Table 4-2 Vehicle Number in 2010

Zone	Trip no.		Alt.1				Alt.2				Alt.3			
	SCS	HCS	SCS Veh	SCS Trip/ Veh	HCS Veh	HCS Trip/ Veh	SCS Veh	SCS Trip/ Veh	HCS Veh	HCS Trip/ Veh	SCS Veh	SCS Trip/ Veh	HCS Veh	HCS Trip/ Veh
I	30	35	19	1.6	10	3.5	19	1.6	11	3.2	16	1.9	7	5.0
II	53	21	32	1.7	6	3.5	34	1.6	6	3.5	28	1.9	5	4.2
III	47	12	25	1.9	4	3.0	23	2.0	4	3.0	22	2.1	3	4.0
IV	40	15	25	1.6	5	3.0	25	1.6	5	3.0	23	1.7	4	3.8
V	14	4	9	1.6	2	2.0	10	1.4	2	2.0	9	1.6	2	2.0
VI	38	32	24	1.6	9	3.6	24	1.6	10	3.2	23	1.7	8	4.0
VII	18	4	10	1.8	2	2.0	13	1.4	2	2.0	9	2.0	2	2.0
Tot.	240	123	144	1.7	38	3.2	148	1.6	40	3.1	130	1.8	31	4.0

In light of the above results for Alt. 1, a second location for the incineration plant at S/W was studied under Alt. 1b. Under Alt. 1b. it was possible to reduce the number of compactor and haul container vehicles down to 133 and 31 vehicles. A proposal by the Counterpart team to locate the incinerator at Serdika, north of the central station is also expected to contribute to decreasing costs. But the Study Team visited that site and concluded that no sufficient area or access roads are available to accommodate inflow of waste collection vehicles.

4.3 Vehicle Operating Costs

Vehicle operating costs were calculated for the 24 districts, under each alternative, as a summation of the following costs:

- Fuel and oil costs
- Salaries (SCS: driver + 4, HCS: driver)
- Maintenance and garage overhead (40% of vehicle cost/number of usable years)
- Depreciation (8 years)

The results of the calculation are shown in Table 4-3.

Table 4-3 Vehicle Operation Costs in 2010

Dist.	Alt. 1a	Alt. 1b	Alt. 2	Alt. 3	1993	Alt.1b/ 1993
1.SRED	294	226	321	226	528	0.4
2.KSEL	304	214	343	214	379	0.6
3.VAZR	295	295	295	288	414	0.7
4.OBOR	282	241	282	263	435	0.6
5.SERD	334	329	334	334	317	1.0
6.PODU	351	351	351	285	398	0.9
7.SLAT	239	301	349	286	405	0.7
8.IZGV	308	308	328	308	441	0.7
9.LOZN	302	273	358	273	347	0.8
10.TRID	303	228	346	228	548	0.4
11.KPOL	327	263	327	263	324	0.8
12.ILIN	362	268	362	268	329	0.8
13.NADZ	317	317	317	317	313	1.0
14.ISKR	292	348	348	292	355	1.0
15.MLDT	282	366	366	282	413	0.9
16.STDN	321	346	346	321	399	0.9
17.VITS	286	191	368	191	381	0.5
18.OVKU	366	256	366	256	370	0.7
19.LYIN	323	351	352	351	292	1.2
20.VRAB	333	333	333	333	322	1.0
21.NISK	375	375	375	375	420	0.9
22.KREM	408	409	409	409	468	0.9
23.PANC	454	471	471	439	746	0.6
24.BANK	477	477	477	477	343	1.4
	318	307	348	296	387	0.8

Note: Alt. 3 and 4 have the same figures

Calculations of the present voc were calculated based on different conditions for depreciation (vehicle costs were depreciated) and trip lengths. However it is possible to achieve a 20% overall reduction when applying Alt. 1b. This achievement results from the decreased vehicle number brought about by efficient use of vehicle capacity. In the case of Alt. 3, reduction of the 1993 voc by 27% is possible.

One important feature of the 1993 voc figures by district was the high fluctuation. In the case of Alt. 1b (Figure 4-3) the

fluctuations, which are not as wide as the 1993 figures, may be explained by the districts' proximity to the incinerator plant location with those closer having lesser costs. Vitosha district is an obvious example. Another interesting feature is the sharp reduction in unit rates for some districts such as Triadiste. where the use of Meva containers only increases the cost significantly at present. The master plan's shift to Ra containers in this district significantly improves vehicle utilization and decreases costs. Another interesting feature is the increase in unit rate in Lyulin district under the master plan compared to the present. As explained in Chapter 3 of this report, Lyulin district's vehicle utilization is very efficient and therefore there was little room for improvement. On the contrary, introduction of new vehicles and the consequent high depreciation costs incurred contributed to making the Alt. 1b. unit rate higher in that district.

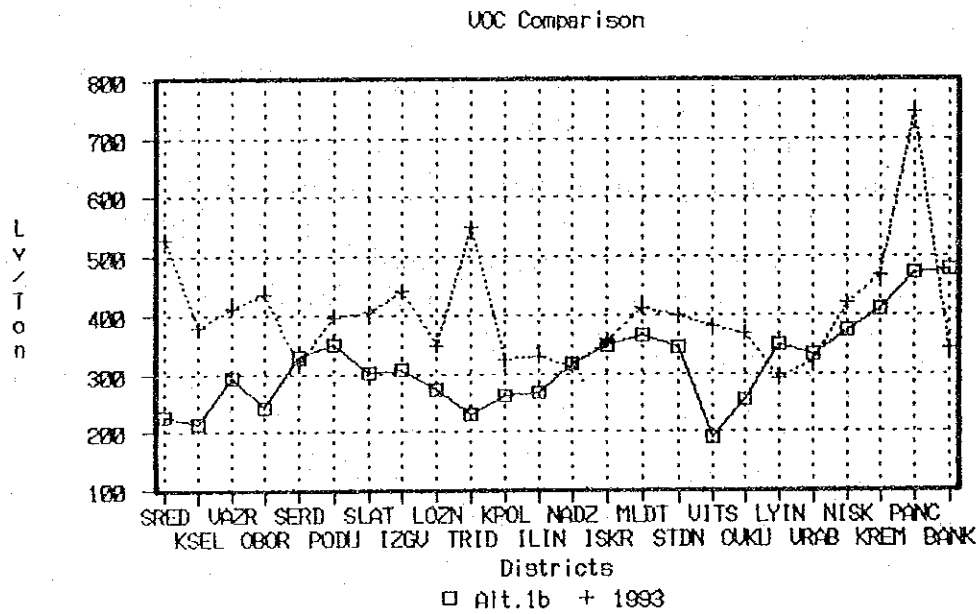

Figure 4-3 VOC in 1993 and for Alternative 1b.

(4) Secondary Haulage

(1) General

Presently all municipal waste is collected and transported directly to the disposal sites by the same vehicles without going through any intermediate transfer stations.

The 24 districts are collecting waste and transporting it directly to disposal sites at Suhodol and Dolni Bogrov. For 15 of the districts average distance to disposal site is between 15 and 25 km. Pancharevo district (No.23) is the farthest from the disposal site (44 km) and this may explain the high cost for waste collection and transport in 1993 for that district.

In line with the new disposal site proposed at Katina the master plan will examine the necessity of construction of intermediate transfer facilities to maximize the use of vehicles and reduce vehicle operating costs.

Secondary haulage refers to the transport of waste from the intermediate facility in Alt. 3 and 4 (and ash from the incinerator in Alt. 1) to Katina disposal site. Alt. 2 has no secondary haulage.

(2) Transport Mode and Equipment

In the past a single railway line used to run up to the Katina quarry from the central station. This line would have offered an interesting possibility of transporting the waste into Katina by rail after situating transfer stations at locations suitably located along the railroad. However after a careful field survey it was found that the line does not exist anymore and its right of way has been invaded upon along most of the stretch. Therefore this option was not considered any further.

Waste from Koriata and S/W and ash would be transported by road to Katina in the year 2010 as follows.

- Alternative 1:
  Transport of Ash: 90 t/day
  Truck: Number 3, Capacity 10m^3, Max. wt. 8t
  Trips/day: 5 per vehicle

- Alternative 3:
  Transport of compacted waste (550 t/m^3), amount: 899 t/d
  Truck: Tractor 9, Trailer-container 16 (40 m^3, 25 t)
  Trips/day: 41 trips/shift

- Alternative 4:
  Transport of compacted waste (850 t/m^3), amount: 899 t/d
  Truck: Tractor 8, Trailer-container 14 (40 m^3, 25 t)
  Trips/day: 36 trips/shift

The waste transported from intermediate facilities in Alternatives 3 and 4 shall be via the outer ring road. This route is not the shortest to Katina but is considered the most suitable due to the heavy vehicle loading and to avoid traffic problems. Distances from Koriata and S/W to Katina are 35 and 28 kilometers respectively.

(5) Conclusion

In terms of collection and primary haulage Alternatives 3 and 4 are the least expensive. When secondary haulage cost is added, then Alternative 1b. becomes the least expensive, followed by Alternative 4.

Table 4-4 summarizes the voc for the primary and secondary haulage in terms of Lv/ton.

Table 4-4 VOC in the Year 2010

	Alt.1a	Alt.1b	Alt.2	Alt.3	Alt.4
I. PRIMARY TRANSPORT					
Lv./Ton	318	307	348	296	296
II. TOTAL PRIMARY AND SECONDARY TRANSPORT					
Lv./Ton	324	311	348	318	314

Therefore comparing the master plan alternatives together from collection and haulage point of view, Alt.1b is the most cost effective.

Compared with the present collection and haulage cost which was calculated to be 390 Lv/Ton based upon the 1993 survey for one week, and the unit cost for the same year based on the 1993 BKC expenditures for this service of 425 Lv/Ton (Volume II, Chapter 2) all the master plan alternatives contribute to reduction in cost.

CHAPTER 5

COST ESTIMATION FOR PRIORITY PROJECT

5. COST ESTIMATION FOR PRIORITY PROJECT

5.1 Collection and Haulage Priority Project Cost

1) Basis for Cost Estimates

In 1995 the fleet is proposed to be completely formed of the existing vehicles. Therefore existing system for calculating vehicle operating costs employed by SGM was used to calculate the costs of the older vehicles used during the five years.

Vehicle depreciation costs represent a very low share of the total due to the depreciated costs of the vehicles at present used in the BKC calculations. Salaries were calculated for a driver and four crew members. Fuel/oil costs were calculated based on distance to be covered and existing prices. About 45% of the salaries, fuel/oil and depreciation prices were set aside for maintenance and repair costs.

In the case of new vehicles, depreciation costs formed a large portion of the cost as the purchase price of the vehicles was used over an 8 year period (vehicle usable period). Maintenance and repair costs were calculated at 40% of the vehicle purchase cost divided by number of usable years. Fuel/oil costs were calculated based on actual distances between depots, collection routes and disposal site. Salaries were calculated based on the manpower requirements.

Costs were calculated annually and by collection zone.

2) Annual Operating Costs

Annual operating costs were calculated using July 1993 prices for fuel & oil, and salaries (Table 5-1).

