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Tourism Development Authority

Red Sea Governorate

U.S. Agency for International Development



**Red Sea Sustainable Development –
Red Sea Sustainable Tourism Initiative Sub-Component**

D E L I V E R A B L E N o . 2

**Integrated Solid Waste Management Plan for Shagra
Tourism Center**



INTERNATIONAL RESOURCES GROUP AND PARTNERS:

Winrock International

PA Government Services, Inc.

Development Alternatives, Inc.

Environmental Quality International

Capacity Building International

September 2004

Integrated Solid Waste Management Plan for Shagra Tourism Center

U.S. Agency for International Development
(USAID)

Prime Contract #GS-1F-0076M

Order #263-M-00-04-00004-00

Subcontract to IRG: No. 2007-000-PA.

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Prepared by:

PA Government Services Inc.
1750 Pennsylvania Avenue
Suite 1000
NW Washington
DC 20006
Tel: +1 202 442 2000
Fax: +1 202 442 2001
www.paconsulting.com

Version: 1.0

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1. EXECUTIVE SUMMARY

Current solid waste management in the region is inadequate. Little of the waste collected from operating resorts is processed and disposed in an environmentally sound manner. The Red Sea Sustainable Tourism Initiative (RSSTI) has been actively working to improve solid waste management practices on the Red Sea coast.

This solid waste plan has been prepared for the Shagra Tourism Center. The purpose of this plan is to provide a realistic system for properly handling the waste within Shagra's borders and control. Once a basic sustainable system has been implemented, it will be possible to pursue more comprehensive, regional strategies. Ultimately it is hoped that the Shagra Tourism Center will be a model, and that the solid waste management system presented here will be the foundation for a more comprehensive system in the region.

The solid waste plan consists of the following sections: description of the Shagra Tourism Center, current waste management practices, estimated waste generation and composition, assessment of stakeholder interests and capacity, principles of integrated and sustainable solid waste system, description of the proposed waste management system, solid waste system costs, and conclusions.

Description of the Shagra Tourism Center – The Shagra Tourism Center is located 15 km north of Marsa Alam. The center lies within Tourism Development Authority (TDA) land and is being developed under the Limited Development model. Currently, eleven resorts operate in the center and three more are under construction. Currently operating resort plus those under construction total approximately 2,500 guest rooms. TDA plans indicate an ultimate capacity of 5,100 guest rooms and over LE 860 million in hotel investments alone.

Current waste management practices – A private company (Clean Home Company) collects waste from 10 of the 11 operating resorts. The company charges each resort a flat fee of LE 1,200 per month for waste collection service. Several local individuals recently selected a new dumpsite, which is located on the southern border of the Center abutting Marsa Alam lands. The company brings all resort waste to the dumpsite, where staff scavenges recyclables, food waste, and landscape waste. Waste is not consolidated, but dumped and scattered across the surface of the site.

Estimated waste generation and composition – The Shagra Tourism Center's waste generation and composition are estimated using results from studies conducted at other resorts on the Red Sea coast; no Shagra-specific data are available. It is estimated that currently operating and under construction resorts will generate approximately 1,550 tonnes per year of solid waste. Organic waste (primarily kitchen waste) and landscape waste together account for an estimated 61% of the waste. Much of the resorts' waste is readily recyclable.

Assessment of stakeholder interests and capacity – Stakeholders in the Shagra waste management system include the TDA, Shagra Investors Company, resort operators and staff, the solid waste company, resort construction companies, the local Bedouins, and tourists. All are interested in, and can benefit from, a well-operated waste management system. However, there is little coordination among stakeholders, and a general lack of the knowledge and capability needed to upgrade the current system.

Principles of integrated and sustainable solid waste system – Experience in many countries, including Egypt, has demonstrated that a strictly technical approach to solid waste management does not work. Numerous efforts to implement and upgrade solid waste management systems by providing merely facilities, equipment, and/or funding have failed because they ignore the human, political, and institutional components. Integrated waste management systems require comprehensive review, and coordinated planning and implementation of all aspects of the waste system – source reduction, source-separation, collection and transfer, reuse, recycling, composting, and disposal. An integrated system of programs and facilities will not be sustainable unless it is designed and operated to fit into the human systems, i.e., socio-economic, legal, institutional, financial, and administrative. Public education and institutional capacity building are essential to sustainability.

Description of the proposed waste management system – The heart of the technical system is source-separation, collection, recovery of recyclables at a materials recovery facility (MRF), and disposal of residue in a controlled disposal facility. The institutional framework to ensure a sustainable system is centered on the establishment of an NGO that coordinates the activities of various stakeholders; facilitates capacity building, training, and awareness programs; and manages the integrated waste management system. A system of written agreements, incentives, and penalties are incorporated into the system to ensure that waste is properly handled. Money to develop the waste management system may be sourced from donor agency grants, the Shagra Investors Company, and (if necessary) bank loans. Funding to operate the system and generate a return on investment will come from user fees paid by the resorts (and any other waste generators that use the system) and the proceeds of recycled materials sold in the Egyptian market.

Solid waste system costs – Cost estimates are provided for general planning and decision-making purposes. Capital and operating costs are provided for collection, Material Recycling Facility (MRF) operations, sale of recovered materials¹, and operation of the controlled disposal site. Total annual costs for the first year of operation are estimated at approximately LE 277,200 and escalating to approximately LE 528,700 in ten years due to assumed increases in labor and operational costs. An average collection fee of LE 2000 per resort per month (approximately LE 11 per guest room per month) would generate enough revenue to cover the cost of the entire solid waste system, provide a 10-year return on investment (ROI) of 112% and a 6 - 7 year payback period. Clearly this cost is higher than the current LE 1,200 per month paid by Shagra resorts for solid waste collection. However, it is also clear that the current system is inadequate. The proposed integrated solid waste management system addresses these problems and reflects the true cost of solid waste management.

¹ The recycling revenue for the MRF is calculated separately in order to show the net cost of operating the MRF component of the integrated system.

2. INTRODUCTION

2.1 BACKGROUND AND PURPOSE

The Red Sea Sustainable Tourism Initiative (RSSTI) has been actively working to improve solid waste management practices on the Red Sea coast. Current solid waste management in the region is inadequate.² Although waste is collected from operating resorts, little is processed and disposed in an environmentally sound manner. Large quantities of waste are randomly dumped along roadsides and in the open desert. Existing dumpsites are poorly selected and managed. Open burning is commonly practiced and dumpsites are major sources of windblown litter. There is no management of construction waste. Instead, it is randomly disposed on vacant lands and along roadsides.

As noted in RSSTI's 2003 publication *Best Practices for Solid Waste Management*: "Unless solid waste best practices are adopted, the solid waste management problems in developed areas of the Red Sea Coast will only get worse, and pristine areas in the south will experience the same problems when they are developed."³

This solid waste plan has been prepared for the Shagra Tourism Center. It provides the Center with the information and justification needed to begin implementation of an integrated solid waste management system. When implemented, the Shagra solid waste system will demonstrate to other Red Sea tourism centers that environmentally sound and cost-effective solid waste management is feasible. It is hoped that the Shagra Tourism Center will become a model for tourism centers on the Red Sea coast and elsewhere in Egypt.

The scope of this plan is limited to construction waste and operations waste from the resorts and hotels within the Shagra Tourism Center. It does not address Marsa Alam municipal waste or dive boats and marina waste. The purpose of this plan is to provide a realistic system for properly handling the waste within Shagra's borders and control. Once a basic system has been implemented, it can serve as the foundation for a more comprehensive system in the region, accepting wastes from sources outside the Shagra Tourism Center.

2.2 INTEGRATED DEVELOPMENT COMPANIES

Shagra Tourism Center is being developed by individual investors who have purchased concessions within the center from the Tourism Development Authority (TDA) and formed Shagra Investors Company. Each investor owns shares of the Company and together they contribute the capital needed to develop the center's infrastructure (e.g., water supply, wastewater treatment, power generation, etc.). The Company then develops, operates and maintains infrastructure either directly or through agreements with third parties. The Company recovers its costs by billing the projects (resorts, hotels, commercial shops, etc.) that use the infrastructure.

² Assessment Report of the Current Solid Waste Practices in the Red Sea Tourism Centers, prepared by PA Government Services Inc., 2003.

³ Best Practices: Solid Waste Management, prepared by PA Government Services, 2003.

2. Introduction...

Solid waste facilities and services (collection, processing, and disposal) are the type of infrastructure or utilities that Shagra Investors Company might provide. However, Red Sea tourism centers of the Limited Development type⁴, have not yet undertaken solid waste infrastructure development. This reflects the general attitude that waste management is not part of essential infrastructure, but rather the responsibility of individual properties or nearby municipalities. Throughout Egyptian culture (as in many emerging economies) the presence of solid waste problems has not yet led to comprehensive enforcement of existing environmental regulations, internalizing solid waste management costs, and accepting the fact that solid waste management costs money.

The lack of solid waste infrastructure in the Shagra Tourism Center also reflects the desire of the Center's investors to limit their infrastructure investments to the minimum required (or enforced) by TDA and needed to get the tourism center up and running. However, the lack of adequate solid waste systems (and random disposal of waste) throughout Red Sea tourism centers clearly demonstrates that solid waste should be considered part of their infrastructure.

2.3 HOW THIS PLAN IS ORGANIZED

Sections 2 through 5 of this solid waste plan describe the Shagra Tourism Center – current waste management practices, waste stream characteristics, and stakeholders' interests and capabilities. Section 6 explains the principles of integrated and sustainable waste management. Section 7 describes the technical and institutional components of an integrated and sustainable waste management system. Section 8 presents estimated costs for the Shagra Tourism Center waste management system. And finally, Section 9 offers conclusions on the implementation of the plan.

⁴ Limited Development Tourism Centers consist of a number of adjacent tourism development projects, each separately owned and operated, but organized as a "center" for administrative purposes.

3. DESCRIPTION OF SHAGRA TOURISM CENTER

The Shagra Tourism Center (also referred to as Blondie Center) is located approximately 15 km north of Marsa Alam. The center's southern boundary abuts Marsa Alam. To the north of the center is the Nabai El-Sagheer tourism center.

