Assessment the Need of Al Kut City for Solid Waste Transfer Station

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ABSTRACT: *The design of efficient collection routes is the key of solid waste management, for the most costly element in solid waste management are collection and transfer. It represents (75-80) % of the solid waste budget.*

An optimal collection route is specified by using Geographical Information System (GIS) for Al-Kut city, in south of Iraq. GIS is one of the modern technologies which have contributed a lot in very less time span to the waste management society.

The present study included assess whether Al Kut city in need to construct transfer station for the collection of solid waste before sending it directly to the landfill site. The period of study is from April 2013 until April 2014.

Al Kut city in need to construct of transfer station in the right side of Tigress river districts (Al Azaa Wa Al Jahad and Al Karama Wa Al Falahea).

1-INTRODUCTION:-

A transfer station is a terminal station where smaller collection vehicles empty their loads for continued haul by a larger vehicle, can be considered as part of the collection process (1). No long - term storage of waste occurs at the transfer stations. It is quickly consolidated and loaded into a large vehicle and moved off site. There are not any transfer stations in Al-Kut city. The waste does not always transit by the transfer station and is often disposed of in an open area between the collection area and the landfill. In some instances, waste truck drivers empty their loads in open areas and sell their load to scavengers who will search through the waste for recyclable and salvageable items.

1.2 Transfer stations need in Al Kut city

Been addressed the need to establish a transfer station or stations for the collection of solid waste in Al Kut city during the study by calculating the cost of solid waste collection with transfer stations and compared with the current cost combination (without the transfer stations).

Al Kut city districts are distributed on both sides of the Tigris River to the north and south, and includes neighborhoods in the northern part of the city center and the old neighborhoods, high and middle income within sectors of Al Markaz and Al Kafaat, Damok and Al Zahra, either neighborhoods in the southern part include Allowate and medium income neighborhoods within the sectors of Al Ezaa and Al Jihad, Al Karama and Al Falahea.

We were excluded neighborhoods in the northern part of the Tigris River from the study of the need to establish of transfer stations for the following reasons:

1. The average of distance between the centers of neighborhoods and the location of disposal point does not exceed the (16 km), which is less than (15 to 20 miles) ((Although cost-effectiveness will vary, transfer stations generally become economically viable when the hauling distance to the disposal facility is greater than 15 to 20 miles (2), so the problem of solid waste management in this part of city wasn't because the long distance from neighborhoods to the final disposal point for solid waste.

2- The neighborhoods of the northern part of the Tigris River represents the region of old commercial center of Al Kut city, therefore there aren't land that could be exploited to set up transfer stations because the most of the land were exploited or intended for different uses in addition to the non-compliance to the environmental and planning limitations for construction of transfer stations through their closest from the residential areas and main roads.

3- The high price of lands in this part of city leads to non-availability of economic feasibility for construction of the transfer stations because the initial costs for construction will be very high.

4. Because of the solid waste disposal point is located at the same side of the residential neighborhoods for the Tigris River, which means there aren't bridges that the solid waste trucks should cross it and may be cause of delay in the transfer of waste.

The above reasons prompted us to delete the study of the need for the transfer stations of solid waste in this part of city and just focusing on the neighborhoods located in the south part of the city, which suffers from problems in the process of transferring waste to the site of chucking the final and for the following reasons:

1. The average distance between the centers of neighborhoods and the location of final disposal point is exceed (24 km), the highest of (15 miles) (3).

2. There are more of lands that can be used for construction of transfer stations because of the proportion of construction and exploitation within this part of city less than 60% (4) in addition to that there are more lands that applied on it the environmental and planning limitations for construction of transfer stations of solid waste.

3- This part of city represents the low and middle income neighborhoods, this point will making the cost of land is relatively low comparative with north part, which could provide the economic feasibility for project of constructing of transfer stations because the initial costs will be relatively low.

Because the site of final disposal point is located in the north part of the city, therefore the trucks of collecting waste in the south part should cross the bridges over the Tigris River, this point was caused a delay in the transfer process as a result of the jam of the traffic on this bridges, especially for Al Jihad neighborhood areas that need to cross two bridges there are two rivers separated between Al Jihad neighborhood and the final disposal point waste (Tigris and Al Dujaili rivers) and both must crossing the bridges that constructions on these rivers.

