The distribution of the equipment in the above table was done based on the following considerations:

- Waste amount to be collected in each collection zone
- Compactors ($8m^3$) are distributed in all the urgent priority areas (refer to Figure 15.2.1)
- Compactors ($12m^3$) are distributed to the new development areas of the city where it may be easier to quickly introduce the proposed new collection system
- Arm roll trucks are distributed according to the generation of the commercial waste
- The smaller size existing trucks (KO 413, 431 and 424) shall be utilized at the block housing areas in each district as at present
- The larger size older trucks (KO 415) are proposed to be utilized in the distant areas of the city because of the advantage they have over the smaller trucks in terms of long distance haulage

15.4 PROCUREMENT PLAN

15.4.1 Condition of Existing Fleet

Table 15.4.1 shows the breakdown of the existing trucks by age and type (explanation of the table is also made in Chapter 2, section 2).

Table 15.4.1 Existing Truck Fleet

Truck type	1-3 years old	4-5 years	6-10 years	TOTAL(type)
1) KO 413	15	27	11	53
2) KO 415	5	0	0	5
3) KO 424	17	0	4	21
4) KO 431	19	0	0	19
5) GAZ Dump Truck	0	7	17	24
6) Zil Dump Truck	0	10	34	44
TOTAL (age)	56	44	66	166

Although the estimated total fleet is 213, trucks above 10 years old have been excluded from the table because they are unreliable. Therefore the utilization of 166 trucks only is considered.

Applying the indicators obtained from the surveys made in this Study (and explained in the Supporting Report) of number of trips/day and waste haul/trip for each truck type in both cases of direct haul to the disposal site and haul to the transfer facilities, the haulage capacities of the trucks were estimated in both cases as explained in the Supporting Report. Table 15.4.2 shows the number of existing trucks to be used by type during the period of 2000 to2005.

Table 15.4.2 Utilization of Existing Trucks

EXISTING EQUIPMENT USE	2000	2001	2002	2003	2004	2005
(1) KO small	93	93	93	51	51	51
(2) KO 415	5	5	5	5	5	5
(3) Dump Trucks	68	68	---	---	---	---
TOTAL	166	166	98	56	56	56

15.4.2 Procurement of New Equipment

During the priority project period (year 2000 to 2005) it is determined that there are two years where new trucks need to be introduced:

(1) Year 2002

It is urgently required to improve collection service in individual housing areas and some low rise block housing areas. However because of the preparations needed to prepare the required financing the year 2002 is determined as the earliest possible time to introduce the new collection system in these areas.

(2) Year 2003

Because of the trucks age by the end of the year 2002 it will be necessary to retire all existing trucks above 4 years, i.e. 110 trucks. Therefore it will be necessary to replace them in the year 2003. The partial introduction of the new collection system in block housing areas and for commercial waste will start at that time.

(3) Complete retirement of existing fleet

Fifty-six trucks are less than three years old and they may be used up to the end of the planning period of the priority project. Therefore no more new trucks procurement is required during this period.

Based on the above explanation the truck procurement and requirements will be as shown in Table 15.4.3.

Table 15.4.3 Equipment Procurement Schedule up to the Year 2005

Equipment	2000	2001	2002	2003	2004	2005	Total
(1) Compactor 8 m^3			32				32
(2) Compactor 12 m^3				8			8
(3) Arm roll 6m^3				27			27
(4) Container 1.1m^3							
(5) Container 6m^3				180			180
(6) Container 0.75m^3 (for KO)			2000				2000

15.5 Operation and Maintenance Plan

15.5.1 Working Schedule

The transfer stations shall operate 10 hour shifts and the collection shifts should be prepared taking that into consideration. Arrival of the collection trucks at the transfer stations should be staggered in order to avoid delays in waiting time. Therefore it is preferable that start times differ slightly by collection zone.

Collection shall be implemented in one shift, with overtime added as necessary, with six working days per week.

15.5.2 Required Staff (by Collection Zone)

Based on the required equipment the number of staff by collection zone is as shown in Table 15.5.1.

Table 15.5.1 Manpower Requirements by Collection Zone in 2005

	Supervisor	Driver	Worker	Total Zone
1. Almalinski	2	22	28	52
2. Auezovski North	2	18	21	41
3. Auezovski South	1	11	17	29
4. Bostandykski	1	13	19	33
5. Zhetysuski West	1	8	12	21
6. Zhetysuski East	2	15	20	37
7. Medeuski North	1	6	11	18
8. Medeuski South	1	5	10	16
9. Turksibski North	1	14	21	36
10. Turksibski South	1	11	17	29
TOTAL	13	123	176	312

The staff are estimated as follows:

- 1 supervisor for about 10 trucks
- 1 driver for each truck
- 1 worker for arm roll truck
- 2 workers for compactor $8m^3$ and compactor $12m^3$ using mechanical loading
- 3 workers for compactor $8m^3$ using manual loading

15.5.3 Maintenance Plan

The private collection companies shall be responsible for the daily maintenance of their trucks and have depots equipped with small workshops to accommodate such activity.

However periodic maintenance and large repair works shall be done at specialized workshops. The collection companies shall be responsible to contract out such repairs and shall provide evidence of such works with details to the Waste Authority upon request or on a periodical basis.

Chapter 16

CONSTRUCTION OF WEST AND SPASSKAYA TRANSFER STATIONS

CHAPTER 16 CONSTRUCTION OF WEST AND SPASSKAYA TRANSFER STATIONS

16.1 PLANNING CONDITIONS OF TRANSFER STATIONS

16.1.1 Basic Principles

According to the M/P prepared in this study, construction of two transfer stations, West transfer station and Spasskaya transfer station, should be complete by the year 2005. The basic principles for the plan of transfer stations are conceived as follows.

- All waste carried to transfer stations will be re-loaded directly to transfer vehicles and transported to Karasai disposal site
- A simple system to minimize investment and operation costs shall be considered
- The elevations plan of transfer stations shall utilize present topographic features of the proposed sites
- Smooth traffic and operation of collection and transfer vehicles at transfer station will be carefully taken into account for the site plan
- Layout plan of transfer stations shall be designed to minimize the environmental impact in the surrounding area

16.1.2 Planning Conditions

Planning conditions of West and Spasskaya transfer station are shown in Table 16.1.1

Table 16.1.1 Planning Conditions of West and Spasskaya Transfer Station

No	Item	West T/S	Spasskaya T/S
1	Service area (District)	Auezovskii, Zhetysuskii, Almalinskii, Bostandykskii, Medeuskii (south)	Turksibskii, Medeuskii (north)
2	Average haulage distance to Karasai disposal site	29 km	40 km
3	Site area	4.4 hectare *)	2.7 hectare
4	Access road/ improvement	2.0 km	1.5 km
5	Waste amount to be hauled-in and transferred	753 ton/day in 2005 782 ton/day in 2010	295 ton/day in 2005 318 ton/day in 2010
6	Plant capacity	800 ton/day	480 ton/day
7	Waste re-loading method	Direct-load type	Direct-load type
8	Number of re-loading stations	3 stations	2 stations
9	Upper Staging level of re-loading stations	GL+795.00 (4.5m higher than lower level)	GL+663.50 (4.5m higher than lower level)
10	Transfer vehicles ($40m^3$ semi-trailer)	14 units 4 trips/vehicle (average)	7 units 3 trips/vehicle (average)
11	Types of waste handled	Domestic waste Commercial waste Street sweeping waste	Domestic waste Commercial waste Street sweeping waste

Note: *) Site area of West T/S includes the future area for waste recycling (approx. 0.4 ha).
No.8, 9 and 10 are described/discussed in the following Sections of 16.2 and 16.3.

Waste amounts to be received by each transfer station from service areas/districts are shown in Table 16.1.2. Figure 9.2.1 in Chapter 9 shows the information described in Table 16.1.2 in graphical form.

Table 16.1.2 Service Area and Hauled-in Waste Amount in each Transfer Station

Transfer Stations	Service area		Waste received in 2005 (ton/day)	Total waste received
	District	Collection area		
West T/S	Auezovskii	North	126 (136)	753 ton/day (782 ton/day)
		South	119 (131)	
	Zhetysuskii	West	87 (90)	
		East	92 (95)	
	Almalinskii		157 (158)	
	Bostandykskii		123 (122)	
	Medeuskii	South	49 (51)	
Spasskaya T/S		North	68 (70)	295 ton/day (318 ton/day)
	Turksibskii	South	116 (126)	
		North	111 (122)	

Note: ( ) shows a waste amount in the year 2010

16.1.3 Major Component of Transfer Stations

Both West and Spasskaya transfer stations are composed of the following major components, and the design concept of each component is described as follows.

Access Road : Access road has been planned based on the Russian Standard of SNiP 2.07.01 - 89 "Urban and Rural Settlements Planning and Building". Design speed has been set for 40 km/hour. Road design includes two traffic lanes each 3.5m width, asphalt pavement, pedestrian ways on both sides, etc.. Basically, access roads will be implemented through improvement of existing roads which connect to the sites.

Receiving Facility : Near the entrance of transfer stations, receiving facilities shall be introduced. Incoming collection vehicles hauling waste and outgoing empty vehicles shall be weighed here by using truck-scales so as to obtain vital data for SWM. Data collected will be processed and reported periodically.

Interior Site Roads : In order to keep the smooth traffic and operation of transfer stations, interior site roads are basically planned for one-way traffic; 4.0m width for collection vehicles and 5.0m width for waste transfer semi-trailers.

Waste Re-Loading Station : A direct-load design, as described in Part I of this report has been used for waste transfer in both West and Spasskaya transfer stations. This design incorporates two levels. Arriving trucks discharge waste on the upper level which passes directly unto transfer trucks waiting on the lower level. The upper staging level of re-loading stations has seen set at 4.5m higher than the lower level to match the specifications of the proposed transfer trucks. Taking into account the amount of hauled-in waste in each transfer station, three waste re-loading stations and two stations are to be provided for each West and Spasskaya transfer station, respectively.

Transfer Vehicle Parking : In order to maintain a smooth entry and exit of waste transfer semi-trailers the parking area has been designed for drive through operations.

Green Belt/ Buffer Zone : For environmental protection measures, green belt/buffer zone will be provided along the perimeter of both West and Spasskaya transfer stations, based on Russian standard of "Instructions for Sanitary Protection/ Green belt in Industrial Area, Moscow 1984".

Schematic flow of transfer station operation and waste loading at re-loading stations are shown in Figure 16.1.1 and Figure 16.1.2, respectively.

16.1.4 Environmental Protection Measures

Expected environmental impacts on the surrounding environs due to operation of transfer stations, and counter measures proposed in this plan are described in Table 16.1.3.

Table 16.1.3 Environmental Impacts and Counter Measures

No	Environmental Impacts Predicted	Proposed Countermeasures
1	Offensive odor	• In principle, waste will not be kept in the air and/or accumulated at the transfer stations. • Direct-load method is introduced. Hauled-in waste by collection vehicles will be directly re-loaded to transfer semi-trailers without delay/waiting, then immediately transferred to Karasai disposal site.
2	Waste scattering	• Same measures as mentioned above. • Surrounding fence and trees will be installed. • Waste transfer vehicles (open top semi-trailers) will be covered immediately after waste loading to prevent the waste scattering during transportation.
3	Water-body contamination by leachate	• Leachate production is minimized; ⇒ 1st due to the introduction of direct-load method for waste re-loading (no waste accumulation at the site is proposed). ⇒ 2nd waste re-loading stations are covered by roof. • Wastewater will be collected and transported to the treatment facilities of Karasai disposal site. • Monitoring well will be installed.
4	Landscape (visual)	• Green belt will be installed along the perimeter of the transfer stations. • Basically, width of the green belt is 14m. However, along the adjacent local road, 23m width is adopted.

