A Manual for Water and Waste Management: What the Tourism Industry Can Do To Improve Its Performance

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A Manual for Water and Waste Management: What the Tourism Industry Can Do to Improve Its Performance

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Foreword

Jacqueline Aloisi de Larderel
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700 million international tourists per year and 500 billion dollars in annual receipts make tourism one of the biggest industries in the world, with a correspondingly serious environmental footprint. Currently, the intense use of freshwater and the generation of solid and liquid waste from tourism operations causes serious environmental degradation, which in turn can impact the viability of a facility and even of the larger destination.

According to the European Environmental Agency, tourism contributes about 7% of wastewater pollution in the Mediterranean, by generating up to 180 liters of wastewater per tourist/day. In the late 80s, the coastal Adriatic Sea was heavily polluted by agricultural and tourism-related wastewater, and this had a serious impact on hotel occupancy rates in Italian resorts as visitors preferred to avoid them. It took all the efforts of the tourism industry and local authorities to solve the problem and offer visitors the clean beaches they expect.

UNEP's Division of Technology, Industry and Economics (DTIE) has already addressed water and waste management in the tourism industry with their environmental action and training packs published jointly with the IHRA and the International Hotel Environment Initiative. In addition, DTIE's Japan branch (International Environmental Technology Centre) has contributed manuals and sourcebooks on environmental management systems, integrated waste management and solid waste for local authorities and for the industry.

The present manual for water and waste management specifically addresses small and medium enterprises, which represent 80% of tourism businesses worldwide. Although some of them are committed to sustainability, most are not, for reasons such as lack of awareness, perverse incentives that raise costs, lack of technology suppliers, or absence of appropriate information and feasible demonstration sites. In developing countries, existing information is often too theoretical, too technical or dispersed. In many countries, few if any regulations exist to encourage or force operators of tourism facilities to optimize resource consumption. This is particularly true for small island developing countries, where scarce freshwater resources and limited waste processing capacities endanger their sensitive environment. This jeopardizes their tourism industry, often an essential component of their economy. In these circumstances the industry must take a leadership role to achieve sustainability in tourism development and operations. A healthy and clean environment to attract tourists is one of tourism's most valuable assets. This publication aims at addressing this gap, and with it, UNEP hopes to speed up the process of implementing sustainable water and waste technologies in the tourism industry.

Traveling is one of the most effective ways of learning: experiencing tourism services that apply sustainable technologies can bring political support to worthy causes, through raising awareness of guests and hosts on environmental issues. This power has to be harnessed: the tourism industry can play an invaluable role, by acknowledging its part in the problem and confirming its commitment to the solution.

Foreword

Günter Dresrüsse
Director General
Country Department Asia/Pacific, Latin America/Caribbean
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When we first began to consider tourism from a development perspective in the 1990s, we encountered a great deal of skepticism. Many in the sustainable development and environmental fields questioned how we could become involved in helping to support an industry that had left such a negative environmental footprint in many parts of the world. Our response was that many in the tourism industry had learned their lessons from the environmental damages that had occurred during the early days of tourism development and were earnestly looking for solutions and approaches that could make them better environmental stewards for the future. This concern was very much prompted by the growing awareness that tourists were beginning to avoid places that had been damaged by poor environmental practices.

We were also very much aware that in many of the developing economies there was a distinct lack of information and guidance for the government authorities who are responsible for regulating tourism development. This problem is compounded by the fact that in many of these developing environments there is also a significant lack of technical expertise and information. Given that tourism is the largest industry in the world, and for many national as well as local economies one of the major sources of foreign exchange and job creation, we are very much of the opinion there is no choice but to ensure that tourism development occurs in a sustainable fashion. When good environmental practices are incorporated into the standard operating procedures of tourism facilities, we will be in a position to ensure that tourism development can provide opportunities to both improve the quality of life of the residents and protect and enhance the environment of tourism destinations.

There are many examples of the negative impact that tourism has had on the environment. In the case of Italy, one of the mass tourism destinations particularly popular with the Germans, the quality of the Mediterranean environment became a significant factor in the loss of German tourists visiting the country. This concern was very much prompted by reports of high bacterial levels in the sea. I am happy to report that some of the best wastewater treatment plants in the world are now installed all along the Mediterranean coast.