Shagra Tourism Center stretches along 10 km of coast and covers a total area of 1,914 feddans. It includes three major wadis and marsas – Marsa Shagra, Wadi Abou Ariky, and Wadi Gebel El Rosas.

Currently, eleven resorts operate in the center and three more are under construction. Table 1 provides the name, type, and size of these properties. According to the Ministry of Tourism publication *Sparkling Lights in the Desert*, Shagra Tourism Center will have 5,100 hotel rooms when fully developed. However, given current development trends it is unlikely that projects other than those listed as “Under Construction” in Table 1 will be undertaken in the foreseeable future.

While conducting research for this project, PA asked all the operating resorts to provide information regarding occupancy rates and the total number of guest nights per year. Data was provided by some of the resorts, while others did not respond. Based on the data provided by some resorts and discussions with resort operators, PA made assumptions regarding occupancy and total guest nights for those resorts that did not provide actual data. (See Table 1).

According to *Sparkling Lights in the Desert*, investment in hotel capacity in the center will total over LE 860 million. Planned infrastructure includes 27 km of roadways, 4,200 cubic meters/day of water production, 3,400 cubic meters/day of wastewater treatment, 21 mega/V/A electricity generation, and 250 communication lines.

Each property has developed its own electrical generating capacity and wastewater treatment facilities. And each property contracts separately with a private company for solid waste collection and disposal, as described more fully in the following section.

3. Description of Shagra Tourism Center...

Table 1 – Shagra Tourism Center Resorts

| <u>Resort Name</u> | <u>Type</u> | <u>Total Guest Rooms</u> | <u>Occupancy Rate</u> | | | <u>GN per Year</u> |
|---------------------------------|-------------|----------------------------------|-----------------------|----------------|-------------|------------------------|
| | | | <u>Low</u> | <u>Average</u> | <u>High</u> | |
| <u>Currently Operating</u> | | | | | | |
| Beach Safari * | Camp | 10 | 35% | 50% | 70% | 3,468 |
| Breaky Bay | Resort | 450 | 10% | 20% | 30% | 62,415 |
| Cataracts | Resort | 302 | 35% | 50% | 70% | 84,000 |
| Flora * | Resort | 150 | 35% | 50% | 70% | 52,013 |
| Abu Nawas * | Resort | 85 | 35% | 50% | 70% | 29,474 |
| Eden Village * | Resort | 134 | 35% | 50% | 70% | 46,465 |
| Shagra Eco-village ⁵ | Camp | 90 | 30% | 70% | 100% | 21,900 |
| Kahramana | Resort | 277 | 45% | 70% | 95% | 76,030 |
| Sol y Mar | Resort | 127 | 30% | 65% | 100% | 37,138 |
| Elphistone * | Resort | 120 | 35% | 50% | 70% | 41,610 |
| Egypt Marine * | Resort | 125 | 35% | 50% | 70% | 43,344 |
| Total | | 1,870 | | | | 497,855 |
| <u>Under Construction</u> | | | | | | |
| Master Resort * | Resort | N/A | | | | |
| Queen Marsa Alam * | Resort | N/A | | | | |
| Wadi Sabhara * | Resort | N/A | | | | |
| | | 627 | 35% | 45% | 70% | 195,671 |
| Total Planned | | 5100 | 35% | 45% | 70% | 1,591,583 |

Notes:

* Resorts for which occupancy rates and Guest Nights assumptions are used.

N/A = not available

GN = Guest Night

⁵ Also known as Red Sea Diving Safari.

4. CURRENT SOLID WASTE SYSTEM

4.1 WASTE PREVENTION

PA did not undertake a complete inventory of current waste prevention activities at operating resort in the Shagra Tourism Center. Nevertheless, we observed the following waste prevention strategies at some resorts:

- Guest Rooms:
 - Bulk soap dispensers
 - Eliminating plastic liners in waste baskets
 - Glassware in place of plastic cups
- Food & Beverage:
 - Bulk condiments
 - Electrically heated serving units
 - Washable napkins and tablecloths

Opportunities exist to significantly increase waste prevention efforts.

4.2 COLLECTION

4.2.1 Resort Waste

Each resort's staff collects solid waste from various points of generation (i.e., guest rooms, food and beverage facilities, beach, landscaping, and staff housing). Waste is consolidated in a single trash room that typically measures 10 to 15 square meters. With few exceptions, resorts have no specific programs for source-separating waste (e.g., glass bottles, plastics, metals, or food waste). Instead waste is mixed. Trash rooms have tile walls and floors that facilitate washing, and at most resort they are cooled (although not refrigerated).

One private company – Clean Home Company – collects waste from all Shagra Tourism Center resorts except Abu Nuwas, which uses its own collection trucks. All resorts receive at least daily collection service; three resorts – Cataract, Kahramana, and Breaky Bay – receive twice daily service. The company charges a flat rate of LE 1,200 per month regardless of the resort size and collection frequency. Collection service is provided under verbal agreements; there are no signed written contracts between the resorts and the collector.

The profile of Clean Home Company in Section 4.4 provides details regarding collection operations.

4. Current solid waste system...

4.2.2 Construction Waste

A formal system does not exist currently for collecting construction waste. Construction companies dispose construction waste in open areas of the concession area, along the paved road, or beside desert tracks. The general practice is to find the easiest and cheapest way to simply remove the waste from the immediate area of the resort that is being constructed.

4.3 RECYCLING AND DISPOSAL

4.3.1 Resort Waste

In 2003, several of the resort operators identified a new disposal site located on the southern boundary of Shagra's concession area with an entrance road just south of the municipal check point. The disposal site is located approximately 1 km off the paved road. Currently an area of about 3 – 5 feddans has been covered with waste to a greater or lesser extent. The Shagra Investors Company provided money for grading the track from the paved road to the site as well as a small litter fence located along part of the disposal site's southern perimeter.

Clean Home Company operates and brings all resort waste to the dumpsite, where staff separate recyclables, food waste, and landscape waste. Waste is not consolidated, but dumped and scattered across the surface of the site.

The company pays LE 500 monthly to the Marsa Alam City Council to use the dumpsite even though the site is on TDA land. This payment helps to guarantee that the City Council does not make it difficult for Clean Home Company to operate in the area.

The profile of Clean Home Company in Section 4.4 provides details regarding operations at the Shagra disposal site.

4.3.2 Construction Waste

As mentioned above, there is no formal system for disposing construction waste, individual construction contractors generally find the easiest way to remove and dispose of waste, namely random dumping in open areas.

4.4 CLEAN HOME COMPANY OPERATIONS

Clean Home Company started collection solid waste in Qusier in 2000 where the company now serves about 90% of the households. The company is the major waste collector for resorts between Qusier and Marsa Alam.

For Shagra resorts, Clean Home generally collects waste between 7:00 AM and 12:00 AM daily in two shifts. The company has one 4-ton truck dedicated to collect waste in the Shagra Tourism Center. Waste is collected manually. The truck is a simple cargo truck without a lift gate or hydraulics for mechanical loading or dumping. The company employs 5 people for solid waste collection in Shagra Tourism Center – two collectors for each shift and one driver who covers both shifts.

4. Current solid waste system...

The head of the company, Mr. Galal Azzam, indicated that his one truck and two-shift operation would be able to handle more resorts in Shagra. They currently average 7 – 8 loads of resort waste per day and 12 loads per day during peak seasons.

Clean Home Company employs 5 people at the disposal site who pick through incoming waste for recoverable materials. The operation is essentially organized scavenging. The following bullet points summarize recovery efforts (recovery estimates were provided by Clean Home Company and it is not clear whether they are weight based or volume based):

- ❑ *Food waste* is separated and laid out to dry and then packed in medium-sized sacks (e.g., 50 kg grain sacks). Dried food waste is sold to a broker in Qusier. This accounts for an estimated 30% of waste recovery by volume. Dried food waste is sold as fish food.
- ❑ *Plastics* are separated into three types: water bottles, other containers, and large plastic items. Plastics are then packed in large sacks and sold to traders who pick up materials in Qusier. Plastics account for an estimated 25% of waste recovery.
- ❑ *Glass bottles* are separated into many categories. Whole bottles are sorted by brand, while broken glass is sorted by color. All are packed in medium-sized sacks and sold to traders who pick up materials in Qusier. Glass represents approximately 20% of recovered materials.
- ❑ *Landscape waste* is separated and the local Ababda families take it for feeding to their livestock. It represents an estimated 5% of recovered materials.
- ❑ *Other recyclables* that are separated include cardboard, paper, aluminum cans, other metals, and textiles. These account for the remainder of recovered materials

Given the nature of Clean Home Company's operations, it is not possible to estimate the current waste diversion rate. However, based on a quick assessment of the waste remaining on the site, significant amounts of recyclable are not captured. Overall recovery rates are probably much lower than could be achieved through source-separation and handling at a materials recovery facility. Prices for diverted materials are summarized in Table 2.

Clean Home Company has established a contractual relationship with Marsa Alam City Council. The company pays LE 500 annually to the City Council ostensibly for the right to collect waste in the City and to use the Shagra Tourism Center dump site (even though the dump site is located on TDA land). In essence, the payment gives the company a franchise to operate in the area and keeps it in the good graces of the City Council. Clean Home Company has a written contract with the City Council to provide residential collection. However, Mr. Azzam has refused to initiate any such service because few if any households would be willing to pay him to collect waste that the City already collects from the street.