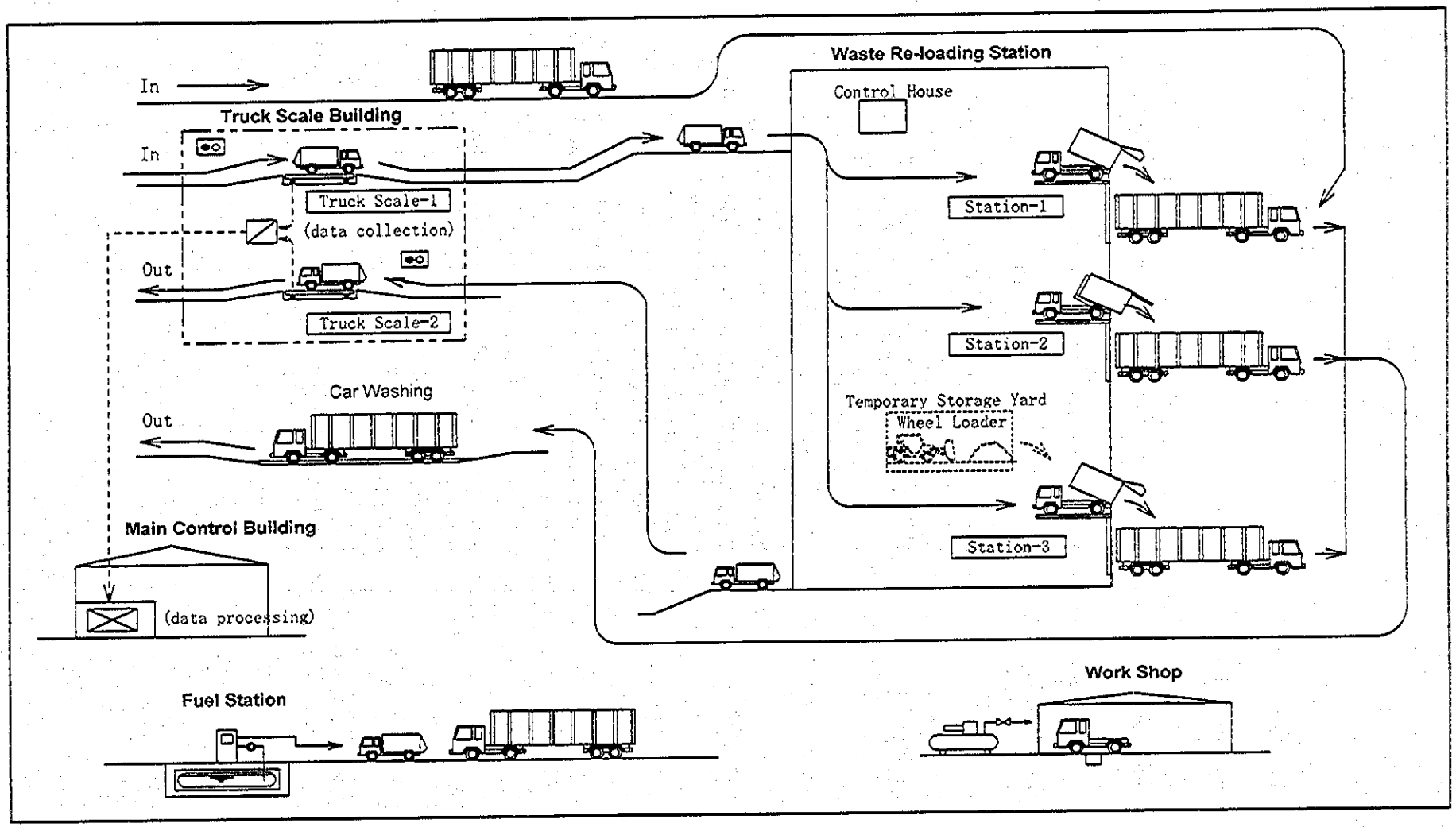
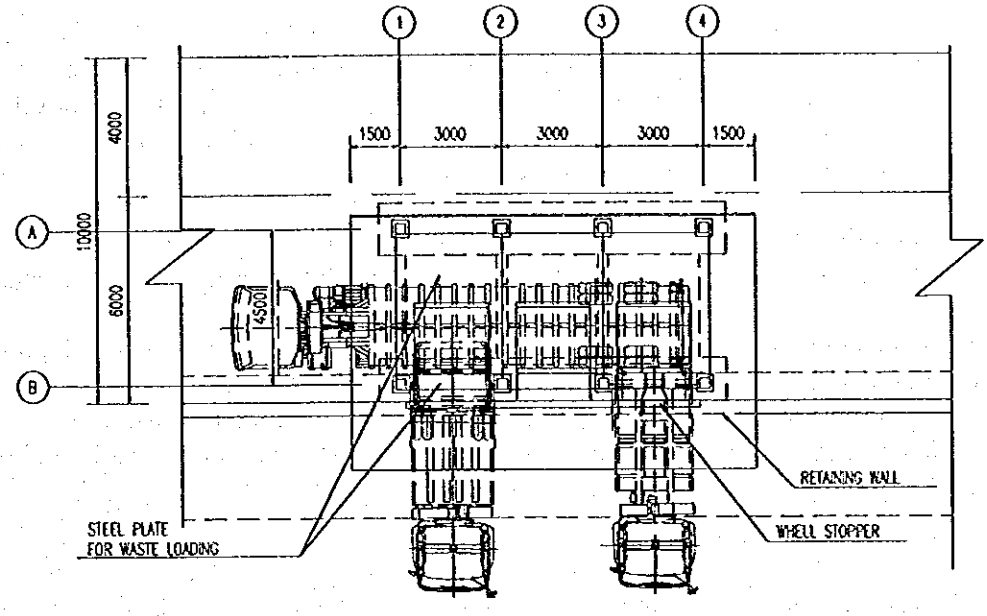
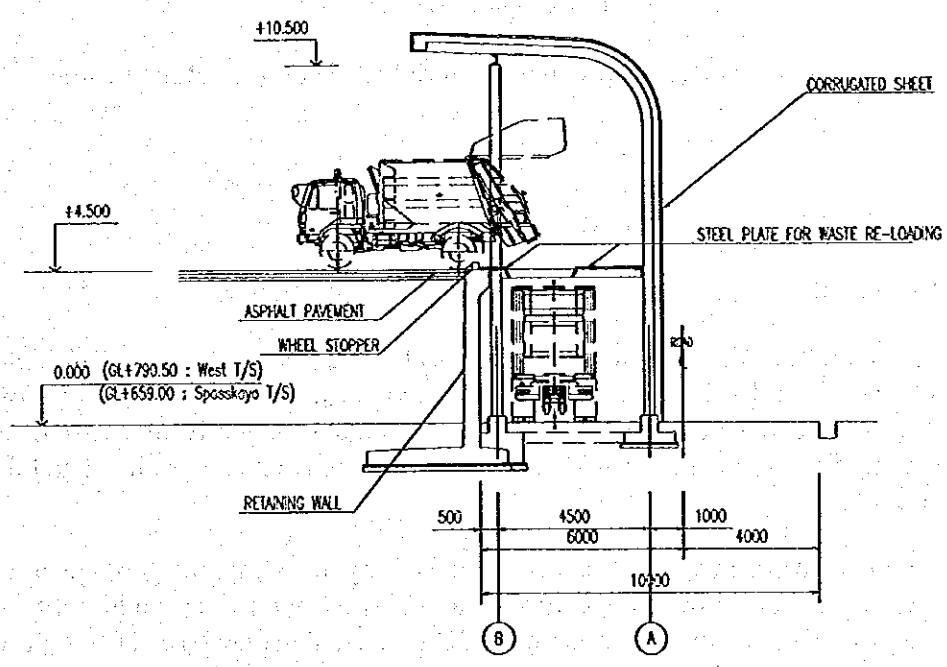


Figure 16.1.1 Schematic Flow of Transfer Station Operation



PLAN



SECTION

Figure 16.1.2 Waste Loading at Re-loading Station

16.1.5 Implementation Schedule

Current waste transfer capability of facilities and equipment in Almaty is very limited (approx. only 200 ton/day; based on the survey carried out by the study team). Existing transfer station has almost ceased operation recently because of uncontrolled waste accumulation in the site. This has created environmental problems. Instead the adjacent old compost plant is being operated as a transfer station.

Based on the consideration of this current situation of existing waste transfer system in Almaty, two transfer stations (West and Spasskaya T/S) are proposed in this study.

Implementation and operation schedule of transfer stations are shown in Figure 16.1.3. West transfer station shall be implemented as an urgent improvement project as it has the larger capacity of the two and serves a larger area. Spasskaya transfer station shall be implemented as a second priority project. Existing transfer station shall be closed after Spasskaya comes into operation.

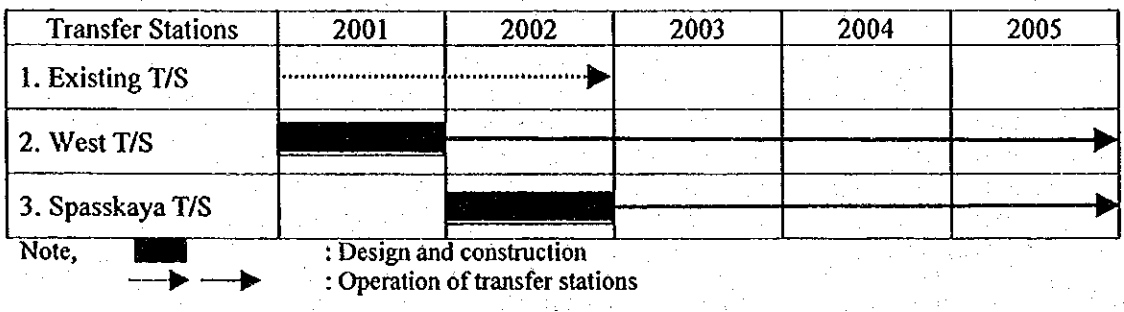


Figure 16.1.3 Implementation Schedule of Transfer Stations

16.2 WEST TRANSFER STATION

16.2.1 Introduction

Proposed site for West transfer station is located 1.2 km north-east from TES-2 power plant, Auezovski district, Almaty city. The site is near the crest of a gently sloping hill, approx. 80m higher than the surroundings, which slopes gently in a eastern direction. Elevation of the site is between 796.0m to 788.0m above mean sea level and the area is 4.4 hectare.

Based on the hydro-geological survey carried out by the Study, the geological features of the site is represented by loam, clay sand and clay. Groundwater could not be found by the survey, even in the bores sunk to 50 meters. Personnel of TES-2 power plant separately informed the Study team that the groundwater level is lower than 50m below the surface.

16.2.2 Requirement of Major Facilities and Equipment

Required number of re-loading stations and waste transfer semi-trailers for the West transfer station are calculated based on projected waste amounts in the years 2010 and 2005, respectively.

Projections

- Hauled-in waste amount to West T/S in 2010: 782 ton/day
- Hauled-in waste amount to West T/S in 2005: 753 ton/day
- Incoming waste amount at the peak hour of the day: 15%
- Density of re-loaded waste in semi-trailer: 0.35 ton/m^3
- Capacity of waste transfer trucks: 40 m^3 semi-trailer
- Trip number of waste transfer trucks: 4 trips (maximum)
- Waste re-loading time at the transfer station: 20 minutes/truck

(1) Waste Re-loading Station

Required number of waste re-loading stations are calculated as follows.

Calculation:
782 ton/day x 15% / 0.35 ton/m^3 = 335 m^3
335 m^3 / 40 m^3 x 20/60 = 2.8 Therefore, 3 re-loading stations are required.
Operation plan of waste re-loading stations of West T/S is shown in Figure 16.2.4.

(2) Waste Transfer Semi-trailer

Required number of waste transfer semi-trailers are calculated as follows.

Calculation:
753 ton/day / (4 trips x 40 m^3 x 0.35 ton/m^3) = 13.4
Therefore, 14 semi-trailers are required.
Operation plan of waste transfer semi-trailers of West T/S is shown in Figure 16.2.4.

16.2.3 Facility Plan

(1) Layout Plan

Layout plan of West transfer station has been based on the following considerations.

- To facilitate smooth traffic and operation of both collection vehicles and transfer vehicles, one way traffic and separate lanes were introduced for the plan of site interior roads.
- So as to keep a smooth entrance and exit of waste transfer semi-trailers to and from the parking area, a drive through plan was adopted.
- Elevations of GL + 795.00 for the upper level and GL + 790.50 for the lower level were chosen to take advantage of natural topographical features of the site.
- In order to control the incoming collection vehicles hauling waste and outgoing empty vehicles, truck-scales were set near the entrance of the site.
- To protect the environment, green belt/buffer zone was provided along the site perimeter.

