Rincon Verde disposal site, the access roads would serve for two disposal sites, thus there would be massive traffic congestion. Moreover, the waste-pickers and the recyclables traders who are now working in the Rincon Verde disposal site might intrude on the operation of the Naucalpan site. If the two disposal sites were to be integrated to one, the new site had to absorb the waste-pickers and the traders in the Rincon Verde disposal site, or had to firmly exclude them from there. In the former case, social conflicts between them and those currently earning from wastes of the DF could be severe. The latter case might end up with the unemployment of the poor.

As for traffic, the Naucalpan, Huixquilucan and Ixtapalupa sites will have a large increase in transport, which could affect other local activities. The BP-V site, on the other hand, should not encounter major change in traffic condition.

D.3.4 Economic Feasibility

Economic feasibility evaluation is, in essence, to estimate whether expenditure for construction is worthwhile to invest and how much financial burden will be imposed on the authority for the construction, operation and maintenance of the disposal site. Accordingly, evaluation components will include the following.

- Landfill capacity: The more the landfill capacity is, the more the project will be economical in general.
- Access road condition: The construction or rehabilitation of the access road to let large trailers go in both directions could be considerably costly.
- Distance of waste transport: This is a determinant of the cost for waste haulage.
- Availability of covering soil: Covering soil is one of major input for operation, thus requiring constant expenditure.

Table D-4 is the summary of the economic feasibility evaluation.

Table D-4: Evaluation of Economic Feasibility

Naucalpan	Huixquilucan	Ixtapaluca	BP-V
Landfill Capacity			
About 5.5 million m ³ .	About 10 million m ³ .	About 30.4 million m ³ .	About 27.4 million m ³ .
Access Road Condition			
The last two km is not paved, narrow and bumpy. Extensive repair work is required.	A new access to the current Autopista will be needed or the unpaved road currently used by trucks to transport extracted construction material can be upgraded.	The road condition is fair, but the last section of about 4 km may not be wide enough for two-way traffic of the large trailers. There is another paved road which is currently used by trucks to transport extracted construction material. This will also require the expansion work.	Current road condition is mostly sufficient and requirement for additional road work is minimal.
Distance of Waste Transport			
19.9 km	18.5 km	28.4 km	13.4 km
Availability of Covering Soil			
Covering soil can be supplied from the site itself and its surrounding area.	Covering soil can be supplied from the site itself.	Covering soil can be supplied from the site itself.	Covering soil will be supplied from Magdalena and Chimalhuacan towns.

At present, the amount of waste which has to be disposed of at the final disposal site is approximately 4.6 million tons per year, corresponding to 5.75 million m³ assuming that waste density is 0.8. Therefore, the service lives of the four sites are roughly estimated at 1.3, 2.1, 6.5, and 6.0 years, respectively in the order shown in the table. The economic feasibility of first two sites will be significantly small unless the landfill capacities are greatly expanded.

With regard to the investment requirement for access road development, it will be huge for the Naucalpan site, moderately large for the Huixquilucan and Ixtapaluca sites, and negligibly small for the BP-V site. There could be a case where road development for the final disposal site attracts other productive activities, hence contributes to overall economic growth, but the first three sites are presumed not to be such case from the observation of those areas.

In order to estimate the distance of waste transport, the center of weight balance of the DF's wastes was obtained first by using the coordinates of the transfer stations of the DF and the waste amount handled there. The center of balance was then positioned at 19° 23'16" north and 99° 01'47" west. The distance from the center of balance to the candidate site, shown in the above table was then calculated and considered to be the distance of waste transport for the comparison purpose. The result suggests that the BP-V has an advantage over the Naucalpan and Huixquilucan sites, and the Ixtapaluca site with significant disparity. It is noteworthy that the cost for transport is the major component of operation and maintenance costs for a final disposal site.

The BP-V site can not supply covering soil by itself, while the other three sites can do so *in situ* thus have an advantage. The cost for covering soil at the BP-V is, however,

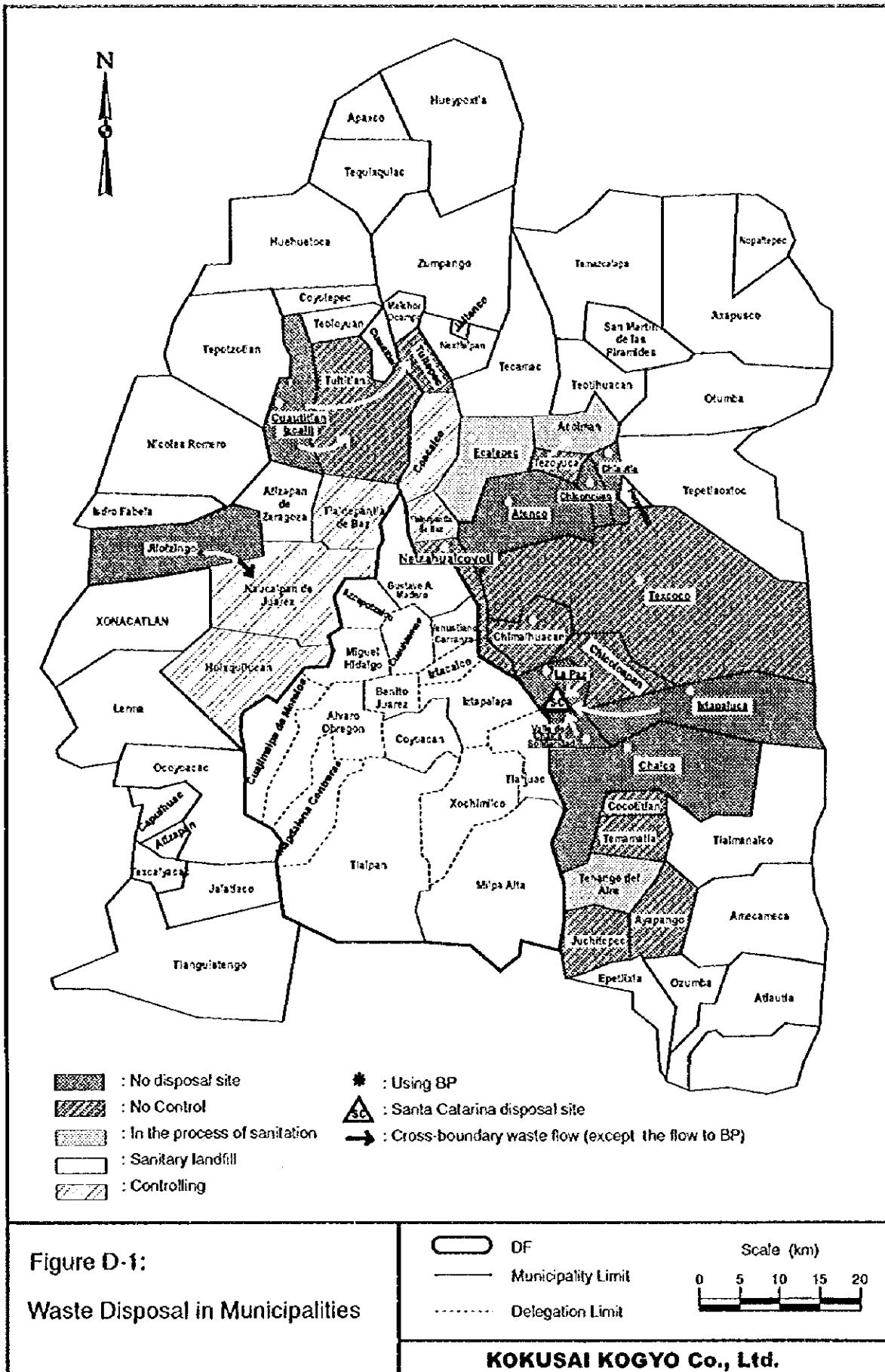
a considerably small portion of total operation and maintenance cost. Therefore the advantage of the other three should be minimal.

D.3.5 Regional View to be Considered

Finally, implications for the municipalities in the State of Mexico which might be given by the construction of a new final disposal site should be considered. Figure D-1 shows the situation of waste disposal in the municipalities surrounding the DF. What should be pointed out are as follows.