Water and solid waste management strategies will only be successful when there are joint efforts between the tourism industry and local and national government policies and regulations. An example of the challenges and opportunities that we face can be illustrated by what has occurred in Managua, Nicaragua, just as in many other places around the globe. At one point the wastewater produced by the city's one million inhabitants and by the hotels was simply collected and emptied into Lake Managua. The good news is that when the development community joins with the tourism industry an improvement in the environmental conditions of tourism destinations can occur. The Lake Managua sanitation program has just started with a US$100 million investment from the Inter-American Development Bank and the Kreditanstalt für Wiederaufbau (KfW, the German Development Bank). Appropriate solid waste management systems are also being established at the municipal level in developing countries with the assistance of a number of ongoing donor partnerships.

Many of the larger international and national hotel chains now have well-established environmental management systems. However, we clearly recognize the challenge of dealing with solid and wastewater management in small and medium-sized tourism enterprises (SMEs) given their limited economic and technical capacity to implement environmentally sound solutions.

This manual addresses two target groups: the first is the tourism SMEs who do not have access to basic information and best practices in solid waste and water management. We also want to reinforce and supplement the strategies and practices that the industry has already established in many places.

We hope this manual will encourage tourism facility operators to work towards environmental sustainability. We recognize that this is but one source of information and there are a number of web sites, technical bulletins and books that can be consulted. This publication provides the reader with a number of areas for further consultation.

It has been our pleasure to support UNEP in the development of this manual.

About the Manual

This manual provides guidelines and examples of how tourism operations can achieve positive results in waste management and minimize harm to a community's ecological and physical systems. It does not replace academic or professional publications and it does not deal with all the technical dimensions of wastewater or solid waste management but introduces important methods and major impacts. The manual is designed for people involved in the operation of diverse tourism facilities and presents information in a user-friendly and practical manner. The intent is not to replace experts but to provide opportunities for management and staff to ensure that operations meet required environmental standards. Additional information sources are provided when appropriate.

The manual looks at the two major outputs of most facilities – solid waste management and water management. It is understood that facilities must also consider other dimensions, e.g. power and the design and use of materials in construction, operation and maintenance in an overall environmental management strategy.

A number of suggestions in this manual require the action of management; others can be carried out by individual employees or a small staff team. Some proposed actions involve a change in procedures or significant financial investment. In many cases improving a facility's environmental performance must be seen as a long-term process.

There are four significant activity areas in tourist facilities that mainly generates solid waste and wastewater including accommodation, food and beverage, maintenance of open spaces and grounds, and administrative and office functions. To provide an integrated, concise presentation, these problems and methods are dealt with by activity - not tourism function type (Figure1).

Please note that unless otherwise indicated all the figures in this manual have been developed by the consulting team.

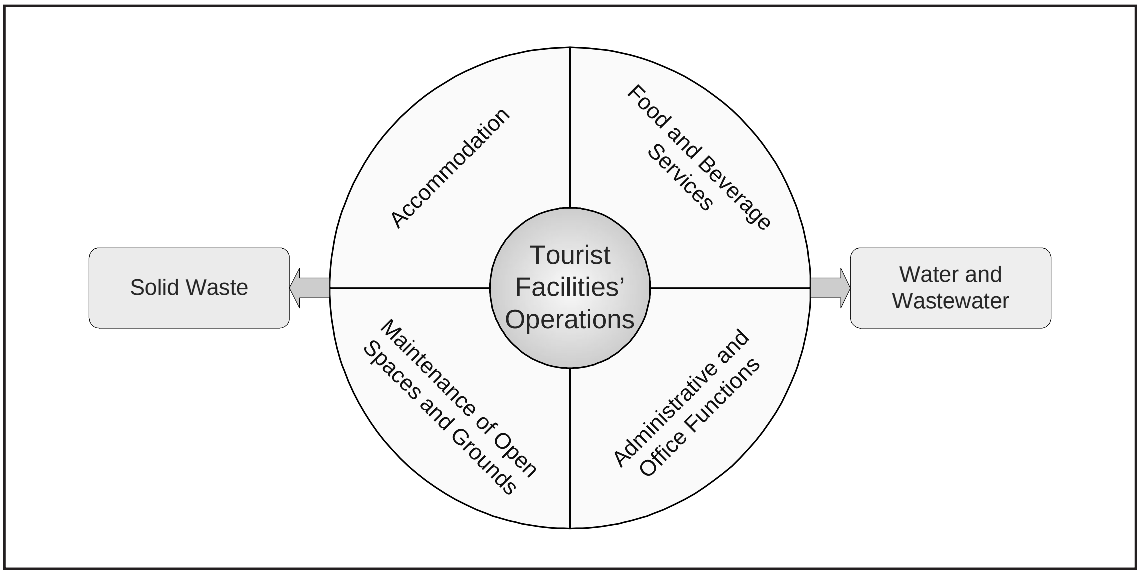

Figure 1: Tourism Facility Operations and Outputs

Many larger hotel chains have already implemented environmental management systems and some of the cases highlighted draw on their experience. The main focus of this manual on the other hand is on small and medium tourism enterprises in developing countries and economies in transition, Small Island Developing States (SIDS) and developing tourism destinations.