Layout plan of West transfer station is shown in Figure 16.2.1. A bird's eye view from the south is shown in Figure 16.2.2.

(2) Facilities

Facilities and/or work items for the implementation/construction of West transfer station are shown in Table 16.2.1.

Table 16.2.1 Facilities of West Transfer Station

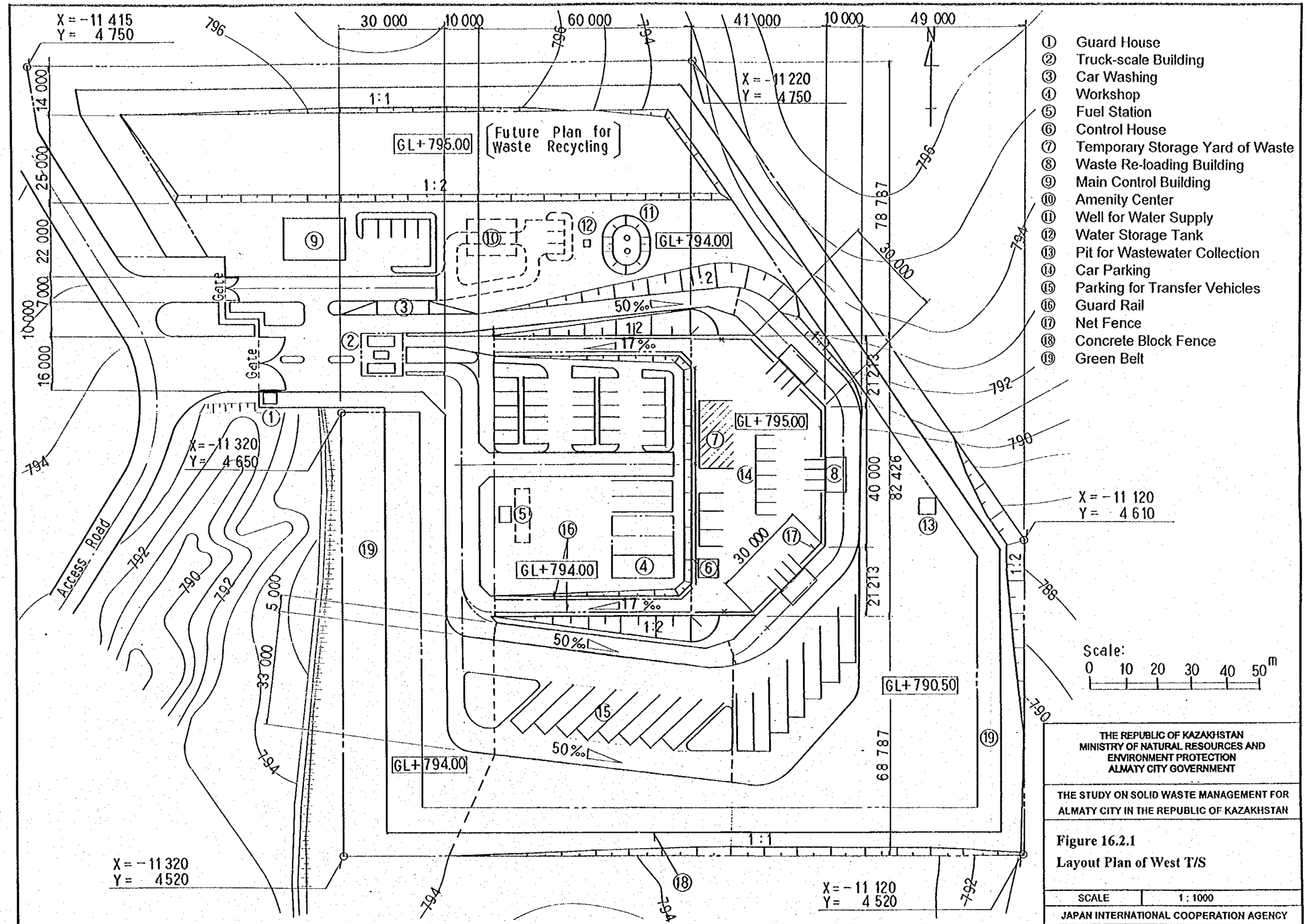
Main facilities/ Work items	Dimension/ Specification	Unit	Quantity
1. Civil/ Earth works			
a. Soil cut and filling w/compaction	Upper staging level: GL+795.0	m^3	56,800
b. Site interior road	W = 4-5m, one way traffic	m	990
c. Access road	W = 3.5m x 2 + 1.5m x 2 = 10m	m	2,000
d. Retaining wall	H = 5.7m (Re-loading station)	m	140
2. Building works			
a. Waste re-loading station	3 nos, 2 level arrangement (4.5m)	m^2	540
b. Main control building		m^2	216
c. Truck-scale building	2 truck-scales equipped	m^2	144
d. Work shop	2 maintenance bays & storage	m^2	108
e. Control & guard houses		m^2	48
3. Water supply and drainage	*)		
a. Water supply system	2 wells: 300m depth, piping & tank	Ls	1
b. Drainage	U-shaped w/cover, open cut	M	1,400
4. Facilities/ Equipment			
a. Truck scale	30ton capacity, load-cell type	Nos	2
b. Leachate treatment	sedimentation/ aeration	Ls	1
c. Lighting/electric facilities		Ls	1
5. Landscaping			
a. Greenbelt –1	W = 23m : along adjacent road	M	185
b. Greenbelt –2	W = 14m : site surroundings	M	610
c. Installation of humus/ lawn	Humus: 0.3m thick	m^2	16,200
6. Other facilities			
a. Fence	Net-fence & concrete block	M	1,045
b. Gate		Nos	2
c. Others	Car washing, fuel station, parking, guard rail, generator, boiler, etc.	Ls	1

Note: *) One of two wells for water supply will be used for groundwater monitoring purpose also.

16.2.4 Equipment Plan

Open-top semi-trailers of 40 m^3 capacity, equipped with ejection plate for waste unloading at Karasai disposal site and cover to prevent waste scattering during waste transportation, are used for the waste transportation from West transfer station to Karasai disposal site.

Wastes carried into transfer station during night time or day-off when re-loading stations are not operating shall be stored in the temporary storage yard of the transfer station. During operating hours, the stored waste shall be re-loaded to waste transfer semi-trailers by wheel loader. Cleansing work at illegal dump sites shall also be carried out by wheel loader.


X = -11 415
Y = 4 750
30 000
10 000
60 000
41 000
10 000
49 000
N
X = -11 220
Y = 4 750
1:1
GL+795.00
Future Plan for Waste Recycling
1:2
GL+794.00
GL+795.00
GL+794.00
GL+790.50
GL+794.00
50‰
17‰
Gate
Gate
Access Road
X = -11 320
Y = 4 650
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14 000
25 000
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78 787
21 213
40 000
82 426
68 787
792
794
796
790
788
① Guard House
② Truck-scale Building
③ Car Washing
④ Workshop
⑤ Fuel Station
⑥ Control House
⑦ Temporary Storage Yard of Waste
⑧ Waste Re-loading Building
⑨ Main Control Building
⑩ Amenity Center
⑪ Well for Water Supply
⑫ Water Storage Tank
⑬ Pit for Wastewater Collection
⑭ Car Parking
⑮ Parking for Transfer Vehicles
⑯ Guard Rail
⑰ Net Fence
⑱ Concrete Block Fence
⑲ Green Belt
Scale:
0 10 20 30 40 50 m
THE REPUBLIC OF KAZAKHSTAN
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT PROTECTION
ALMATY CITY GOVERNMENT
THE STUDY ON SOLID WASTE MANAGEMENT FOR ALMATY CITY IN THE REPUBLIC OF KAZAKHSTAN
Figure 16.2.1
Layout Plan of West T/S
SCALE 1 : 1000
JAPAN INTERNATIONAL COOPERATION AGENCY

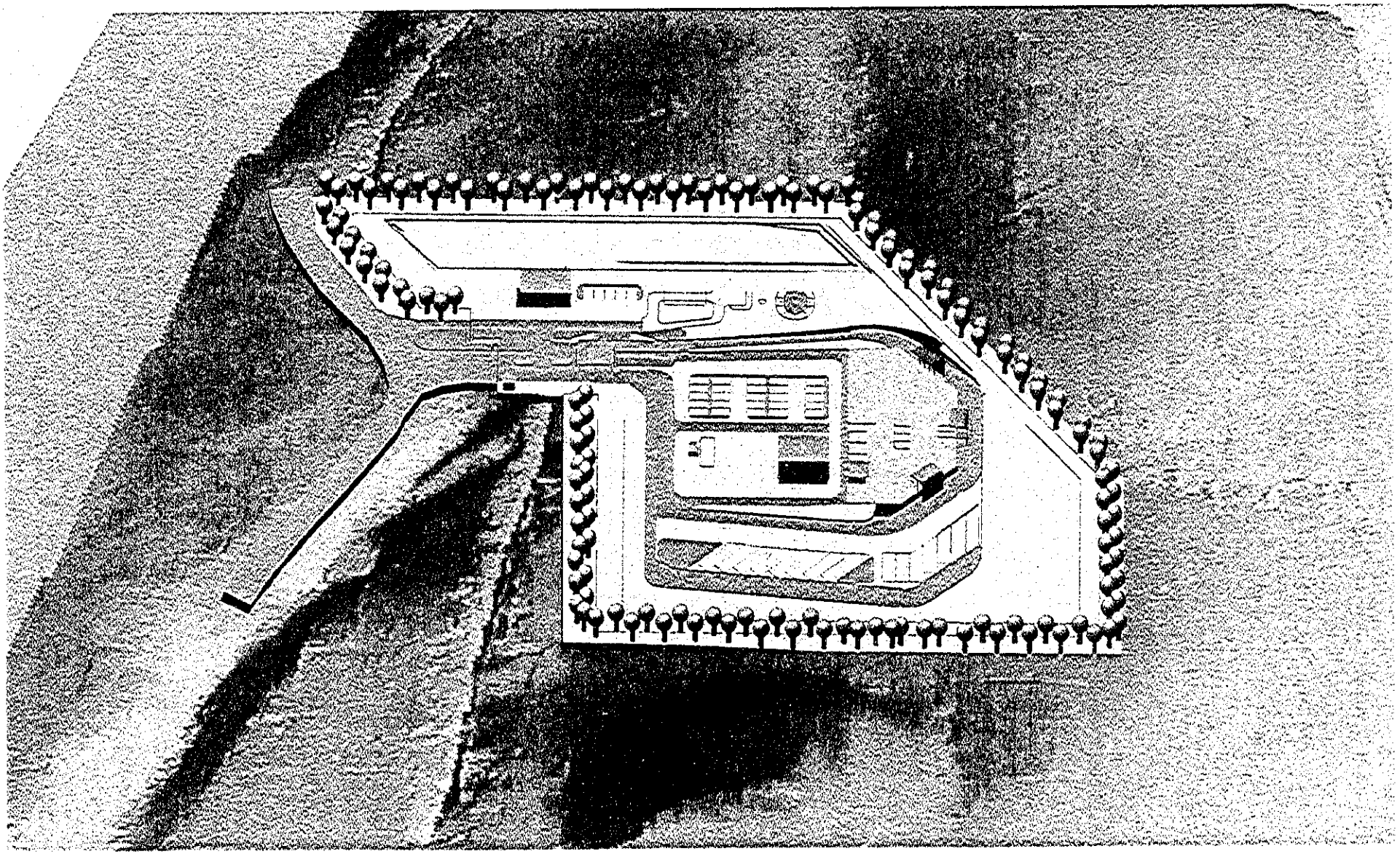


Figure 16.2.2 Bird's Eye View of West Transfer Station

The list of equipment required at West transfer station in 2005 is shown in Table 16.2.2.

Table 16.2.2 List of Equipment at West Transfer Station

Equipment	Number	Operation
1. Semi-trailer ($40\ m^3$)	14 (15)	• Direct waste acceptance from collection vehicles at the waste re-loading stations • Waste transportation from West transfer station to Karasai disposal site
2. Wheel loader ($1.5\ m^3$)	2 (2)	• Waste carriage from temporary storage yard to re-loading stations and loading to waste transfer semi-trailers at the re-loading stations • Cleansing work of illegal dump site
3. Water tanker (6000 liter)	1 (1)	• Transport collected wastewater to the treatment facilities of Karasai disposal site

Note: ( ) shows equipment requirements in 2010.