Costs were calculated by collection zone. In terms of unit cost (Lv/Ton) suburban zones VI, VII and VIII were the highest. This is explained by the combination of large compactor vehicles and meva containers used in these zones. This, and the relatively long distances the vehicles have to travel to disposal sites and depots, makes it impossible for a vehicle to make more than one trip per day.

In actual terms, the collection and transport costs for these three zones combined is just over a quarter of the total costs. There is an imbalance when compared to the population share of these three zones (about 15% in 2000). But due to

the nature of the zones housing (predominately single or semi-detached unit dwellings) Meva containers are the more suitable of the three container types proposed for SGM. Also calculations using smaller capacity vehicles still show that it is difficult to achieve two trips per shift.

Table 5-1 Annual Vehicle Operating Costs

ITEM	1995	1996	1997	1998	1999	2000
1)WASTE COLLECTED(TON)	368624	382384	396657	411464	426823	442753
2)TOTAL COST (1000Lv)	129676	124019	138058	150584	165606	166757
- Fuel & Oil	30651	25228	25241	26694	27178	27666
- Salary	59240	52844	50194	51478	52433	53388
- M & R	37357	33580	35724	35919	32683	20432
- Depreciation	1131	10878	25104	34611	51225	63240
- Other	1297	1488	1795	1882	2087	2030
3)UNIT COST (LV/TON)	352	324	348	366	388	377
- Zone I Central	469	451	484	509	540	547
- Zone II North	293	257	275	289	307	295
- Zone III East	288	272	292	307	326	317
- Zone IV South	316	275	295	311	329	313
- Zone V West	263	250	269	283	300	295
- Zone VI Suburban	511	462	495	521	552	535
- Zone VII Suburban	490	510	547	575	610	595
- Zone VIII Suburban	646	563	604	635	674	617
4)COST BY ZONE(1000Lv)	129675	124018	138058	150584	165606	166757
- Zone I Central	16943	16900	18813	20520	22567	23354
- Zone II North	16132	14629	16285	17763	19534	19486
- Zone III East	14964	14666	16327	17808	19585	19760
- Zone IV South	26261	23718	26403	28798	31671	31187
- Zone V West	20135	19925	22181	24193	26607	27108
- Zone VI Suburban	15065	14129	15728	17155	18867	19155
- Zone VII Suburban	10407	11218	12488	13621	14980	15446
- Zone VIII Suburban	9767	8833	9833	10725	11795	11261

Unit rate in Central Zone I is also comparatively high, and this is due to the more costlier lower capacity compactor vehicles used there. In the case of this zone, unlike the suburban zones both larger and smaller capacity vehicles can make two trips per shift and therefore larger vehicles would be more cost effective. But the nature of the areas narrow

streets and on-street parking encourages the use of smaller compactors. The estimation assumes a maximum of two trips/shift but under strict supervision and a good collection routing system it may be possible to achieve three or maybe even four trips per shift. As the new collection system takes hold and efficiency levels improve operation of more than two trips per shift is recommended. This will reduce vehicle operation costs.

Figure 5-1 shows a graphical presentation of the annual cost breakdown by item.

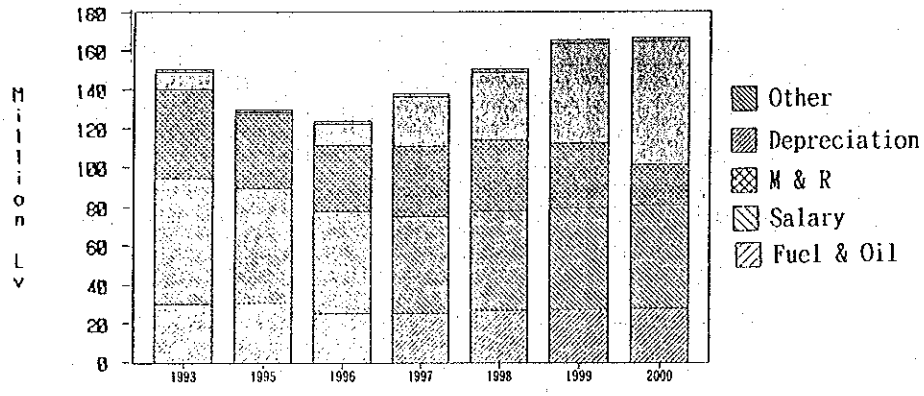

Figure 5-1 Vehicle Operating Cost Breakdown

As newer vehicles are gradually introduced maintenance and repair costs will decrease, and depreciation costs increase. Total cost in 1996 will fall, compared to 1995 but gradually rise thereafter. This is due to the fall in vehicle number because of commencement of new large capacity compactor vehicles introduction.

Finally based on the figures shown in Table 5-1, waste collected in 2000 will increase by 1.2 times the respective amount in 1995, while total cost will increase by 1.3 times during the same period. It must be noted that 1995 figures are calculated under the assumption of more efficient utilization of existing vehicles and therefore costs will increase at a more rapid rate than increase in waste amount in 2000. In that year depreciation costs of the new vehicles will contribute to a substantial increase in costs, which will not be offset by the decrease in maintenance and repair costs. But because of the old age of the existing vehicles it is not possible to continue using them and they should be replaced gradually by new vehicles.

3) Cost Comparison with Limitted Improvement and Do-nothing Cases

Should SGM fail to implement collection and transport improvements as proposed in this study, two scenarios which may evolve are;

- Limitted Improvement Case
  SGM introduces new Faun compactors, as it already has plans to do so, while extending use of existing vehicles to about 10 years. No new collection zones nor rationalization of collection system are introduced.
- Do-Nothing Case
  At the start of 1994, SGM received three medium size compactor vehicles (about 8-10 years old) donated from the Municipality of Paris, and is said to have purchased about 4 similar vehicles (4-6 years old) from Switzerland. This scenario assumes that SGM will continue to operate the collection and transport system very much similarily to the present manner relying on donations or purchase of inexpensive used vehicles.

Operating costs under the limited improvement case were calculated (as shown in Table 5-2) assuming the following conditions;

- Exsiting vehicles will be used for a maximum 10 year period.
- In order to meet the waste haul demand it will be necessary to renew the fleet. Vehicles will be renewed by Faun (5.4t) and Gaz 53KM vehicles.
- For existing vehicles loading capacities are estimated based on 1993 survey results, after deducting about 15% due to vehicle aging.
- Capacities of new vehicles were deducted by 15% to reflect longer time spent on collection routes.
- For new vehicles present trip frequencies were adopted after deduction due to increased distance to disposal site.
- Under priority project 1 compactor vehicle and 1 haul container type vehicle were added to each collection zone as standby vehicles. Under this case, and assuming SGM will be reorganized into 14 districts (plans to reorganize the municipality into a lesser number of districts are presently under study at SGM), then 14 compactor vehicles and 14 haul container type vehicles shall be added.
- Katina disposal site will commence operation in 1997.

Table 5-2 Vehicle Operating Cost in Limited Improvement Case

ITEM	1993	1995	1996	1997	1998	1999	2000
1)WASTE COL.(T)	353889	368624	382384	396657	411464	426823	442753
2)VEHICLES (Total)	319	362	379	372	381	380	391
(1) Existing Fleet							
Bobar	112	107	107	70	50	20	2
Norba	51	30	30	16	16	0	0
RTK	17	17	12	6	6	0	0
GAZ53M	26	20	20	5	5	2	2
GAZ53KM	77	68	68	35	35	15	15
GazTrck	16	18	18	4	4	1	1
Zil	20	20	16	8	8	1	1
(2) New Vehicles							
Faun L	0	38	51	112	136	186	209
GZ53KM(New)	0	44	57	116	121	155	161
3)TOT. COST(1000Lv)	150457	196211	197183	224428	239707	238889	238035
- Fuel	30091	33501	35319	43127	44733	43972	45704
- Salary	64697	83358	85682	78481	80072	77066	78925
- M & R	45137	55999	53245	57609	56163	47305	29846
- Depreciation	9027	21410	20985	42989	56367	68180	81204
- Misc.	1505	1943	1952	2222	2373	2365	2357
4)UNIT COST (LV/T)	425	532	516	566	583	560	538
5)HAUL CAP.(T/D)	1078	1234	1300	1376	1423	1472	1523
- Capacity Surplus	0.95	1.05	1.06	1.09	1.08	1.08	1.08
6)COMPARISON WITH CHIPP (LIMITED IMPROVEMENT/CHIPP)							
- Tot. Cost	NA	1.51	1.59	1.63	1.59	1.44	1.43

In the year 2000, without the priority project an increase of 1.43 times is estimated.

The Do-Nothing case is the worst scenario and there are serious doubts that under it SGM may continue to provide waste collection and transport services for all the city. But it has nevertheless been considered in order to compare operating costs with those incurred under the priority project. Costs are assumed by maintaining the collection unit rate (Lv/Ton) for 1993 in calculating the expenses for the future years, using the waste amounts needed to be collected

in those years. The unit rate does not consider any additional expenses for the purchase of old vehicles, and so actual unit rates inurred will probably be higher. The result of this exercise is shown in Table 5-3.

Table 5-3 Cost Estimate by 1993 Unit Rate

ITEM	1993	1995	1996	1997	1998	1999	2000
1)WASTE COL.(T)	353889	368624	382384	396657	411464	426823	442753
2)UNIT COST (1993) (Lv/Ton)	425	425	425	425	425	425	425
3)TOT. COST(1000LV)	150457	156722	162572	168640	174935	181465	188238
4)COMPARISON WITH CHIPP (DN/CHIPP)							
- Tot. Cost	NA	1.21	1.31	1.22	1.16	1.10	1.13

This case illustrates that even under this do-nothing case, operating costs will be higher than those incurred under the priority project by 1.13 times in 2000. It is necessary to note however that investment costs necessary for implementation of the priority project are not included here, although these costs are represented in the depreciation cost component of the operating costs.

4) Differences between Master Plan and Priority Project

Volume I of the Main Report contains the SWM master plan produced in this study. After submission of the Interim Report in October 1993, which contained the master plan, the Study Team returned to Sofia for executing Phase II. At that time many discussions were held with the counterpart team and other authorities, and a number of additional surveys were conducted.

As a result of these activities various modifications to the master plan were adopted in the collection and haulage priority project. Among these changes are:

- Amount of waste to be collected by the municipality was increased to include non-hazardous industrial waste.
- Collection zones were increased from seven to eight.
- Small size compactors were adopted for Central Zone I.
- Plastic bag containers suggested for the central and suburban zones were replaced by Meva containers.

- Some unit prices were adjusted as follows:
  * Compactor (L) : US$ 95,000
  * Compactor (S) : US$ 70,000
  * HC Vehicle : US$ 15,000
  * Kison container: (LV 15,000)
- Six (6) day working week adopted (instead of 5 days)
- Miscellaneous costs (1-2%) of total costs added to the operating costs.
- Distances from depots to collection routes and disposal site more accurately estimated after determining locations of depots.
- Vehicle operating speeds between depot, disposal site and collection route decreased to 30 Kph based on time and motion surveys during the winter.

These changes have led to increase in operating costs as a result unit prices reported in the priority project (Lv/T) will increase by about 1.25 times those stated in the master plan.