- Currently 11 municipalities in the State of Mexico use the Bordo Poniente final disposal site to dispose of all or part of their wastes. Understandably enough, most of them are close to Bordo Poniente and all of them but Netzahuallcoyotl do not have their own landfill sites.
- On the other hand, municipalities within the eastern Metropolitan Zone which do not bring their wastes to the final disposal sites of the DF do have their waste disposal sites, and most of them are managed fairly well.
- Most of municipalities within the western Metropolitan Zone which do not use the DF's final disposal sites have their disposal sites, but they are not well controlled.

Considering such geographical feature of SWM in the Metropolitan Zone, placing a new final disposal site at a long distance from the present one (i.e. Bordo Poniente) can pose critical effects on not only SWM and but also whole economy and society of municipalities in the eastern part of the Metropolitan Zone. Hence, the long-term planning of SWM with thorough examination from a regional view point is inevitable.



D.4 Overall Evaluation

The comparative evaluation performed above is summarized in Table D-5.

Table D-5: Comparative Evaluation of the Candidate Sites

Comparative Evaluation Items	NJ	HXQ	IXT	BP-V
1. Possibility of Land Acquisition	XX	XX	XX	-
2. Possibility of Neighborhood Consensus	XXX	X	X	-
3. Environmental Acceptability				
i. Natural resources	=	=	=	=
ii. Hydrology	XX	X	-	-
iii. Geology and Hydrogeology	XX	XX	XXX	X
iv. Social environment	XXX	X	X	-
4. Economic Feasibility				
i. Available Capacity for Landfill	XXX	XX	X	X
ii. Cost for Access Road	XXX	X	X	-
iii. Operation and Maintenance Cost	XX	XX	XXX	X
Overall Evaluation	not recommended	3rd preference	2nd preference	1st preference

Notes.

- : No or very limited disadvantage
- = : Uncertain
- x : Minor disadvantage
- xx : Major disadvantage
- xxx : Significant disadvantage

Conclusion is as the following.

- The Bordo Poniente Etapa V is the most preferable site for final disposal of solid waste mainly due to the reasons below.
 - ♦ Land acquisition will not see particular difficulty. This can further be facilitated by proposing the return of the land of the Bordo Poniente Etapa I, II and/or III to the CNA.
 - ♦ Neighborhood consensus will be easier than in the others which have or may have residential areas near the access road.
 - ♦ Geological, hydrological and hydrogeological characteristics of each site suggests that potential impacts on the environment and society at the BP-V site will much smaller than those at the other candidate sites.
 - ♦ The BP-V site has an absolute economic advantage.
- The Ixtapaluca site could be used as the next final disposal site if the following are fulfilled.
 - ♦ Urban development around the site does not obstruct the development of the final disposal site.
 - ♦ Costs for land acquisition, construction or rehabilitation of the access road, and long-distance waste transport are ensured to be acceptable for society.
 - ♦ Detailed hydrogeological study reveals that hydrogeological effect is minimal or can be reduced to be minimal by technical measures not entailing excessive cost.

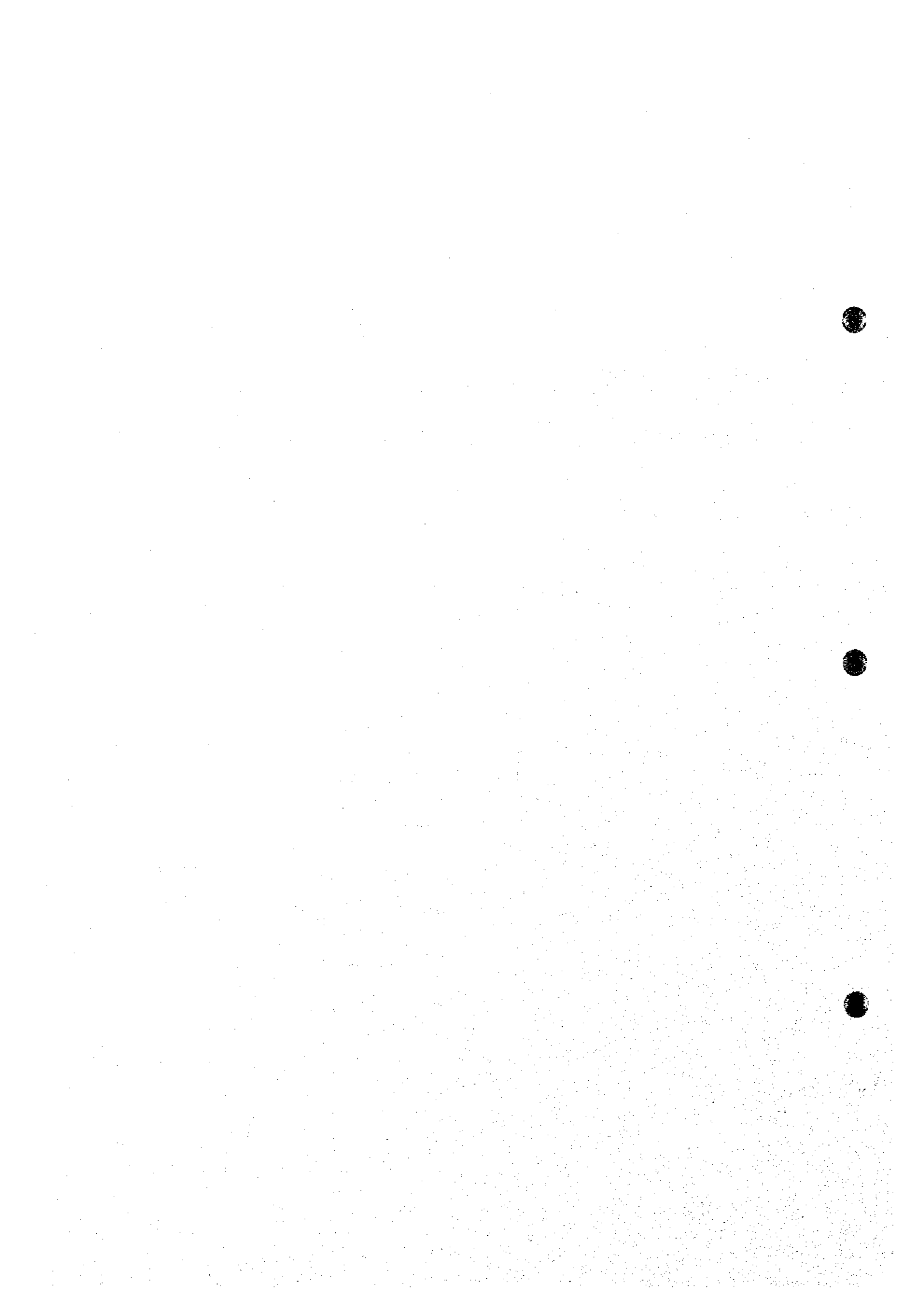
- ◆ The study on rainfall catchment behind the site proves that the volume of inflow and runoff into the disposal site does not affect the leachate collection system.
- The Huixquilucan site has a subsequent possibility to be used as a final disposal site if the following are fulfilled.
 - ◆ Urban development around the site does not obstruct the development of the final disposal site.
 - ◆ Costs for land acquisition, construction or rehabilitation of the access road, long-distance waste transport are ensured to be acceptable for society.
 - ◆ Much higher landfill capacity than previously stated is proved to be available.
 - ◆ Detailed hydrogeological study reveals that hydrogeological effect is minimal or can be reduced to be minimal by technical measures not entailing excessive cost.
 - ◆ Detailed hydrological study shows that effects on subsurface water bodies is minimal or can be reduced to be minimal by technical measures within acceptable costs.
 - ◆ A comprehensive planning process is followed taking account of long-term SWM of entire Metropolitan Zone (with a particular attention to municipalities whose SWM heavily relies on the Bordo Poniente final disposal site) with the involvement of all relevant entities.

It should be noted, however, that when the regional use of a landfill is concerned, the Huixquilucan site can possess a potential benefit for SWM of the eastern Metropolitan Zone.