16.2.5 Operation and Maintenance Plan

(1) Operating Organization and Personnel

Management of West transfer station, including maintenance of facilities and equipment, shall be contracted out to private company.

West transfer station will be operated under the organization shown in Figure 16.2.3.

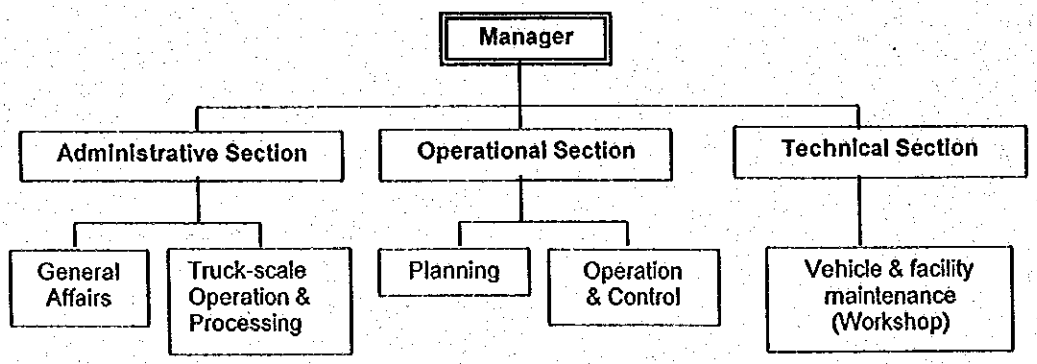


Figure 16.2.3 Organization of West Transfer Station Operation

Table 16.2.3 shows the staffing and their responsibilities for the operation and maintenance of West transfer station. The total number of staff required is estimated to be 34.

Table 16.2.3 Staffing of West Transfer Station

Staffing	Number	Responsibilities
Site manager	1	• Overall management/ operation of transfer station
Secretary (Accountant)	1	• general affairs including schedule of site manager, recording income and outlays daily management

Truck-scale operator	3	• operates truck scale, data collection and processing, reporting (daily, weekly, monthly and yearly)
Chief engineer	1	• responsible for planning and conduct of smooth operation of transfer station
Inspector	3	• traffic control and inspection of loads of collection and transfer trucks
Chief mechanic	1	• responsible for maintenance of trucks (mainly transfer trucks)
Operator/ Wheel loader	2	• handling of waste temporarily stored at the yard
Driver/ Transfer vehicles	12	• operation of transfer trucks
Worker	8	• waste re-loading operations • vehicle maintenance (at workshop) • fuel station operation
Security guard	2	• maintain security of the transfer station
Total	34	

(2) Operation Plan of Re-loading Stations and Transfer Vehicles

Operation plan of West transfer station has been prepared taking into consideration the following conditions and calculations.

Conditions

- Distance from West T/S to Karasai disposal site: 29 km
- Design speed of waste transfer semi-trailers: 40 km/hour
- Numbers of waste transfer semi-trailers operated: 14 units
- Number of waste re-loading stations: 3 stations
- Transit and unloading within Karasai disposal site: 10 minutes
- Waste re-loading time at West transfer station: 20 minutes
- Capacity of waste transfer semi-trailers: 40 m^3
- Unit weight of transferred waste: 0.35 ton/m^3
- Waste amount to be transferred (in 2005): 753 ton/day
- The peak load of waste per hour: 15 % of total daily waste
- Working hours of transfer station: 07:00 to 19:00 (12 hours)
- Hauled-in waste amount to West transfer station in each hour of the day is estimated as follows (based on experience in other developing countries):

Time	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00
%	3	10	15	11	11	4	15	12	11	8
ton/h	23	75	113	83	83	30	113	90	83	60

Calculations

- Round trip to Karasai disposal site: 29km / 40km/h x 2 x 60min + 10min = 97min
- Capacity of waste transfer semi-trailers: $40m^3$ x $0.35ton/m^3$ = 14ton/unit

Based on the above described conditions, the time schedule of operation for the waste transfer semi-trailers and waste re-loading stations of West transfer station is shown in Figure 16.2.4.

A total of 54 trips by waste transfer semi-trailers to the Karasai disposal site will be required daily. Each vehicle will make 3 or 4 trips. The schedule for transfer vehicles must be coordinated with the schedule of the collection trucks. The three re-loading stations will be operated separately with no interference with each other.

The operation schedule of waste transfer semi-trailers and waste re-loading stations are heavily dependent on the time schedule of the private collection companies. Therefore, after confirmation of actual movement of incoming vehicles operated by these companies, operation schedule of West transfer station shall be verified and revised in the same manner shown in Figure 16.2.4.

Figure 16.2.5 shows a vehicle routing plan of West transfer Station

16.3 SPASSKAYA TRANSFER STATION

16.3.1 Introduction

Proposed site for Spasskaya transfer station is located at north-western end of Turksibskii district, Almaty city. The site lies between two rivers, Sultanka river and Moyka river, very close to the steep bank of Sultanka river. However, the site itself is basically flat. The elevation of the site is approximately 658.5m above mean sea level and the area is 2.7 hectare. Fill covers much of the site to a depth of 2-3 meters, and was probably placed a few years ago.

The water table is 12-16 m below the surface. Sub-surface water flows west towards the Sultanka river valley.

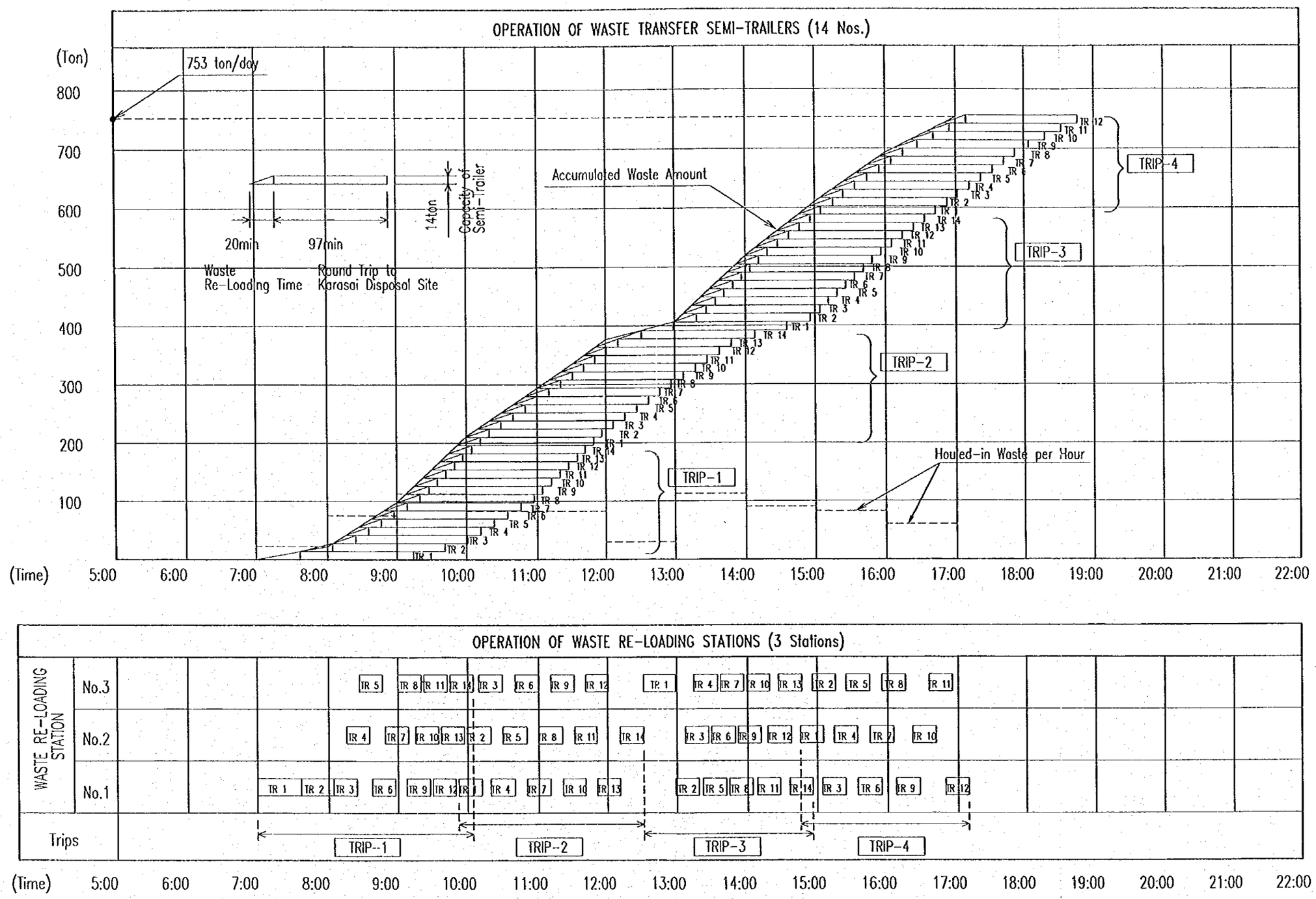
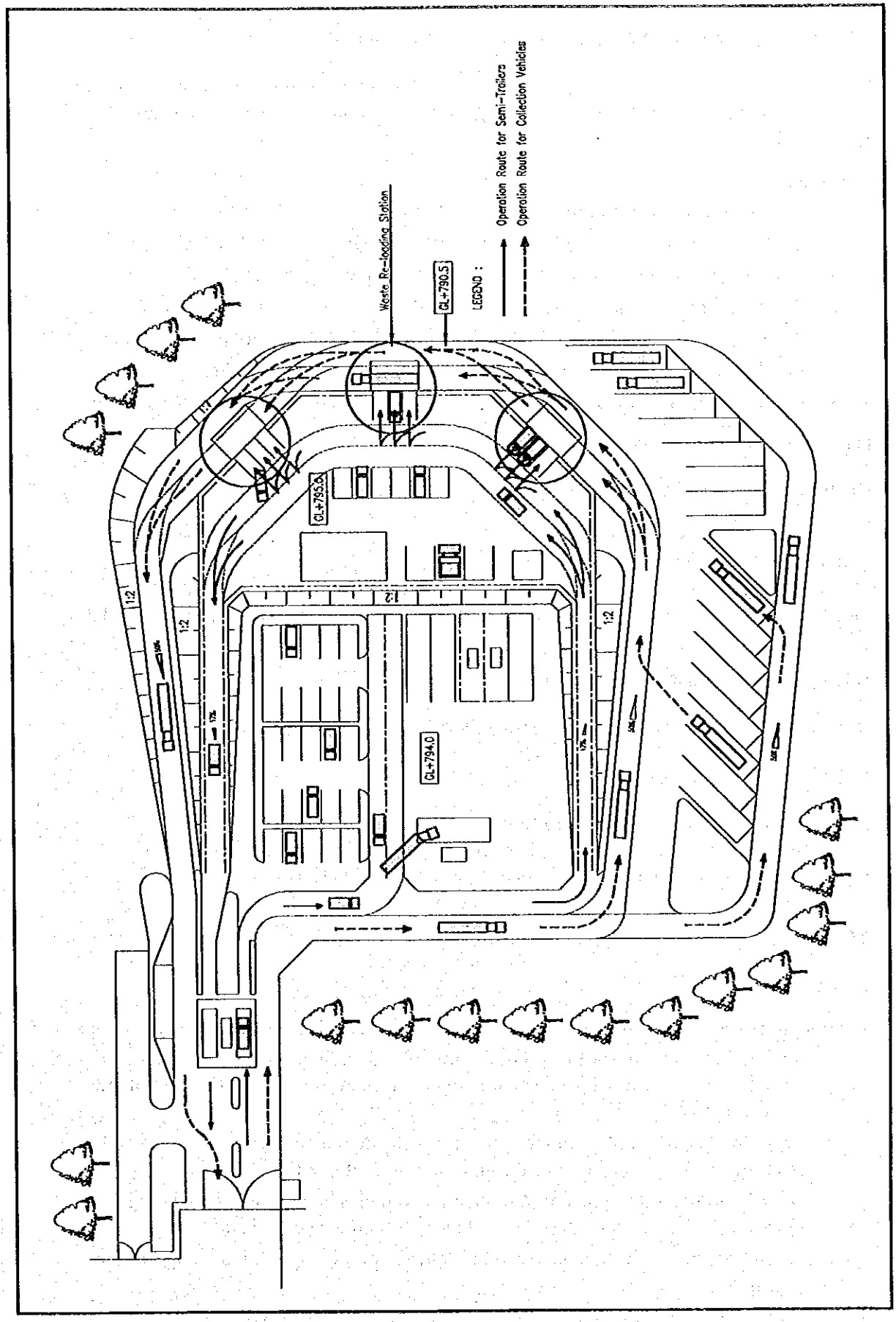


Figure 16.2.4 Operation Schedule of West Transfer Station


Waste Re-loading Station
GL+790.5
LEGEND :
Operation Route for Semi-Trailers
Operation Route for Collection Vehicles
GL+795.0
GL+794.0
1:2
1:2
1:2

16.3.2 Requirement of Major Facilities and Equipment

Required number of re-loading stations and waste transfer semi-trailers at Spasskaya transfer station are calculated based on projected waste amounts in years 2010 and 2005, respectively.