4. Current solid waste system...

Table 2 – Prices for Materials Recovered at Shagra Dump Site

| <i>Material</i> | <i>Price (LE)</i> | <i>Method</i> |
|------------------------|---------------------|--------------------------|
| Food Waste | 200 – 300 per tonne | Sold to broker in Qusier |
| Water bottles | 700 – 800 per tonne | Sold to broker in Qusier |
| Other plastics | 200 – 600 per tonne | Sold to broker in Qusier |
| Glass bottles (whole) | 0.07 – 0.08 each | Sold to broker in Qusier |
| Glass bottles (broken) | 150 per tonne | Sold to broker in Qusier |
| Landscape waste | 0 per tonne | Taken by Ababda |
| Cardboard | 150 – 200 per tonne | Sold to broker in Qusier |
| Paper | 250 per tonne | Sold to broker in Qusier |
| Aluminum | 4 – 5 per kg | Sold to broker in Qusier |
| Copper | 8 – 9 per kg | Sold to broker in Qusier |

5. WASTE GENERATION AND COMPOSITION

5.1 WASTE GENERATION RATES AND WASTE COMPOSITION

In order to prepare a realistic sustainable solid waste plan and develop cost estimates, PA first estimated the quantity and composition of waste in the Shagra Tourism Center. Waste generation or composition has not been directly measured in the Shagra Tourism Center. However, studies have been performed elsewhere on the Red Sea coast. The two most reliable sources of data on hotel waste generation and composition are:

- The *Draft Assessment of Solid Waste Management in Qusier City, Red Sea Governorate* prepared by the Centre for Environment and Development in the Arab Region and Europe (CEDARE), 2004.
- The *Best Practices: Solid Waste Management* prepared by PA Government Services Inc., 2003.

Each project present the results of detailed waste characterization studies that measured both waste generation and waste composition. (See Table 3)

Table 3 – Waste Generation Rates and Composition for Red Sea Resorts

| | <i>CEDARE (2004)</i> | <i>PAGS (2003)</i> |
|--------------------------|----------------------|--------------------|
| <u>Waste Generation</u> | 2.3 (Kg/GN) | 2.2 (Kg/GN) |
| <u>Waste Composition</u> | | |
| Organics | 64% | 45% |
| Landscape Waste | | 18% |
| Cardboard | 12% | 14% |
| Paper | 5% | |
| PET Bottles | 4% | 8% |
| Other Plastics | 4% | |
| Metal | 3% | 4% |
| Glass | 4% | 6% |
| Textiles | N/A | 3% |
| Wood | 3% | N/A |
| Other | 1% | 3% |
| Total | 100% | 100% |

Notes:

PA Government Services Inc. (PAGS) data is the average of results from three types of resorts (5-star, 4-star and 3-star)

GN = Guest Night

N/A = not applicable

5. Waste Generation and Composition...

Despite different methodologies and waste stream components, the results from the two sources are quite comparable. For this plan, PA has utilized CEDARE's higher waste generation rate because it is more recent (2004 versus 2003) and from a hotel known to be similar in character to those in Shagra that account for the majority of hotel rooms. With regard to waste composition, PA developed a hybrid waste composition based on the data in both reports. (See Table 4)

Table 4 – Waste Generation Rate and Composition Used for this Plan

| <u>Waste Generation</u> | 2.3 (Kg/GN) |
|--------------------------|-------------|
| <u>Waste Composition</u> | |
| Organics | 45% |
| Landscape Waste | 16% |
| Cardboard | 12% |
| Paper | 4% |
| PET Bottles | 4% |
| Other Plastics | 4% |
| Metal | 4% |
| Glass | 5% |
| Textiles | 2% |
| Other | 4% |
| Total | 100% |

Notes:

GN = Guest Night

5.2 SHAGRA TOURISM CENTER WASTE CHARACTERIZATION

Based on the data presented in Tables 1 and 4, it is possible to estimate the quantity and composition of waste generated by the Shagra Tourism Center. For the two camps currently operating in Shagra, PA used a much lower waste generation rate (0.6 Kg/GN) because they produce much less waste than full service resorts. (See Tables 5 and 6)

5. Waste Generation and Composition...

Table 5 – Shagra Waste Generation

| | <i>GN/Year</i> | <i>Kg/GN</i> | <i>TPY</i> | <i>TPD</i> | | |
|----------------------------|----------------|--------------|-------------|------------|----------------|-------------|
| | | | | <i>Low</i> | <i>Average</i> | <i>High</i> |
| <u>Currently Operating</u> | | | | | | |
| Beach Safari | 3,468 | 0.6 | 2 | 0.00 | 0.01 | 0.01 |
| Breaky | 62,415 | 2.3 | 144 | 0.20 | 0.39 | 0.59 |
| Cataracts | 84,000 | 2.3 | 193 | 0.46 | 0.66 | 0.92 |
| Flora | 52,013 | 2.3 | 120 | 0.23 | 0.33 | 0.46 |
| Abu Nawas | 29,474 | 2.3 | 68 | 0.13 | 0.19 | 0.26 |
| Eden Village Blue Reef | 46,465 | 2.3 | 107 | 0.20 | 0.29 | 0.41 |
| Shagra Ecovillage | 21,900 | 0.6 | 13 | 0.03 | 0.07 | 0.10 |
| Kahramana | 76,030 | 2.3 | 175 | 0.54 | 0.85 | 1.15 |
| Sol y Mar | 37,138 | 2.3 | 85 | 0.17 | 0.36 | 0.55 |
| Elphistone | 41,610 | 2.3 | 96 | 0.18 | 0.26 | 0.37 |
| Egypt Marine | 43,344 | 2.3 | 100 | 0.19 | 0.27 | 0.38 |
| Total | 497,855 | | 1102 | 2.3 | 3.7 | 5.2 |
| <u>Under Construction</u> | 195,671 | 2.3 | 450 | 1.0 | 1.2 | 1.9 |
| <u>Projected</u> | 1,591,583 | 2.3 | 3661 | 7.80 | 10.03 | 15.60 |

Notes:

GN = Guest Night

TPY = Tonnes per year

TPD = Tonnes per day

5. Waste Generation and Composition...

Table 6 – Shagra Waste Composition

| | <u>Tonnes per Year</u> | |
|-----------------|------------------------|-------------------------------|
| | <u>Current</u> | <u>Current + Construction</u> |
| Organic Waste | 495.9 | 698.39 |
| Landscape Waste | 176.3 | 248.32 |
| Cardboard | 132.2 | 186.24 |
| Paper | 44.1 | 62.08 |
| PET Bottles | 44.1 | 62.08 |
| Other Plastic | 44.1 | 62.08 |
| Metal | 44.1 | 62.08 |
| Glass | 55.1 | 77.60 |
| Textile | 22.0 | 31.04 |
| Other | 44.1 | 62.08 |
| Total | 1,101.9 | 1,552.0 |

6. STAKEHOLDER ASSESSMENT

6.1 TOURISM DEVELOPMENT AUTHORITY

The TDA's primary mission is to plan and supervise project development in tourism centers. It has the authority to acquire and grant concessions to tourism development lands, retain income from the sale of concessions, and charge fees for monitoring project implementation. The TDA typically focuses its work on traditional infrastructure projects (roads, water supply, and electricity). However, TDA is increasingly motivated to be actively engaged in ensuring proper waste management in response to growing public concern about solid waste problems and realization that solid waste problems threaten the economic viability of the tourism industry.

TDA has the authority to review Environmental Impact Assessments during planning and enforce environmental regulations during construction, which will be crucial to any efforts to implement construction waste management. The TDA would also play a key role in any effort to designate new TDA lands for development of solid waste infrastructure.

6.2 SHAGRA TOURISM CENTER

The shareholders of the Shagra Tourism Center are the owners and investors in the individual concession areas with the center. The Shagra investor group is primarily motivated by business interests – seeking to maximize return on investment. The Shagra Investors Company currently has a relatively limited role in the development of the center. Each individual concession is responsible for its own financing, construction, and operations.

Shagra Investment Company has managed development of two de-salination plants that provide water to the operating resorts. The plants were developed through a BOOT process (build-own-operate-transfer) whereby a private company is responsible for aspects of developing and operating the plants, with ownership transferring to the Shagra Investors Company at the end of the contract term.

The Shagra Investment Company will consider any efforts to improve solid waste management primarily in terms of whether they protect the value of the tourism center and are critical to the proper functioning of the resorts. The Shagra Investment Company is a potential source of capital needed to develop solid waste infrastructure as well as the entity for implementing a BOOT or other similar development process, so long as the development cost and return on investment are justified.

6.3 SHAGRA ECO-VILLAGE ENVIRONMENTAL CHAMPION

One key member of the Center is Hossam Helmy – the owner and operator of Shagra Ecovillage. Mr. Helmy was one of the first resort operators in the region and has been instrumental in development of the Shagra Tourism Center. He has been an advocate for environmental programs, organized litter collection efforts, assisted in selecting the current dumpsite, and persuaded the investor group to fund the small litter fence recently installed at the dumpsite. He was also instrumental in the development of the hyperbaric re-compression chamber and medical clinic in the Shagra Tourism Center.

6. Stakeholder Assessment...

Mr. Helmy is active in the Shagra Tourism Center, and has excellent contacts within relevant agencies of the Government of Egypt. Mr. Helmy has expressed interest in spearheading efforts to implement a sustainable solid waste management system for the Shagra Tourism Center.

6.4 RESORT OPERATORS

Resort operators are focused on managing their properties to attract and retain guests and maximize return on investment.⁶ Their interest in solid waste is primarily expressed in terms of the negative impact that solid waste can have on their guests – either nuisances caused by poor waste storage and collection or the impact litter has on guests' general impressions of the Red Sea Coast environment.

Resort operators are motivated to keep their property and beach clean, invest in practices that have low cost and high return (such as waste prevention), and to have reliable solid waste services. Some resorts also strive to establish comprehensive environmental management programs and to achieve international recognition, such as Green Globe certification.

Resort staff are directly involved in the collection and handling of waste. Their willingness to participate in a sustainable system is determined by how well they understand waste handling procedures, the reasons for proper waste handling, and the consequences (both job-related and environmental) of not participating. Their active support is needed if source-separation is to work. Solid waste handling systems need to be designed with consideration of the amount of extra work required of resort staff. Staff involved in waste management will need the proper training and safety equipment to perform their jobs properly.

6.5 CURRENT SOLID WASTE CONTRACTOR

Clean Home Company has invested money and effort to establish a solid waste collection management service in the Shagra Tourism Center. The company wants to protect its business and hopefully grow larger. The company director, Mr. Galal Azzam, has invested in collection equipment and makes annual payments to the Marsa Alam and Qusier municipalities.