5.2 Disposal Project Cost

Cost estimates in respect of Katina are prepared in respect of:

- Capital Construction Cost
- Purchase of Operational Vehicles and Plant
- Land acquisition, wayleaves and compensation
- Fees and Contingencies
- The Cost of the Novi Iskar Bypass Road
- Operational Costs

The basis of these cost estimates are respectively reported here, and are summarized with the total project estimates and analysis in Volume II of the Main Report.

A detailed cost estimate of the construction of the work at Katina has been prepared and is summarized with the other project costs in the Main Report II. This Section explains the basis of the unit prices and rates used to prepare the figures.

The cost estimates prepared assume that the construction of the Works at Katina will require funding support from a lending agency and that in consequence, an approved consultancy, a formal 'FIDIC Type' contract and a detailed set of designs and specifications will be internationally tendered.

1) Lack of Bulgarian Cost Database

Existing 'official' civil costs data examined was found to date back to the early 1980's when the socialist organizations controlled expenditures and arranged for state supplies to be made to the construction organizations. The data was substantially out-of-date and considered to be barely usable. It could not be used as representative of international competitive bidding costs.

It is only some 3 years or so since a private sector civil contracting industry began to emerge in Bulgaria and in consequence there is no local experience of comparable civil projects.

Accordingly a new data base was constructed of probable cost rates which, together with calculations of quantities, costs and overheads, produced a set of construction cost estimates which could be presented with confidence.

2) Costing Sources and Procedures

To establish the unit costs, use was made of a comprehensive UK 1994 civil construction costs and unit rate analysis database. The data base was the source for elemental cost breakdowns for the various types and items of work required at Katina. Unit cost and rate elemental analysis was then undertaken with particular care made to the working methods and costs in respect of the large-scale earth moving operations necessary @ Katina (around 1,000,000 cu m of soil has to be moved - mostly clay):

- The cost, item by item of related Labor, Plant and Materials for the work
- Imported and Local Materials and Services
- Construction consumables (fuel and spares)
- Probable construction plant likely to be used
- Earthwork haul distances, stockpiles and bulking
- Production and output rates for construction plant
- Temporary works and site reinstatement
- Insurances, and performance bonding
- Services to the Employer and Engineer
- Contracting profits and on costs
- Consultancy and contingencies

In parallel with this work:

(i) A draft 'Bill of Quantities' and outline specification for construction work in the area was issued to, and priced by two firms of local consultants and one constructing organization.

(iii) A firm of solid waste consultants (Infracom) were commissioned to assist with the compilation costs and unit rates.

(ii) Materials prices were sought from local suppliers.

(iv) Cross reference was made to the data used in and the findings of the 1993 IBRD Water sector Study.

3) Data Base Used

A data base comprising some 20 schedules of elementally priced and scheduled quantities was then compiled using figures drawn from the UK data base. Estimated rates were then finalized per item adjusting for the above factors, the Bulgarian situation, the currency exchange (to US$), local labor and material costs, and the standards likely to be specified for the Work

All unit prices, costs and allowances were calculated in Dollars with rates applicable in January 1994.

4) Significant Work Unit Rates

The main costs are those of the deployment and running costs of the contractors plant for the mass earthmoving and the careful drainage and sealing and drainage work on the site. Examples of some of the significant unit contractor's cost rates used are:

- Pumping out the lake water 0.04 $/cu m
- Clearing lake sediments 5.30 $/cu m
- Strip topsoil for reuse 1.32 $/sq m
- Mass earth filling of lake in compacted layers 2.30 $/cu m
- Graded underdrain to site seal 9.13 $/cu m
- Selected clay for site seal 9.00 $/cu m
- Excavate (in depth and stock mass earth from culvert 3.6 $/cu m
- Precast concrete Culvert 403.50 $/lin m
- Prepare cells and dispose of surplus 3.50 $/cu m
- Stabilize access road slopes 10.91 $/cu m
- Imported granular road base 2.28 $/cu m
- Establish tree and bush plants 5.00 $/sq m
- Bird control Measures:
  Set up falconry 210,000 $
  Provide nets 650,000 $

5) Foreign and Local elements

Each scheduled item was additionally analyzed in respect of the currency in which an international contractor would request payment or incur costs. Accordingly, the costs of each item was proportioned in terms of the 'foreign' and 'local' currency for the estimates. The foreign element is seen to be principally in overheads, profit, construction plant (depreciation, spares, service) and imported materials. Fuel is additionally determined as 'foreign'.

6) Operational Spares

The construction provisions costs include the supply, by the construction Contractor, of a stock of additional materials to enable the operating company to be initially self sufficient and establish a reserve base of materials on site from which their roads can be extended and such as gas pipes, drains etc installed as filling progresses.

7) Time based earthwork allowance

The mass earthmoving costs include the 'day work' (ie time-based) provision for 3 months on site of a Mining Engineer, a Geotechnical Engineer, two tracked earth moving excavators, and specialist equipment to enable the burning coal seams to be cut open, extinguished and sealed.

8) Pressure Grouting Allowance

Although not anticipated, a provisional sum of $250,000 has been included should it be decided that after exposing the coal seams, that a selected clay cover may be insufficient and that some pressure grouting should be additionally included to prevent gas migration or re-ignition of the coal.

9) Novi Iskar Sewer Connection

A provisional sum of $ 3,000 has been included to allow for the (unknown) cost of the final connection of the wastewater sewer to the New Novi Iskar sewerage system.

10) Cost Synopsis

The Katina site Construction Contract cost estimate is summarized:

- General Items $ 562,025
- Enlarge and strengthen local public access road $ 296,528
- Mass Earthmoving $ 7,980,489
- Clay seal to Lake area $ 1,836,000
- External drainage connections $ 483,490
- Drainage Water and Leachate systems $ 337,340
- Site roads $ 646,434
- Perimeter Screen and track $ 932,449
- Power and lighting $ 260,442
- Domestic and operational Water supplies $ 134,105
- Administration and entrance control $ 677,495
- Misc. Facilities $ 70,255
- Provide operational Facilities and Equipment $ 1,033,275
- Initial Operational Stock $ 415,622
- Provisional Sums $ 253,000

The above totals to give a project estimate of some $ 15,900,000 for the site construction contract. Of this, the foreign element is appraised as $7,003,000 and the local element as the equivalent of $7,897,000.

10) Operational Vehicles and Plant

Road Vehicles
Manager's Car 1 No @ $ 20,000
Site Van2 No @ $ 15,000
Personnel Bus1 No @ $
30,000 Falconer's Vehicles 2 No @ $ 25,000
Mobile Plant
Waste Compactors 3 No @ $150,000
Dozers/Graders 4 No @ $135,000
Excavators-Tracked 4 No @ $175,500
Dump trucks 6 No @ $ 88,500 Backacting excavator 1 No @ $ 44,250
Dumper (small works) 1 No @ $ 15,000
Tanker 1 No @ $ 60,000

The above provision totals $ 2,232,250

11) Land, Compensation, Etc

Following consultations with the counterpart team, the Land, wayleave and Compensation costs of the Katina development is set at $2,500,000. It is reported that the Land Commission consider that the Site is already the Property of the Municipality.

12) Fees and Contingencies

In line with current works elsewhere allowances are made of 3% for design fees, 5% for supervision and 10% as a contingent addition.

13) Novi Iskar By-Pass Roadway

Although this roadway is due to be completed by the Ministry of Transport, it is never-the-less included in the project costs as, without the construction of the roadway, traffic nuisance to local residents would be severe: Its construction is recommended as essential to the project.

Additionally, the Municipality wish the costs to be presented in anticipation that a prospective funding agency might consider the monies: Some $6,000,000 in 'local equivalent'; as part of their 'local percentage ' contribution to the project.

14) Operating Costs

Based on a the detailed operational plan for landfilling and on projections of the waste quantities and earth cover a year-by-year set of operational estimates have been prepared and are set out in Volume II of the Main Report.

Notable basis of these are:

- Receipt of increasing waste quantities up and until incineration is introduced in 2005: Proportional projections for plant fuel and service and maintenance
- Cover material to be moved proportionally varying from around 351 cu m/day to 406 cu m/day
- Hourly plant operating costs in the range of $1.81 to $4.09 (Eg $3.795 per hour for a Bomag BC601 RB Waste compactor)
- Plant depreciation of 9 years for tracked vehicles and 6 for wheeled site vehicles
- Annual Vehicle and Plant insurance rates of 4% of capital cost
- A corresponding reduction in plant and staff levels in the event of the introduction of incineration
- The inclusion of Bird control contractual costs of $355,000 (foreign Costs) for the first two years and $80,000 thereafter (local costs)
- Annual 'top up' of consumable stocks (road materials, pipes etc) until the latter part of the landfilling period when the allowances necessary for stock purchase falls off as the stocks are drawn down.
- Leachate discharge fees levied by the Sofia Municipal Water Company: Ranging from $3972 per annum in 1999 to $104286 in the year 2010
- Staff salaries and 'add-ons'

15) After care Fund

It is assumed that, in line with EU guidelines, the operating company will require to allocate funds for the long term aftercare of the Site. The current EC requirement is that funds be set aside sufficient for 30 years.

Accordingly, it is assumed that the allowance of some $104,286 per annum should be continued (the 2010 sum for leachate treatment).

CHAPTER 6

ADDITIONAL INFORMATION

6. ADDITIONAL INFORMATION

6.1 Review of Related Studies

Thus, a number of information and data important and useful for the study were collected. Prior to the field survey, a preparatory study was carried out to establish the field survey plan based on the general survey of the study area.

A number of previous studies having relevance to the Study were collected and reviewed by the Study Team, as follows:

1. Solid Waste Management Studies

1) "Evaluation of present waste transport operation and suggestions for new types of household solid waste vehicles and containers for the separate collection of glass and paper in the city center and residential areas". (December, 1992, Eng. Nikola G. Danchev)

Summary: Considering general information on the waste transport system in Sofia and organizational, technical and economic evaluation of existing organization, the strongly decentralized structure of the enterprises and cleaning companies does not guarantee the most effective utilization of the available resources of the system - mechanization, personnel and other resources. In changing the existing organization, the advantages of partial concentration of available equipment were shown. New container types for household waste and separate collection of paper and glass are proposed.

2) "Report on Engineering and Geological Study of Deposit Site for Solid Household Wastes, Sofia, Suhodol, Stage II" (Dec. 1990, Dr. Nikolava, Dr. Parazov, Dr. Radev and Dr. Ahtchiiski)

Summary: The engineering and geological study of the dumping site for the depositing of household solid waste in Sofia, Suhodol was done, after surveys of borehole drilling, sampling of water, laboratory investigation and etc.

3) Preliminary Design of Disposal Site Suhodol II
(1991, Infrakom)

Summary: A second disposal site, Suhodol II, adjacent to the existing site was designed. The site area is 215,000 m^2 and its volume is 2,472,300 m^3, and its operation period is expected to be 3 years and 4 months, according to the forecast amount of solid waste.

4) "Preliminary Design of Candidate Disposal Site, Katina"
(1984, Infrakom)

Summary: A detailed review of the geological characteristics of the Katina Site was undertaken. The review took the form of some shallow bores (15 to 20 m) in the region of proposed new structures, and a comprehensive soils appraisal of existing geological and soils investigation, bore holes and other geotechnical data belonging to the mining company that utilized the site.