PART I

Solid Waste Management

1. INTRODUCTION

In many destinations and regions dealing with solid wastes is becoming a pressing challenge as the amount of waste increases and the cost of dealing with this waste in a sustainable manner rise at an ever increasing rate.

In order to understand the challenge of tourism-related waste at the global scale, it is useful to evaluate the order of magnitude from the perspective of total weight. Every international tourist in Europe generates at least 1 kg of solid waste per day (IFEN 1999). In fact, tourists from developed countries probably produce more (up to 2 kg/person/day for the United States - EPA, UNEP/Infoterra). Based on these figures in 2001 the world's 692.5 million international tourists are likely to have generated no less than 4.8 million tons of solid waste, 58% of this total in Europe alone.

In considering the total weight of waste generated by tourism one also needs to take into account the impacts of domestic travelers. In France, there seems to be no significant difference between international and domestic tourists in terms of waste generation, although individuals seem to create more waste when on vacation than in everyday life. For example annual solid waste generation per capita at coastal holiday resorts in France is 25% higher than the national average of 392 kg/inhabitant (IFEN). If, for the sake of an overall estimate, one assumes a relatively similar rate between domestic and international tourism, the next step could be to evaluate the proportion between international and domestic tourism. In Germany, domestic tourism accounts for around 7.5 times the volume of inbound international tourism (Federal Statistics Office, 2003). In Brazil, the ratio is estimated at 10 (EMBRATUR, 2001). If a conservative ratio of 6 is assumed globally, the global figure for solid waste generated by domestic and international tourism should be close to 35 million tons per year, or just about the total amount of waste generated in France every year (IFEN, 2001).

In most tourism facilities guest rooms, kitchens, restaurants, laundries, offices, gardens and conference rooms generate large volumes of solid waste which can result in negative ecological, disease and aesthetic impacts (if not properly managed). In many destinations there is an urgent need for hotels, guesthouses, restaurants and golf courses to reduce waste, protect the environment and meet a growing customer demand for environmentally-friendly facilities. This section of the manual examines waste reduction opportunities that are designed to provide a number of long-term benefits to tourism facilities and their destinations such as cost savings, greater operational efficiency, environmental protection, improved image and customer satisfaction.

Figure 2 presents an overall view of the solid waste management process and how the manual deals with these major components. Managing waste should begin with understanding the nature of a problem in a facility (possibly through a solid waste audit system) and examining a range of technical and management approaches for dealing with this solid waste. As illustrated in Figure 2 there are five main solid waste management techniques that will be discussed in this manual namely source reduction, green purchasing, waste reuse and recycling, waste recovery and waste disposal. Once a facility has identified appropriate methods to address its solid waste problems a solid waste management plan comprising of operational structures and procedures, phasing process, budgeting, and staff training and involvement should be developed. In order to assess how well a facility is dealing with solid waste, a monitoring program needs to be developed and implemented.