- The Naucalpan site is hardly recommended to be used as a final disposal site for the following reasons.
 - ◆ The impact on the population along the access road will be enormous and has to be compensated with huge expense.
 - ◆ Compared to such compensation cost and other financial requirement for the development of the site and the access road, the landfill capacity is far small.
 - ◆ Considerable efforts will have to be made in order to work out the potential social conflicts among people who gain their livelihood by handling wastes.
 - ◆ A comprehensive planning process has to be followed taking account of long-term SWM of entire Metropolitan Zone (with a particular attention to municipalities whose SWM heavily relies on the Bordo Poniente final disposal site) and it requires all competent entities to be involved.

Annex E

Setting up Planning Frameworks for the Master Plan



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E Setting up Planning Frameworks for the Master Plan

E.1 Scope of Planning Frameworks for the Master Plan

According to the relevant legislation in Mexico, the responsibility of the collection of municipal waste rests with the delegations, which correspondingly carry out the actual works of waste collection.

Considering the facts that the DGSU is in a position to supervise and assist those delegations regarding waste collection and that this M/P is the one for SWM by the DGSU, the M/P should focus on SWM components incumbent on the DGSU.

On the other hand, the GDF and the Section 1 signed an agreement in July 1998 that the Section 1 would withdraw its waste collection service from primary schools, parks and markets in early 1999. Further, each delegation was appointed as a responsible body to manage the waste collection service for those institutions, or hereafter "Sub-System", which will operate independently of the conventional collection system of Section 1 (Figure E-1).

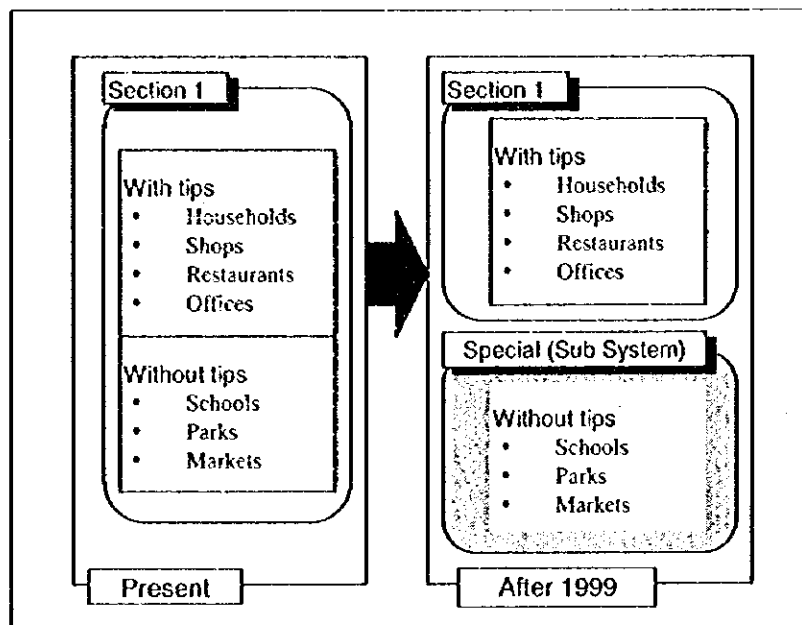


Figure E-1: Change in the Collection System

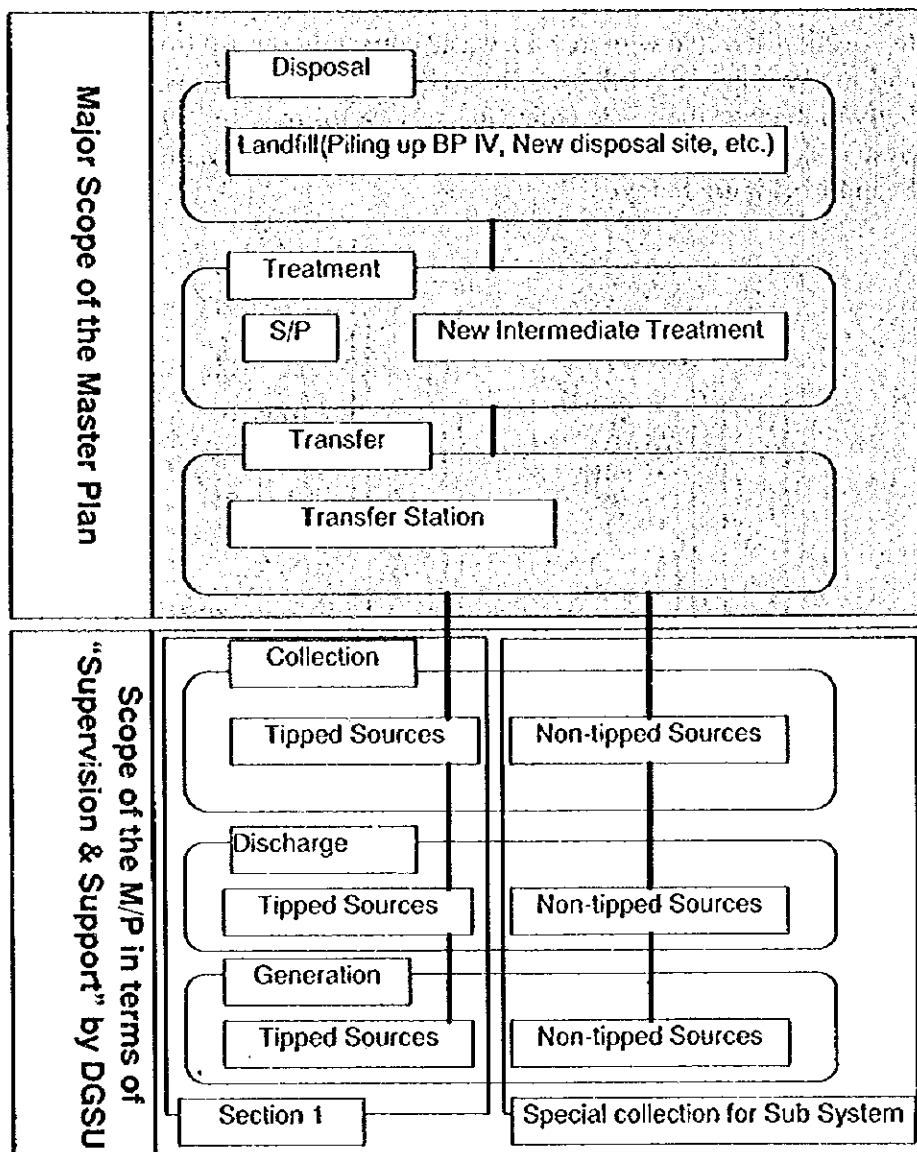
As a result, a new type of waste collection, sub-system, is to be established in SWM of the GDF, which allows unrestricted suggestions on the collection method irrelevant to the issues of Section 1.

What the delegations are in charge of will not be explored deeply since the M/P should be prepared for the municipal SWM by the DGSU. The introduction of source separation and separate collection is, however, inevitable taking into account the fact that the GDF's SWM is required to achieve the following.

- Waste minimization to cope with the limited capacity of the final disposal site, and
- Promotion of recycling in order to efficiently utilize natural resources and save the environment.

Therefore, the M/P will not formulate a plan of source separation and separate collection at the delegation level. Instead, it attempts to give a picture of how the waste discharge and collection system should be and examine what steps should be taken by the DGSU for this purpose. Besides, the regional use of the final disposal site involving the State of Mexico will be considered in respect of the future shortage of the final disposal site for the GDF.

Consequently, the major study scope field of the M/P is defined as shown in Figure E-2.



BP: Bordo Poniente final disposal site

Figure E-2 :Scope of the M/P

E.2 Goals, Targets and Strategies

E.2.1 Goals and Targets Year

a. Goals

The principal goal of the Master Plan is to establish a sound Solid Waste Management System by the target year 2010 in Mexico City, where the population and major economic activities of the country are centered.

The Master Plan aims to:

- ◆ promote the citizens' well-being;
- ◆ implement sustainable SWM; and
- ◆ contribute to environmental conservation.

The goals in practice of the Master Plan are as follows:

1. The improvement of public health and the reduction of health hazards in and around the city will be a primary task of the SWM, in order to promote the citizens' well-being.
2. As sustainable SWM services is required as the duty and mandate of the GDF, the GDF should expedite:
 - cost-effective SWM from technical improvement;
 - cost-effective SWM from institutional/legislative improvement; and
 - cost-effective SWM administration by GDF.
3. As the environmental conservation through SWM is today's requirement, the GDF should expedite the following:
 - public should be encouraged to be more environmentally aware of waste minimization.
 - environmental conservation through "reduction", "recycling" and "recovery" of waste should be promoted by the GDF; and
 - SW treatment and disposal facilities should be operated not to pollute the environment.