5) "Report on results of laboratory tests on waste water composition carried out on samples from the solid waste disposal site -Sofia- 1st stage/Suhodol dumping site"
(1991, Vodokanalengineering)

Summary: This study on laboratory tests on waste water composition from the dumping site for household solid waste, Suhodol, Stage 1 is carried out on a regular basis.

6) "Suhodol Solid Waste Disposal Site Leachate Analysis"
(1993, Vodokanalengineering)

Summary: Since the site was first opened in 1987, only some three sets of sample analyses of the solid waste leachate have been analyzed. These are indicative of containing dilute leachate levels with COD in the region of 3800 to 6300, high Ammonia levels (N) and an alkaline nature probably sufficiently corrosive to represent a risk to the life of the perforated steel underground drainage.

7) "A Study on the Composition of Waste in Sofia"
(1968, National Institute of Hygiene)

Summary: The low content of organic substances in winter as well as the low calorific value makes the waste unsuitable for incineration and the small amount of "useful components" makes it unsuitable for resource recycling. In the other months these reach values which could be termed as satisfactory for their utilization in both processes. It is also appropriate to carry out investigations of the regions having central heating and those without. This could solve the problem of determining the efficiency of the purification plants in winter. Of agrotechnical interest would be the determination of some microelements for their usage in the compost. The question of the deactivation and utilization of the wastes produced in Sofia can be solved after making a comparison with the related technical, agrotechnical and economic data.

8) "Specifications for Incineration Plant"
(1983, Babcock)

Summary: An incinerator with total burning capacity 300,000 t/year (3 units X 15t/h) was designed. However capital cost was considered too large for the Sofia Greater Municipality's budget.

9) "Concept and program for the development of solid waste disposal and utilization in Bulgaria until 2010"
(1989, Committee for the Territorial Development and Urbanization at the Council of Ministries)

Summary: Discussion on the concept for the development of solid waste disposal and its utilization in the Peoples' Republic of Bulgaria up to 2010.

10) "Quantity, Physical and Chemical Composition, and Deactivation of Wastes Generated from Industrial Plants on the Territory of Sofia Greater Municipality"
(1989, Mr. Royachiki)

Summary: Property of the old hazardous waste, and quality, composition and deactivation methods of cyanide containing solid waste, and recommendations for its treatment are studied.

11) "Qualitative and quantitative characteristics of solid household waste in Bulgaria"
(1992, Comunaltechmach)

Summary: Investigation of the composition and properties of the household waste was done for a population of 150,000 to 250,000, 250,000 to 300,000 and over 300,000. Also, forecast for the change in the morphological composition of the solid household waste and the most important physical and chemical properties of the waste until 2005 were given.

12) "Year-book for the state of the environment in the Republic of Bulgaria"
(1990, Ministry of Environmental, Center for Environment Monitoring)

Summary: During the last few decades considerable qualities of waste have been accumulated due to the low degree of utilization of the resources. Statistic show that about 2.1 billion tons of industrial, 2.7 millions tons of household and 9 millions tons of agricultural waste or a total of 21 thousand tons per km^2 have been accumulated. Recycling system was proposed for the reduction of waste generation.

13) "1991-Year-book on the state of the environment (green book)"
(1991, Ministry of Environment, The Laboratory and Information complex)

Summary: The statistical data of solid waste indicated an increase in amount of household waste. Waste disposal in the urban sites has resulted in complicated ecological problems and groundwater pollution. The major portion of waste is landfilled (95%), 4.3% is incinerated, and 0.5% is composted. The introduction of waste monitoring for a chain of generation, collection, transportation, disposal and recycling and the ecological monitoring system was explained.

2. Related Studies

- Population forecasts

1) "Migration and Development of Sofia"
(1993, SGM "Analyses and Forecast" Dept.)

Summary: No decrease in population of Sofia as a result of migration from the city is expected. National growth will be "zero" or negative in the forthcoming 5 years. Existing infrastructure will need proper labor force.

2) "Population Data of Sofia Greater Municipality"
(1993, SGM)

Summary: Statistical data on population in 1992 was shown.

3) "Household Budget (1985-1991)"
(1992, National Statistics Institute)

Summary: Statistical data on total income and expenditure of households during 1985 and 1991 were shown.

- Transportation Master Plan

1) "An updated master plan of the communication and the transport of Sofia up to 2000 year and a phased program for its realization"
(1990, Capital Municipality Architectural and Town Planning Dept. in cooperation with City Com)

Summary: A transportation master plan for Sofia comprising road network plan, public transport plan, and investment plan was developed. Six alternatives for the transportation plan were proposed. Economical evaluation of each plan was made.

- Town Development

1) "Town Development and Municipal Economy"
(1992, National Statistics Institute"

Summary: Statistical data for national level of water supply, sewage, roads, etc. are shown.

6.2 Study Surveys

During two long stays in Sofia, of 3-4 months each in the Summer and Winter periods the Study Team, with the cooperation of the Counterpart Team conducted a number of surveys to grasp the existing conditions.

These surveys were implemented by the various professional and private concerns in Bulgaria, and the Study Team would like to thank them for their dedication in the surveys. These firms are:

- National Center of Hygiene; Team Leader Prof. Al. Spassov
- Institute of Ecology: Prof. Michev
- Vodokanalengineering: Mr. Stoyichev
- STIV 88: Dr. Frangov
- MBMD: Mr. Yanev

The surveys conducted were as follows:

1) Solid waste amount and composition survey (Summer and Winter)
2) Environmental and ecological surveys at existing disposal sites and candidate disposal sites
3) Topographic survey at Katina disposal site
4) Geological survey at Dolny Bogrov and Katina
5) Citizens Awareness Survey of 150 households and commercial concerns
6) Time and motions surveys both in summer and winter

The results of these surveys and the various hearings and interviews conducted were used extinsevly in this study.

6.3 Katina Site Geotechnical Appraisal

6.3.1 Preface

This section describes the initial Environmental Geotechnical Appraisal Work implemented under this Study at the Proposed Katina Landfill Site.

The work has been carried out in accordance with the recommendations of Section R1 of "Geotechnics of Landfills and Contaminated Land", as Prepared by the European Technical Committee. (ETC 8 is referenced ISBN 3-433-01212-8).

6.3.2 Location: Brief Characteristics of the Terrain

The terrain is located around 1 km south-east of the village of Katina, on the left from river Katinska and is an abandoned, open cast coal mine. It occupies an inner area of about 60 ha within a land allocation of 160 ha.

From geomorphological aspect the terrain is situated into the higher upland slopes of the northerly edge of Sofia plain. The highest points of the Site are to the north with an elevation of 622 to 624 m. The lowest site level is to the South at the center of the Katinska river valley at an elevation of 540 m.

The entire site and its surrounds are predominantly artificial with the natural terrain only observable to the North and East from the slopes of the old mine and only in places does the natural terrain remain in this region of the Katinska river valley. All of the rest is a result of the human activity - steep slopes, terraces, landslips, soil subsidence, embankments and dumps, a lake in the middle of the mine.

The inner quarry topography therefore has an unnatural and derelict appearance which is compounded by exposed layers of reddish exposed coal ash and plumes of smoke from burning coals at some places.

Due to lack of top-soil covering, the vegetation is somewhat meager and only on the north-western slopes can the more natural and rich grasses be found. Around the banks of the central lake, at the waters edges, there is swamp vegetation - (noted in the Ecological review).

The difference in levels between the highest point of the north slope and the lake is about 64 m. To the south of the lake, there are large artificial embankments and dumps. These rise to around 17 to 27 m above the lake level. The very lake is approximately 15 m deep.

6.3.3 Main Data Resources

The site appraisal is based on both desk and fieldwork. Initial desk studies and site visits led to the formulation of a programme of supplementary field explorations, geotechnical site borings, hydrogeological appraisals and soils sampling and laboratory tests.

Desk Studies were based on the general area Geological and Hydrogeological regional archives and historical records of the following:

- The original geological coal field investigations by the Bulgarian Committee of Geology in 1954. It was on the basis of these explorations that the two open cast coal mines at Katina were started and these now are represented by the two main lakes on the larger site area. Later, at the end of the 1960's these mines were abandoned as uneconomic.

- This 1954 study contains a wealth of data on the geological and lithological strata because of the extent (coverage and depth) of the boreholes and the pits - within and beyond the bounds of Katina site. 10 deep bores of between 50 to 60 m give an idea of the water capacity and the geological profile. The study (being mainly for coal exploitation) did not include the hydrogeological tests and geotechnical tests which would have been of value for current purposes although some data is available in respect of the coal deposits.

- Geological and hydrological explorations of "Katina" mine - Energoproject, 1982. This former study is a very detailed appraisal of coal deposits under an area of some 0.3 km^2 located south-west of the Katina site on the right bank of Katinska river. The geotechnic & hydrogeological conditions were based on the findings from 16 nos boreholes (depth from 50 to 170 m), 3 well pumping trials, 140 undisturbed soil samples and 32 disturbed soil samples and complete laboratory analyses.

Data from this study was used mainly in respect of the statistical geotechnical soils characteristics and the hydrogeological characteristics of the area.

The geological and lithological data from these two previous investigations used to construct the Sections across the Katina Landfill Site which are under use for the Master Plan and Priority project Studies.

Following the desk studies, a programme of further supplementary Field Work based on ETC 8 was commenced. This was adjusted as the investigations proceeded (in response to the initial findings) and the final scope comprised:

- topographic and geological mapping of site area - 60 ha;
- geological mapping of the site and surrounds;
- 10 exploration boreholes, total length of 206.5 m;
- 15 trial pits, with depth of 2.5 m each;
- 10 nos standard penetration tests (SPT);
- 25 m dynamic probing resistance (DP);
- 5 in-situ permeability tests;
- 21 undisturbed soil samples and 8 disturbed samples for determination of the geotechnical characteristics of the soils;
- 16 soil samples for leachate contact tests;
- 6 soil samples for Roengeno-structural analysis of the clay minerals;
- 14 water samples for determination of the physical, chemical and radiological water quality.

6.3.4 Geological, Lithological and Tectonic Characteristics of the Region

The region around Katina site is composed by rocks of the early Triassic period and deposits of the Pliocene and Quaternary periods.

The early Triassic period, represented by variable or red mostly coarse-grain sandstones, form the basis of the higher levels of the surrounding slopes north of Katina and Novi Iskar and outcrops at about 1 km north-east of Katina site. In the region of the old mine this sandstone was found at depths of 50 to 80 m by the old boreholes.

Pliocene formations dominate the whole area around Katina village and westwards to Novi Iskar. The Pliocene deposits are represented by the three main stratae:

base strata (under the coal) - gravels, various grain-size, usually compacted and clayey sands and various clays with an average thickness of 15 to 20 m.

coal-bearing strata - deep gray or black clays, unclean coal and coal. In some places with interlayers of compacted and usually clayey sands. With an average thickness of 30 to 50 m.

upper strata (over the coal-bearing strata) - gray, grayish-yellow or grayish-brown clays, in some places with a small-size sand pockets and interlayers. The thickness range from: 15 to 20 m just northwards from Katina site to 150 to 200 m and over to the south, towards the Sofia plain.