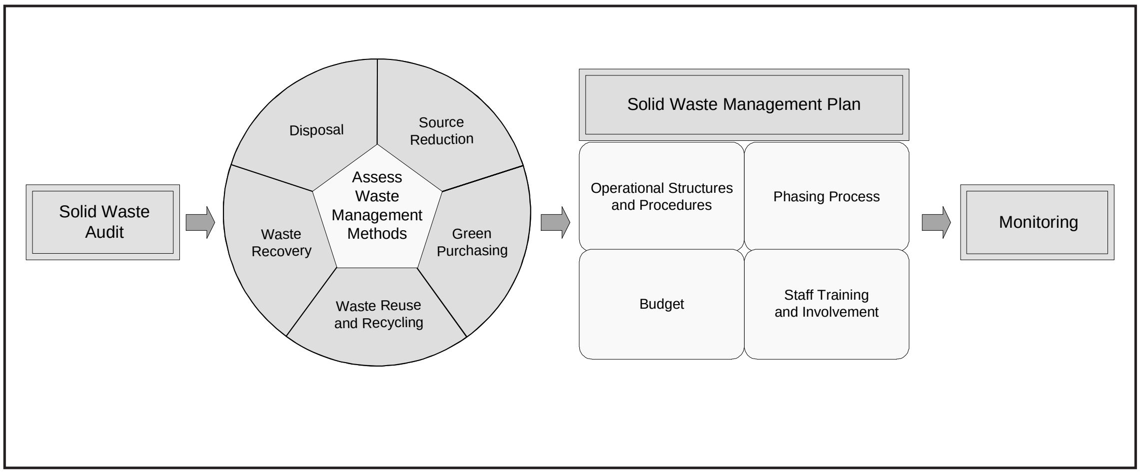

Figure 2: Solid Waste Management Process

2. THE NEED FOR SUSTAINABLE WASTE MANAGEMENT PRACTICES

Solid waste significantly impacts the environment in several ways: the use of energy and materials required to produce supplies and pollution problems created when waste is disposed of in landfills and incinerators or illegally dumped. A great deal of the solid waste generated from tourism facilities is dumped illegally creating a safety hazard for humans, disrupting wildlife habitats and destroying a destination's beauty. These impacts threaten a facility's economic well-being and ultimately a destination's. The following discussion highlights various types of system impacts.

2.1 Impact on Ground Water

Improper solid waste disposal can directly impact the quality of ground water resources. Solid waste, frequently organic in nature, begins to decompose when it comes in contact with water and then carries with it the dissolvable waste components. Since this "dirty" ground water (leachate) is dynamic, the contaminants can spread far beyond the immediate pollution area. For example, if people at a construction site for a new tourism facility do not dispose of or store toxic paint thinner correctly, it can leak into the water table thereby causing ground water pollution. Long-term impacts can occur when a tourist facility improperly disposes of solid waste significantly affecting the quality of the area's ground water or attracting scavengers and other vermin. Figure 3 demonstrates how leachate seeps into the ground and enters ground water resources.

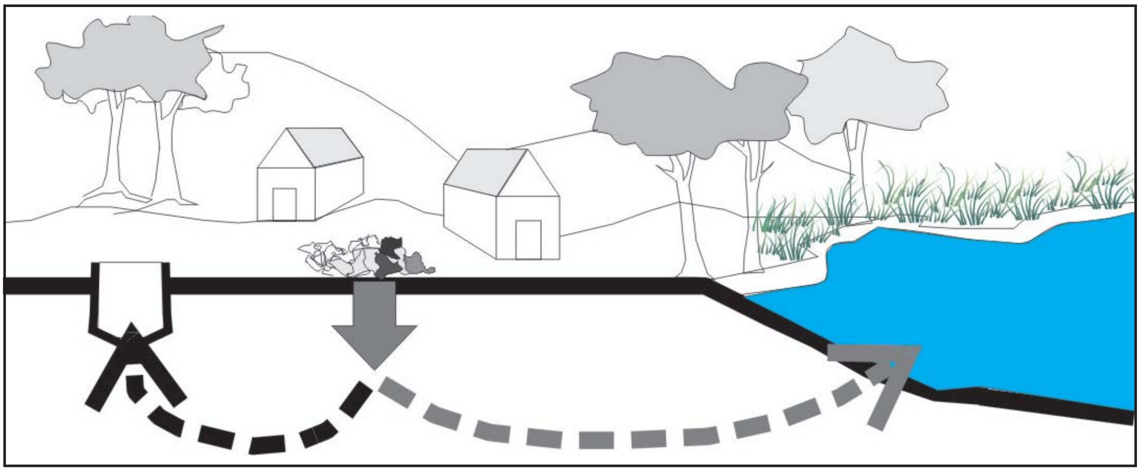

Figure 3: Seepage of Solid Waste Leachate into Ground Water

2.2 Impact on Water Resources

The migration of solid waste from disposal sites can also contaminate water resources such as rivers, streams, ponds and wetlands. This occurs directly if the water resource is near a dumpsite or indirectly if contaminated ground water moves through the water cycle. This contaminated water cannot be used for drinking or any other domestic application, therefore affecting water availability and the cost of providing safe drinking water to residents and visitors.