Recent developments in Qusier may threaten his resort collection operations there. The City Council plans to take over collection from the resorts located within the City in order to receive a LE 5 per hotel room per month fee mandated by the Governor. Mr. Azzam has refused the City's offer to give him a contract for collecting its residential waste because he would be unable to receive enough compensation from the City and residents to cover his costs. He hopes that ultimately the hotels will still hire him to collect their waste since it's unlikely that Qusier City Council will provide reliable and quality service.

Despite his efforts to stay in the good graces of the local governments, they can very easily make it difficult for Clean Home Company to operate in municipal areas. Therefore, Clean Home Company will work hard to protect its business in TDA areas (like Shagra Tourism Center) and to provide a quality service at price that resorts are willing to pay. Mr. Azzam

⁶ It should be noted that nearly two-thirds of Egypt's foreign visitors come from Europe where solid waste management and recycling efforts are very advanced.

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states that he can collect source-separated waste if the resorts separate it and there is facility capable of handling it. He is interested in taking on a greater role in a new solid waste system, such as operating recycling and disposal facilities. However, he lacks the technical knowledge and experience.

6.6 CONSTRUCTION COMPANIES

Construction companies work under contract to the resort investor group and/or developer. Their primary motivation is to complete construction within time and budget. Their interest in environmental control, and solid waste management in particular, is limited to what they are required to do by contract. Without contractual requirements, penalties, and specific regulations, they will continue to randomly dispose construction waste wherever it is cheapest and most convenient.

6.7 BEDOUINS

Throughout the Red Sea coast, Bedouin families regularly visit or reside at open dumpsites and scavenge food waste and landscape waste to feed themselves and their livestock. They live and work under very harsh and unsafe conditions. The role of the Bedouins in solid waste management is informal and very tenuous. In the Shagra Tourism Center, they rely on the charity and willingness of the Clean Home Company to allow them to scavenge at the dumpsite. Having access to the waste stream is their primary motivation.

In Nuweiba, the Hemaya NGO has developed a successful incentive system with local Bedouin families to properly handle organic waste. The NGO established specific requirements for families that are granted access to the waste: waste must be sorted to remove non-organic contaminants, contaminants must be gathered together for collection by the NGO, and the family must control any litter problems. If the Bedouins do not live up to their responsibilities, the NGO will stop bringing waste to them. If they do a good job, the NGO brings them greater quantities of organic waste.

6.8 TOURIST AND TOUR OPERATORS

The tourists visiting the Shagra Tourism Center are involved in the solid waste management system primarily as generators of waste. They are generally willing to participate in source separation and proper waste disposal as long as it is relatively convenient and instructions are clearly understandable. In a secondary sense, their holiday experience and attitude about the Red Sea coast is affected by their perception of the natural environment. Random roadside disposal of solid waste, desert scenery cluttered with plastic bags, and beachfront litter leave a lasting, negative impression. As noted earlier with Red Sea Divers, some guests participate in hotel or resort organized clean-up campaigns on a voluntary basis.

Tour operators have a great deal of influence over resort operators because they control the majority of tourism business on the Red Sea coast. Although much of the relationship centers around cost, resorts will be very responsive if tour operators express their concerns about environmental issues.

7. INTEGRATED AND SUSTAINABLE SOLID WASTE MANAGEMENT

Experience in many countries, including Egypt, has demonstrated that a strictly technical approach to solid waste management does not work. Unlike other infrastructure, solid waste management systems are highly dependent on the participation and cooperation among many different stakeholders. Numerous efforts to implement and upgrade waste management systems by providing merely facilities, equipment, and/or funding have failed because they ignore the human, political, and institutional components.

In order to be viable and sustainable, a new solid waste management system for the Shagra Tourism Center must be multi-disciplinary and address the following elements: technical, economic, environmental, socio-economic, legal, institutional, and administrative.

7.1 INTEGRATED SOLID WASTE MANAGEMENT

Integrated solid waste management systems are based on a waste management hierarchy that favors the following management strategies in descending order:

- Waste prevention – reduce the quantity and/or toxicity of waste.
- Waste diversion – reuse: retain maximum value of resources; recycle: recover materials for beneficial use; and compost: convert organic waste for horticultural use.
- Land disposal – place remaining waste in a well managed, controlled dumpsite site.

Integrated solid waste management can result not only in important environmental benefits, but also economic benefits, as summarized below.

| <u><i>Environmental Benefits</i></u> | <u><i>Economic Benefits</i></u> |
|--|---|
| <ul style="list-style-type: none">• Resource conservation | <ul style="list-style-type: none">• Waste management cost savings |
| <ul style="list-style-type: none">• Reduced impact from raw materials extraction | <ul style="list-style-type: none">• Material and supply cost savings |
| <ul style="list-style-type: none">• Energy savings | <ul style="list-style-type: none">• Savings from efficient work practices |
| <ul style="list-style-type: none">• Reduced burden on disposal sites | <ul style="list-style-type: none">• Revenues from recovered materials |

Integrated solid waste management requires a comprehensive assessment of systems. Collection systems are based on careful study of waste characteristics, the number of customers, and options for source reduction, source-separation, collection and transfer, reuse, recycling, composting, and disposal. The relationships between processing and disposal facilities must be evaluated in order to maximize handling efficiency and waste diversion. Opportunities for dual use of equipment and economies of scale at various levels of operations should be considered. And finally the facilities, equipment, and operations are conceived and implemented as a whole system rather than a set of fragmented pieces.

7.2 SUSTAINABLE SOLID WASTE MANAGEMENT

An integrated system of operations and facilities will not be sustainable unless it is designed and operated to fit into the existing socio-economic, legal, institutional, financial, and administrative systems. Public education and institutional capacity building are essential to sustainability. For the Shagra Tourism Center, training and public awareness efforts must address many audiences: resort operators and their staff, the Shagra Investors Company and individual resort investors, the TDA, the current waste collection company, tourists, Bedouin families and others.

To address socio-economic issues, one needs to consider the impact on the informal sector and opportunities for community development. To address institutional and administrative issues, it is important to clearly define who is responsible for managing the waste management system and to ensure that they have the necessary knowledge and authority to carry out their functions. Consolidating waste management functions within a single entity often is the most reliable strategy. Financing the solid waste system will require a workable solution for capital investment and fees for services that remunerate the operator and provide a return on investment, as well as demonstrated understanding and capability for developing and operating the overall system.

8. PROPOSED SOLID WASTE MANAGEMENT SYSTEM

This section of the plan discusses and recommends the technical components of an integrated solid waste management system for the Shagra Tourism Center. Technical components include the services, facilities, and equipment for handling solid waste – namely waste prevention, collection, recovery and processing of recyclables, and disposal of remaining waste. The second part of this section discusses the non-technical elements of the solid waste system that are necessary to make it sustainable, i.e., the institutional framework, responsibility for ownership and operations, and financing.

8.1 TECHNICAL SYSTEMS

8.1.1 Waste Prevention

The goal of waste prevention is to reduce the amount and/or toxicity of waste. RSSTI's *Best Practices for Solid Waste Management* provides an extensive inventory of waste prevention ideas that may be incorporated by individual resorts. While it is beyond the scope of this document to provide waste prevention recommendations for individual resorts, Shagra resorts should consider the following strategies that are relatively inexpensive to implement and can have a significant impact on waste generation:

- Business Office – double sided printing and copying; route single documents to staff rather than making separate copies for each person; maximize use of e-mail to eliminate paper; eliminate disposable cups and mugs; recycle printer and photocopying ink cartridges.
- Food and Beverage Service – Practice good inventory management to minimize food spoilage; request that suppliers utilize reusable packaging; purchase products in bulk and/or concentrated form and dispense them in reusable/refillable containers; and adjust quantities prepared and served to reduce food waste.
- Grounds Keeping Service – Install or convert landscaped areas to drought resistant plants; use mulching mowers to eliminate collection of grass clippings; and replace disposable plastic bags with reusable bags for collecting landscape waste.
- Housekeeping and Laundry Service – Purchase guest bath products in bulk and/or concentrated form and dispense in reusable/refillable containers; purchase cleaning products in bulk and/or concentrate; provide guests with reusable cloth laundry bags and use baskets for delivering clean laundry instead of disposable plastic or paper wrappings; and eliminate disposable cups and mugs.

8.1.2 Collection

Three aspects of waste collection are discussed: source-separation, collection frequency, and method of collection.

Source-separation of waste is a fundamental best practice for enabling waste diversion. By separating waste according to material type, characteristics, and/or market value, resorts make it easier to keep recyclable materials clean and uncontaminated. Based on discussions

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with several resorts in the Shagra Tourism Center, a three-way separation of waste can be readily adopted. The categories of waste are as follows:

1. Food waste from food and beverage services
2. Landscape waste from grounds keeping services
3. All other waste

This separation method facilitates waste diversion and beneficial use. Food waste and landscape waste are not contaminated. Meanwhile other waste is primarily dry, which makes it easy to sort out recyclable materials like cardboard, paper, glass, metal, plastic, textiles, etc.

Three-way source separation will require changes in current waste handling practices. Most notably, food and beverage service areas will need separate containers for food containers and all other waste. Staff would need to be trained to properly separate waste. The other major area where change will be necessary is the trash room where each category of waste will need to be stockpiled separately. It should be noted that foods waste needs to be stored in a refrigerated room in order to reduce potential for contamination and food borne illnesses.

It is recommended that color-coded bags or reusable bins be used to collect and store waste on site, for example green bags for food waste, clear bags for landscape waste, and black bags for all other waste.

Resorts require that waste be collected every day in order to minimize odor and vector problems. Once implemented, three-way source-separation would theoretically make it possible to collect other waste less frequently – for example, twice per week. Less frequent collection could enable more cost effective collection. However, resorts' trash rooms are very limited in size. And more importantly, most resorts are very concerned about controlling odors and disease vectors. Therefore, less frequent collection is not acceptable to resorts. It would require significant capital investment to either expand the size of trash rooms or install waste compaction equipment.

Currently there are 11 resorts in the Shagra Tourism Center and three more currently under construction. So for the foreseeable future there will be only 14 resorts requiring waste collection service. Daily waste quantities are expected to average less than 5 tons and not exceed 7 – 8 tons during peak seasons.