Pliocene layers lie transversely over early Triassic sandstones. The inclination of the layers with Pliocene deposits is some 5 to 15^{o} to the south-east.

Quaternary deposits are represented by thin (2 to 3 m) alluvial clays and clayey gravels around the bed of Katinska river and talus sandy clays with thickness of 4 to 5 m in the rest of the region.

The region is typical of a complex tectonic structure. The surrounding slope is separated from the Sofia valley by several parallel faults running west to east or northwest to southeast. The most northern fault in the area passes approximately along the Katinska river bed.

The intensive tectonic activity which formed the Sofia valley commenced in the Pliocene period, resulting in the lowering of the present valley floor and the elevation of the surrounding slopes. During these times favorable sedimentary conditions were created for the thick Pliocene deposits in the valley.

6.3.5 Hydrogeological Characteristics of the Region

The groundwaters in the region are linked with the Pliocene sediments.

1) Aquifers in the upper strata (above the coal strata)

These are linked to the thin sand pockets and interlayer lenses. They are not well formed, the water-bearing layers

and interlayers are lacerate. Water source explorations within these strata have insignificant yields of some 0.5 to 0.8 l/sec. Usually the waters are under slight artesian pressure which is rapidly lost as drilling progresses due to the low storage coefficient.

These surface aquifers are fed by the infiltration of the rainfall through surface fissures within the early Triassic sandstones - those exposed on the surrounding slopes.

Aquifer drainage is naturally to the south-east and central parts of the plain and more recently to the several excavated and abandoned mines and quarries in the region.

2) Aquifers in the coal-bearing strata

These aquifers mainly travel in the in the coal seams. The more carbonized the lignite coals are the more they are fissured and the higher their reservoir properties. The sand pockets and interlayers which are observed within the coal and clay layers at the horizon are also saturated. The aquifers are confined and generally under pressure. The value and the duration of the pressure head depends mainly on the area, the inclination of the coal layer and the location of the bore hole in the layer.

Boreholes into these strata typically yield up to 3 L/sec with a typical total dissolved solids burden of around 1000 to 2000 mg/l. Sulfates are high from contact with the coal. The relatively high water quality burden compared with that of the surface level aquifers is evidence of the low vertical transmissivity between the strata.

In general, the waters in the coal-bearing strata (well isolated by their 'sandwiching clay layers' and covering of the upper level clays) have a very slow water interchange rate, accordingly infiltration into the south-east, at the center of the plain is insignificant.

3) Aquifers of the base strata (under the coal-bearing strata)

These layers being formed of gravels, sands and clays, carry aquifers which are found to be comparatively rich in water, especially in the center of the plain where flow rates of up to 5 to 8 L/sec can be obtained. The aquifers are confined (under pressure) and in some places thermal. However locally these aquifer flows are smaller due to restricted local

aquifer recharge. Local wells to these lower levels all yield less than 3 l/sec.

A characteristic feature of the region is that the base strata is a incorporates a compacted clay layer around 15 to 20 m thick which isolates the layer from the waters of the upper coal-bearing regime. This forms a natural screen which will serve to protect the underlying layers from infiltration of any contaminants might eventually penetrate into them (say as leachate).

6.3.6 Regional Seismicity

The seismological map of Bulgaria is reproduced in Supporting Report I1. More Particularly, the area around Katina site (together with the whole Sofia plain) lies within a region of expected earth tremor intensity of the IXth degree on the Medvedev, Sphonchoer, Karnick scale, and a seismic coefficient k_c = 0.27.

6.3.7 Specific Section

1) Geological and Lithological Strata of Katina Site

The geological strata of Katina site comprises the following geological-lithological type:

- brown, sandy clay, usually with gravel - Quaternary in age, it forms the upper part of the geological profile. During the studies in 1954 it was found in all of the boreholes and trial pits, but at present it forms and is stripped at the upper slice of the north-west, north and east parts of the slopes of the abandoned mine. The thickness does not exceed 3 m.

- grayish-brown, grayish-yellow dustlike clays - that are clays from the top (over coals) horizon of the Pliocene. In some places with calcareous inclusions and rusty spots. They form the upper slices of the slopes under the Quaternary materials. They are well traced out in BH No. C-1 and BH No. C-2, where are forming the profile up to elevation of 588 m approximately (depth 18.00-10.60 m from the surface). The thickness decreases to the south, and in some places are denudated and does not present in the profit (BH No. S_{10}, BH No. S_{25}, Pit No. $III_{I/5}$).

Then follow different kinds of the coals horizon:

- deep gray, grayish-green, grayish-blue dustlike clays;
- black-brown, black dustlike clays;
- coals;
- unclean coals (coal clays);
- various grain-size, compacted, usually clayey sands;

They are stripped to the surface in the medium and main parts of the pit. But in some places they are covered by clayey materials with thickness of 0.5-1.0 m that have slid down the slope. As is evident from the geological profiles and profiles of the boreholes, there is an irregular alternation and there is no any regularity in the vertical and horizontal allocation of the different layers and interlayers. Their thickness is over 60 m. And under the bottom of the pit (minimum level 543 m) the thickness of the coal horizon is not less than 30 m (in the geological profile of Pit No. $III_{II/2}$). The boreholes taken, Nos. 3, 4 and 5, in the central part of the pit also do not reach the bottom of the coal horizon.

Further down follow sediments of the base (under coals) horizon:

- light gray, compacted, dustlike clays, in places with marl and calcareous inclusions;

- compacted, usually clayey sands - their thickness is not greater than 10-15 m, and at some places they are missing and the coal horizon lies directly over the early triassic various grain-size sandstones.

Finally, mention should be made of the existence of huge embankments (dumps) left by the miners. They are formed from the disposals during the opening of the mine, and are comparatively well compacted but with non-homogeneous matter of different clays with insignificant quantity of sand, gravel and coals. The embankments are unevenly distributed mainly southwards from the pit, with a height up to 20 m in some places.

2) Physical-mechanical Characteristics of the Soils

In order to determine the physical-mechanical characteristics of the soils during the study 21 undisturbed soil samples were taken. 10 Standard Penetration Tests (SPT) and 25 m Dynamic Probing Resistance (DP) were undertaken.

To characterize the physical-mechanical properties of the soils reference was made to the results from the study conducted by Energoproject in 1982, for an open coal mine located at about 0.7-0.8 km south-west from Katina site. During that study some 140 soil samples were processed. This allowed the complete characteristics of the different lithological kinds to be appraised. This data is used when the number of samples was insufficient.

In terms of the physical-mechanical properties of the facies and the age of the different lithological kinds, and taking into consideration the specifics of the designed construction works in Katina site the region, the following soil types are identified:

Soil No. 1- **brown sandy clays with gravel** - that includes all clays with Quaternary age. Because of their sporadic distribution only one sample only was analyzed (Lab. No. 239). Taking into consideration the studies of Energoproject, the determined the basic characteristics are:

bulk weight	:	2.02 g/cm^3
porosity	:	29%
voids ratio	:	0.41
humidity	:	10%
angle of internal friction	:	10^o
cohesion	:	0.25 x 10^5

Soil No. 2-**gray dustlike clays** - that includes all Pliocene clays with dominant gray color (gray, grayish-yellow, grayish-brown, grayish blue, light gray, deep gray) - They are widely spread throughout the bottom and the slopes of the pit. The 8 nos samples that were analyzed (Lab. Nos. 223, 224, 226, 228, 230, 231, 243, 244) showed the following properties:

bulk weight	:	1.44 - 1.70 g/cm^2 (1.59 average)
porosity	:	53-68% (61% ave)
voids ratio	:	1.14-2.12 (1.58 ave)
natural humidity	:	42-78% (58% ave)
angle of internal friction	:	10^o
Atterberg limits	:	W_l = 90 W_p = 41 I_p = 49

The results from the triaxial tests that were made are as follows.

under total stress:

p_u - in the range of $4^o20'$

c_u - in the range of 0.10-0.40 x 10^5 Pa

The recommended values are; for the calculations to be used the average minimum values - $p_u = 5^o$ and $c_u = 0.18 \times 10^5$ Pa.

under effective stress:

p_u - in the range of $10^o17'$

c_u - in the range of 0.10-0.23 x 10^5 Pa

The recommended calculation values to be used as the average minimum values are - $p_u = 11^o20'$ and $c_u = 0.15 \times 10^5$ Pa.

The shear stress tests gave the following results for the angle of internal friction and the cohesion:

ultimate strength : p = $20^o30'-21^o$
c = 0.34-0.61 x 10^5 Pa

residual strength : p = 16^o-22^o
c = 0.18-0.21 x 10^5 Pa

swelling force : 0.44 x 10^5 kN/m^2

Soil No. 3- **black dustlike clays** - these include all Pliocene clays with dominant black color (black, black-brown) - They are widely spread through-out the bottom and middle and lower parts of the slopes of the quarry. 5 samples of these clays were analyzed (Lab. Nos. 225, 227, 229, 242, 249). The values that were achieved (average values) are reported as:

bulk weight : 1.59 g/cm^2
porosity : 57%
voids ratio : 1.23
natural humidity : 54%
Atterberg limits : W_l = 75
W_p = 49
I_p = 26

The average values received from the 3 triaxial tests and recommended for use in the calculations are:

under total stress:

$p_u = 3^o$, $c_u = 0.50 \times 10^5$ Pa

under effective stress:
$p_u = 15^o40'$, $c_u = 0.27 \times 10^5$ Pa

The shear stress tests of two samples gave the following results for the angle of internal friction and the cohesion:

ultimate strength	:	$p = 12^o30'-16^o$
		$c = 0.36-0.64 \times 10^5$ Pa
residual strength	:	$p = 15^o30'-16^o30'$
		$c = 0.09-0.13 \times 10^5$ Pa
swelling force	:	0.9×10^5 kN/m^2

Soil No. 4-**coals and unclean clays** - there are observed single layers and interlayer not extracted during the operation of the mine, mainly at the foot of the slopes of the pit and deeper. The physical-mechanical characteristics were taken as in the studies of Energoproject:

bulk weight	:	1.23 g/cm^2
porosity	:	63%
natural humidity	:	94%
ultimate strength	:	$p = 17^o07'$
angle of internal friction	:	$c = 0.35 \times 10^5$ Pa
cohesion		
residual strength	:	$p = 14^o27'$
angle of internal friction	:	$c = 0.22 \times 10^5$ Pa
cohesion		
swelling force	:	0.50×10^5 kN/m^2

Soil No. 5-**sands, various grain-size, usually compacted and clayey** - they are observed as thin layers and interlayers in the whole Pliocene profile. The following characteristics are assumed:

bulk weight	:	1.66 g/cm^3
porosity	:	50.4%
natural humidity	:	39%
angle of internal friction	:	$12^o20'$
cohesion	:	0.02×10^5 Pa

Regarding the type of the designed construction, the physical-mechanical characteristics of the soils are satisfactory. It should be taken into consideration, if necessary, that the gray and black clays, as well as the unclean coals have tendency to swell.