1.3 Transfer stations calculations:

Al Kut municipality has 80 different qualities and size Waste trucks (5), as shown in Table (1-1):

Table (1-1): Types and numbers of waste trucks

Nr.	Size Of waste truck	Type of Truck	Nr. of Truck	%
.1	5 m^3	Nissan	18	22.5
.2	12 m^3	valvo	16	20
.3	15 m3	Nissan	11	13.75
.4	6 m3	Hino	13	16.25
.5	4 ton	Mitsubishi	13	16.25
.6	12 m3	Rino	4	5
.7	6 m3	Azuza	3	3.75
.8	3 m3	Tractor	2	2.5
Total			80	100

The table show that 36.25% of waste trucks are Nissan type because of the success of this type of vehicles through its durability, low maintenance costs in addition to the design life is not less than 7 years and it is the best from other types which does not exceed the design life 5 years in addition to the suitability of Iraqi airspace for their ability to work in hot climates.

1.3.1 Calculation the consumption amount for waste truck:

For the reasons above and in addition to that more of complete data about the amounts that spent on maintenance and perpetuation of the mechanics of the type of Nissan, has been analyzing the amounts spent on maintenance and perpetuation of this kind of trucks, therefore we can get the monthly rate of exchange of the trucks and rate of exchange per km, as shown in the table (1-2):

Table (1-2): Average of consumption amount for waste truck in ID\M

Nr.	Truck type	Truck Model	Purchasing price	Login Service	Average of consumption amount ID\M 2010	Average of consumption amount ID\M 2011	Average of consumption amount ID\M 2012	Average of consumption amount ID\M 2013	Average of consumption amount ID\M 2014
1.	Nissan 5 m3	2009	130000000	2010	29727	**97743.51**	**102676.1**	**88635.42**	**103333.3**
2.	Nissan 15 m3	2009	150000000	2010	50236	**105781.8**	**117327.3**	**91823.33**	**52483.33**

Monthly spend rate has been calculated for solid waste trucks (83976.71) Iraqi dinars per month, this amount represents the spend on maintenance work for solid waste trucks.

Meter reading for all the solid waste trucks within the study area has been taken and through the analysis of these readings, the rate Kilometers per day was (25 km \ day) (750 km \ month

Thus, the rate of spend for each truck and each Kilometers is:

Spend rate per km = monthly rate of spend\ distance rate per month

= 83976.71 / 750

=111.9689466666667

= 112 ID/Km

1.3.2 Calculation the Maintenance amount for waste truck:

Maintenance works include all the works that happen on the solid trucks during operation period to maintain truck efficiency in the performance of work.

Maintenance works includes:

- Fuel
- rotating maintenance (washing and cleaning)
- Engine Oil
- Gear Oil
- brake fluid
- Tire

Monthly disbursements maintenance and fuel has been calculated as shown in the table (1-3):

Table (1-3): Average of maintenance amount for waste truck in ID\KM

Nr.	Truck type	Truck model	Fuel ID\KM	Maintenance ID\KM	Gear oil ID\KM	Engine oil ID\KM	Break oil ID\KM	Wells ID\KM	Total
1	Nissan 5 m3	2009	500	50	2	3	1	400	956
2	Nissan 15 m3	2009	750	50	4	6	2	600	1412

Spending rate for solid waste trucks has been calculated (1184) ID \ km.

1.3.3 Calculation the management amount for waste truck:

Managing of movement of the solid waste collection trucks process is requires a lot of disbursements to control the movement and follow-up maintenance and perpetuation of these trucks and include disbursements below:

- salaries of staff within the department of Solid Waste Management, this department is responsible for the movement of trucks, the distribution and supervision of the work

- salaries of employees within the municipal garage and those responsible for the operation and maintenance of the perpetuation of the trucks.

- wages for water, electricity and fuel for generators within mechanisms department.

Through analyzing the data of management the movement of trucks which have been obtained from Al Kut municipality according to the table (4-4):

Table (1-4): Average of management amount for waste truck in ID\KM

Nr.	Truck type	Nr.	Av. Pay ID\Month	Av. Amounts ID\Month
1	The salaries of the staff in Solid Waste department	20	500000	10000000
2	The salaries of the staff in Garage department	90	350000	31500000
3	Water wages	1	350000	350000
4	Electric wages	1	750000	750000
	Generators wages	2	375000	750000

The salaries of employees within the municipal garage, those officials on the process of maintaining and sustaining trucks do not represent all of the amounts spent on the trucks of the transfer of solid waste, and to the fact that the municipal garage contains (250) trucks are working and (80) of which only dedicated to the process of collecting waste and as we explained in the table (4 -1), so the rate of disbursements on the trucks of solid waste collection of paragraph (2) in the table (4-4) are:

The rate of disbursements on the trucks of solid waste collection (salaries garage) = (rate of the total amount spent on the trucks of municipal salaries for all staff garage \ total number of the trucks of the municipality) X number of trucks of solid waste collection.