In other words, for example, well-being of citizens will be indirectly achieved by providing cost-effective SWM services to the citizens, meanwhile, a "beneficiary-pays-principle (under which recipients pay for the services)" has to take root in the citizens' value. These will improve the cost-consciousness of the citizens and induce "waste minimization at source" by each citizen, and it consequently will also contribute to the environmental conservation.

4. Meanwhile, as part of the goal of the M/P (citizens' well-being), well-being of all those who work for SWM should also be reminded in the formulation of the M/P.

b. Targets

In accordance with the S/W of the Study, the target year for master plan is set up as follows:

Master Plan: Year 2010

E.2.2 Examination of the Master Plan Framework

a. Basic Alternatives

The three alternatives shown in Table E-1 were examined in series of discussion between the team and counterpart to establish the M/P framework.

Table E-1: Basic Alternatives for the M/P

	Purpose	Basic concept	Outline	Result
ALT 1	Social welfare for ex pepenadores	No change	No change in present situation.	No improvement
ALT 2	Financial benefit	Cost saving	Closure of the S/Ps	<ul style="list-style-type: none"> • DGSU will save operation and maintenance cost for the S/Ps. • Increased landfill amount.
ALT 3	Material recovery, resources conservation and reduction of disposal amount	Improvement of recovery efficiency	Improvement of waste input condition of the S/Ps. <ul style="list-style-type: none"> • Improvement of input waste quality (by introducing "source separation" and "separate collection" systems). • Reduced input amount Improvement of recovered material market system <ul style="list-style-type: none"> • Storage mechanism to adjust supply to demand in the market. 	<ul style="list-style-type: none"> • Material recovery and resources conservation. • Reduction of disposal amount

Alternative 1 does not involve any changes or improvement in the current system.

Alternative 2 aims to financial benefit not by investing into the construction of new facilities but by closing the S/Ps, which do not make any revenue of the GDF at an expense of about 100,000,000 pesos (1997)¹. On the other hand, this alternative will encounter such problems as below:

- Social problems of unemployed S/P workers.
- Increased waste disposal amount.
- No resource conservation.

Therefore, Alternative 2 is not acceptable.

¹ Cost in 1997 amounted to 107,718,000 pesos according to *Costos de los Servicios Urbanos* (DGSU, 1997).

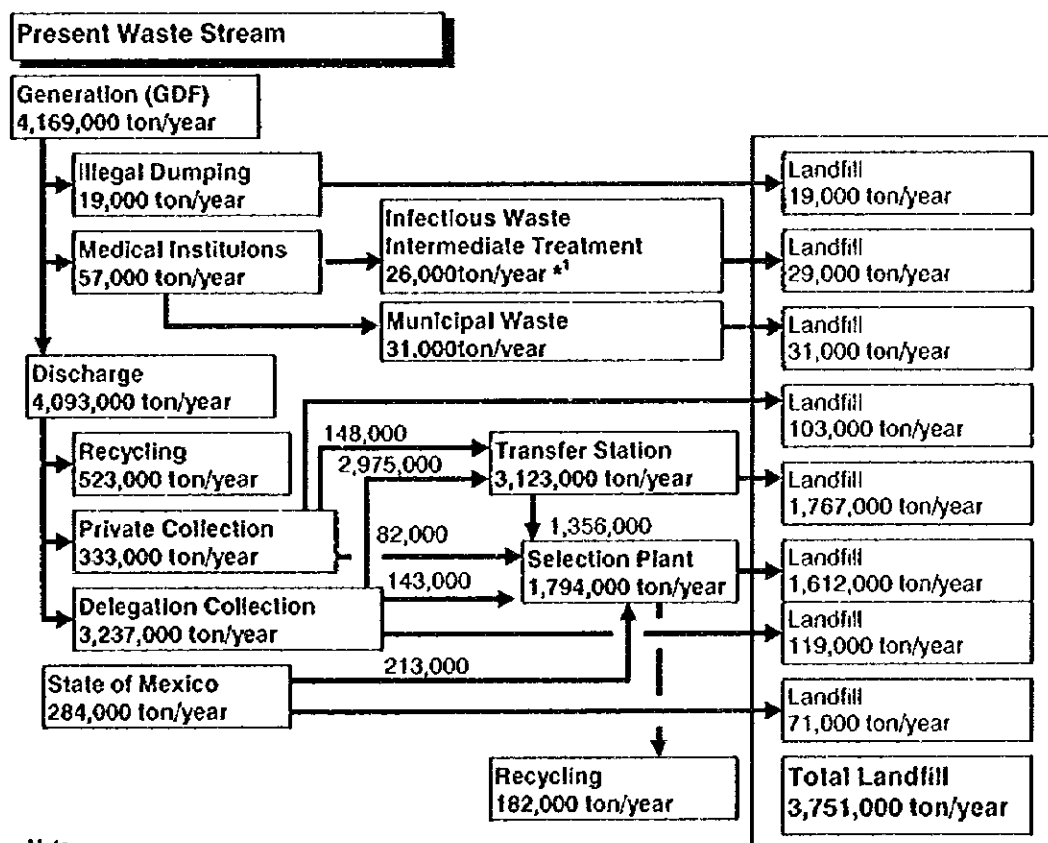
Alternative 3 has to be associated with changes in waste discharge, collection and transportation systems, but will reduce the waste disposal amount and render the SWM of Mexico City more sustainable.

Taking the goals of the M/P described in the previous section into account, the framework of the M/P (i.e. the SWM Outline in the target year 2010) should be formulated in line with Alternative 3.

b. Basic Concept

b.1 Discharge System

Figure E-3 illustrates the present waste stream, in which materials are recycled at the generation source, in the process of mixed waste collection and in the S/Ps. Although it is estimated that potentially recyclable materials account for 37% of the total waste generation, material recovery rates are only about 14% in the collection process and 4% in the S/Ps of the total generation.



Note:
*1: Increase of 3,000 ton/year due to the treatment agents.

Figure E-3: Present Waste Stream

Sustainable SWM requires the promotion of material recovery and the minimization of waste amount to be disposed of. These, in turn, inevitably necessitate separate waste discharge at source and separate collection.

Nevertheless, separation of waste at source indicates additional burden on the waste generators, who are currently paying tips for collection service. Therefore, it is necessary to progressively carry out environmental education for the waste generators so that they will appreciate its importance for the environment such as resource conservation and adapt themselves to separate discharge.

Meanwhile, the special collection of the sub-system is going to start in 1999 for such places as markets, primary schools, parks and housing complexes of institutions through the sub-system. The success of separate discharge is highly anticipated in the sub-system since these waste generators are:

- not paying tips for waste collection at present, and
- some of those which have cooperated the separate discharge and collection program by the DGSU since 1996 and achieved 92% separation rate in 1998, thus supposed to be ready for separate discharge.

It follows that separate discharge is to be introduced step by step into the sub-system aiming at 100% separation rate in 2004 in the M/P.

On the other hand, "source separation" program is to be introduced in later years to the generators whose waste collection services are currently provided by the delegations more gradually with due attention by making use of experience gained in the sub-system aiming at 50% separation rate by 2010.

The separate discharge and collection program in the M/P is presented in Figure E-4.