2.3 Impact on Flora and Fauna

In open dumps, waste (blown by wind) can damage surrounding flora and fauna. For example, animals can choke on plastic material which has landed on grazing land.

2.4 Impact on Coastal Areas

Coastal areas, especially islands, often present significant challenges for solid waste management. A shortage of land for landfill sites after result in solid waste being dumped into the sea with obvious detrimental impacts on marine ecosystems and create unwanted algae growth leading to a loss of biodiversity, breeding and nesting grounds. In addition, the visual pollution created by improper solid waste management can seriously threaten the viability of a facility and its destination.

3. THE NATURE OF SOLID WASTE

It is useful to look at the nature of solid waste. Solid waste can be divided into three categories: hazardous, biodegradable and non-biodegradable, and combustible and non-combustible waste (Figure 4). Each material should be assessed individually since the nature of these characteristics leads to different types of waste management approaches.

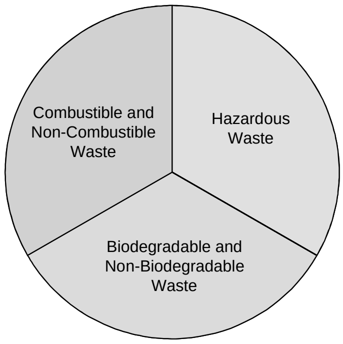

Figure 4: Types of Solid Waste

3.1 Hazardous Waste

Hazardous waste contains harmful chemicals and produces harmful by-products when burned or placed in a landfill site. Common hazardous wastes at tourism facilities include paints, cleaners, oils, batteries and pesticides, all of which can have a severe impact on the environment if left untreated. Hazardous waste requires special treatment procedures before disposal and is not appropriate for ordinary on-site treatment, placement in open landfill sites or burned in an uncontrolled manner. While some instances, hazardous waste disposal is regulated (fines are imposed for improper practices); however, in many countries, especially in more remote areas, there is often little government regulation or inspection of hazardous waste treatment.

3.2 Biodegradable and Non-biodegradable Waste

Biodegradable waste contains organic substances which can be broken down over time, treated and recycled into useful by-products such as biogas and compost; non-biodegradable waste (textiles, chemicals, rubber and plastics) do not. Biodegradation time depends on the type and nature of the substance and can range from a few weeks to many years. When wastes are placed in a covered landfill site, decomposition time can be significantly extended.

3.3 Combustible and Non-combustible Waste

Combustible waste such as paper, used oils, rubber and leather, has a high heat value, burns easily and releases heat energy when combusted. Non-combustible waste such as glass, aluminum and most organic waste (e.g. food scraps and garden trimmings) has a lower heat value and cannot be easily burned.

3.4 Examples of Solid Waste Generated by Tourist Facilities

Accommodation Sector (hotels, guesthouses)

Accommodation facilities generate various types of solid waste:

- newspapers and magazines
- cleansing agent containers used by housekeeping and laundry services
- flowers in guestrooms and public areas
- plastic shampoo and cosmetic soap bottles
- old towels, linens, bed sheets and furniture
- paint and varnishes, used fittings, fixtures and plumbing supplies, refrigerators and other bulk items.

Food and Beverage Services

Most restaurants or restaurant/bar sections of hotels, guesthouses or golf courses dispose of large quantities of solid waste including:

- empty cans, bottles, tins and glass
- food
- small non-refillable product containers (sugar, salt, pepper, flour and cream)
- paper serviettes, coasters, straws, toothpicks and cocktail napkins
- used aprons, kitchen towels and napkins.

Open Spaces and Grounds

Landscaping and gardening activities at golf courses and many hotels generate ground related solid waste including:

- plant trimmings
- empty pesticide/insecticide bottles and fertilizer packs, pesticides, insecticides and fertilizer products (which are often hazardous).

Administrative and Office Functions

A facility's main office, front desk and shipping/receiving areas create solid waste including:

- paper and envelopes
- travel pamphlets and brochures which are often quickly discarded by tourists.

4. AVOIDING SOLID WASTE

Prior to recycling, recovery, treatment or disposal the first consideration in sustainably managing solid waste is how a facility can reduce the amount and/or toxicity of materials used and generated by its operations. This calls for careful consideration before purchasing materials or services. Source reduction can save facilities money while helping the environment.

4.1 Waste Minimization

The only economically viable, long-term approach to avoiding environmentally harmful waste is to prevent its production in the first place. Waste prevention requires altering the way business is conducted and eliminating problems at the source rather than dealing with them in the future.