Total average management amount for waste truck ID\M	Total Av. Amounts = for salaries of the staff in Solid Waste department	Total Av. Amounts + for salaries of the staff in Garage department	+Water wages	+ Electric wages	+ Generators wages
	= 10000000	+ 31500000	+ 350000	+ 750000	+ 750000
	= 43350000 ID\M				

Total average management amount for one waste truck ID\M	Total average =management amount for waste truck ID\M	/ Total number of garage trucks
	= 43350000	/ 250
	= 173400 ID\M	

Total average management amount for waste truck ID\KM	Total average =management amount for one waste truck ID\M	\ Average KM traveled per day for one truck
	= 173400	\ 750
	= 231 ID\KM	

Total average amount for waste truck ID\KM	Total Average of consumption =amount for waste truck in ID\KM	Total Average of maintenance +amount for waste truck in ID\KM	Total average +management amount for waste truck ID\KM
	= 112	+ 1184	+ 231
	= 1527 ID\KM		

1.3.3 Consumption as a result of obsolescence

The statute of limitations, which exposed the trucks through the truck design age, should calculate as an expense for each kilometer that the truck drive it during its work in the transport of waste and added this amount to the amounts that calculated on the maintenance, perpetuation of the trucks and management of solid waste collection. This amount has been calculated based on the amounts of these equations (4-1 to 4-4).

The economic life for waste trucks of Nissan type that are using in Al Kut municipality is 7 years as defined by the Ministry of Municipalities and Public Works. The costs of consumption for this type was calculated depending on the amount of the purchase of these truck, and assumption that the sale price for the mechanics as scrap equal to 30% of the purchase price.

1.3.3. A Calculation the consumption for Nissan 15 M3:

Purchasing price = 150000000 ID
Sale price of scrap = 45000000 ID
Economic life = 7 years

Annual consumption according to the straight-line= (purchase price- sale price of scrap)\ Economic life ---- (4-1) = (150000000 – 45000000) \ 7 = 15000000
Percentage of annual consumption according to the straight-line=Annual consumption according to the straight-line\ (purchase price- sale price of scrap) ---------- (4-2)

= 15000000 \ (150000000 – 45000000)
= 0.142
= 14 %

Double consumption = Percentage of annual consumption according to the straight-line X 2 ----------- (4-3)

= 14 x 2
= 28 %

The proportion of consumption multiplier = 2 X 1\ Economic life ---------- (4-4)

= 2X 1\7
= 0.2857 ≈ 0.3

The balance of the original = purchase price- sale price of scrap
= 150000000 – 45000000 = 105000000

Table (1-5) consumption at the expense of premiums seven years

Year	The balance of the original (1)	The proportion of consumption multiplier (2)	The depreciation charge (3)	Accumulated balance (4)
1	105000000	30%	31500000	31500000
2	73500000	30%	22050000	53550000
3	51450000	30%	15435000	68985000
4	36015000	30%	10804500	79789500
5	25210500	30%	7563150	87352650
6	17647350	30%	5294205	92646855
7	12353145	30%	3705943.5	96352798.5

1= (The balance of the original) – (4)
3= (1) * (2)
4next= (4) later + (3)

Through the table above shows that the mechanism consumes (96352798) dinars during the seven years, which represents the economic life and the imposition of the mechanism need to 4 days per month for acts of MRO and maintenance, which means that each mechanism works amounted to (317 Day \ years) and it is the mechanism going rate annual rate (317 days x 25 km = 7925 km \ years) meaning that each mechanism going (7925 x7 = 55475 km \ seven years).Consumption rate as a result of consumption through economic life of the mechanism = (depreciation \ number of kilometers traveled by the machine during the economic life = 55475 / 96352798.5
= 1736.868
= 1737 ID/Km
Total average
Amount for waste truck consumption ID\KM = 1364 + 1737 = 3101 ID\KM
= 2.4808 $\ KM

1.4 Transfer Station Needs:

1.4.1 Transfer Station site:

The transfer station site must be large enough to include a building for collection trucks to enter and unload and outside space for moving and turning both collection and transfer vehicles. If construction and demolition material.