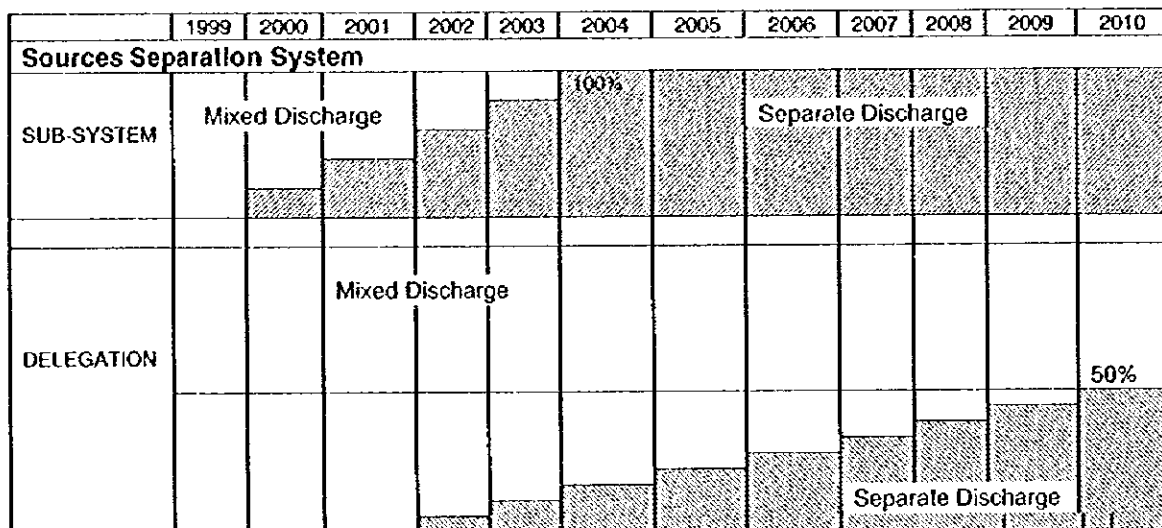


Figure E-4: Separate Discharge and Collection Program

b.2 Treatment and Disposal System

The sub-system will involve the Central Market (*Central de Abasto*) and public markets, which generate a great amount of organic wastes. On the assumption of

separate waste discharge, a practicable treatment of organic waste will have to be introduced.

Regarding the S/Ps, in order to raise the material recovery rate, measures to efficiently recover materials from mixed wastes and/or separately discharged recyclable wastes will be figured out in the M/P.

b.3 Target Year for Feasibility Study

The year 2004 is set as the target year for the F/S, when separate discharge rate in the sub-system will reach 100%.

E.2.3 Targets and Strategies

a. Target Figures

In order to achieve the principal goals, the target figures for the major components that constitute SWM were set as indicated in the table below.

Table E-2: Target Figures for the SWM System

		Present (1997/98)	F/S (2004)	M/P (2010)
Generation Amount (ton/year)		4,169,000	4,302,000	4,430,000
Source Separation	Sub-system	0(%)	100(%)	100(%)
	Delegation	0(%)	14.5(%)	50(%)
Separate Collection	Sub-system	0(%)	100(%)	100(%)
	Delegation	0(%)	14.5(%)	50(%)
Separated Waste S/P Input Amount	Sub-system	0	247,000 (ton/year)	253,000(ton/year)
	Delegation	0	191,000(ton/year)	591,000(ton/year)
New Intermediate Treatment	Sub-system	0(%)	100(%)	100(%)
	Delegation	-	-	-
Final Disposal Amount (ton/year)	Sub-system	0	302,000	308,000
	Delegation	3,407,000	2,738,000	2,624,000
	Medical Institution	60,000	61,000	62,000
	State of Mexico	284,000	284,000	284,000
	Total	3,751,000	3,385,000	3,278,000

b. Strategies

Strategic actions to achieve the goals and targets should be, in practice, introduced step by step toward the target year 2010. Therefore, it is recommended to divide the period up to the target year into three phases, as shown in Table E-3, Table E-4, Table E-5 and Table E-6.

- Phase 1: Short term improvement (1999 to 2001)
- Phase 2: Medium term improvement (2002 to 2004)
- Phase 3: Long term improvement (2005 to 2010)

Table E-3: Recommended Alternative for the Strategies in Phase 1 for the Master Plan (1999-2001)

	Technical Aspects		Institutional Aspects	
	Sub-system	Delegation	Sub-system	Delegation
Discharge/Storage	<ul style="list-style-type: none"> Promoting public awareness of separate discharge (3 items) through environmental education. Implementation of a pilot project of source separation (3 items). Phased introduction of source separation (3 items). 	<ul style="list-style-type: none"> Preparation and implementation of a pilot project of source separation (2 items). 	<ul style="list-style-type: none"> Preparation of the Code for the Solid Waste Management at the Sources 	
			<ul style="list-style-type: none"> Implementation of the Code 	
Collection	<ul style="list-style-type: none"> Implementation of a pilot project of separate waste collection (3 items). Phased introduction of separate waste collection (3 items). 	<ul style="list-style-type: none"> Formulation of a M/P for separate collection (2 items) in each delegation. 	<ul style="list-style-type: none"> Contract out to Private Sector 	<ul style="list-style-type: none"> Examine conditions for institutionalizing Section 1 into Private entities
TS & Tr.	<ul style="list-style-type: none"> Installation of weighbridges for every station. Utilization of a single common format for data compilation. Establishment of a transport monitoring and control system (for 3 flows)¹ based on accurate incoming/outgoing weight measurement. 		<ul style="list-style-type: none"> Contract out 	
S/P	<ul style="list-style-type: none"> Experiment of operation modification (by reducing input amount reduction and lowering lines velocity) to incorporate an objective of quantity oriented picking, although the present objective may be sustained and more important. Experiment of "storage system" for recovered materials to cope with market prices fluctuation. 		<ul style="list-style-type: none"> Examination of Concession (Examine conditions for institutionalizing Ex-pepenadores Groups into Cooperatives) 	
NIT ²	<ul style="list-style-type: none"> Design and construction. 		<ul style="list-style-type: none"> Investment by the DGSU Establishment of quality standards for the product <p>1st Priority Financing</p>	
Final Disposal	<ul style="list-style-type: none"> Establishment of leachate collection and re-circulation system in the Bordo Poniente "Etapa IV". Vertical expansion at the Bordo Poniente "Etapa IV". Design and construction of a new landfill site. 		<ul style="list-style-type: none"> Investment by the DGSU for BP-IV and BP-V <p>1st Priority Financing</p>	

Note: This Table shows alternatives proposed by the JICA team which will be subject to further examination by the GDF.

1) 3 flows refer to waste flows from the transfer stations to the S/Ps, from the transfer stations to the final disposal sites, and from the S/Ps to the final disposal sites.

2) NIT: New Intermediate Treatment

Table E-4: Recommended Alternative for the Strategies in Phase 2 for the Master Plan (2002-2004)

	Technical Aspects		Institutional Aspects	
	Sub-system	Delegation	Sub-system	Delegation
Discharge/Storage	<ul style="list-style-type: none"> Promoting public awareness of separate discharge (3 items) through environmental education. Phased introduction of source separation (3 items) aiming at 100% coverage in 2004. 	<ul style="list-style-type: none"> Promoting public awareness of separate discharge (2 items) through environmental education. Phased introduction of source separation (2 items). 	-----	<ul style="list-style-type: none"> Implementation of the Code for the Solid Waste Management at the Source
Collection	<ul style="list-style-type: none"> Establishment of separate collection methods (3 items). Phased introduction of separate collection (3 items). 	<ul style="list-style-type: none"> Phased introduction of separate collection (2 items). 	<ul style="list-style-type: none"> Contract out to Private Sector (Preparation of Concession and Permission) 	<ul style="list-style-type: none"> Preparation of Concession/Permission (Formalize the Section 1 as private entities with necessary funding) <p>2nd Priority Financing</p>
			<ul style="list-style-type: none"> Preparation of the criteria to fix the tariffs* and subsidies 	
TS&T	<ul style="list-style-type: none"> Utilization of the transport monitoring and control system (for 5 flows¹⁾) based on the accurate incoming/outgoing weight measuring Efficient transport allocation by the monitoring and control system 		<ul style="list-style-type: none"> Contract out 	
S/P	<ul style="list-style-type: none"> Implementation of operation control (input amount control and lines velocity control) with 2 objectives of: (a) revenue oriented picking; and (b) quantitative picking, and (a) may be less important than (b). Establishment of "storage system" for recovered materials to cope with market prices fluctuation, in view of experiment results. 		<ul style="list-style-type: none"> Preparation of Concession (Formalize the Ex-pepenadores Group as Cooperatives with necessary funding) <p>2nd Priority Financing</p> <ul style="list-style-type: none"> To negotiate the implementation of improvements at the S/P conditioned at the institutionalization of ex - pepenadores as cooperatives or another appropriate juridical form 	
NIT	<ul style="list-style-type: none"> Starting operation of the new facility. 		<p>Examination of four options:</p> <p>A. Status quo (DGSU)</p> <p>A1. DGSU direct operation</p> <p>A2. Contract out operation</p> <p>B. Parastatal</p> <p>C. Concession</p> <p>and preparation for B or C if it is chosen.</p>	
Final Disposal	<ul style="list-style-type: none"> Starting operation of the new facility. 		<p>Examination of three options:</p> <p>A. Status quo (DGSU)</p> <p>A1. DGSU direct operation</p> <p>A2. Contract out operation</p> <p>B. Parastatal</p> <p>and preparation for B if it is chosen.</p>	

Note: This table shows alternatives proposed by the JICA team which will be subject to further examination by the GDP.