There are a number of ways to prevent facility waste at source including:

Accommodation

- Introducing sorting/recycling of glass, aluminum, paper and plastics from guest rooms.
- Providing bulk dispensers and eliminate the use of individual bottles and other containers.
- Returning laundered clothes to guests in reusable cloth bags/baskets thereby eliminating plastic bags.
- Offering rarely used items such as sewing kits by request only.
- Instructing housekeeping not to replace half-used rolls of toilet paper/tissue boxes and leave replacements for guests to use when required.
- Using partially used items from guestrooms in employee restrooms or donating to charities.
- Extending the lifespan of equipment by having it serviced regularly.

Case Study: Radisson Hotel – Asheville, North Carolina

At the Radisson (a 281-room hotel), guests can take part in a waste reduction program by opting to keep the same sheets/towels for more than one night. If a special card is left on the bed, the housekeeper does not change the linen. This is accompanied by the training of housekeeping staff in their primary language and trial runs to ensure procedures are understood and followed.

Results: This program saves person-hours, detergent, hot water, wear and tear on linens, washing machines and dryers. Costs have been reduced by 30% per load. According to the Rooms Division Manager of this facility, there have been 25 written compliments on the program in 8,000 room nights and only two complaints.

Additional information: N.C. Division of Pollution Prevention and Environmental Assistance (DPPEA), E-mail: nowaste@p2pays.org

Food and Beverage

- Establishing purchasing guidelines to encourage the use of durable equipment (which can be repaired easily) and high-quality, reusable products such as linens and tableware.
- Using refillable containers for such items as sugar, salt, pepper, flour, soda, syrup and cream.
- Replacing plastic/foam cups, utensils and plates with washable cups, dishes and utensils.
- Using dispensers for straws and toothpicks and avoid purchasing individually wrapped items.
- Reusing linens for aprons and kitchen towels.
- Using cloth roll towels or hand dryers instead of paper products.
- Donating unused food to local food banks or other charitable organizations.
- Offering guests the option to order half-portions of food.
- Collecting unusable food scraps and giving or selling them to local pig farmers for animal feed.

Case Study: Harvey Mansion Restaurant and Lounge – New Bern, North Carolina

The restaurant has 20 employees and 300-400 customers weekly and generates waste primarily at shipping/receiving areas and during food preparation. Raw food arrives at the restaurant packaged in cardboard, metal, glass, styrofoam and wood; beverages are in metal cans and glass bottles packed in cardboard.

Activities:

- Kitchen staff and waiters are trained to segregate recyclables.
- Meat, fish, fruit and vegetable trimmings and uneaten food are placed in plastic-lined cans and held in the walk-in freezer for pick-up by local swine farmers.
- Wooden shipping containers are taken to farmers' markets for vendor reuse.
- Styrofoam box containers are re-used in freezer storage and given to other purveyors for reshipping.
- Metal, glass, recyclable plastics and newspapers are segregated for recycling.
- Uncoated cardboard materials are broken down for weekly pick-up.
- The reverse side of printed materials is used for message paper and customer orders.
- Trade publications are distributed to local elementary schools for nutrition and art projects.

Results: Previously an 8-yard dumpster was emptied daily; now a 2-yard dumpster is emptied once weekly. These practices save money annually in dumpster rental, emptying and disposal fees.

Additional information: North Carolina Office of Waste Reduction – P.O. Box 29569, Raleigh, NC 27626-9569.

Open Spaces and Grounds

- Phasing out the use of hazardous materials where possible.
- Using organic gardening techniques and products.

Administrative and Office Functions

- Using bulletin boards for memos, pamphlets and brochures instead of circulating copies to all staff.
- Using e-mail.
- Purchasing refillable pens and toner cartridges.
- Using shredded paper instead of bubble wrap or foam for packaging purposes.

4.2 Green Purchasing

Green purchasing is increasingly seen as an important approach to waste management. Purchasing "green" products makes good business sense since it can save money, addresses the problems of persistent toxic substances in the environment, conserves natural resources, reduces the quantity of solid waste generation and saves energy and resources in dealing with waste. There are three main dimensions that green purchasing policies should address when making purchasing decision including:

The environmental qualities of products

- Products should release no persistent toxic substances into the environment during production process, use and disposal.
- It should conserve energy and resources during production, use and disposal.
- Choose products that contain little or no toxic substances to avoid any harm to humans and the environment.
- Consider the life cycle cost of products.
- Substitute non-toxic cleaning products and try alternative methods of pest control.