Projections

- Hauled-in waste amount to Spasskaya T/S in 2010: 318 ton/day
- Hauled-in waste amount to Spasskaya T/S in 2005: 295 ton/day
- Incoming waste amount at the peak hour of the day: 15%
- Unit weight of re-loaded waste in semi-trailer: 0.35 ton/m^3
- Capacity of waste transfer vehicles: 40 m^3 semi-trailer
- Number of trips per day for waste transfer vehicles: 3 trips
- Waste re-loading time at the transfer station: 20 minutes/vehicle

(1) Waste Re-loading Station

Required number of waste re-loading stations are calculated as follows.

Calculation:

318 ton/day x 15% / 0.35 ton/m^3 = 136 m^3
136 m^3 / 40 m^3 x 20/60 = 1.1 Therefore, 2 re-loading stations are required.
Operation plan of waste re-loading stations of Spasskaya T/S is shown in Figure 16.3.3.

(2) Waste Transfer Semi-trailer

Required number of waste transfer semi-trailers are calculated as follows.

Calculation:

295 ton/day / (3 trips x 40 m^3 x 0.35 ton/m^3) = 7.0
Therefore, 7 semi-trailers are required.
Operation plan of transfer semi-trailers of Spasskaya T/S is shown in Figure 16.3.3.

16.3.3 Facility Plan

(1) Layout Plan

Layout plan of Spasskaya transfer station has been based on the following considerations.

- To facilitate smooth traffic and operation of both collection vehicles and transfer vehicles, one way traffic and separate lanes were introduced for the plan of site interior roads.
- So as to keep a smooth entrance and exit of waste transfer semi-trailers to and from the parking area, a drive-through plan was adopted.
- In order to control the incoming collection vehicles hauling waste and outgoing empty vehicles, truck-scales were set near the entrance of the site.
- To protect the environment, green belt/buffer zone was provided along the site perimeter.

Layout plan of Spasskaya transfer station is shown in Figure 16.3.1.

(2) Facilities

Facilities and/or work items for the implementation/construction of Spasskaya transfer station are shown in Table 16.3.1.

Table 16.3.1 Facilities of Spasskaya Transfer Station

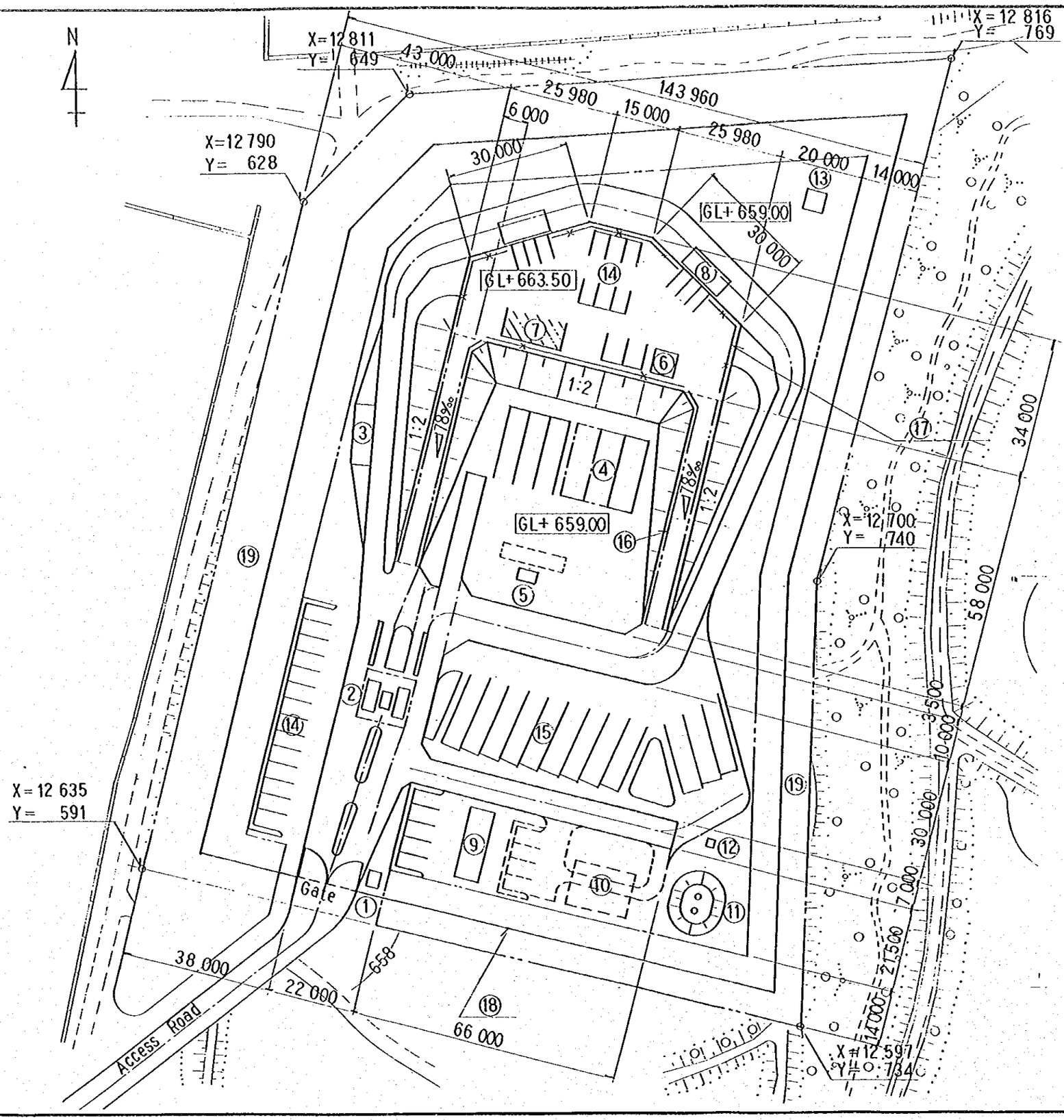
Main facilities/ Work items	Dimension/ Specification	Unit	Quantity
1. Civil/ Earth works			
a. Soil cut and filling w/compaction	Upper staging level: GL+663.5	m^3	31,900
b. Site interior road	W = 4-5m, one way traffic	m	710
c. Access road	W = 3.5m x 2 + 1.5m x 2 = 10m	m	1,500
d. Retaining wall	H = 5.7m (Re-loading station)	m	115
2. Building works			
a. Waste re-loading station	2 nos, 2 level arrangement (4.5m)	m^2	360
b. Main control building		m^2	108
c. Truck-scale building	2 truck-scales equipped	m^2	144
d. Work shop	2 maintenance bays & storage	m^2	108
e. Control & guard houses		m^2	48
3. Water supply and drainage	*)		
a. Water supply system	2 wells: 300m depth, piping & tank	Ls	1
b. Drainage	U-shaped w/cover, open cut	M	1,540
4. Facilities/ Equipment			
a. Truck scale	30 ton capacity, load-cell type	nos	2
b. Leachate treatment	sedimentation/ aeration	Ls	1
c. Lighting/electric facilities		Ls	1
5. Landscaping			
a. Greenbelt –1	W = 23m : along adjacent road	m	340
b. Greenbelt –2	W = 14m : site surroundings	m	320
c. Installation of humus/ lawn	Humus: 0.3m thick	m^2	14,600
6. Other facilities			
a. Fence	Net-fence & concrete block	m	815
b. Gate		nos	1
c. Others	Car washing, fuel station, parking, guard rail, generator, boiler, etc.	Ls	1

Note: *) One of two wells for water supply will be used for groundwater monitoring purpose also.

16.3.4 Equipment Plan

Open-top semi-trailers of 40 m^3 capacity, equipped with ejection plate for waste unloading at Karasai disposal site and cover to prevent waste scattering during waste transportation, are used for the waste transportation from Spasskaya transfer station to Karasai disposal site.

Wastes carried into transfer station during night time or day-off when re-loading stations are not operating shall be stored in the temporary storage yard of the transfer station. During operating hours these stored wastes shall be re-loaded to waste transfer semi-trailers by wheel loader.



① Guard House
② Truck-scale Building
③ Car Washing
④ Workshop
⑤ Fuel Station
⑥ Control House
⑦ Temporary Storage Yard of Waste
⑧ Waste Re-loading Building
⑨ Main Control Building
⑩ Amenity Center
⑪ Well for Water Supply
⑫ Water Storage Tank
⑬ Pit for Wastewater Collection
⑭ Car Parking
⑮ Parking for Transfer Vehicles
⑯ Guard Rail
⑰ Net Fence
⑱ Concrete Block Fence
⑲ Green Belt

Scale :
0 10 20 30 40 50 m

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Figure 16.3.1
Layout Plan of Spasskaya T/S

SCALE	1 : 1000

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The list of equipment required at Spasskaya transfer station in 2005 is shown in Table 16.3.2.

Table 16.3.2 List of Equipment at Spasskaya Transfer Station

Equipment	Number	Operation
1. Semi-trailer ($40m^3$)	7 (8)	• Direct waste acceptance from collection vehicles at the waste re-loading stations • Waste transportation from Spasskaya transfer station to Karasai disposal site
2. Wheel loader ($1.5m^3$)	1 (1)	• Waste carriage from temporary storage yard to re-loading stations and loading to waste transfer semi-trailers
3. Water tanker (6000 liter)	1 (1)	• Transport collected wastewater to the treatment facilities of Karasai disposal site

Note: ( ) shows equipment requirements in 2010.

16.3.5 Operation and Maintenance Plan

(1) Operational Organization and Personnel

Management of Spasskaya transfer station, including maintenance of facilities and equipment, shall be contracted out to a private company.

Spasskaya transfer station will be operated under the organization shown in Figure 16.3.2.

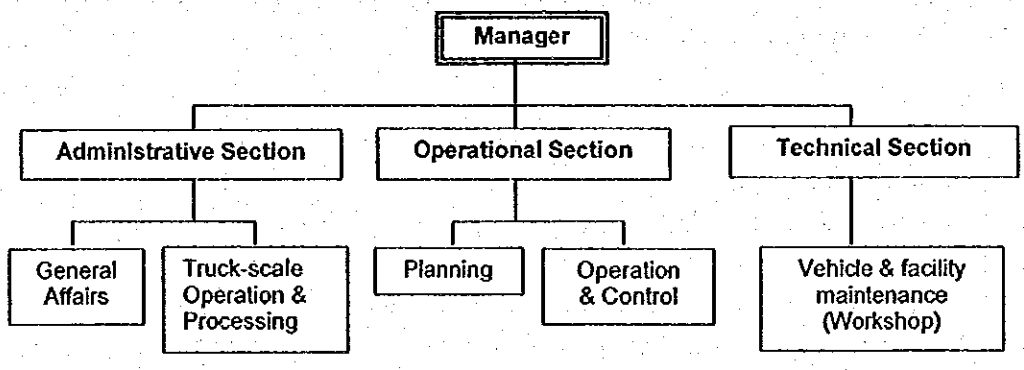


Figure 16.3.2 Organization of West Transfer Station Operation

Table 16.3.3 shows the staffing and their responsibilities for the operation and maintenance of Spasskaya transfer station. The total number of staff required is estimated to be 23.