* Tariff: Price of the service that the citizen pays to the concessionaire

1) 5 flows refer to additional waste flows from the transfer stations to the NIT and from the NIT to the final disposal sites, and current 3 flows.

Table E-5: Recommended Alternative for the Strategies in Phase 3 for the Master Plan (2005-2010)

	Technical Aspects		Institutional Aspects	
	Sub-system	Delegation	Sub-system	Delegation
Discharge/Storage	<ul style="list-style-type: none"> Continuation of promoting public awareness of separate discharge (3 items) through environmental education. Maintaining 100% coverage on source separation (3 items) 	<ul style="list-style-type: none"> Promoting public awareness of separate discharge (2 items) through environmental education. Further introduction of source separation (2 items) aiming at 50% coverage in 2010. 	-----	-----
Collection	<ul style="list-style-type: none"> Maintenance and/or improvement of the separate collection methods (3 items). 	<ul style="list-style-type: none"> Further introduction of separate collection (2 items). 	<ul style="list-style-type: none"> Concession/Permission to Private Entities To approve and monitor the tariffs* 	<ul style="list-style-type: none"> Start Concession/Permission
TS & T	<ul style="list-style-type: none"> Utilization of the transport monitoring and control system (for 5 flows)¹⁾ based on the accurate incoming/outgoing weight measurement. Efficient transport allocation by the monitoring and control system. 		<ul style="list-style-type: none"> Contract out 	
S/P	<ul style="list-style-type: none"> Implementation of operation control (input amount control and lines velocity control) with the major objective of "quantity oriented picking". Utilization of the optimum "storage system" for recovered materials to cope with market prices fluctuation. 		<ul style="list-style-type: none"> Concession 	
NIT	<ul style="list-style-type: none"> Operation and maintenance of the new facility. 		One of the four options: A. Status quo (DGSU) A1. DGSU direct operation A2. Contract out operation B. Parastatal C. Concession and preparation for B or C if it is chosen.	
Final Disposal	<ul style="list-style-type: none"> Operation and maintenance of the new facility. 		Three options: A. Status quo (DGSU) A1. DGSU direct operation A2. Contract out operation B. Parastatal and preparation for B if it is chosen.	
Special Considerations: <ul style="list-style-type: none"> Regional use of the future final disposal sites Examination of wastes volume reduction technologies (such as incineration) 				

Note: This table shows alternatives proposed by the JICA team which will be subject to further examination by the GDF.

* Tariff: Price of the service that the citizen pays to the concessionaire

1) 5 flows refer to additional waste flows from the transfer stations to the NIT and from the NIT to the final disposal sites, and current 3 flows.

Table E-6: Institutionalization Alternative for the M/P

	Waste Flow	Institutionalization Flow	Phase 1	Phase 2	Phase 3	
			1999 - 2001	2002 - 2004	2005 - 2010	2011 -
Sub-system		↓	Contract out to Private Entities	(Preparation of Concession) Contract out to Private Entities	Concession to Private Entities	Concession to Private Entities
Collection	↓		Examination of Concession (Examine conditions for institutionalizing Section 1 into private entities)	Preparation of Concession/Permission (Formalize the Section 1 as private entities with necessary funding) 2nd Priority Financing	Start Concession and Permission to Private entities	Concession and Permission
S/Ps	↓		Examination of Concession (Examine conditions for institutionalizing Ex-pepenadores Grous into Cooperatives)	Preparation of Concession (Formalize the Ex-pepenadores Groups as Cooperatives with necessary funding) 2nd Priority Financing	Concession	Concession
T/Ss and Transport	↓	↑	Contract out	Contract out	Contract out	Contract out
NIT	↓	↑	Investment by the DGSU 1st Priority Financing	A1. DGSU direct operation or A2. Operation contracted out by DGSU. Examination of four options: A. Status quo (DGSU) either A1. or A2., B. Parastatal, and C. Concession and preparation for B or C if it is chosen.	A1, A2, B or C.	A1, A2, B or C.
Final Disposal		↑	Investment by the DGSU 1st Priority Financing	A1. DGSU direct operation or A2. Operation contracted out by DGSU. Examination of three options: A. Status quo (DGSU) either A1. or A2., and B. Parastatal and preparation for B if it is chosen.	A1, A2, or B	A1, A2, or B

Note: This table shows alternatives proposed by the JICA team which will be subject to further examination by the GDF.

E.3 Forecast of Future Waste Amount and Composition

E.3.1 Population Forecast

In order to forecast the amount and composition of wastes which the DF has to deal with in coming years, population in the DF was estimated.

Estimated population for 2010, the target year of the M/P, in the DF and the delegations is as seen in Table E-7.

Table E-7: Population and Population Density in the DF by Delegation

Delegation	Area (ha)	2010	
		Population (persons)	Population Density (persons/ha)
Alvaro Obregon	8,586	731,600	85.21
Azcapotzalco	3,451	455,100	131.87
Benito Juarez	2,750	390,200	141.89
Coyoacan	5,540	755,100	136.30
Cuajimalpa	7,700	184,500	23.96
Cuauhtemoc	3,309	561,400	169.66
Gustavo A.Madero	8,700	1,234,300	141.87
Iztacalco	2,306	431,800	187.25
Iztapalapa	11,940	1,867,100	156.37
M.Contreras	7,004	244,600	34.92
Miguel Hidalgo	4,764	383,300	80.46
Milpa Alta	27,820	91,200	3.28
Tlahuac	9,300	326,600	35.12
Tlalpan	31,200	684,000	21.92
V.Carranza	3,442	488,900	142.04
Xochimilco	12,740	375,900	29.51
Total DF	150,552	9,205,600	61.15

As the tables show, the total population of the DF in 2010 will amount to 9,205,600, with the population density of 61.15 person/ha.

The DF's population growth from 1997 to 2010 is, therefore, 7.5%, which is equivalent to the annual average growth of about 0.6%.

E.3.2 Assumptions for Waste Amount Forecast

Waste amount which is to be covered by the waste stream of the DF was forecasted.

Assumptions for the waste amount forecast are as follows.

- Waste generation units for sectors were as shown in the results of study on waste generation amount by the DGSU in 1997.
- Future waste amount from households was obtained from the waste generation units and projected population shown above.
- The increase in numbers of establishments (such as offices, market and hotels), their employees and/or other related parameters was obtained by assuming that

it is proportional to the population growth from 1997 to 2010, and used to estimate the future waste generation from those establishments.

- The waste amount from the municipalities was assumed to be proportional to their population. As for the future waste stream, all whose waste were supposed to be simply disposed of at the final disposal site of the DF since the introduction of source separation in those municipalities is very unlikely.

E.3.3 Waste Composition

The DGSU has conducted a detailed waste composition survey. The figures resulted from this survey were presumed to be fairly constant during the concerned period and employed in this study.

Table E-8 gives the classification of waste composition adopted by the DGSU, and also the present study. It should be noted that waste marked with "R" is regarded as recyclable, while the letter "O" represents organic waste.