Clean Home Company currently collects waste from the Shagra resorts using a 4-ton cargo truck and a three-person crew (one driver and two collectors). Waste is manually loaded and discharged, and there is no compaction. PA compared Clean Home's method against one that (a) collects food waste and landscape waste in a compactor truck and (b) collects all other waste in a non-compacting truck. (Other waste is primarily recyclable materials and should not be compacted because this breaks glass and makes it more difficult to sort out recyclables.)

PA's analysis confirms that compactor trucks do not make sense at this time. Resorts have relatively small trash rooms and desire daily collection. Therefore, compaction cannot be used to reduce collection frequency. And given the relatively small quantity of waste

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generated in the Shagra Tourism Center, compacted collection does not provide enough improvements in collection efficiency to reduce the number of trucks.

Therefore, the current truck-crew configuration should continue to be used, however with two important changes in their collection method:

1. When collecting waste, the crew should separate it so that, for example, all food waste is placed together on the truck – likewise for landscape waste and other waste. The use of color-coded bags by the resorts will facilitate separation on the collection truck.
2. The collection truck should be equipped with a hydraulic mechanism to facilitate loading and/or unloading, such as a lift-gate or dump-body. Clean Home Company stated that this is one feature it wished it had on its collection truck. Given three-way source-separation, a hydraulic lift-gate makes the most sense since a self-dump cargo body would make it very difficult to separately unload each waste category.

8.1.3 Materials Recovery Facility

A materials recovery facility (MRF) makes sorting, processing and storing of recyclable materials more efficient, less hazardous for workers, and more environmentally sound (reduce potential for litter, odors, and vectors). The MRF should be located adjacent to the controlled disposal site. The following activities occur at the MRF:

- Incoming collection trucks deliver all other waste to the MRF (food waste and landscape waste are then delivered to the controlled disposal site).
- Dry waste is unloaded and manually sorted using a flat conveyor.
- Recyclable materials are further sorted and processed for sale in a series of small workshops – cardboard and paper are baled, water bottles and other plastic bottles are run through a perforator and then baled, aluminum and metal cans are flattened, whole glass bottles are consolidated by type and bagged, broken glass is stockpiled by color and then bagged, and textiles are baled.
- Residue from MRF operations are collected in a dump truck and transported to the controlled disposal site.

An excellent model exists in Nuweiba where the Hemaya NGO operates a MRF that can be used as the basis for design and operation of a Shagra MRF.

Recovered materials should be marketed in a manner similar to how they are currently marketed from the Shagra dumpsite. However, the MRF will not only produce recyclables with a higher market value than the current system (e.g., baled plastic bottles versus loose), it will achieve much higher diversion rates due to source-separation and sorting on a conveyor belt at the MRF. Therefore it may be possible to attract higher prices and/or access better markets. And since materials will be processed (i.e., baled or densified) it is anticipated that larger quantities can be stockpiled at the MRF and greater transportation efficiencies achieved when hauling recyclables to market.

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8.1.4 Controlled Disposal Site

The controlled disposal site should consist of two distinct areas: (a) an area for receiving food waste and landscape waste from collection trucks and (b) an area for burying residuals from MRF operations as well as leftover food waste and landscape waste.

A controlled disposal site will eliminate many of the problems of the current open dumpsite. First of all, the dumpsite will only receive residuals from the MRF operation and leftovers from food waste and landscape waste; therefore much less waste will require disposal. Second, the disposal operations will be designed and operated based RSSTI's *Best Practices: Solid Waste Management*, namely:

Design Features:

- A clearly defined filling area where all waste is consolidated in cells.
- A limited working face where waste is received.
- Design to control windblown litter including below grade working face, sheltering the working face from prevailing winds, and litter fencing.

Operating Features:

- Access limited to truck carrying residuals from the MRF.
- Covering of waste at the working face at the end of each day with inert soil.
- Use of a front-end loader to compact and consolidate waste on the working face and to spread daily cover.

For the management of food waste and landscape waste, the following activities occur at the disposal site:

- Food waste is de-bagged and spread out on the ground to dry, after which dried food waste is re-bagged.
- Landscape waste is de-bagged and stockpiled in a designated area for feeding to Ababda livestock.
- Discarded plastic bags are either taken to the MRF for recycling with other plastic or, if no market exists, disposed at the working face.

8.1.5 Construction Waste Management

Given the severe cost constraints on construction in Red Sea tourism centers and the general lack of environmental oversight, it is unrealistic to expect a comprehensive program for collection, centralized processing, and disposal of construction waste. In a tourism center like El Gouna where a single master developer is responsible for all aspects of development, it is possible. And indeed, El Gouna has reliable construction waste collection and uses a single disposal site. Such an approach is not immediately feasible in the tourism centers of the limited development type. Given current conditions, the most viable solution for construction

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waste management is on-site disposal of construction waste and collection of waste generated by worker encampments for disposal at the controlled disposal site.

8.2 INSTITUTIONAL FRAMEWORK – IMPLEMENTATION OF A SUSTAINABLE SYSTEM

8.2.1 Resort Waste Management

Based on its assessment of stakeholders and the current waste management system, PA offers the following recommendations for the institutional framework needed to implement a sustainable waste management system:

1. The TDA and Shagra work together to designate a site for the MRF and disposal facilities. Expert consultants should be engaged to help ensure that site selection and preliminary design conform to best practices.
2. Local activists establish an environmental NGO to take the lead in developing and operating a sustainable solid waste management system. Such an organization will need to work with multiple stakeholders. An NGO is preferable to a strictly private-sector approach (see discussion below). A local champion, such as Mr. Helmy, will be essential for empowering this NGO and negotiating relationships and agreements with other stakeholders.
3. The Shagra Investors Company develops terms of reference and tender documents for the NGO to develop a MRF and controlled disposal site on the designated site. A single agreement for all solid waste management facilities is preferable to one where different entities operate the MRF and disposal site or where ownership and operations is split between the Shagra Investors Company and an NGO (see discussion below).
4. The NGO works in collaboration with the resorts to develop minimum collection standards and prepares draft contract language for Clean Home Company (or other collection company) to service the resort. The contract language includes provisions that establish the MRF and controlled disposal site as the only designated facilities for waste management.
5. The NGO then negotiates on behalf of the resorts and enters a single collection contract to serve all resorts. It may be appropriate to place the contract out for competitive bidding if it is determined that companies other than Clean Home Company are interested and qualified.
6. The collection contract language establishes a chain of custody system that documents the quantity of waste collected and makes payment for collection service contingent on proof that waste was delivered to the NGO facilities (see discussion below).
7. The NGO establishes a tip fee structure for the MRF and disposal site based on the level of separation and the quantity of waste (e.g., higher fees if waste is not source-separated, and prices per unit of waste). Such a fee structure will encourage waste prevention and proper source-separation.

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8. The NGO then works with each resort to establish a written agreement that covers payment for collection services (which are in essence operated by the private company under contract to the NGO) as well as fees for processing and disposal.
9. The NGO seeks grant money and investment capital to develop the MRF and disposal site⁷, and subsequently undertakes the development and operation of the facilities either directly or through subcontract with a private operator.
10. The Shagra Investors Company serves as the primary source of investment capital for the MRF and disposal site, with a reliable return on investment secured by the fees paid by the resorts (and other generators such as commercial shops and residential unit developments) to the NGO.

8.2.2 Construction Waste Management

With regard to construction waste, TDA must implement a series of actions to enforce proper waste management on the project developers. Other stakeholders have little influence in this matter, so it is TDA actions that are needed. PA offers the following recommendations for developing a functioning construction waste management program:

1. TDA establishes minimum standards for the following aspects of construction waste management: managing excess fill; on-site disposal of inert construction waste; and on-site storage, collection, and disposal of worker waste and non-inert construction waste in the controlled disposal site.
2. TDA incorporates the minimum standards into the procedures for review and approval of concession agreements, development plans, and final development.
3. Project developers are required submit a detailed construction waste management plan that quantifies and characterizes construction waste and addresses all standards listed above.
4. Project developers are required submit a signed contract with a waste collection company for handling waste that requires offsite disposal.
5. Project developers must submit a construction budget that shows funds allocated for construction waste management (both on-site and off-site).
6. Project developers must submit a construction waste performance bond that is held by TDA as insurance in case the developer or construction company does not properly manage waste.
7. TDA design approval is contingent on accurate calculations, compliance with standards, submittal of an acceptable plan, and submittal of the performance bond.

The proposed program will require a re-shuffling of TDA priorities. Currently, the TDA's primarily monitoring activity is to determine the consistency of development and construction

⁷ The Social Fund for Development financed part of the Nuweiba solid waste management project.

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activities with the approved masterplan for the site. It will be important for TDA to incorporate monitoring and enforcement of solid waste management practices.

8.2.3 Capacity Building

The existing solid waste management system in Shagra Tourism Center is tenuous. Stakeholders lack the technical know-how to implement an integrated and sustainable system. In addition, the relationships and responsibilities for developing and operating a solid waste system are absent. Therefore, work is needed to cultivate and sustain the institutional infrastructure. Capacity building is needed at several levels. TDA may require help in enforcing construction companies to follow proper waste management practices. Hotel operators and staff will need solid waste and environmental awareness training. Clean Home Company will need training and skill development if it is to continue serving as collector and possibly expand into other aspects of waste management. The Bedouins need to be consulted to ensure that they are not disenfranchised and educated about minimum standards for gaining access to organic waste. And the NGO will need guidance when developing terms of reference, interfacing with stakeholders, negotiating contracts, developing the MRF and disposal site (design, engineering, cost estimating, and construction), and ultimately training its staff.

PA has previously worked with TDA and resort properties for capacity building efforts. Other donor-based agencies may be able to assist in capacity building as well. In addition, Egyptian national source of funding (such as the Social Fund for Development, Environmental Protection Fund) and organizations such as Hemaya NGO may be able to assist in capacity building.

8.2.4 Ownership and Operations

Land ownership should be conveyed to the Shagra Investors Company in the same manner that concessions for resorts are conveyed. This will secure the site for a sufficient period of time to ensure that the Shagra Investors Company can recover its investment without threat of losing control of the site. In addition, by having long-term control and responsibility for the site, the Shagra Investors Company should have a vested interest in ensuring that the site and facilities are properly operated.