The recycling and reuse quality of products

- Give preference to products made from recycled materials or renewable resources used in a sustainable way. Items with a recycled content include paper, packaging materials, plastic, glass and metal.
- Buy reusable products (i.e. refillable pens and pencils, cloth wipers and other linens, reusable mugs and other dishes) as opposed to those that can only be used once.
- Choose products that are easily recycle or composted, or are truly biodegradable.

Products that used minimal packaging

- Packaging for the product is minimal but adequate to ensure protection.
- Purchase items shipped in bulk to avoid individual wrapping of items.
- Purchase from suppliers that are committed to the environmental improvement to encourage the use of green products.
- Minimize non-recyclable packaging. Chicken, fish, and vegetables are often packaged in waxed cardboard. Facilities can reduce waste by asking vendors to pack materials in reusable or recyclable containers.

Although green purchasing has a number of advantages there are also some obstacles including a lack of choice of environmental alternatives, at times significantly higher costs in some products, conflicting and confusing information on product labels and advertising, and the lack of understanding of staff, especially in the purchasing department, of the facility. It is important to provide adequate information about green purchasing and its importance to the staff since they are directly involved in the procurement of goods and services. Encouraging and supporting employees to search for products that meet the specifications can also help in the success of the green purchasing program. More information on green purchasing can be found at http://www.iclei.org/europe/ecoprocura/info/gpg/GPG_fullversion.pdf.

Case Study: Sheraton Rittenhouse Square Hotel, Philadelphia, USA

Starwood Hotels and Resorts opened their first 'eco-smart' hotel in the US with the hotel procuring several 'Green Products' in order to maintain a healthy internal environment. Some of the features that were incorporated are:

- A challenge to builders and suppliers to review how their products and services are produced, packaged and delivered in order to create a more environmentally product.
- All paint, wallpaper, carpets and curtains are free of toxic chemicals.
- Wooden furniture is painted with catalytic varnish through which harmful chemicals cannot penetrate.
- Bamboo, a sustainable product, was used on the walls of the lobby area.
- Recycled materials feature strongly in the design process. For example 93% recycled granite was used for the lobby flooring; bed side tables were made from recycled wooden shipping pallets and the room number signs and parts of the lobby floor and front desk were fabricated from recycled glass.
- Beds are 'organic sleep systems' comprising of organic cotton and wool produced without any toxic bleaches or dyes.
- The cleaning of rooms and linens is carried out using non-toxic detergents.

Additional information: Deborah Bernstein, Starwood Hotels and Resorts,
E-mail: deborah.bernstein@starwoodhotels.com

5. SOLID WASTE MANAGEMENT METHODS

5.1 Waste Audits

Before management can select appropriate waste management methods, an assessment (audit) of the facility's waste stream must be conducted. A waste audit guides an individual/team through the steps required to provide data on the composition and quantity of waste generated, disposed of and recycled. An audit can also supply information required to help design an effective solid waste management program. Typically a waste audit can be divided into two major steps.

Step 1: Determine the Current Volume of Solid Waste Being Produced at a Facility

An initial step in assessing a facility's solid waste management situation is to determine the actual levels of solid waste being produced. Depending on the scale of a facility and the sophistication of its management and staff, the assessment can be done on an overall basis (i.e. waste from the overall facility) or dealt with at a high level of precision (i.e. assessment by activity). In larger-scale facilities, this evaluation should be carried out in areas such as food and beverage, accommodation and groundskeeping. This provides a facility with an assessment of its solid waste situation before considering and possibly introducing solid waste management procedures.

The form below can be used to collect information and subsequently measure improvements in solid waste management practices on a yearly basis. The current situation can be assessed using the factors identified in Table 1. Quantities of waste can be determined as:

- volume and/or weight
- percentages of the total waste stream
- cost of different waste management techniques.

Material	Recycled	Reused On-site or Off-site	Sent to Landfill Site	Composted	Disposed of by Combustion
Paper					
Plastics					
Glass					
Metals					
Organic materials					
Textiles					
Demolition and construction debris					
Chemicals and products with chemical components					
Rubber and rubber products					
Human/animal waste					
Other/s					

Table 1: Quantity of Waste by Different Waste Management Techniques

Step 2: Assess Whether Higher Rates of Reuse and Recycling Can Occur

This step calculates the estimated percentage of waste which could be recycled or is currently being recycled by identifying areas requiring improvement. The facility operator can estimate the savings based on the introduction of more sustainable approaches to waste management.