Table E-8: Waste Composition

Subproductos			
	1	Abatelenguas	Spatula
	2	Algodon	Cotton
R	3	Carton	Cardboard
	4	Cuero	Leather
	5	Envase de Carton	Paper container
O	6	Fibra Dura Vegetal	Vegetable fiber
R	7	Fibra Sintetica	Synthetic fiber
	8	Gasa	Gauze
O	9	Hueso	Bone
R	10	Hule	Vinyl
	11	Jeringa Desechable	Disposable syringe
R	12	Lata	Cans
	13	Loza y Ceramica	Ceramics
	14	Madera	Wood
	15	Material de Construccion	Construction waste
R	16	Material Ferroso	Metal
R	17	Material No Ferroso	Nonferrous metal
R	18	Papel Bond	Paper
R	19	Papel Periodico	News paper
	20	Papel Sanitario	Toilet paper
	21	Panal Desechable	Deposable diaper
	22	Placas Radiologicas	X-ray film
R	23	Plastico de Pelicula	Plastic film
R	24	Plastico Rigido	Hard plastic
	25	Poliuretano	Polyurethane
	26	Poliuretano Expandido	Foamed polyurethane
O	27	Residuo Alimenticio	Food waste
O	28	Residuo de Jardinaria	Garden waste
	29	Toallas Sanitarias	Sanitary napkin
	30	Trapo	Rags
	31	Vendas	Bandage
R	32	Vidrio de Color	Color glass
R	33	Vdrio Transparente	Transparent glass
	34	Residuo Fino	Fine fraction
	35	Otros	Others

In the sub-system, waste separation into three categories, namely recyclable, organic and the other wastes, will be applied. On the other hand, waste separation into two categories, recyclables and the other wastes including organic wastes, will be employed to wastes collected by the delegations. The former is hereafter called "type 3", the latter "type 2", while the current practice is called "type 1". This is summarized in Table E-9.

Table E-9: Source Separation Types

	Outline	Categories of Separation
Type 1	Wastes discharged and collected without separation.	None
Type 2	Wastes separated into two when discharged and collected.	Recyclable Others
Type 3	Wastes separated into three when discharged and collected.	Organic Recyclable Others

E.3.4 Future Waste Stream

The waste amount of each component in the future waste stream was considered for three alternatives (see Table E-10).

Table E-10: Alternatives Formulation

Alternative 1	No change in present waste stream
Alternative 2	The S/Ps are closed.
Alternative 3	Source separation partly introduced.

a. Alternative 1

Alternative 1 is a scenario where the present practice will persist. Figure E-5 presents the waste stream in 2010 for Alternative 1. As this figure shows, waste generation amount in the DF will be 12,136 ton/day, representing 6.5% increase compared to the 1997 level, and waste transported from the municipalities of the State of Mexico will be 777 ton/day. From the total of these, 2,048 tons/day will be recycled per day. Wastes of 10,871 ton/day are to be disposed of at the final disposal site.

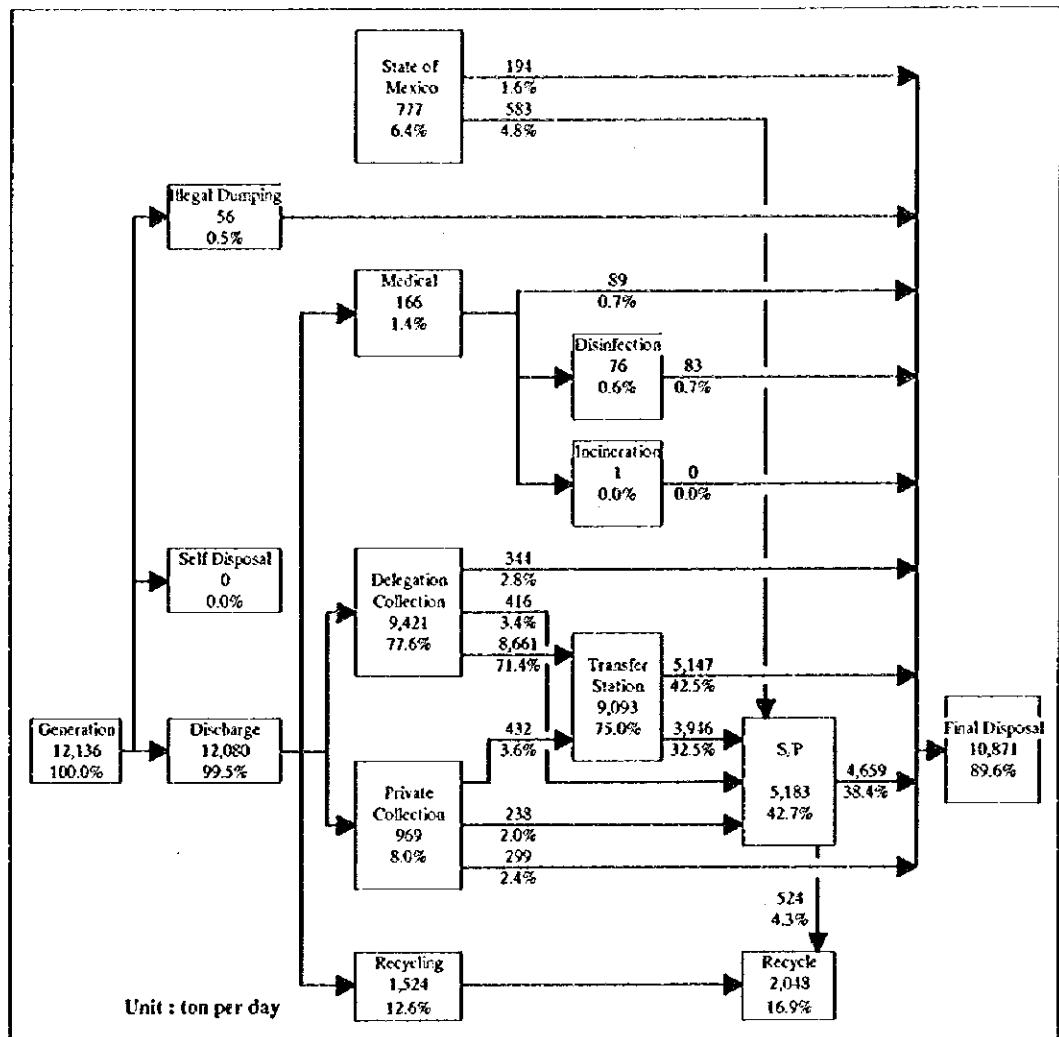


Figure E-5: Waste Stream in 2010 (Alternative 1)

b. Alternative 2

In Alternative 2, all the current S/Ps are to be closed by 2010. Figure E-6 presents the waste stream in 2010 for Alternative 2. The amount of generated wastes is same as Alternative 1, but the recyclable materials are not recovered as in the case of Alternative 1 due to the closure of the S/Ps. Accordingly, more wastes has to be disposed of at the final disposal site.