(1) Physical-mechanical Characteristics of the Soils in Embankments

In order to determine the properties of the material from the bottom and the slopes of the pit as an embankment, there were taken 8 nos of soil samples - Lab. Nos. 232-239. The samples that were taken of soils Nos. 1, 2 and 3 from different places throughout the whole site and from depth of up to 2.5 m from the terrain and were intended to be tested for use in embankments and insulating screens during the operation.

The results show that all clays in the region of Katina site are suitable for constructing of embankments. The optimal humidity and maximum bulk weight (average values) for the different kinds of soil are:

Soil No. 1 (Lab. Nos. 234, 239) - $W_{opt.}$ = 18%, $S_{max.}$ = 1.98 g/cm^3
Soil No. 2 (Lab. Nos. 232, 236-238) - $W_{opt.}$ = 22.5%, $S_{max.}$ = 1.91 g/cm^3
Soil No. 3 (Lab. Nos. 233-235) - $W_{opt.}$ = 37%, $S_{max.}$ = 1.68 g/cm^3

(2) Leachate Characteristics

In order to determine the possibilities and the danger of leachate of soils in the area of Katina site, there were analyzed 16 nos of soil samples and was determined the carbonates content, water-soluble salts and organic matter. The samples are of:

Soil No. 1 : brown sandy clays with gravel : 2 nos.
Soil No. 2 : gray dustlike clays : 7 nos.
Soil No. 3 : black dustlike clays : 7 nos.

It was determined that the content of water-soluble salts is ranging from 0.470 to 1.020%, average value - 0.754%.

The carbonates content was determined to be within the limits of 0.0-0.45%, average value - 0.22%.

The organic matter varies within wide range, from 0.729% up to 27.219%. The highest organic content was found in the black clays - from 1.128% to 27.219%, average value - 14.703%. The organic matter in the rest of the clays ranges from 0.657-2.060%, average value - 1.087%.

All analyses were carried out with distilled water. 3 set of analyses with drainage waste waters from the "Suhudol" disposal site were undertaken (it is expected that the waste water

from "Katina" site to be similar to that from "Suhudol" disposal site).

Some of the more important parameters of the water from "Suhudol" disposal site are as follows (sample with Lab. No. 363 taken on July 29, 1993):

- conductivity : 11,200 µs/cm
- pH : 9.2
- free CO_2 : 0.0 mg/L
- color : >50 Pt/Co
- turbidity : scale
- COD (chem. oxygen demand) : 9.7 NTU
- dry residue at 105°C : 21902 mg/L
- dry residue at 600°C : 10688 mg/L
- total alkalinity : 158 mg.equiv/L
- total alkalinity $CaCO_3$: 7907.1 mg/L
- sulfate : 54.8 mg.SO_4/L
- chlorine : 4578.8 mg.Cl/L

The results that were received are presented on the following tables:

With Distilled Water

Lab. No.	BH No.	Depth (m)	Carbonates (%)	Organic matter (%)	Water-soluble salts (%)
185	3	4.5	1.08	2.730	1.010
190	1	2.5	0.38	0.661	0.700
191	1	32.0	traces	12.476	0.916

With Water from "Suhudol" Disposal Site

Lab. No.	BH No.	Depth (m)	Carbonates (%)	Organic matter (%)	Water-soluble salts (%)
185	3	4.5	0.0	0.0	1.034
190	1	2.5	0.0	0.0	0.723
191	1	32.0	0.0	0.0	0.954

It can be seen that the "Suhudol" leachate did not react adversely with the clay. - it does not extract neither the carbonates nor the organic matter. Possibly due to the alkaline nature of the contact, pH = 9.2, at that value the corrosive properties are minimal.

(3) Clay Mineral Contents

A qualitative Roentgeno-structural analysis was made on 6 samples in order to determine the mineral composition and the content of clay minerals.

The samples were taken from different places throughout the whole area of Katina site.

All of the clays were found to contain quartz, kaolinite and mica. The clays with higher organic content (the black and gray clays in the coals horizon) also contained montmorilonite, and some clays (sample No. 3) contain chlorite as well.

Accordingly the clay mineral constituents are normal. The kaolinite and the montmorilonite are the dominating (and most frequently encountered) clay minerals with certain swelling properties, that should be considered during the design, if it is necessary.

3) Groundwater Encountered

Ground waters were encountered in all of the boreholes that sunk. They are linked with the waters in the upper coal strata.

The waters in the top (over coal) strata were encountered by boreholes No. C-1 and No. C-2 at depth of 19.00 m and 15.40 m respectively. They are dependent on the sand inclusions that were found at depth 32-35 m for BH C-1 and 25-28 m for BH C-2. The Pliocene clays further in depth are water saturated and slowly infiltrate boreholes or trial pits.

The waters in the coal bearing strata were encountered by the other boreholes (Nos. 4-10) at varying depths. In the general part it was found accumulated in the coals layers and the adjoining sand pockets and lenses.

With the operation of the mine and its abandonment afterwards was disturbed the natural hydraulic balance of the underground waters. During the operation of the mine there was

continuous water pumping from the pit to waste which at the end of the operational period reached 50 to 80 l/sec. This has lead to considerable drying of the surrounding area and diminished static water resources. When the operation of the two coal pits was stopped (the eastern one is Katina site) the two existing lakes formed which now are the main hydrological features in the region.

(1) Hydrogeological Characteristics

In order to determine the filtration characteristics of the layer (permeability coefficient - K and transmissibility coefficient - T), 5 trial drawdown and filling tests were commissioned.

The drawdown tests were performed by means of bailer, and the recharge rate noted. Temporary well screens were 200mm dia. K and T are determined for the complete borehole saturated length.

The water filling trials were was used the method of short (momentary) action over the layer by instant increase of the water level. Only the permeability coefficient is determined at a fixed place because the boreholes are lined with pipe-column and the filtration is performed through the bottom of the column only.

The data from these tests were the basis of the following conclusions:-

BH No.	Type of Test	Depth (m)	Static Water level	K (cm/s)	T (m^2/d)	K and T valid for:
C-3	water suction	20	2.17	6.8×10^{-5}	1.05	2.17-20 m
C-4	water suction	20	1.94	3.0×10^{-5}	0.48	1.94-20 m
C-5	water suction	20	6.10	2.1×10^{-5}	0.25	6.10-20 m
C-6	water filling	15	10.02	8.8×10^{-4}	-	15 m clayey sand
C-6	water filling	19	8.05	8.3×10^{-6}	-	19 m gray clay

These values are fully consistent with:

- The studies in 1954 included 10 trial pits with a depth of 32 to 62 m. Bottom water was pumped at continuous flow rate 0.8 to 3.3 l/sec; only one pit showed side infiltration. The flow rate at the start of the trials was two to

three times greater than the stable rate after 2 to 3 days.

- During 1988 the Committee of Geology drilled a borehole W No. 29 in the area of the Repair shop (south-west from Katina site). Its depth is 150 m and it draws waters from the Pliocene and early Triassic sandstones. The flow rate at water level 18.20 m is only 1.1 l/sec, specific flow rate - 0.06 L/s/m.

- The laboratory values for the filtration coefficient are in the order of 10^{-4}-10^{-5} cm/sec (though, many of the values are increased because of the exiting cracks and cleavage planes in the samples).

(2) Level, Direction of Flow, Hydraulic Inclination

A drawing of the isohypses of the groundwaters as on July 27, 1993 is included in the main text. It can be seen that the general direction of the flow of the ground waters is east-southeast (from lake 2 towards lake 1). Besides that, there is a flow from lake 1 to south-southeast (towards Katinska river). Lake 1 drains all waters coming from north. The difference in the levels of the two lakes - 10.53 m which over a distance of 650 m, gives quite high hydraulic inclination - 0.016, showing once again the slow filtration in the layers.

(3) Water Feeding and Draining Conditions

The groundwater charging and draining conditions were formed on the basis of the natural conditions of the region, and are now adjusted with the alterations as a result of the operation of the coal mines. The aquifer charging is mainly through the infiltration of the atmospheric and surface waters. The rainfall is accumulated in the two lakes and from there is passed into the coal strata, thus feeding the waters stored there. In the past 3 to 4 years, part of the water of Katinska river has been diverted into the western lake (the one near Katina village). As a result of that the water level was increased by 2.7 m and the water quality has improved its chemical content (as can be seen from the following section).

All waters from the water-bearing layers intercepted during the development of the mines are now drained into the lakes. These flows are small. There are no permanent springs on the north slopes of Katina site. Traces of seasonal water activ-

ities can be observed (dried ditches, remains of water-demanding vegetation).

At present, the water level retained in the lake inside the Katina site is considered to result from the balance of the inflows (from atmospheric and surface waters, infiltration from lake 2) and the outflows (draining to the south and south-east and evaporation). It is considered that evaporation is a major balancing factor. It is determined There is a large exposed water surface and the loss is possibly enhanced increased temperature in the pit as a result of its seclusion & the continuous burning of the coal layers.

(4) Physical-chemical Composition of Waters

To determine the physical-chemical characteristics of ground and surface waters 13 water samples were analyzed (see Tables).

It was found that the waters in the region are characterized predominantly as sulfate-calcium ions with high TDS values (solid residue ranging from 467-3,840 mg/L) and high hardness (total hardness 6.8-105 mg.equiv/L). Of course here are not included the samples taken from lakes 1-a and 1-b, which appeared to be only puddles for disposal of municipal and industrial wastes and their water should be considered as infiltrated water similar to that from the disposal sites (for example, the solid residue has value of 20,150-24,804 mg/L).

It is of interest that the waters of lake 2 is considerably diluted (solid residue 467.6 mg/L) from the intake of the Katinska river during the greater part of the year. At present the water quality of lake 2 is almost similar to that usable for drinking purposes whereas the waters of the inner lake are notably richer in minerals.

The waters of Katinska river (which was almost dry at the time), and its flow of 1-2 L/sec is formed by the infiltration of water from lake 1) has worse quality than that of lake 2 (solid residue - 487.9 mg/L, sulfate - 313.6 mg/L, calcium - 125.25 mg/L, etc.).

From the water samples taken from the boreholes the one from BH C-3 should be noted. BH C-3 is located at 10-15 m distance from lake 1 its water is entirely different from the water of the lake:

	C-3	Lake 1	
pH	6.03	8.12	
free CO_2	228.7	0.0	mg/L
dry residue	3840.2	11633.8	mg/L
sulfate	2337.7	1400.7	mg/L
chlorine	354.5	6204.3	mg/L
calcium, etc.	651.3	1402.8	mg/L

These considerable differences in the physical-chemical composition of the surface and ground waters show the extremely low water rate of flow between them and minimal filtration in the water-bearing layers - a favorable factor for construction of disposal sites for municipal wastes.

Regarding the radioactivity, a certain increase of the radioactive background was found in samples from lake 1, but this is within acceptable values of background radiation (the effect of long term accumulations of uranium in the lake fish has not been appraised):

uranium	:	0.01 mg/L
radium	:	0.0 mBq/L
total β -radioactivity	:	1150 mBq/L

4) Physical-geological Phenomena and Processes

(1) Slopes Stability

At present, the highest slopes of Katina site are those of the north-west and the north-east, which have average natural inclinations of $10^{o}11'$ and $11^{o}12'$ respectively. The slopes are stable.