Table 16.3.3 Staffing of West Transfer Station

Staffing	Number	Responsibilities
Site manager	1	• overall management/ operation of transfer station
Secretary (Accountant)	1	• general affairs including schedule of site manager, recording income and outlays for daily management
Truck-scale operator	2	• operates truck scale, data collection and processing, reporting (daily, weekly, monthly and yearly)
Chief engineer	1	• responsible for planning and conduct of smooth operation of transfer station
Inspector	2	• traffic control and inspection of loads of collection and transfer vehicles
Chief mechanic	1	• responsible for maintenance of vehicles (mainly transfer vehicles)
Operator/ Wheel loader	1	• handling of waste temporarily stored at the yard
Driver/ Transfer vehicles	6	• operation of transfer vehicles
Worker	6	• waste re-loading operations • vehicle maintenance (at workshop) • fuel station operation
Security guard	2	• maintain security of the transfer station
Total	23	

(2) Operation Plan of Re-loading Stations and Transport Vehicles

Operation plan of Spasskaya transfer station has been prepared taking into consideration the following conditions and calculations.

Conditions

- Distance from Spasskaya T/S to Karasai disposal site: 40 km
- Design speed of waste transfer semi-trailers: 35 km/hour
- Numbers of waste transfer semi-trailers operated: 8 units
- Number of waste re-loading stations: 2 stations
- Transit and unloading within Karasai disposal site: 10 minutes
- Waste re-loading time at West transfer station: 20 minutes
- Capacity of waste transfer semi-trailers: 40 m^3
- Unit weight of transferred waste: 0.35 ton/m^3
- Waste amount to be transferred (in 2005): 295 ton/day
- Working hours of transfer station: 07:00 to 19:00 (12 hours)
- Hauled-in waste amount to Spasskaya transfer station in each hour of the day is estimated as follows (based on the experience of other developing countries):

Time	07:00-08:00	08:00–09:00	09:00–10:00	10:00–11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00
%	3	10	15	11	11	4	15	12	11	8
ton/h	9	30	44	32	32	12	44	36	32	24

Calculations

- Round trip to Karasai disposal site: 40km / 35km/h x 2 x 60min + 10min = 147min
- Capacity of waste transfer semi-trailers: $40m^3$ x $0.35ton/m^3$ = 14ton/unit

Based on the above described conditions, the time schedule of operation for the waste transfer semi-trailers and waste re-loading stations of Spasskaya transfer station is shown in Figure 16.3.3.

Twenty-one (21) trips of waste transportation to Karasai disposal site by semi-trailers (3 trips per one semi-trailer) will be carried out during one day operation. As shown in the figure, some time difference may happen on 6 of 21 trips between in-coming time of collection vehicles and the waiting semi-trailers. However, the number is low, the difference is only 15 minutes (maximum) and it can be recovered after few trips of vehicles. While, two of re-loading stations will be operated without any interference with each other.

The operation schedule of waste transfer semi-trailers and waste re-loading stations are heavily dependent on the time schedule of the private collection companies. Therefore, after confirmation of actual movement of incoming vehicles operated by these companies, operation schedule of West transfer station shall be verified and revised in the same manner shown in Figure 16.3.3.

Figure 16.3.4 shows vehicle routing plan for Spasskaya transfer station

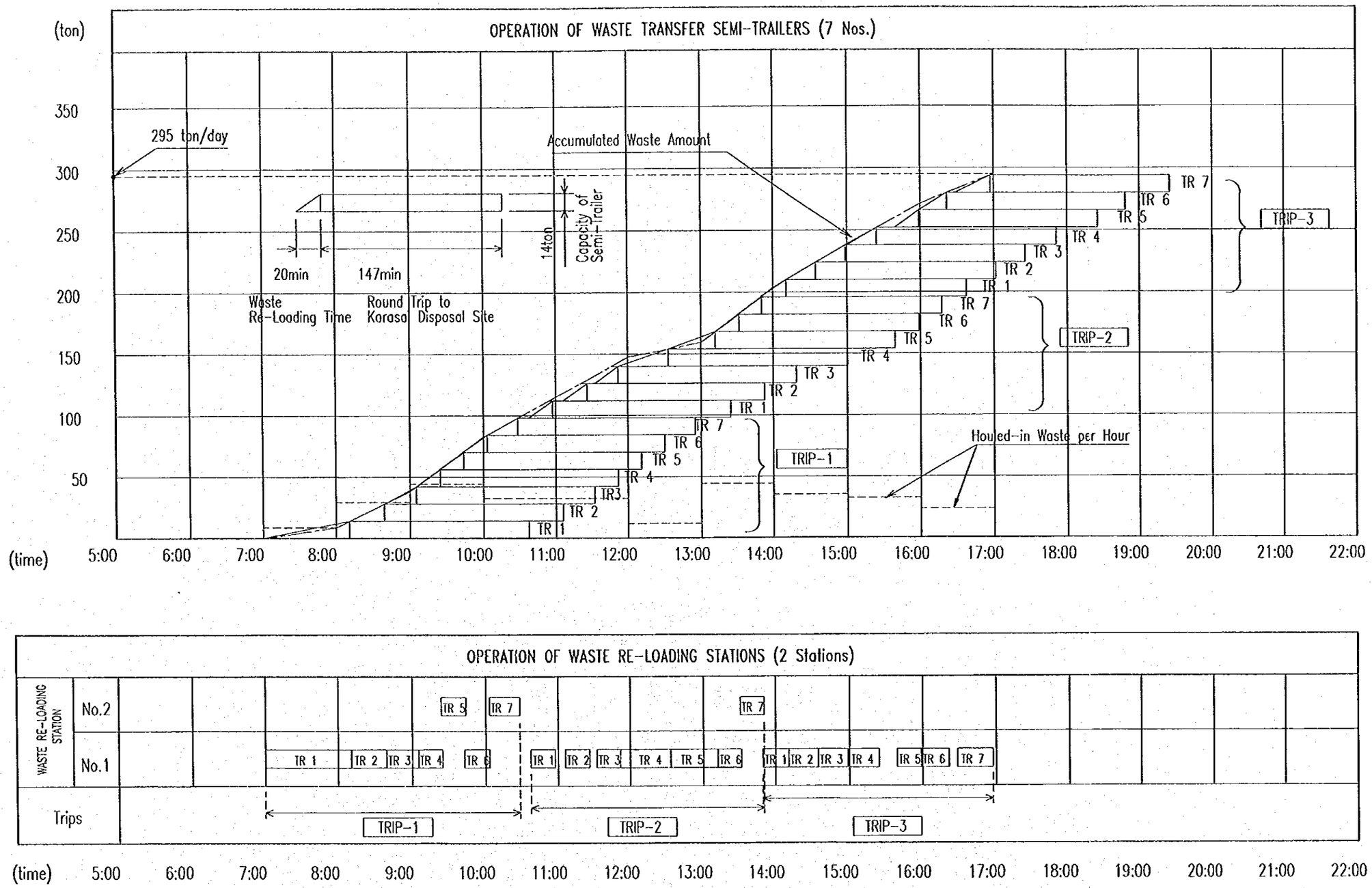


Figure 16.3.3 Operation Schedule of Spasskaya Transfer Station

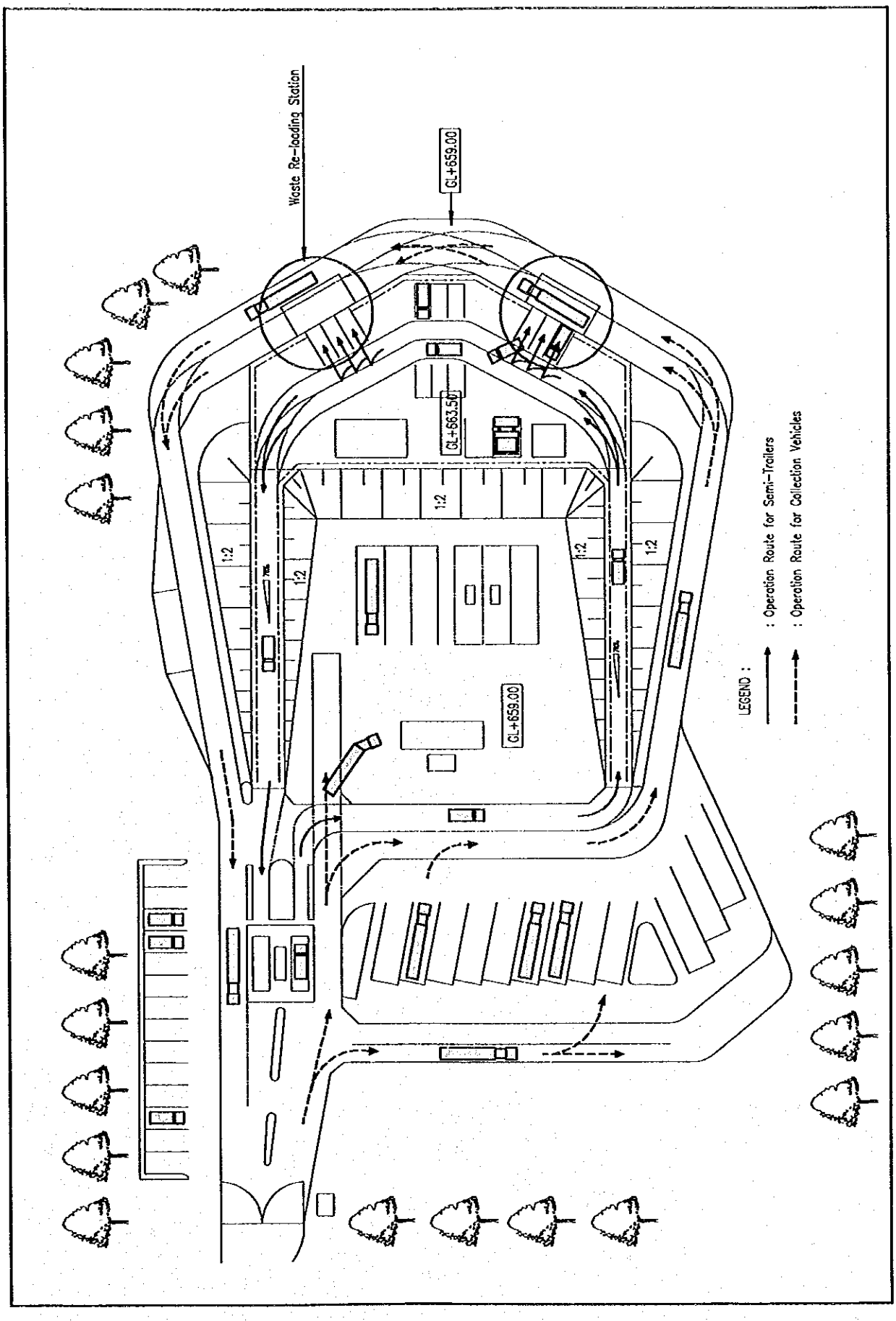


Figure 16.3.4 Vehicle Routing Plan for Spasskaya Transfer Station

Chapter 17

IMPROVEMENT OF KARASAI DISPOSAL SITE

CHAPTER 17 IMPROVEMENT OF KARASAI DISPOSAL SITE

17.1 OUTLINE OF THE REQUIRED FACILITIES

As described in Section 9.3, existing facilities and operations plan for the Karasai disposal site should be improved. The upgraded facilities shall be used until the year 2010 and provide better protection of the surrounding environment. Major planning parameters are:

a. Solid waste to be received

Type of waste	Year 2005	Year 2010
From Almaty City	827 t/day	869 t/day
From cities other than Almaty City	19 t/day	22 t/day
Street sweeping waste	82 t/day	86 t/day
Non-hazardous industrial waste from Almaty City	70 t/day	70 t/day
Total	998 t/day	1,047 t/day

b. Total disposal amount up to year 2010
   Weight : 3,956,500 t*
   Volume : 3,956,500 m^3
   * Bulk density of waste at the site varies from 0.4 to 1.7; an average of 1.0 has been assumed.

c. Total capacity of the disposal site
   3,991,900 m^3

d. Expected useful life
   11 years from year 2000

To improve the operation of the disposal site as quickly as possible, heavy equipment required for the sanitary landfill operation in 2005 will be procured first.

The following descriptions give an outline of the major facilities of the site.