1.4.2 Transfer Station building:

Size of the transfer station building will de¬pend on the type and volume of waste material to be handled. Future need for expansion must also be considered. At a minimum, the building should be large enough to allow col¬lection vehicles to enter and dump either onto the floor or directly into the transfer vehicle. It is not necessary for the transfer vehicle to be inside. However, a structure extending over the transfer vehicle will keep water from entering the material to be transferred. An enclosed building will prevent weather from interrupting operations and also help contain waste material. Venting and/or a circulation system will help control odors. Space may be provided in the building for an office, restroom, associated transfer equipment, and any vehicles.

If white goods and other bulky items are to be separated at the transfer station, the area where the material is to be dropped into transfer containers may be, but does not have to be, in the building. Inside or outside, this area should be constructed on a sloping lot or a ramp so that these materials may be dropped into transfer containers. Additional turn-around space should be included in the layout of the transfer station for these additional collection containers.

1.4.3 Transfer Station Equipment's:

A wide variety of equipment is available for solid waste transfer operations. The volume and type of solid waste, regulations, and political or personal choice will influence the type and amount of transfer equipment to be used. There are two common methods of transferring solid waste with semitrailers and tractors or with large roll-off boxes hauled by a specially built tilting tandem-axle straight truck. The trailers and roll-off boxes can be open-top containers or enclosed compactable containers. Open-top containers may be used to haul any type of solid waste, but are necessary for separating white goods from other bulky items. Wassit rules require that open-top containers be covered while in transit.

There are several common ways of compacting solid waste into compactable containers. At a minimum, a steel plate attached to the back of a backhoe can be used to tamp solid waste into an open-top transfer trailer. A second option is the use of a stationary compactor. In this case, the solid waste is placed into a hopper and chute directly above or beside the stationary compactor. The compactable container (trailer or roll-off box) is attached to the stationary compactor, and a hydraulic ram compresses the material in the container. When the container is full, it is removed and another put in its place. The material is emptied by gravity from this type of container by tilting the container, or by mechanical devices that move the material out the back of the container.

The third most common method of compacting solid waste is with a self-contained compaction trailer. In this case the collection vehicle dumps its load into the hopper and chute directly over an opening at the front of the compaction trailer. A hydraulic ram in the trailer compacts the material into the back of the trailer. Hydraulic pressure is supplied either by an on- site electric motor and hydraulic pump combined with a hydraulic pump on the tractor, or by a separate motor and pump on the trailer. When the trailer is full, it is removed and an empty trailer is placed in position for loading. The compac¬tion trailer is emptied at the landfill by opening the end of the trailer and pushing the material out with the hydraulic ram.

Open-top containers can be either roll-off boxes or trailers. Trailers can be the type with a simple tilt bed, or those that are unloaded with a special hydraulically operated undulat¬ing floor (walking floor) or blade that moves waste out the back. Roll-off containers typically hold up to 10 tons (40-50 cubic yards) of material, and trailers up to 20 tons (80-120 cubic yards). Trailers hauling 20 tons of waste usually weigh approximately 80,000 pounds, which often is the maximum truck weight permitted on highways. State regulations on truck weight may influence the decision to use a tilt bed or undulating floor trailer, both of which weigh less than a trailer with a hydraulic ram. Distance to the disposal site and daily volume of solid waste to be handled will influence the type of transfer equipment chosen.

A self-contained compaction trailer system requires more maintenance and an additional staff person at the transfer station to move materials dumped onto the floor into the compaction trailer. The basic weight of the compaction trailer is greater because of the need for thicker walls and the weight of the ram, motor, and hydraulic system. The additional weight reduces the payload approximately five tons which means less income as each load to the landfill is less than what can be hauled in an open-top compacted system. Use of a stationary compactor reduces the payload to approximately three tons, but still requires a trailer with a lightweight ram, thicker walls, and a hydraulic system to push out the trash. The walking floor type of open-top trailer with compaction done by a backhoe is the most economical type of transportation.

Some operators might want to install scales as a part of the transfer station. The cost of scales is approximately \$20,000 plus an additional \$5,000 for installation, including concrete piers and slab, electrical wiring, and groundwork. Installation costs can be absorbed as in-kind

1.4.4 Estimated Cost of Basic Rural Transfer Station:

The population to be served, type of solid waste to be accepted, type of transfer equipment, distance to the disposal site, and other factors affect the size and cost of a rural transfer station. The estimated costs discussed below are based on the best and most recent information available from various sources.