The first impressions of Katina site create the feeling that the slopes of the abandoned quarry (especially the north and the north-east ones with level difference of 60 m) are a result of huge and deep landslips.

The thorough geological mapping, the boreholes that were made, the collection of all existing analyses and data concerning the mine showed that the slopes are stable:

- during the operation of the mine there were no landslips at the pit edges;
- when comparing the state map, scale 1:5000, issued in 1989 and the present survey of July 1993, there is no evidence of any widening of the pit;

- the presence of a single lake at the foot of the slopes with depth of 15 m is incompatible with an eventual earth-creeping slope. For not more than 2-3 years the lake would have filled with earth-creeping materials. The lake has not changed its shape in 20 years;

- 2 boreholes (No. C-1 and No. C-2) sunk showed that there were no displacements of the geological layers in depth. Nevertheless the first impression was that borehole C-2 is located in a land-creeping berm with a slip of more than 7 m;

- Despite these observations some local land slippage has recently occurred in the inner sanctums to the South East of the Site on the slopes above and next to the small ponds, earth displacements with varying volumes and depth of not more than 1 to 1.5 m, which although locally significant, do not influence the total stability of the overall slopes. These lesser unstable portions are apparent and can be readily dealt with at the time of construction.

- Additional instability in the inner quarry reaches occurs due to the destruction of the burning coal seams. Collapses occur periodically and some possibly triggerable by minor earth tremors - the following text refers.

(2) Burning of the Coal

Following closure of the quarry, the coals self ignited at several places. This burning continued for more than 20 years. The burning released a lot of heat, gasses and crystallized sulphur & tars now evident as surface deposits. A consequence of the coal destruction is the presence of cinder layers with possible depth of more than 20 m at some places. The cinder is not well compacted and that is why it is continuously self-compacting under the action of its weight and the rainfall. Sudden soil subsidence has occurred and is still likely. During the fieldwork (on July 15) an area of 1500 m^2 collapsed overnight. The subsidence was with a depth of 0.80-1.20 m and concentric cracks at the ends that still continue to exhaust smoke and hot fumes. Once compacted, the cinder has a favorable effect concerning the stability of the slopes - in one hand it has significantly smaller bulk weight compared to the other soils, in second it has draining and stabilizing effect for the clays it is in contact with.

(3) Generation of Gasses

Coal burns to form gasses - carbon monoxide (CO, at temperature up to 200°C), carbon dioxide (CO_2, at temperature of 250-400°C), sulphur dioxide, hydrogen sulphide nitrogen. Unpleasant site odors were due to the sulphur-containing gasses.

In the Katina region now is also methanogenic (generates methane). This is from the biological decay of the marsh vegetation in the lake and the burning of the coal. At present condition are not conducive to methane detonation. The site is airy and the possibility of the accumulation of explosive mixtures in not considered to be high. (3.5-7.5% methane in air is necessary).

5) Environmental Aspects - Changes With Land filling

(1) Increase of the Water Level in the Quarry

Before the development of the mine, the level of the groundwater in the Katina region was 10-15 m from the old ground surface. During the operation of the mine were drawn significant water quantities, most of which have been a static water reserve accumulated in the layers during the geological periods. At present, there is balance created between the lake water level, the feeding from rainfalls and the slope waters and the water discharge by evaporation and insignificant infiltration of waters from the lake towards the field.

When the operation of the disposal site starts, having in mind the complete insulation of the bottom of the pit with watertight screen, the water level of the lake in the pit will start to rise. It is hard to determine the value of that rise. According to us it will not be less than reaching of bench mark 561.1 (not less than 3 m), because during September 1989 the water level of the lake had such value (and maybe there is observed a many-years period of fluctuation of the lake water level).

On hydrological grounds there is a good argument for preserving the existing water level of the lake (558 m) as the maximum water table level under the fill. That can be made by a drainage system (the elevations will allow a gravity discharge directly into Katinska river) that will carry away the water exceeding that level (or at level 1-2 m lower).

Adoption of this level will however lead to excessive expense as the undermost layers of the waste landfill must be kept at least 2 m above the max water table. The drainage area will be substantial and the cost of raising the entire central section of the quarry up to a level of 560 m will be massive. Some loss of capacity will occur even if the source of the fill was the quarry sides. The fill burrow area would extent towards Katina village and lower the crest of the separating ridge.

(2) Pollution of the Groundwater

The natural conditions in the region of Katina site - geological-lithological and tectonic strata, hydrogeological conditions: insulated, ruptured and segregated water-bearing layers having low filtration parameters The presence of thick watertight clays, will enable the construction and operation of the solid wastes disposal site to proceed without serious danger of pollution of the groundwaters.

It should be stressed on that in the region of Novi Iskar there are no operating wells for water supply from the ground water (the town is water supplied by gravity from the Rilla water main pipeline for Sofia). At about 1.5 km northwards from Katina site, in Stara Planina mountain, there exists a mineral water borehole, without hydraulic connection with the waters in the study area and there is no risk of cross contamination.

It is of course necessary that all coal outcrops, cinder deposits and sands in the area of the pit be covered and screened. They can be covered with clay taken from the bottom or the slopes of the quarry.

(3) Generation of Gasses in the Disposal Site

If not removed the organic marsh residues of the central quarry lake may well decay and generate marsh gasses - methane, etc., having all potential dangers during the initial operation of the disposal site.

(4) Slopes Stability

As already mentioned the main and general slopes of Katina site are stable. In respect of the shallow, surface landfalls and creepages due to the gravity, denudation, burning and erosion processes which appear and will repeat from time to time some special measures must be taken in advance. The

crushed land material should be moved or leveled when necessary.

The progressive filling of wastes at the foot of the slopes during the operation of the disposal site will of course increase gradually the stability of all slopes.

Further calculation slope stability may only be necessary if it is envisaged, that rapid draw down conditions could occur and it is preferable that this be avoided (eg Lake emptying by pumping) in order to avoid the risk of massive slippage due to the higher level of pore pressure gradient within the clays.

The data determined from the investigations and lab work for stability calculations follows:

Soil No. 1 : brown sandy clays
- bulk weight : 2.02 g/cm^3
- angle of internal friction: 10^o
- cohesion : 0.25 x 10^5 Pa

Soil No. 2: gray dustlike clays
- bulk weight : 1.59 g/cm^3
- angle of internal friction: 11^{o}20'
- cohesion : 0.15 x 10^5 Pa

Soil No. 3: black dustlike clays
- bulk weight : 1.59 g/cm^3
- angle of internal friction: 15^{o}40'
- cohesion : 0.22 x 10^5 Pa

Soil No. 4: coals and unclean coals
- bulk weight : 1.23 g/cm^3
- angle of internal friction: 14^{o}27'
- cohesion : 0.22 x 10^5 Pa

6.3.8 Conclusion

From the studies carried out for the area envisaged for construction of Katina solid wastes disposal site, concerning the geological, engineering-geological and hydrogeological conditions examined and apparent from the laboratory work it was determined that the construction and operation of the landfill within the quarry is feasible, without dangers of polluting the ground waters and the environment, if all the recommendations made are observed.

6.4 Breakdown of PLC Required Staffing and Responsibilities

The following Tables 6-1 to 6-4 show more details for the estimated staffing required for the PLC departments and their activities.

Table 6-1 Headquarters Organization

Specification of Departments and Sections of new company, positions and activities							
No.	NAME OF ENTITY, DEPARTMENT, SECTION, ETC.	POSITION	No. OF PER.	TOTAL DEP.	ACTIVITIES	SUBORDINATED TO	COOPERATION WITH
1	GENERAL ASSEMBLY (Owners representatives and Management of the company)	DEPUTY MAYOR - INFRASTRUCTURE	1				
		DEPUTY MAYOR - FINANCE	1				
		HEAD OF CHISTOTA - DEP.	1		Decision on companies policy, budget and balance approval, control of overall activities	Municipal Council	
		GENERAL MANAGER	1				
		DIRECTOR FINANCE	1				
		DIRECTOR PLANNING - OPERATION	1				
		REPRESENTATIVE OF EMPLOYEES	1				
				7			
2	HEAD OF COMPANY	GENERAL MANAGER	1		Overall management of company	Decision of General Assembly	Director Admin. & Finance Director Planning & Operation
3	SECRETARIAT	CHIEF SECRETARY	1		Communication, Coordination and Correspondence	General Manager	Secretariats of Central Dept. Admin.&Fin.&Plan.&Oper.
		ASSISTANT SECRETARY	1				
				3			
4	COMMON SERVICES						
	* LEGAL SECTION	CHIEF ADVISOR	1		General and specific legal matters of the company, legal activities related to personnel, legal assistance for by-laws, rules & regulations	General Manager Chief advisor	Departments and Sections concerned
		DEPUTY ADVISOR	1				
	* PUBLIC REL. SECTION	CHIEF OF PUBLIC REL.	1		External representation, public relation campaign, public education, advertisement, etc.	General Manager Chief of Public Relations	Departments and Sections concerned
		EMPLOYEES	2				
				5			

Table 6-1 (cont..)

			b.f.	5			
	* EDP SECTION	CHIEF OF EDP	1		Management information data, budget & balance sheets, data processing for personnel	General Manager	General Manager & Departments & Sections concerned
		EMPLOYEES	3			Chief of EDP	
	* GENERAL SERVICES	CENTRAL OPERATOR	1		Central telephone switchboard,	Section 1	Departments and Sections concerned
		RADIO OPERATOR	1		Depots, disposal sites communication,	Administration, internal organisation	
		DISPATCH	1		Dispatch services, mailing, etc.		
		CLEANING	1		Office cleaning (2 persons 1/2 day)		
				13			
5	CENTRAL DEPARTMENT ADMINISTRATION & FINANCE	DIRECTOR ADMIN. - FINANCE	1		Deputy General Manager acting only during absence of General Manager, management of department with subsections	General Manager	Central Department Planning&Operation incl. outstations
		SECRETARY	1		Communication, Correspondence, etc.	Director Admin. & Finance	
5.1	SECTION 1 ADMINISTRATION	CHIEF OF SECTION	1		Internal organisation, general administration personnel affaires, records and filing	Director Admin&Finance	Departments and Sections concerned
		EMPLOYEES	4			Chief of Section 1	
5.2	SECTION 2 FINANCE	CHIEF OF SECTION	1		General accounting, salary structure, budget, expenditure, income statements, tariff system, invoicing	Director Admin&Finance	EDP Section and other Departments & Sections concerned
		EMPLOYEES	6			Chief of Section 2	
5.3	SECTION 3 CONTROLLING	CHIEF OF SECTION	1		Internal audit and control	General Manager	Director Admin. & Finance
		EMPLOYEES	1		Internal audit and control	Chief of Section 3	Chief of Section 3
		CONTROLLERS	8		Control of level of service in collection Zones, time & motion control, etc.	Chief of Section 3	Superintendents of depots & Section 2
5.4	SECTION 4	CHIEF OF SECTION	1		Public complaints, liaison, commerce, industry special contracts	Director Admin. & Finance	Superintendents of depots, planning & design department
	EXTERNAL RELATIONS	EMPLOYEES	2			Chief of Section 4	
				27			
6	CENTRAL DEPARTMENT PLANNING & OPERATION	DIRECTOR PLANNING - OPERATION	1		Management and coordination of departments	General Manager	Central Department Admin.&Finance Departments & outstations concerned
		SECRETARIES	2		Communication, correspondence (as well for Head of Departments of Oper. 1÷2)	Director Planning/Operation	
6.1	DEP. PLANNING - DESIGN						
				3			