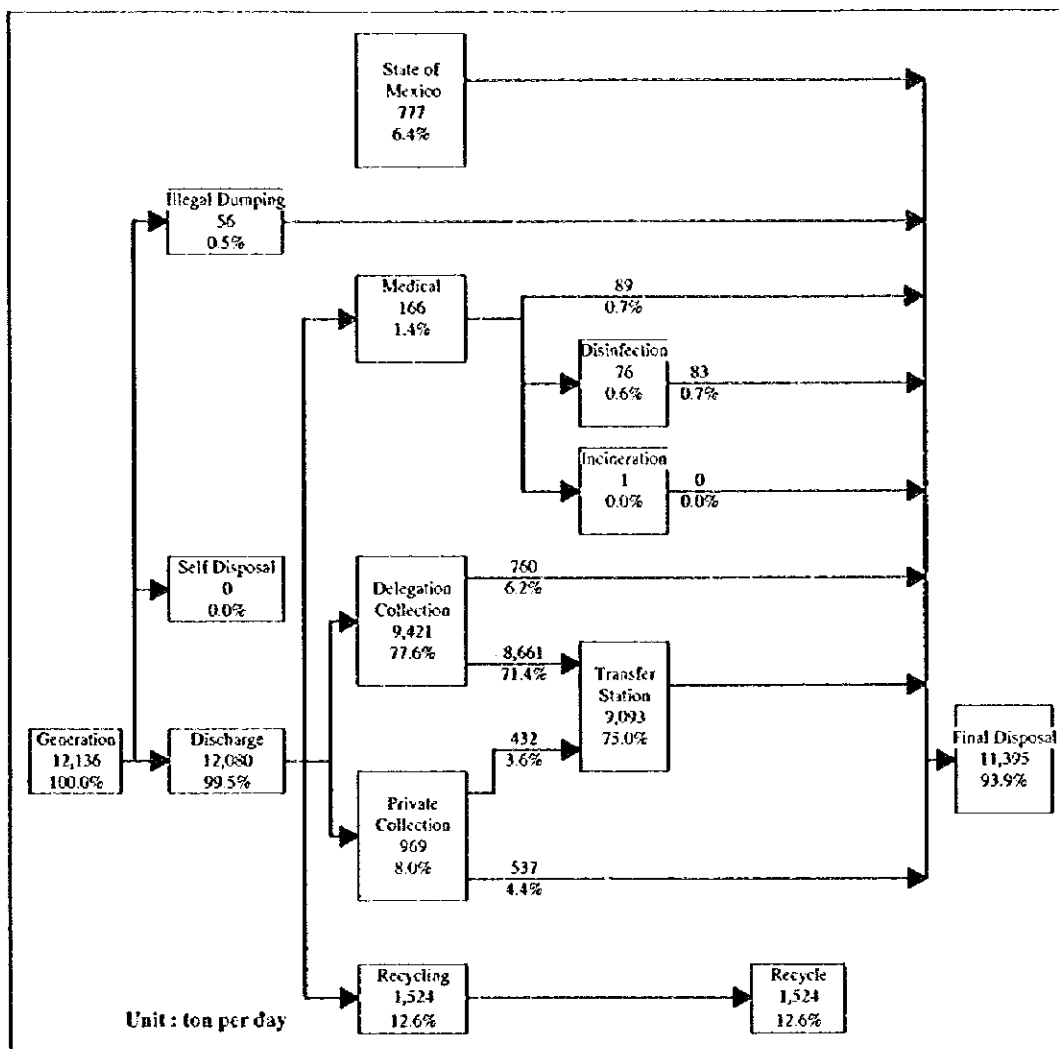


Figure E-6: Waste Stream in 2010 (Alternative 2)

c. Alternative 3

In Alternative 3, it is supposed that the sub-system is introduced to public facilities such as schools and markets which are to be excluded from the delegation's collection. As already mentioned, the sub-system will employ source separation of type 3 shown in Table E-9. Regarding the other wastes, which the delegations continue to collect, type 2 separation will be employed for half of those wastes.

The facilities to be covered by the sub-system will be the following.

- Housing complex of institutions.
- Markets (including the Central Market (*Central de Abasto*)).
- Primary schools.
- Institutions.
- Green areas (such as parks and cemeteries).

Alternative 3 was examined on the following assumptions.

1) Sub-System

- Wastes are discharged and collected according to their three categories.
- The ratio of recyclables to the total wastes obtained by the DGSU in their study of 1997 can be used to estimate the amount of recyclable wastes.
- The ratio of organic wastes to the total wastes obtained in the said study by the DGSU can also be used to estimate the amount of organic wastes.
- The recovery ratio of recyclable materials at the S/Ps is 70%, considering the experiences of other recycling plants and the fact that the wastes to be fed to the plants should be rich in recyclables due to the source separation.
- The weight decrease rate at the compost plant is 50%, although this could be higher, considering the experiences of other recycling plants. In fact, such decrease will require about two months, but this time lag can be neglected for the current study purpose.

2) Delegation's Waste Collection

- The amount of wastes to be collected by the delegations is given by subtracting the amount of medical wastes and wastes covered by the subsystem from the total waste amount.
- The recovery ratio of recyclable materials during the collection process is the same as the 1997 level (i.e. 12.8%).
- Separate collection into two categories is applied to half of the wastes collected by the delegations.
- The ratio of recyclables to the total wastes obtained by the DGSU in their study of 1997 is valid to estimate the amount of recyclable wastes.
- Wastes which are not separated and discharged together with recyclables are not fed into the S/Ps.
- The recovery ratio of recyclable materials at the S/Ps is also 70%.

The amount of the waste stream of 2010 was then calculated as seen in Figure E-7. The total waste amount of 12,136 ton/day does not change for all alternatives.

The key figures are as follows.

- Medical waste amount: 166 ton/day
- Waste handled by the subsystem: 2,423 ton/day
- Waste collected by the delegations: 9,547 ton/day
- Waste transferred from the municipalities to the DF: 777 ton/day
- Waste disposed of at the final disposal site: 8,986 ton/day

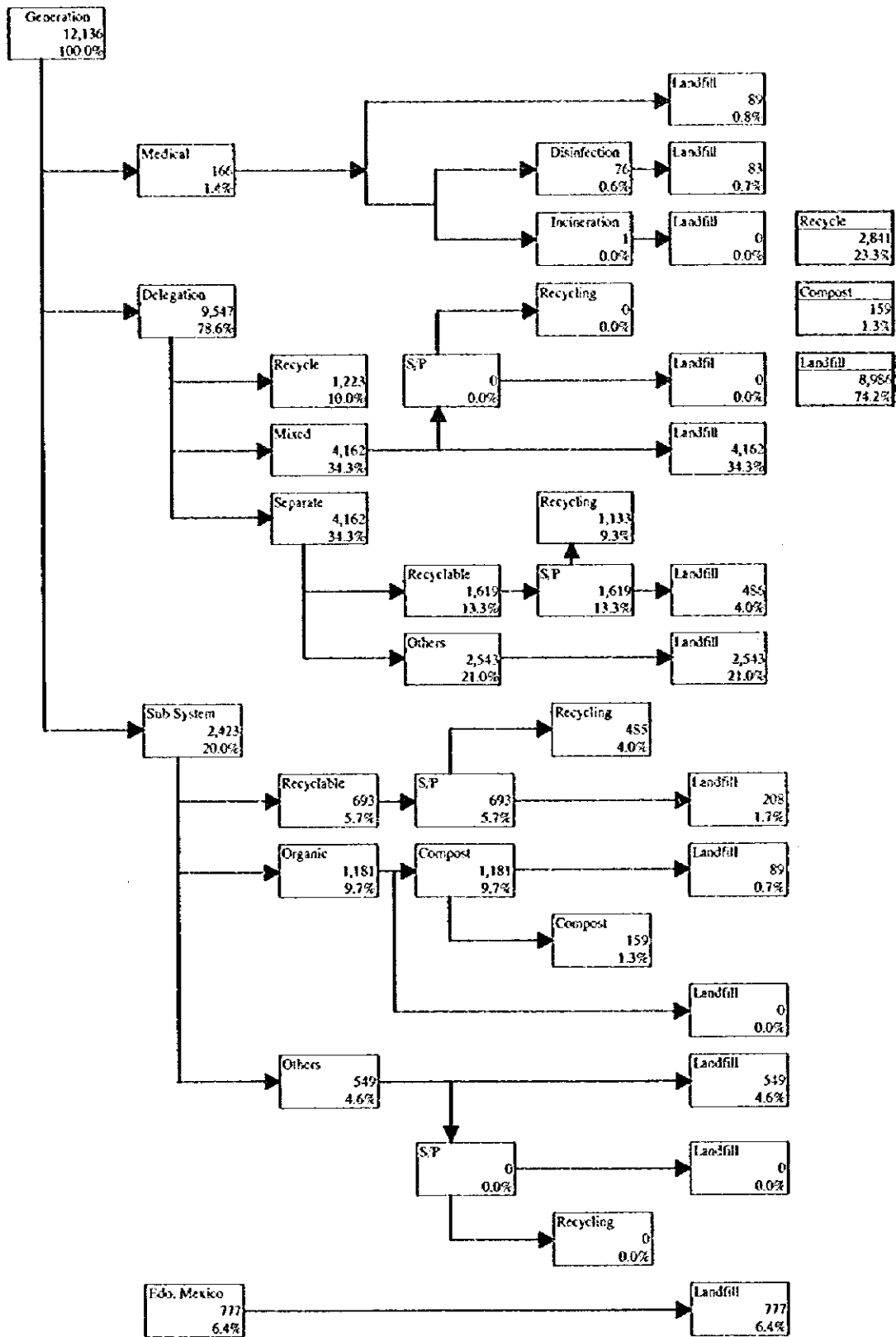


Figure E-7: Waste Stream in 2010 (Alternative 3)