1.4.4.1 Initial Capital Costs for Basic Transfer Station:

Initial capital costs are the cost of land, buildings, and equipment's. Table (1-6): Land costs can range from \$75 to \$125 per M2.

Table (1-6): Initial Capital Costs for Basic Transfer Station.

Nr	Item	Cost per unit*	Sub-total
1	Land (3000 M^2 @ \$100/ M^2)	\$ 300000	
2	Building & Site Building		
	(1,500 M^2 @ \$300/ M^2)	\$ 450000	
	Office equipment	\$ 900	
	Ramp and wall	\$ 20,000	
	Crushed rock (@ \$12/M2)	\$ 12000	
	Fence (220 M@ \$150/ linear M)	\$ 33000	
			815900 \$
3	Fees		
	Legal & engineering	\$ 5000	
	Contingency	\$ 25000	
			\$ 30,000
4	Equipment		
	Hopper & chute	\$ 5000	
	(2@ \$10000 each) Open top trailer	\$ 20000	
	Semi-tractor (1)	\$ 50,000	
	Backhoe	\$ 35000	
			\$ 110000
TOTAL			**955900\$**

*Data for calculations obtained from local service providers

1.4.4.2 Building and Site (170 Ton \ day) = 540 M3

The building is assumed to be a 1,500 M2 steel building. It includes a concrete floor and concrete retaining wall on the back of the building. The retaining wall is high enough to place the transfer vehicle below the level of the floor in the building. Also included in the cost of the building is a roof at the rear that extends over the transfer trailer, an overhead door, and a small office with restroom. (See Figures 1, 2, and 3.) An estimate of 300 \$ per square meter is used to calculate a building cost of 450000 \$ (300 \$ x 1,500 square meter). Size, terrain, and local market factors could significantly affect this estimate. Office equipment includes a desk and chair (200 \$), computer and printer (300 \$), and air conditioner (400 \$).

Utilities, including electricity, gas, water, sewer, and telephone, will cost approximately 300 \$ per month. Cleaning supplies, including supplies for the restroom and bleach to clean the dumping floor, will cost approximately 30 \$ per month. It is critical to control odor at the transfer station. Internal odor control will cost approximately 30 \$ per month. External control of odor for the site will cost approximately 30 \$ per month. Pest control that includes spraying and setting bait both inside and outside the transfer station will cost approximately 30 \$ per month.

It is assumed that crushed rock will be used for all the roadways and parking areas at the site, except for the concrete pads. The delivered cost of crushed rock can double or triple depending on the distance from the quarry. Quarry prices can also vary considerably. A reasonable delivered price ranges from 8 \$ to 12 \$ per M2.

For this example, it was assumed that the roadbed and parking area covered 1000 M2. A 15 cm layer of crushed rock at 10 \$ per M2 would total 12000 \$. A 2.5 m chain-link perimeter fence enclosing the 3000 M2 area would cost 33000 \$ (150 \$ per linear meter)(150 \$ x 220 ML).

Other expenses for the development of a transfer station include legal and engineering fees, estimated at 5000 \$, and an additional contingency of 25000 \$ to allow for underestimation of any items that may have higher costs due to local conditions, to cover vehicle license(s), or to cover items that may have inadvertently been excluded. Total estimated other expenses is 30000\$.

1.4.4.3Equipment:

Costs presented are the estimated purchase price of selected equipment for transferring solid waste. Minimal equipment needed are a hopper and chute to direct solid waste into the trailer (5000 \$), two 100 M2-yard open-top trailers (10000 \$ each), one tractor (50000 \$), and a backhoe (35000 \$). The backhoe can be used to compact the waste in the transfer trailer. Compaction helps to assure maximum utilization of capacity of the transfer trailer. Two transfer trailers are needed so that one is on-site at all times of operation. The volume of waste collected at the transfer station combined with the distance to the landfill will determine the number of trips taken daily and the need for additional semitrailers and tractors. Purchasing used equipment would reduce equipment costs. Estimated equipment costs total (110000 $).Total estimated cost for construction and equipment for a basic transfer station is $ 955900.

1.4.5 Annual Capital and Operating Costs for Basic Transfer Station:

Annual capital costs are the straight-line depreciation of the capital items such as building and equipment. Operating costs are the daily costs for labor, fuel, utilities, etc.