Table 6-1 (cont..)

			b.f.	3			
6.1.1	SECTION 1 COLLECTION & HAULAGE	CHIEF OF SECTION EMPLOYEES	1 3		Optimisation of collection and haulage movements waste separation, preparation and monitoring of Pilot Project considering reutilisation and recycling, monitoring of amenity center	Director Planning&Operation Chief of Section 6.1.1	Department Operation 1 Area Managers and other Departments & Sections concerned
6.1.2	SECTION 2 DISPOSAL SITES	CHIEF OF SECTION EMPLOYEES	1 2		Design updating of disposal sites, control of operation, monitoring of closed disposal sites, building activities including tendering	Director Planning&Operation Chief of Section 2	Department Operation 2 Superintendents of disposal sites and depots incl. other Dep.&Sections concerned
6.2	DEPARTMENT OPERATION 1 COLLECTION & HAULAGE	HEAD OF DEPARTMENT	1		Deputy of Director Planning&Operation Control and coordination of activities of depots	Director Planning&Operation	Superintendents of depots & disposal sites & Department 6.1.1
6.2.1 to 6.2.5	5 DEPOTS AS OUTSTATIONS FOR COLLECTION&HAULAGE				For specification, activities, etc. see separate sheet 2. Vehicles depot	–	–
6.3	DEPARTMENT OPERATION 2 TREATMENT & DISPOSAL	HEAD OF DEPARTMENT	1		Control and coordination of activities of disposal sites	Director Planning&Operation	Superintendents of disposal sites & Department 6.1.2
6.3.1	KATINA DISPOSAL SITE AS OUTSTATION	SUPERINTENDENT	–	–	For specification,, activities, etc. see separate sheet 3. Disposal site	–	–
6.4	CENTRAL WORKSHOP AS OUTSTATION				For specification,, activities, etc. see separate sheet 4. Central workshop	–	–
				12			
	TOTAL MANPOWER HEADQUARTER			55			

Table 6-2 Vehicles Depot Organization

SPECIFICATION OF TYPICAL ORGANISATION FOR ONE OF THE FIVE VEHICLE DEPOTS							
No.	NAME OF ENTITY, DEPARTMENT, SECTION, ETC.	POSITION	No. OF PER.	TOTAL PER DEPT.	ACTIVITIES	SUBORDINATED TO	COOPERATION WITH
6.2.1/1	DEPOT - 1	SUPERINTENDENT	1		Management of depot and coordination of activities	Head of Department & Operation 1	Area Manager, Central Workshop & Departments & Section concerned
		SECRETARY	1		Communication, correspondence, time-sheets	Superintendent	
6.2.1/2	COMMON SERVICES						
	WASHING AND FUEL SERVICES	OPERATOR	1		Operation of fuel station and Oil depot, maintenance of washing facilities	Superintendent	Drivers
	CONTAINER SERVICES	OPERATOR	1		Maintenance of container depot, organisation of repair work with replacement	Superintendent	Area Managers & Drivers
	AMENITY CENTER	OPERATOR	1		Management of center, supervision of waste separation and disposal, assistance to public	Superintendent	Dept. of Planning and Design - Section 1
		LABORER	1			Operator	
	GENERAL SERVICES	GATEMAN	1		Registration of in- and outgoing vehicles	Superintendent	
		LABORER	1		Cleaning of area & offices	Operator wash & fuel station	Operator w & f
				8			

Table 6-2 (cont..)

			B.F.	8			
6.2.1/3	AREA OPERATION	AREA MANAGER-1	1		Deputy Superintendent acting during absence of S.I.,coordination of collection and haulage crews, drivers and laborers, communication with selected foremen	Superintendent	Foremen, Drivers
6.2.1/4	AREA OPERATION	AREA MANAGER-2	1		Coordination of collection and haulage crews, drivers and laborers, communication with selected foremen	Superintendent	Foremen, Drivers
	TOTAL MANPOWER FOR VEHICLE DEPOT			10			

Table 6-3 Disposal Site Organization

SPECIFICATION OF DISPOSAL SITE ORGANISATION - KATINA 1997							
No.	NAME OF ENTITY, FUNCTION, SECTION, ETC.	POSITION	No. OF PER.	TOTAL PER DEPT.	ACTIVITIES	SUBORDINATED TO	COOPERATION WITH
6.3.1 1	SITE MANAGER	SUPERINTENDENT (Geotechn. Eng.) SECRETARY	1 1		Overall management for the disposal site Communication, correspondence	Head of Department Operation 2 Superintendent	Site operator and all other sections, Headquarter, Depots and Central Workshop
				2			
6.3.1 2	COMMON SERVICES						
	* MAINTENANCE OF FACILITIES	MECHANICS	1		Maintenance of weigh bridges, washing facilities, firefighting system etc.	Superintendent	All sections of 6.3.1
	* TRANSPORT	DRIVER	1		Messenger, mail services between headquarters, disposal site, depots etc.	Superintendent	Superintendent and Deputy Superintendent
	* GENERAL SERVICES						
	- GATEMAN	GATEMAN	2		Identification of incoming vehicles, operation of in- and outgoing gates	Superintendent	Weigh bridges accountant
	- SECURITY	WATCHMAN	4		Security of disposal site, 2 shifts	Superintendent	Police service
	- CLEANING	LABORERS	6		Cleaning of access and internal roads, offices weight bridges, washing facilities, heavy equipment depot, ground maintenance	Superintendent	All sections concerned
				14			
6.3.1 3	SECTION 1 ACCOUNTING (two separate weigh bridges for incoming and two for outging vehicles)	CLERKS	3		Vehicles registration, weigh bridge reading, invoicing and related administration	Superintendent (two SGM - employees for monitoring)	Section 6.3.1/4 and Central Department for Administration & Finance
				3			

Table 6-3 (cont..)

6.3.24	SECTION 2						
	WASTE INSPECTION	FILL INSPECTOR	2		Assessment of waste quality - non-hazardous /hazardous	Superintendent	Scientist
		SCIENTIST	1		Inspection of doubtful waste, eluate test, leachate control, gas emission monitoring, bird control, waste treatment efficiency	Superintendent	Central Department of Planning& Design - Section 2 Institute for analysis
				3			
6.3.15	SECTION 3						
	SITE OPERATION	DEPUTY SUPERINT. SITE OPERATOR (Geotechn. Eng.)	1		Management and coordination of operations for waste distribution, compaction, cover material, tankers	Superintendent	Central Department for Planning & Design - Section 2, Central Workshop
	DISTRIBUTION	DRIVERS	2		Distribution of delivered waste and levelling of daily covering material with bulldozer	Site operator	Fill inspectors and earth moving team
	COMPACTION	DRIVERS	2		Permanent compaction of waste up to compaction rate and of daily covering material	Site operator	Drivers for waste distribution
	EARTH MOVING	DRIVERS	4		Extraction, transport and discharge for daily cover material	Site operator	Bulldozer drivers
	TANKER SERVICE	DRIVERS	2		Transport of leachate and sprinkling of waste	Site operator	Scientist and mechanics
				11			
	TOTAL MAN POWER FOR SUHODOL			33			

Table 6-4 Central Workshop Organization

SPECIFICATION OF WORKSHOP ORGANISATION							
No.	NAME OF ENTITY, FUNCTION, SECTION, ETC.	POSITION	No. OF PER.	TOTAL PER DEPT.	ACTIVITIES	SUBORDINATED TO	COOPERATION WITH
6.4.1	WORKSHOP MANAGEMENT	SUPERINTENDENT	1		Overall management and coordination of Central Workshop	Director of Central Dept. Planning & Operation	Depots and disposal sites, Chief Mechanic
6.4.2	SECRETARIAT	SECRETARY	1		Communication, correspondence	Superintendent	Accountant
		ACCOUNTANT	2		Administrative work for spare parts, fuel etc.	Superintendent	Spare part depots & other sections concerned
6.4.3	SPARE PART STORE & FUEL STATION	STORE HEAD	1		Management of store, ordering & delivering of spare parts	Superintendent	Chief Mechanic
		ASSISTANT	1				
		FUEL STAT. OPER	1		Operation of fuel station & oil dept.	Superintendent	Store Head
				7			
6.4.4	MAINTENANCE & REPAREWORK SECTION	CHIEF MECHANIC	1		Coordination of maintenance and repairwork	Superintendent	Superintendents of Depots & disposal sites and repair section
		DEPUTY SUPERINT.					
6.4.5	M&R - VEHICLES	MECHANICS	6		M&R for all collection & haulage vehicles	Chief Mechanic	Common services as required
		ASSISTANT	6				
				13			
6.4.6	M&R - HEAVY EQUIP.	MECHANIC	1		M&R for all heavy equipment like bulldozers, compactors and spec. equipment	Chief Mechanic	Common services as required
		ASSISTANT	1				
				2			

Table 6-4 (cont..)

6.4.7	COMMON SERVICES						
	* WASHING FACILITIES	OPERATOR	1		Washing & steam cleaning	Chief Mechanic	Mechanics
	*TYRE REPAIR	MECH. ASSISTANTS	2		Repair of tyres	Chief Mechanic	Drivers & Mechanics
	*GREASING	MECHANIC	2		Greasing of transport and heavy equipment	Chief Mechanic	Mechanics for maintenance
	*ELECTRIC	ELECTRIC SPEC.	1		Electric system repair & batterie charging	Chief Mechanic	Mechanics
		ASSISTANT	1			Chief Mechanic	Mechanics
	*HYDRAULIC	HYDR. SPECIALIST	1		Hydraulic system repair	Chief Mechanic	Mechanics
		ASSISTANT	1				
	* MACHINE SHOP	ENGINE SPECIALIST	2		Engine repair work	Chief Mechanic	Mechanics
	* BODY SHOP	PANEL BEATER	1		Chassis repair for accident vehicle	Chief Mechanic	Mechanics
		ASSISTANT	1				
	* PAINTING SHOP	PAINTER	1		Painting work	Chief Mechanic	Body shop
		ASSISTANT	1				
	* FIELD SERVICE	MECHANIC	1		Outside service for vehicles out of operation	Chief Mechanic	Outstations depots & disposal site
	*GENERAL SERVICE						
	GATEMAN	GATEMAN	1		Registration of in- and out going vehicles	Chief Mechanic	Chief Mechanic and Secretariat
	CLEANING SERV.	LABORER	2		Cleaning services of offices and repair shops	Chief Mechanic	All sections concerned
	DRIVER SERV.	DRIVERS	2		Vehicle pick up and delivery, internal movements, Field service	Chief Mechanic	All sections concerned
				21			
	TOTAL MANPOWER OF CENTRAL WORKSHOP			43