Several different options exist for ownership and operation of the MRF and disposal facilities:

1. Shagra Investors Company builds, equips, and owns facilities; NGO/contractor operates only
2. Shagra Investors Company builds and owns facilities; NGO/contractor equips and operates
3. NGO/contractor builds, equips, owns, and operates facilities

Option 1 is not recommended because the NGO/operator has little direct incentive to properly care for and maintain facilities and equipment because they do not own them. Proper maintenance would rely on contractual terms. Option 2 is not recommended either. The NGO/contractor does have the direct incentive to properly care for its equipment, but it can be difficult to clearly delineate the responsibilities of the Shagra Investors Company and the NGO/contractor for any damages and normal wear and tear of the facilities. Additionally, the

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Shagra Investors Company may not have the commitment and knowledge needed to properly design the facilities for their intended function. For example, the NGO/contractor could claim that the MRF design is flawed, which makes operations more expensive. Therefore, the third ownership and operations scenario is recommended. This is comparable to the way the Shagra Investors Company has handled the concession for desalination plants. Essentially, the NGO/contractor is provided with the site and is fully responsible for development and operations under a build, own, operate and transfer (BOOT) approach.

8.2.5 NGO vs. Private Company

It is recommended that the Shagra Tourism Center utilize an NGO rather than a private company to develop and operate the MRF and controlled disposal site. However, it is recommended that Clean Home Company continue to have the opportunity to provide collection service, so long as the company is able to comply with minimum standards established by the NGO.

An NGO can operate a small integrated waste management system more reliably and cost effectively because it pay less tax than a private company. And an NGO can seek grants to help defray capital costs. The founder of the Hemaya provides another important reason: an NGO is more willing to endure fluctuations in the tourism economy and to “ride out” low times when cash flow may be tight. Because it is not strictly motivated by profit, an NGO is less likely to reduce service or go out of business all together given its commitment to environmental protection, social issues, and sustainable waste management. Finally, and may be most importantly, an NGO can be more suitable for interacting with the multiple stakeholders in the solid waste management system. Its mission can incorporate capacity building, environmental improvement, local socio-economic development, etc.

8.2.6 Solid Waste Chain of Custody

Random disposal of solid waste is a prevalent problem on the Red Sea Coast. Waste is removed from resorts but rarely makes it to a proper disposal facility. In order for this situation to change, there must be accountability from the point of collection to the point of receiving at processing and disposal facilities. This is called a “chain of custody”.

The following procedures for maintaining and documenting waste handling are recommended:

1. When solid waste is collected from a resort, the collector and resort staff tally the number of bags collected, and sign an itemized collection receipt (e.g., 6 bags of kitchen waste, 4 bags of landscape waste, and 4 bags of other waste were removed by the collection contractor on a specific date).
2. Both the resort and the contractor retain copies of collection receipts.
3. When the collection contractor arrives at the MRF, bags of waste are inventoried and checked against the collection receipts. The MRF staff then checks-off receipt of bags directly on the contractor’s copy of the collection receipt. If contractor does not deliver all waste to the MRF, this fact is made clear on the collection receipts.
4. Both the contractor and the MRF retain copies of collection receipts.

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5. The contractor's collection contract with the NGO will include provisions that payment is contingent upon the contractor submitting collection receipts for all waste delivered to the MRF and controlled disposal facility. The collection contract will include penalties for any discrepancy, thereby creating a direct financial incentive for the collector to deliver all waste to the designated facilities.

8.2.7 Financing

In order to finance development and operation of a sustainable waste management system, first it is necessary to identify potential sources of money and, second, establish a system for generating revenue to cover investments. Four possible sources of money exist in the Shagra Tourism Center: the Shagra Investors Company, donor agencies (both Egyptian and international), bank loans, and the resorts. It is recommended that funding for development of the system is sought from the following sources in the following order: donor agencies, the Shagra Investors Company, and lastly bank loans. Grants from donor agencies can reduce the amount of private investment, reduce development costs, and ultimately reduce the costs of solid waste services. The Shagra Investors Company is a more preferable source of investment capital than bank loans because equity investments will reduce the debt service requirements which can make it difficult in the near term for the project until enough users have signed agreements to participate in the project. Also, as investors in the solid waste management project itself, the Shagra Investors Company will ensure that its hotels and other tourism enterprises participate.

The money to operate the system and generate a return on investment should come from the users and beneficiaries of the solid waste system, namely the resorts (and any commercial shops and residential housing developments that may be developed in the center). The system of payment has been set up so that resorts pay a single fee directly to the NGO which, in turn, uses that revenue to cover its investments, pay for operations, reimburse the Shagra Investors Company for any investment it has made, and pay the collection contractor. Payments to the collection contractor will be based on compliance with the "chain of custody" requirements.

9. SOLID WASTE MANAGEMENT SYSTEM COSTS

PA completed a planning-level cost analysis of the recommended resort waste management system to assess its economic feasibility and to provide a foundation for subsequent planning and implementation (e.g., development terms of reference, bid documents, grant proposals, project budgets, etc.). The cost estimates presented below are for general planning and decision-making only; they are not site-specific and do not necessarily incorporate the specific facilities and equipment that may ultimately comprise Shagra's solid waste management system. More detailed cost estimates will be needed once decisions to implement are made.

9.1 COLLECTION COSTS

As noted previously, the currently used configuration of equipment and labor is most viable for the Shagra Tourism Center. The collection system relies on a 4-ton cargo truck staffed by one driver and two collectors. It is notable that Hemaya also uses the same method to serve resorts.

The first step in estimating collection costs is to determine how many collection crews are required to serve the Shagra resorts. Table 7 (tables are located at the end of this section) documents the assumptions, parameters and calculations used to estimate crew requirements. The calculations are based on serving all currently operating resorts as well as those currently under construction. The calculations confirm that one truck operating 12 hours per day can provide daily collection service for the 14 resorts.

Table 8 provides estimated costs for providing the recommended 3-way source-separation collection service in the Shagra Tourism Center. Capital costs are limited to the purchase of one new collection truck, which operates for two eight-hour shifts per day. The collection crew would have the operational flexibility to either collect all three waste categories at the same time, or to collect one category at a time.

Total capital cost for one new truck is estimated at LE 155,000, which is equal to an annual cost of capital at LE 23,100 (assuming 10 year service life and 8% interest rate). The annual cost for labor and operations and maintenance (O&M) is estimated at LE 117,900.

9.2 MRF COSTS

The MRF represents a significant upgrade from the current practice of dumpsite scavenging. The conceptual design for a Shagra MRF should closely approximate that of the Hemaya MRF in Nuweiba with modifications made to reduce the size and streamline materials handling to reflect the smaller size of the Shagra Tourism Center.

An enclosure wall surrounds the entire facility. As noted above, the facility receives only dry waste, which is manually sorted to recover recyclable materials. Recyclables are then further sorted and processed, and stockpiled for sale to markets. The MRF includes an administration building and employee facilities for both the MRF and disposal site. It is also equipped with a generator based on the assumption that it will need to generate its own electricity. The estimated capital cost is increase by 10% to cover design and engineering and any contingency. The estimated capital cost is about LE 333,800. This equals an annual

9. Solid Waste Management System Costs...

capital cost of approximately LE 9,300 for site work and structures (20 year service life) and LE 31,700 for equipment (10 year service life).

MRF operations are primarily waste sorting and processing. The MRF annual operating costs include a general manager who is responsible for overseeing all NGO operations. The estimated annual operating cost equals approximately LE 64,900.

Revenue from the sale of recycled materials has been calculated based on current prices for un-processed recyclables in Qusier. Since, the proposed MRF will be processing recyclables into more transportable and market-ready form, it is reasonable to assume that Shagra Tourism Center can expect current prices to be paid for processed materials picked up at the MRF. To calculate the quantities of recycled materials, we have made conservative assumptions regarding the percent of material collected that is sorted out and recovered at the MRF. Estimated revenue from recyclable materials equals approximately LE 157,900 per year.

Based on observation of similar sorting operations elsewhere in Egypt, it is likely that a Shagra MRF will achieve higher recovery rates than what is assumed in this analysis. Therefore, more recyclables may actually be recovered and thus more revenue generated.

9.3 CONTROLLED DISPOSAL SITE COSTS

In many ways the controlled disposal site is the most critical component of the integrated waste management system. To date, no controlled disposal site exists on the Red Sea Coast. Ensuring that all non-recoverable waste is delivered to such a facility will be a great stride towards controlling solid waste problems in the Shagra Tourism Center.

The conceptual design for the controlled disposal site is based on design and operating guidelines in RSSTI's *Best Practices: Solid Waste Management* manual, including:

- A well-defined and constructed cell for receiving waste
- Design and operating procedures to control litter
- Controlled working face
- Daily covering of waste with inert soil
- Elimination of open burning
- Elimination of scavenging

The entire disposal area is surrounded by a perimeter fence, which prevents unauthorized access to the site and serves as a litter fence. A moveable litter fence is also installed down wind from the working face. It is intended that workers will collect litter from the fences daily. Residue from the MRF is delivered to the working face by a dump truck. A front-end loader is used to spread out and compact the waste. At the end of each day the front end loader buries that day's waste with a layer of inert soil. Taken as a whole the fences, daily litter collection, and daily cover will greatly reduce litter problems.

9. Solid Waste Management System Costs...

The estimated capital cost for constructing the controlled disposal site is approximately LE 594,250 including a 10% engineering and contingency allowance. A front-end loader (for all materials handling and landfilling activity) accounts for LE 450,000 of the capital cost. The annual capital cost equals approximately LE 14,700 for site work and structures (20 year service life) and LE 67,100 for equipment (10 year service life).

It is assumed that kitchen waste and landscape waste will be delivered to the disposal site and handled in a dedicated area away from the working face. These materials will be de-bagged by disposal site and MRF staff, food waste will be spread out to dry for beneficial use, and landscape waste will be made available for Bedouin livestock in exchange for their help in de-bagging and collecting litter.

Disposal site operating costs include collecting residuals from the MRF in the dump truck and hauling them to the disposal site. The dump truck and loader may also be used to load and deliver daily fill to the working face.