1.4.6 Annual Capital Costs for Basic Transfer Station:

Depreciation of the building, chute, fence, roadway, and equipment are included in annual capital costs. The building, chute, backhoe, and box ramp are expected to have a 25-year life. It is estimated that the rock in the parking area and roadway will be replaced on an average of every five years. The semitrailer, tractor, and fencing will each last about 10 years. It is estimated that office equipment will be replaced every ten years. Annual capital cost (depreciation) is estimated at $23,939 annually. (See Table 1-7.)

Table 1-7. Annual Capital Costs for a Basic Transfer Station.

Nr.	Item	Cost per unit*
1	Building and Site	
	Building (25-year life)	$ 3,000
	Office equipment (10-year life)	$ 165
	Ramp and wall (25-year life)	$ 800
	Crushed rock (5-year life)	$ 2,614
	Fence (10-year life)	$ 1,640
2	Equipment	
	Hopper & chute (25-year life)	$ 120
	Open-top trailer (2) (10-year life)	$ 9,400
	Semi-truck (1) (10-year life)	$ 5,200
	Backhoe (25-year life)	$ 1,000
TOTAL		**$ 23,939**

1.4.7 Annual Capital Costs for Basic Transfer Station:

Annual operating costs are the day-to-day costs of opera¬tions based on the volume of solid waste handled on a yearly basis, number of employees, and distance to the landfill. For many transfer stations, funding comes from service fees and a line-item budget from the governmental agency running the service.

1.4.7.1 Labor:

The transfer station is in need to drivers, attendants, guards and etc. (see Table 1-8).

Table 1-8. Transfer station laborers

Nr.	Type of work	Nr. Of workers	Salary $\day	Total $\ day
1	trailer Drivers	2	15	30
2	attendant	2	**15**	**30**
3	Guard	2	**15**	**30**
4	Cleaner	6	**10**	**60**
5	Super visor	1	**20**	**20**
6	Maintenance worker	2	**15**	**30**
	Shovel Driver	1	**15**	**15**
TOTAL		16		215 $/day

1.4.7.2 Maintenance Costs:

Transfer truck and trailer operations cost $.60 per mile (0.375 $ per KM) for fuel, routine servicing, maintenance, vehicle insurance, and tires. There is greater-than-normal wear on the truck because of the terrain of most landfills and frequent shifting of gears. Similarly, the trash being transported in the trailers often includes caustic materials that degrade the interior of the trailer.

1.4.7.3 Insurance:

Insurance. Additional insurance coverage should be obtained for the building and equipment. Liability insurance should be carried to cover potential injuries at the transfer station site. The estimated cost for this coverage is (200 $ per month).

1.4.8 Annual Capital and Operating Costs for Example Rural Transfer Station:

The amount of solid waste in two sectors (2020) = (57261 persons X 0.94 = 144347 kg/day)
144347/316 kg/m3 = 457 m3/day)

The trailer has a capacity of 60 M3 per load. With 8 load per day (457 m3 / 60 m3) of material to haul, 2536 trips (317 day X 8 load) to the landfill will need to be made yearly. Most transfer stations transport to the landfill daily. At a round trip distance of 50 KM at 45 KMPH, it will take 2840 hours per year (1.12hour x 8 loads x 317 day/year) in driving time. This results in approximately 8 loads per day to the landfill or 56 trips per week.

Maintenance costs are based on 126800 KM per year (2536 trips at 50 KM). One full-time driver and one half-time driver are included to allow time for a 7-day workweek. Costs for utilities, cleaning supplies, and site maintenance are approximately $ 5040 per year. A full-time station attendant is provided. (See Table 1-9.)

Table 1-9. Annual Capital and Operating Costs for Example Urban Transfer Station

N r.	Type of work	Total $\ year
1	Annual Capital Costs	$ 23,939
3	Annual Operating Costs	
4	Maintenance (**0.375 $ per KM**)	$ 53493.75**
5	Utilities, cleaning supplies, site maintenance	$5040 ***
6	Insurance—building, liability ($200/month)	$ 2,400
	Transfer station labors	$68155 ****
	Contingency	$ 25,000
TOTAL		$ 178027.75
COST PER M^3 PER YEAR		$ 1.10

* Data for calculations obtained from local service providers
** Table 4-7
*** (300$ +30$+30$+30$+30$) per month x 12
**** Table 4-8 (215 $\day x 317 days)
166805 M3\ year \ 126800 KM \year = 1.3 M3 \ KM = 1.10 $\M3 x 1.2 M3\KM = 1.32 $\ KM
1.32 $\ KM < amount for waste truck ID\KM = 2.4808 $\ KM

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