17.1.1 Waste Retaining Structures (Earth Dams)

An earth dam will be constructed at the lower (northern) end of the ravine to retain the waste. The topography of the ravine makes it unnecessary to have any retaining structures on the other peripheries of the landfill site, minimizing construction costs. Smaller dams will be built below the waste retaining dam to form the leachate retention pond and leachate treatment pond.

17.1.2 Leachate Collection and Drainage Facilities

At the bottom of landfill zones, an impermeable clayey soil layer should be prepared to prevent the leachate from infiltrating the underground. On the clay lining, a water permeable layer should be provided with the use of cobblestones and gravel, to allow leachate that has percolated through the waste to drain off this protective layer.

17.1.3 Leachate Retention Pond

The leachate collected from the leachate drainage facilities during rainfall and snow melting periods should be totally retained in the leachate retention pond. The required retention volume is estimated based on meteorological data for precipitation and evaporation.

To avoid pollution of the groundwater by leachate stored in the pond, a liner system comprising a clay layer and a synthetic membrane should be provided.

17.1.4 Leachate Treatment Pond

As a result of the Environmental Survey, water quality of leachate retained in the existing retention pond at the site is not so bad compared with typical leachate composition. Therefore, simple treatment, such as storage in an anaerobic pond is recommended because of ease of operation and maintenance. The leachate stored in the retention pond will then be discharged to accelerate its aerobic treatment in another pond located downstream.

17.1.5 Rainwater (Surface Water) Collection Gutter

Surface water should be diverted from both the active and inactive landfill areas using gutters which collect surface runoff upstream of the landfill and discharge it downstream of the site.

17.1.6 Gas Exhaust Equipment

Gas exhaust equipment should be installed to extract gases and vapors generated by the decomposition of organic materials in the waste. The equipment is composed of a perforated PVC pipe covering crushed stones wrapped with a wire basket.

17.1.7 Access Road

The approx. 2 km stretch from the Almaty-Bishkek highway to the disposal site is already paved; however the site road from the entrance to the landfill area is not paved. To reduce the wear and tear on the transport vehicles and increase the travel speed of the vehicles, it would be desirable to surface this distance with a simple asphalt pavement. In addition, a gravel or crushed stone-paved road should be created within the landfill site compound. This road would be used for access by the vehicles delivering wastes and topsoil to the landfill and also the vehicles used for site management.

17.1.8 Groundwater Monitoring Wells

Since the leachate is stored in the leachate retention pond throughout the year, there is a high risk that the leachate may seep into the groundwater with time. It is therefore

necessary to monitor the groundwater quality on an ongoing basis in order to check for groundwater pollution due to leachate seepage.

17.1.9 Site Office

To assure sanitary landfill conditions, various procedures are necessary. These include the weighing of the wastes, the demarcation of the landfill zones (cells), the checking of the landfill height, adjustment of the water content, and monitoring of the leachate volume and water quality. For this purpose, the existing site office building will need to be reconstructed to house the landfill supervisors permanently stationed at the site.

17.1.10 Truck Scale (Truck Weighing System)

The waste amounts delivered to the disposal site each day should be weighed on a truck scale (weighing capacity: 30t) and the weights need to be recorded. For the time being, however, the waste amount may be estimated from the number of waste transportation vehicles.

17.2 DESIGN OF THE FACILITIES

17.2.1 Summary Results of Soil Investigation Survey

1) Geological Structure

The Paleozoic rock foundation has the common immersion from south to north of the site. The rock bed lies at a depth of approximately 1000 m. This Paleozoic foundation is covered with Neogene and Quaternary deposits whose thickness ranges up to 400 m.

The site is located in a ravine that is the plain of a temporary water stream. Water frequently flows during spring time when snow melts and spring rains fall. Unsagging loam is up to the depth of 30 to 50 m covered by a layer of unsagging silty loam with a thickness ranging from 0.5 to 11 m.

Groundwater level in the north part of the site is measured at 0.5 – 1.52 m in depth and 8.95 – 16.32 m in depth at the south. The highest level of the groundwater is usually between May and June.

2) Laboratory Test

Permeability tests were undertaken on soil samples from each borehole. The results suggest that the loam has a permeability in the range of 1×10^{-6}~10^{-5} cm/sec which is considered low.

Based on laboratory analysis, physical characteristics of the loam are summarized as follows:

Table 17.2.1 Physical Characteristics of the Loam at the Karasai Disposal Site

Indices	Unit	Average
Plastic Limit, W_P	%	17.3
Plasticity Index, PI	%	8.7-9.2
Water Content, W_n	%	20.5-21.4
Liquid Index, I_L	-	0.37-0.47
Degree of Saturation, S_r	%	99-99.8
Void Ratio, e	-	0.54-0.56
Unit Weight, γ_m	t/m^3	2.10-2.12
Dry Unit Weight, γ_d	t/m^3	1.73-1.76
Modulus of Deformation, E	MPa	4.6-4.7
Specific Cohesion, C_V	KPa	22-38
Angle of Internal Friction, θ	degree	22-23

In addition, results of grain size analysis show that the loam is categorized into clay or silty clay.

17.2.2 Calculation and Determination of Facility Dimension

1) Access Road

The planned access road will be reconstructed on the existing road alignment. The bearing capacity of the access road is planned to be 10 tons of axle load. Final approach to the landfill site and site for the ponds will be reconstructed to improve access. The design width of the access road is 7 m in accordance with Kazakh standards.

2) Dike (Retaining Structure)

Two small earth dams will be constructed to form the leachate retention pond and leachate treatment pond. They have a trapezoidal cross-section with the following dimensions:

- Width of top: 5 m (Downstream of the retention pond)
  and 2 m (Downstream of the treatment pond)
- Gradient of wall: 1:3

Material of dikes should be selected to ensure stability at low cost. From this viewpoint, it is desirable that materials should be acquired from the landfill site. However, the excavated loam is unsuitable to use as dike material because it contains too fine materials according to the results of the grain size analysis. Therefore, the site soils should be mixed with some coarse materials, such as sand and gravel, with a grain size between 0.1 and 150 mm.

It is necessary to provide a lining on the surface of the retention pond to prevent or reduce contamination of the groundwater by leachate. Currently the groundwater is being polluted by leachate. A synthetic membrane like a HDPE (high density polyethylene) sheet will be used for the liner system.

3) Leachate Collection Facility and Gas Exhaust Equipment

The gas exhausts and sub-surface drains are constructed from perforated PVC (polyvinylchloride) pipes surrounded with crushed stone installed in wire baskets. The

perforated PVC pipes must be imported from outside of Kazakhstan.

Pipe diameter (D) is determined as Q × P (where P is the number of pipes per line), assuming that the flow capacity (Q') is more than the discharge volume of leachate (Q). It is also assumed that the maximum diameter of the PVC pipe available in Kazakhstan is 400 mm. Additionally, the minimum diameter of the pipe should be 200 mm to prevent blockage. The calculation details are described in Chapter 9, Section E of the Supporting Report. The recommended number of gas extraction wells is one well per 1 to 1.5 hectares based on experience from other projects.

Layout of the leachate collection pipes and the structure and gas exhaust equipment are shown in Chapter 9, Section E of Supporting Report.

4) Retention Pond and Leachate Treatment Facility

(1) Quantity of Leachate

The retention and the treatment ponds are designed to confine leachate water. These facilities are expected to confine the leachate even in the rainy and snow melting seasons. Therefore, their sizes should be determined to have enough capacity to contain all leachate without discharging any untreated leachate.

The leachate volume confined in the pond has been stimulated at daily intervals from meteorological data for the period 1988 and 1997. From these ten years, daily precipitation records for 1993 are used for the simulation since the records indicate that rainfall was heaviest in this year. With three cases of simulation depending on the quantity of untreated leachate (T_c) per day, namely, T_c=0 m^3, T_c=100 m^3 and T_c=150 m^3, the maximum quantity of untreated leachate appears to be 52,794 m^3, 15,893 m^3 and 10,987 m^3, respectively. The simulation details are described in Chapter 9, Section E of Supporting Report.

(2) Volume of Retention Pond

From the above simulation, the capacity of the leachate retention pond should be at least 16,000 m^3 if the rate of leachate treatment is 100 m^3/day.

(3) Volume of Treatment Pond

Volume of the treatment pond is determined to have enough capacity to satisfy aerobic treatment procedures. An aerobic pond is designed to receive a high organic loading that is completely devoid of dissolved oxygen. Retention time is planned to be five (5) days to treat the effluent from the retention pond. Thus, the required volume of the treatment pond is estimated at 100 m^3/day × 5 days = 500 m^3.

The design water depth of the treatment pond is set up at 50 cm to accelerate the oxidation process in the pond. The required area for the pond is thus estimated at 500 m^3 / 0.5 m = 1,000 m^2.

5) Rainwater Drainage

The size of channel is determined by comparing Flow Capacity (Q') to Rainwater Runoff (Q). The Flow Capacity (Q') of the channel must be larger than the Rainwater Runoff (Q). The calculation details are described in Chapter 9, Section E of Supporting Report, and layout of the rainwater drainage is illustrated in Figure 9.3.4, Section E of

Supporting Report. The width and depth of gutter is designed to be 300-400 mm.

17.2.3 Summary of the Designed Facility

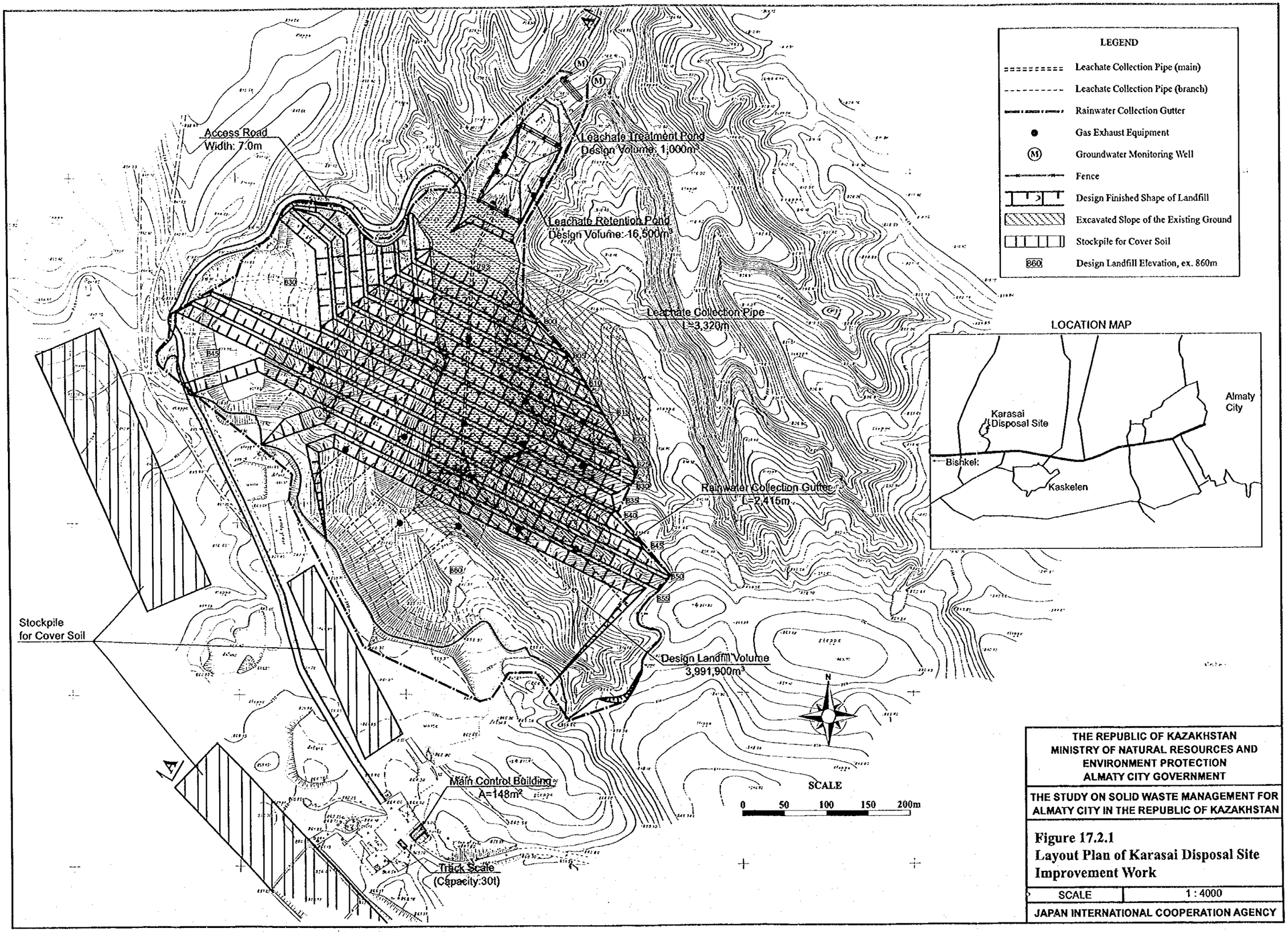
Quantity of the major facilities to be designed in the above are summarized as shown in Table 17.2.1.