Estimated annual operating cost for the controlled disposal site equals approximately LE 106,500.

9.4 LIFE CYCLE COSTS

Table 12 summarizes costs for all components of the solid waste system: collection, MRF, and disposal site. The table includes initial costs plus projected costs for a ten-year life cycle. Total annual costs for the first year of operation are estimated at approximately LE 277,200 and escalate to approximately LE 528,700 in ten years due to increases in labor and O&M costs. This represents the entire cost of the integrated system; it does not include any savings that may be achieved through grants and financial assistance, waste prevention, and higher waste diversion rates.

As shown in the lower part of the Table 12, unit costs for comprehensive solid waste services are estimated at approximately LE 205 to LE 340 per tonne and LE 1,890 to 3,150 per resort per month.

Clearly this cost is higher than the current LE 1,200 per month paid by Shagra resorts for solid waste collection. However, it is also clear that the current system is inadequate – the current dumpsite is littering the desert, working conditions for dumpsite scavengers are poor, and there is no funding for replacement of capital. The proposed integrated solid waste management system addresses these problems.

It may be questioned whether the resorts will be willing to pay for the improved solid waste system. There are approximately 2,500 guest rooms currently operating or under construction in Shagra Tourism Center. An average collection fee of LE 2000 per resort per month (approximately LE 11 per guest room per month) would generate enough revenue to cover the cost of the entire solid waste system as summarized below:

- Return on Investment (ROI) = 112%
- Payback Period = 6 - 7 years
- Assumptions:

9. Solid Waste Management System Costs...

- 10-year analysis
- Labor Cost increases 10% annually
- O&M Cost increases 3% annually
- Average Collection Fee = LE2000 per month per resort
- Collection Fee increases 3% annually
- Recycling Revenue does not change

For comparison, Hemaya charges a variable rate for its services of LE 6 to 10 per month per guest room, depending on the level of source-separation (its services do not include a controlled disposal site). Eleven out of 15 hotels and 13 out of 17 resorts in its area choose to hire Hemaya and pay the fees. So it is likely that resorts in Shagra Tourism Center will be willing to pay for comprehensive waste management services, especially if the Shagra Investors Company has a financial interest in the project.

It should also be noted that Hemaya received a LE 650,000 grant from the Social Fund for Development that entirely covered most of the cost for constructing the MRF and purchasing equipment. If a similar grant were secured for a project in Shagra Tourism Center, the costs for solid waste management would be significantly reduced.

It must be remembered that solid waste fees (even in Nuweiba) do not cover the full cost of proper solid waste management, and it will take education and training to make resorts, the Shagra Investors Company and others aware of and willing to pay the true costs of solid waste management.

Finally, the solid waste system proposed here has a significant amount of extra capacity. Shagra Tourism Center is relatively small, and thus the costs are spread out over relatively few tons and few resorts. It is quite possible for the MRF and disposal site to handle additional waste from other tourism centers and even Marsa Alam. By increasing the quantity of waste handled the unit costs will be reduced due to economies of scale.

9. Solid Waste Management System Costs...

Table 7 – Collection Crew Requirement

| Waste from Currently Operating & Under Construction Scenario: Resorts 3 way source-separation: FW, YW, Other collected daily | | | |
|--|-------------------|---|------------------|
| <u>Number of Resorts:</u> | 14 | | |
| <u>Truck Parameters</u> | | <u>Waste Quantity (tonnes per year)</u> | |
| Type | 4-ton cargo truck | Organic Waste | 698.4 |
| Actual Volume | 8 cubic meters | Landscape Waste | 248.3 |
| Compaction Ratio | 1 to 1 | Cardboard | 186.2 |
| Utilization | 100% | Paper | 62.1 |
| Effective Volume | 8 cubic meters | PET Bottles | 62.1 |
| Stops/Load | 2.8 | Other Plastic | 62.1 |
| Actual Loads/Day | 5.1 | Metal | 62.1 |
| Functional Loads/Day | 5 | Glass | 77.6 |
| | | Textile | 31.0 |
| | | Other | 62.1 |
| | | Total | 1552.0 |
| <u>Collection Parameters</u> | | <u>Collection Crew Requirement</u> | |
| Avg. Time/Stop | 15 minutes | Available Hours/Day | 10.83 hours |
| Avg. Pass Spacing | 900 meters | Stop Time/Load | 0.69 hours |
| Avg. Speed Betw/ Stops | 10 km/hr | Roll Time/Load | 0.16 hours |
| Avg. Distance to MRF | 10 km | Off Route Time/Load | 1.30 hours |
| Avg. Speed to MRF | 25 km/hr | Total Time/Load | 2.15 hours |
| Avg. Dump Time at MRF | 30 minutes | Loads/Crew Day | 5.0 loads |
| AM Truck Inspection | 10 minutes | Number of Crews | 1.0 crews |
| AM Travel to Route | 15 minutes | | |
| PM Travel from MRF | 15 minutes | | |
| Time for Breaks | 30 minutes | | |
| Length of Workday | 12 hours | | |

9. Solid Waste Management System Costs...

Table 8 – Estimated Collection Cost (LE)

| <i>Item</i> | <i>Quantity</i> | <i>Units</i> | <i>Unit Cost</i> | <i>Total</i> |
|-------------------------------|-----------------|---------------|------------------|----------------|
| <u>Capital Cost:</u> | | | | |
| Equipment | | | | |
| 4-Ton Flatbed Truck | 1 | ea. | 155,000 | 155,000 |
| <i>Total Capital Cost</i> | | | | <i>155,000</i> |
| Annual Cost of Capital | Term (yrs) | Interest Rate | | |
| Equipment | 10 | 8% | | 23,100 |
| <u>Annual Operating Cost:</u> | | | | |
| Labor | | | | |
| General Manager | 0 | full time/yr. | 0 | 0 |
| Driver | 1 | full time/yr. | 8,400 | 8,400 |
| Laborer | 2 | full time/yr. | 4,800 | 9,600 |
| Subtotal | | | | 18,000 |
| Equipment O&M | | | | |
| 4-Ton Flatbed Truck | 3756 | hrs | 25 | 93,900 |
| Maintenance & Supplies | | | | |
| Supplies | 12 | months | 500 | 6,000 |
| <i>Total Operating Cost</i> | | | | <i>117,900</i> |

Operating Assumptions:

Cost of a general manager is included in MRF costs

Driver salary = LE 700 per month

Laborer salary = LE 400 per month

Operating days per year = 313 days

Average operating hours per day = 12 hours

9. Solid Waste Management System Costs...

Table 9 – Estimated MRF Cost (LE)

| <i>Item</i> | <i>Quantity</i> | <i>Units</i> | <i>Unit Cost</i> | <i>Total</i> |
|-------------------------------|-----------------|---------------|------------------|--------------|
| Capital Cost: | | | | |
| <i>Site Work</i> | | | | |
| Grading | 800 | sq.m. | 2.50 | 2,000 |
| All-weather Access Road | 2,500 | m. | 7.50 | 18,750 |
| Subtotal | | | | 20,750 |
| <i>Structures</i> | | | | |
| Concrete Slab on Grade | 232 | sq.m. | 25 | 5,800 |
| Enclosure Wall | 94 | m. | 180 | 16,920 |
| Gate | 1 | ea. | 2,500 | 2,500 |
| Workshops | 72 | sq.m. | 400 | 28,800 |
| Administration Building | 40 | sq.m. | 400 | 16,000 |
| Shade Roof | 24 | sq.m. | 10 | 240 |
| Subtotal | | | | 70,260 |
| <i>Equipment</i> | | | | |
| Generator | 1 | ea. | 65,000 | 65,000 |
| Sort Line | 1 | ea. | 85,000 | 85,000 |
| Baler & Perforator | 1 | ea. | 25,000 | 30,000 |
| Can Flattener | 1 | ea. | 20,000 | 25,000 |
| Scale | 1 | ea. | 1,200 | 1,200 |
| Dumping Hoppers | 12 | ea. | 500 | 6,000 |
| Pallet Jack/Bale Hand-truck | 1 | ea. | 250 | 250 |
| Subtotal | | | | 212,450 |
| Total Capital Cost | | | | 303,460 |
| Engineering & Contingency | 10% of total | | | 30,346 |
| <i>Total Capital Cost</i> | | | | 333,806 |
| <i>Annual Cost of Capital</i> | Term (yrs) | Interest Rate | | |
| Site Work & Structures | 20 | 8% | | 9,273 |
| Equipment | 10 | 8% | | 31,661 |

9. Solid Waste Management System Costs...

Table 9 – Estimated MRF Cost (continued)

| <i>Item</i> | <i>Quantity</i> | <i>Units</i> | <i>Unit Cost</i> | <i>Total</i> |
|-----------------------------------|-----------------|---------------|------------------|---------------|
| <u>Annual Operating Cost:</u> | | | | |
| <i>Labor</i> | | | | |
| General Manager | 1 | full time/yr. | 18,000 | 18,000 |
| Equipment Operator | 0 | full time/yr. | 0 | 0 |
| Laborer | 4 | full time/yr. | 4,800 | 19,200 |
| Subtotal | | | | 37,200 |
| <i>Maintenance & Supplies</i> | | | | |
| Generator Fuel | 1000 | liter/yr. | 0.85 | 850 |
| Supplies | 12 | months | 1,000 | 12,000 |
| Buildings Maintenance/Repair | 2% | of capital | | 4,249 |
| Equipment Maintenance/Repair | 5% | of capital | | 10,623 |
| Subtotal | | | | 27,722 |
| <i>Total Operating Cost</i> | | | | <i>64,922</i> |

Operating Assumptions:

Electricity demand = LE 2500 kwh/month average

Generator efficiency = 30%

Energy content of diesel fuel = 10 kwh/liter

General Manager salary = LE 1500 per month

Laborer salary = LE 400 per month

Cost of equipment operator include in disposal site costs

9. Solid Waste Management System Costs...

Table 10 – Estimated Recycling Revenue (LE)

| <i>Item</i> | <i>Quantity</i> | <i>Units</i> | <i>Unit Cost</i> | <i>Total</i> |
|--------------------------------|-----------------|--------------|------------------|----------------|
| <i>Paper</i> | | | | |
| Cardboard (baled) | 158 | per ton | 150 | 23,745 |
| Mixed Paper (baled) | 53 | per ton | 200 | 10,553 |
| <i>Plastic</i> | | | | |
| PET Bottles (baled) | 53 | per ton | 700 | 36,937 |
| Mixed Bottles (baled) | 14 | per ton | 500 | 6,984 |
| Mixed Film (baled) | 23 | per ton | 100 | 2,328 |
| <i>Metal</i> | | | | |
| Aluminum Cans (flattened) | 16 | per ton | 4,000 | 63,321 |
| Steel Cans (flattened) | 16 | per ton | 100 | 1,583 |
| <i>Glass</i> | | | | |
| Whole Bottles | 20 | ea. | 0.08 | 2 |
| Broken Bottles | 26 | per ton | 70 | 1,847 |
| <i>Textiles</i> | 23 | per ton | 50 | 1,164 |
| <i>Food Waste</i> | 63 | per ton | 150 | 9,428 |
| <i>Total Recycling Revenue</i> | | | | <i>157,893</i> |

Recycling Revenue Assumptions:

Unit costs for material picked up at MRF
 Average weight per glass bottle = 0.15 Kg

Average recovery rates:

Organic Waste = 75%
 Cardboard = 85%
 Paper = 85%
 PET Bottles = 85%
 Other Plastic = 75%
 Metal = 85%
 Glass = 85%
 Textile = 75%

Breakdown by commodity:

Mixed Bottles (baled) = 30% of other plastic
 Mixed Film (baled) = 50% of other plastic
 Aluminum Cans (flattened) = 30% of metal
 Steel Cans (flattened) = 30% of metal
 Whole Bottles = 30% of glass
 Broken Bottles = 40% of glass
 Food Waste = 60% of organic waste
 FW moisture reduction = 20% of incoming weight

9. Solid Waste Management System Costs...

Table 11 – Estimated Controlled Disposal Site Cost (LE)

| <i>Item</i> | <i>Quantity</i> | <i>Units</i> | <i>Unit Cost</i> | <i>Total</i> |
|---------------------------------------|-----------------|---------------|------------------|----------------|
| <u>Capital Cost:</u> | | | | |
| <i>Site Work</i> | | | | |
| General Grading | 4,677 | sq.m. | 2.50 | 11,693 |
| Cell Construction | 3,118 | sq.m. | 15.00 | 46,774 |
| All-weather Access Road | 1,000 | m. | 7.50 | 7,500 |
| Subtotal | | | | 65,967 |
| <i>Structures</i> | | | | |
| Perimeter Fence | 274 | m. | 60 | 16,414 |
| Litter Fence | 89 | m. | 60 | 5,346 |
| Gate | 1 | ea. | 2,500 | 2,500 |
| Subtotal | | | | 24,259 |
| <i>Equipment</i> | | | | |
| Front End Loader | 1 | ea. | 450,000 | 450,000 |
| Total Capital Cost | | | | 540,226 |
| Engineering & Contingency | 10% of total | | | 54,023 |
| <i>Total Capital Cost</i> | | | | <i>594,249</i> |
| <i>Annual Cost of Capital:</i> | | | | |
| | Term (yrs) | Interest Rate | | |
| Site Work & Structures | 20 | 8% | | 14,692 |
| Equipment | 10 | 8% | | 67,063 |
| <u>Annual Operating Cost:</u> | | | | |
| <i>Labor</i> | | | | |
| General Manager | 0 | full time/yr. | 0 | 0 |
| Equipment Operator | 0.5 | full time/yr. | 8,400 | 4,200 |
| Laborer | 0.5 | full time/yr. | 4,800 | 2,400 |
| Subtotal | | | | 6,600 |
| <i>Equipment O&M</i> | | | | |
| Front End Loader | 1252 | hrs. | 75 | 93,900 |
| <i>Supplies</i> | 12 | months | 500 | 6,000 |
| <i>Total Estimated Operating Cost</i> | | | | <i>106,500</i> |

Operations Assumptions:
 Cost of general manager included in MRF cost
 Equipment Operator = 700 per month
 Laborer = 400
 Operating Days/Year = 313
 Average Operating Hours/Day = 4

Table 12 – Projected 10-year Life Cycle Costs (LE)

| | 2005 | Future Cost | | | | | | | | | | |
|-----------------------|---------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | |
| <u>Collection</u> | | | | | | | | | | | | |
| Capital Cost | 155,000capital cost | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 | 23,100 |
| Labor Cost | 18,000per year | 18,000 | 19,800 | 21,780 | 23,958 | 26,354 | 28,989 | 31,888 | 35,077 | 38,585 | 42,443 | |
| O&M Cost | 99,900per year | 99,900 | 102,897 | 105,984 | 109,163 | 112,438 | 115,811 | 119,286 | 122,864 | 126,550 | 130,347 | |
| <u>MRF</u> | | | | | | | | | | | | |
| Site & Structure | 121,356capital cost | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 | 9,273 |
| Equipment | 212,450capital cost | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 | 31,661 |
| Labor Cost | 37,200per year | 37,200 | 40,920 | 45,012 | 49,513 | 54,465 | 59,911 | 65,902 | 72,492 | 79,742 | 87,716 | |
| O&M Cost | 27,722per year | 27,722 | 28,553 | 29,410 | 30,292 | 31,201 | 32,137 | 33,101 | 34,094 | 35,117 | 36,170 | |
| Revenue | (157,893)per year | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) | (157,893) |
| <u>Disposal Site</u> | | | | | | | | | | | | |
| Site & Structure | 144,249capital cost | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 | 14,692 |
| Equipment | 450,000capital cost | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 | 67,063 |
| Labor Cost | 6,600per year | 6,600 | 6,798 | 7,002 | 7,212 | 7,428 | 7,651 | 7,881 | 8,117 | 8,361 | 8,612 | |
| O&M Cost | 99,900per year | 99,900 | 109,890 | 120,879 | 132,967 | 146,264 | 160,890 | 176,979 | 194,677 | 214,145 | 235,559 | |
| Total: | | 277,218 | 296,754 | 317,963 | 341,002 | 366,046 | 393,286 | 422,933 | 455,218 | 490,395 | 528,743 | |
| Tonnes/Year of Waste: | | 1,102 | 1,252 | 1,402 | 1,552 | 1,552 | 1,552 | 1,552 | 1,552 | 1,552 | 1,552 | 1,552 |
| Cost Per Ton: | | 252 | 224 | 205 | 220 | 236 | 253 | 273 | 293 | 316 | 341 | |
| Resorts Served: | | 12 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Cost Per Resort/Month | | 1,925 | 1,902 | 1,893 | 2,030 | 2,179 | 2,341 | 2,517 | 2,710 | 2,919 | 3,147 | |

Life Cycle Cost Assumptions: Capital costs are annualized based on straight-line depreciation over serviceable life; Annual Labor Cost Increase = 10%; Annual O&M Cost Increase = 3%; Revenue from sale of recyclable is not adjusted for inflation.

10. CONCLUSIONS

The solid waste management plan presented in this document has been designed to be both integrated and sustainable. It represents a substantial improvement in solid waste management over existing practices. And if implemented, it will serve as a model for environmentally sound, economically viable waste management on the Red Sea Coast.

This integrated and sustainable waste management system will not happen by itself. It will require the hard work and coordination of many individuals and stakeholders within and outside the Shagra Tourism Center. The system is founded on the concept that a newly formed NGO can bridge the gap between stakeholders, represent the needs of resorts, address the needs for capacity building, and ensure the environmental and economic integrity of the solid waste system. Without such an entity leading the way, an integrated and sustainable system will be much more difficult, although not impossible, to achieve.

The proposed waste management system will require expenditures greater than what most entities are accustomed to paying for solid waste management. This is because there are no good examples of comprehensive, environmentally sound solid waste management existing in the tourism sector of Egypt. Everybody assumes that waste management should be either free or generate revenue because there are so many valuable materials in the waste stream. However, the widespread litter and random disposal problems witnessed on the Red Sea coast (and indeed throughout much of Egypt) represent externalized costs. Everybody is expecting to receive the potential benefits from resources contained in the waste stream. Meanwhile no one is paying for proper collection and proper disposal, and everyone suffers the consequences in the form of litter, unsanitary dumpsites, random disposal, and destruction of the pristine Red Sea environment.

Integrated and sustainable waste management systems offer the best hope for overcoming the challenge. It is hoped that by implementing the system described in this document, the Shagra Tourism Center can take leadership in transforming solid waste management practices in Egypt's tourism industry.

10. Conclusions...

Total Initial investment

| | |
|------------------------------|---------------------------|
| 1. Collection fleet = | LE155,000 |
| 2. MRF | |
| - Site & Structures = | LE121,350 |
| - Equipment = | LE212,450 |
| 3. Controlled Disposal Site | |
| - Site & Structures = | LE144,250 |
| - Equipment = | <u>LE450,000</u> |
| 4. Total Investment = | <i>LE1,083,050</i> |

Total annual operating cost

| | |
|---|-------------------------|
| 1. Collection fleet | |
| - Labor = | LE18,000 |
| - Operations & Maintenance = | LE99,900 |
| 2. MRF | |
| - Labor = | LE37,200 |
| - Operations & Maintenance = | LE27,700 |
| 3. Controlled Disposal Site | |
| - Labor = | LE6,600 |
| - Operations & Maintenance = | <u>LE99,900</u> |
| 4. Total Annual Operating Cost = | <i>LE289,300</i> |

Total annual revenues

| | |
|----------------------------------|-------------------------|
| 1. Sale of recyclables = | LE157,900 |
| 2. Collection fees = | <u>LE336,000</u> |
| (@ LE2,000 per resort per month) | |
| 3. Total Annual Revenue = | <i>LE493,900</i> |

Financial Projections

Assumptions:

10-year analysis
Cost of capital (interest rate) = 8%
Labor Cost increases 10% annually
O&M Cost increases 3% annually
Average Collection Fee = LE2000 per month per resort
Collection Fee increases 3% annually
Recycling Revenue does not change

Payback Period = 6 - 7 years

Return on Investment (ROI) = 112%