17.2.4 Layout of the Facility

Layout plan and cross section of the Karasai disposal site are designed as shown in Figures 17.2.1 and 17.2.2, respectively.

Table 17 2.2 Summary of the Designed Facility

Facility	Item	Quantity	Remarks
Intermediate clay laying	Area	62,000 m^2	Thickness: 60 cm
Waste Retaining Structure	Banking	720 m^3	
Retention Pond	Design volume	16,500 m^3	
	Liner laying	4,390 m^2	
	Clay laying	2,640 m^3	Thickness: 60 cm
Leachate Treatment Pond	Design volume	500 m^3	Retention time: 5 days, Treatment capacity: 100 m^3/day
Leachate Collection and Drainage	Perforated PVC pipe ϕ400mm×5	50m	Covered with crushed stone
	Perforated PVC pipe ϕ400mm×3	155m	-ditto-
	Perforated PVC pipe ϕ400mm×2	125m	-ditto-
	Perforated PVC pipe ϕ200mm×1	2,990m	-ditto-
Rainwater Collection and Drainage Gutter	Width: 300mm Depth: 300mm	854m	
	Width: 350mm Depth: 350mm	620m	
	Width: 400mm Depth: 400mm	941m	
Gas Exhaust Equipment	Extraction well	13nos.	
Access Road	On-site road construction	340m	
	Road improvement	120m	
Goundwater Monitoring Well		2	
Fence	Net fence	305m	H=1.6m
Gate		1	
Administration Facilities	Main control building	148 m^2	
	Shelter for workshop	216 m^2	
	Truck scale	1	
	Fuel warehouse	46 m^2	
	Toilet	1	
	Stormwater retention	12 m^2	
	Sewage discharge pond	14 m^2	
	Shelter over the pit	144 m^2	


Access Road
Width: 7.0m
Leachate Treatment Pond
Design Volume: 1,000m³
Leachate Retention Pond
Design Volume: 16,500m³
Leachate Collection Pipe
L=3,320m
Rainwater Collection Gutter
L=2,415m
Design Landfill Volume
3,991,900m³
Stockpile
for Cover Soil
Main Control Building
A=148m²
Track Scale
(Capacity:30t)
LEGEND
Leachate Collection Pipe (main)
Leachate Collection Pipe (branch)
Rainwater Collection Gutter
Gas Exhaust Equipment
Groundwater Monitoring Well
Fence
Design Finished Shape of Landfill
Excavated Slope of the Existing Ground
Stockpile for Cover Soil
Design Landfill Elevation, ex. 860m
LOCATION MAP
Karasai
Disposal Site
Almaty
City
Bishkek
Kaskelen
N
SCALE
0 50 100 150 200m
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ALMATY CITY GOVERNMENT
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Figure 17.2.1
Layout Plan of Karasai Disposal Site
Improvement Work
SCALE 1 : 4000
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A - A

Finished Landfill Elevation
▽ EL 860m

5m

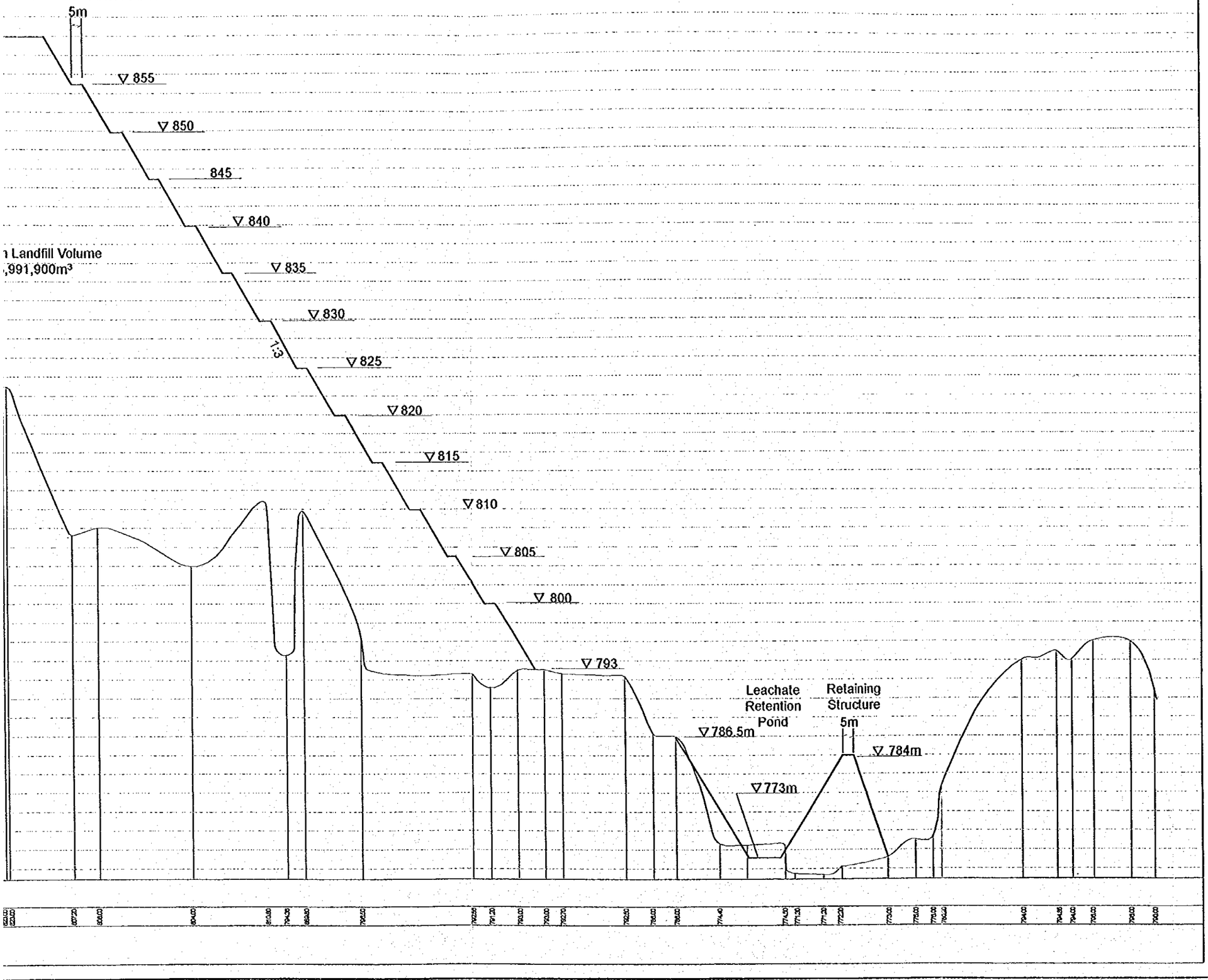
Design Landfill Volume
3,991,900m³

1:3

▽ 855
▽ 850
845
▽ 840
▽ 835
▽ 830
▽ 825
▽ 820
▽ 815
▽ 810
▽ 805
▽ 800
▽ 79

884 882 880 858 856 854 852 850 848 846 844 842 840 838 836 834 832 830 828 826 824 822 820 818 816 814 812 810 808 806 804 802 800 793 796 794 792 790 788 788 784 782 780 788 786 784 782

A - A



Horizontal 1/2000
Vertical 1/400

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Figure 17.2.2 **Longitudinal Section of Karasai Disposal Site Improvement Work**
SCALE: H 1 : 2000, V 1:400
JAPAN INTERNATIONAL COOPERATION AGENCY

17.3 CONSTRUCTION SCHEDULE

The new collection and transportation system will operate from year 2002; simultaneously the sanitary landfill operation should be started using heavy equipment. Therefore, during 2002 the improvement work at the site, which takes more than 8 or 9 months, should be completed.

The present landfill operation will continue until the heavy equipment is procured. The existing operating equipment at the site is assumed to be 2 bulldozers, 1 excavator and 2 dump trucks.

Before starting the landfill operation using the new heavy machinery and equipment procured in 2002, incoming solid waste should be placed at the western side of the site up to the elevation of 830 m.

17.4 PROCUREMENT OF HEAVY EQUIPMENT

17.4.1 Planning Criteria

1) Design Disposal Rates

Design disposal rates are summarized in Table 9.3.1 of Section 9.3.

2) Working Hours

It is assumed that waste collection starts at 7 in the morning and that trucks start arriving at the landfill site around 9 a.m. Landfill disposal work is finished at 6 p.m., including the topsoil placement.

Topsoil excavation and transportation begins when the waste disposal work on the landfill site is half-finished. The topsoil is dumped on the landfill waste. When the waste disposal on the landfill has been completed, the dumped topsoil is spread out and the ground is leveled.

3) Availability of Heavy Equipment and Personnel

In view of the need for repair in case of breakdowns and maintenance/management and in view of a break for drivers, heavy equipment can not be operated at 100% of their capacity all the time. Based on experience from other projects, the availability factor for heavy equipment has been set as follows:

Heavy equipment : 90%

Personnel involved in the disposal work are assumed to have 7 days off each month for holidays and leaves. Thus, the availability is:

Personnel : 80% (23 ÷ 30 = 0.8; 80%)

17.4.2 Equipment Requirements during the Planning Period

During the planning period of the Priority Project, i.e., year 2002 to 2005, equipment requirements are estimated based on projected waste receiving rates.

Table 17.4.1 Number of Required Equipment during the Planning Period (2002-2005)

Item	Quantity
Bulldozer	4
(Landfill)	(3)
(Topsoil)	(1)
Excavator	2
Wheel Loader	1
Dump Truck	5
Water Tanker	1

17.4.3 Manpower Requirements during the Planning Period

Estimated manpower requirements are shown in Table 17.4.2. These estimates take account of holiday and leave entitlements.

Table 17.4.2 Number of Required Manpower during the Planning Period (2002-2005)

Item	Quantity
Administrative	9
Operators	10
Drivers	9
Total	28

17.4.4 Procurement Schedule

The heavy equipment required for sanitary landfill operation, is included in the urgent improvement project. It is assumed to be procured using foreign aid.

The heavy equipment will be procured by the beginning of fiscal year 2002 as long as the preparatory work (engineering and contracting) is completed in 2001.

17.5 PROJECT COST ESTIMATE

17.5.1 Capital Investment

1) Improvement Work

The capital cost for the improvement work is estimated at KZT 874,524,000 (US$ 7,604,557) based on local conditions. Major work items and itemized costs are shown in Table 9.4.2, Chapter 9, Section E of the Supporting Report.

2) Procurement of Equipment

To cover the planning period of years 2002 - 2005, the capital cost for the procurement of heavy equipment is estimated at KZT 248,784,000 (US$ 2,163,339) assuming that equipment is procured from Japan.

17.5.2 Annual Disposal Expenditure

The annual expenditure for improvement work, including procurement cost for heavy equipment is shown in Table 17.5.1.

Table 17.5.1 Annual Expenditure for the Karasai Disposal Site Improvement Work

Year	Cost (Thousand KZT)				
	Design*	Construction	Heavy equipment	O/M Cost	Total Cost
2000	12,439			22,912	35,351
2001	43,726		248,784	22,912	315,422
2002		874,524		64,645	939,169
2003				188,091	188,091
2004				188,091	188,091
2005	1,691			188,091	189,782
2006			33,816	188,091	221,907
2007				198,808	198,808
2008				198,808	198,808
2009				198,808	198,808
2010				198,808	198,808
Total	57,856	874,524	282,600	1,658,065	2,873,045

Note: *Design cost is estimated at 5% of the construction or heavy equipment costs.