5.2 Solid Waste Management Methods

Solid waste, although diverse in nature, is "often a recoverable source" and can be profitable if effective waste disposal management techniques are used. A variety of waste management options exist including waste reuse, recycling, recovery and disposal (Figure 5).

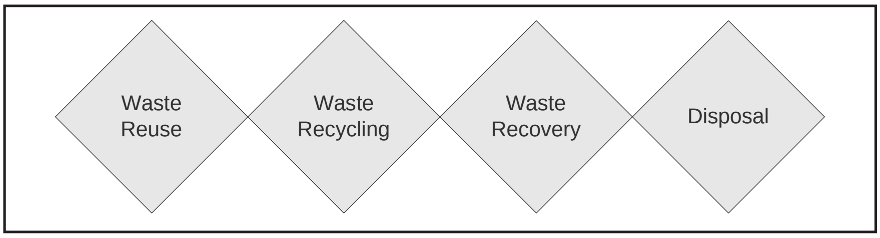

Figure 5: Solid Waste Management Options

5.2.1 Waste Reuse and Recycling

To effectively reuse and recycle waste, segregation is essential in sustainable waste management practices. If paper becomes mixed with food waste, for example, it is difficult to reuse food waste either for animal feed or composting. If glass bottles or feces are mixed with food, it is difficult to recycle the material without health risks. If toxic chemicals are mixed with food waste, composting is impossible.

Waste Reuse

Reusing items by repairing, selling or donating these to charity and community groups reduces waste. Reuse is preferable to recycling since the item does not need to be reprocessed. In addition to environmental considerations, sensitive reuse schemes can have important social and cultural benefits. Here are a number of ways a facility can reuse items:

Accommodation

- Collect used flowers from guest rooms for composting or (if appropriate) donating to local hospitals, schools or charitable organizations.
- Donate used linens, towels and blankets to local charities.
- Install a dispensing system for products such as shampoo, soap and lotions.
- Donate soap used and toiletries to local charities.
- Dye stained towels a dark color for reuse as cleaning rags.
- Use old linens to make aprons or cleaning rags.
- Give old magazines to employees, charities, schools or hospitals.
- Donate the old furniture and equipment to charities.
- Reuse waste paper as telephone answering pads or notes.

Food and Beverage
- Donate empty buckets to schools or employees for storage.
- Donate old utensils and kitchenware to employees or charities.
- Have old refrigerators/appliances repaired/rebuilt.

Maintenance of Open Spaces and Grounds
- Donate older equipment to employees or charities.

Administrative and Office Functions
- Reduce paper use, e.g. double-sided photocopying.
- Donate old computers and equipment to schools or charities.
- Reuse bubble wrap and foam packaging for shipping.
- Re-label and reuse cardboard boxes for shipping.
- Use refillable, reusable toner cartridges for laser printers.

Case Study: Four Seasons Resort Maldives at Kuda Huraa

The resort has recycling, waste separation and staff educational programs in place. It features its own desalination plant and a modern water treatment system. All used water is properly treated and used entirely for landscaping purposes. Landscaping waste is used for composting. Effort has been made in minimizing the use of plastic and other non-biodegradable materials throughout the resort. A mini incinerator is used to reduce the amount of materials exported from the island and the resort is working with the neighbouring island community of Bodu Huraa by sponsoring a waste incineration program and a water treatment study which is currently been conducted with the aim of improving the island's threatened fresh water supply. In-bangalow amenity bottles are ceramic and refillable with biodegradable products.

Additional information: Four Seasons Resort Maldives, North Male' Atoll, Republic of Maldives, Tel: (960) 444-888

Waste Recycling

Recycling turns materials that would otherwise become waste into valuable resources with environmental, financial and social benefits. Recycling diverts waste from landfills, saves energy and water and creates less air pollution.

Simple techniques can be implemented as part of a successful recycling program:
- Contact local recyclers to identify items/areas in which they are interested.
- Collect used flowers in guestrooms for composting.
- Put recycling containers in guestrooms to be emptied regularly by housekeeping staff.
- Provide recycling bins in kitchen/bar areas for glass, aluminum and plastic containers.
- Collect and separate cans, bottles, glass and cardboard for recycling.
- Recycle motor oils, antifreeze, paint, etc. used by groundskeeping and maintenance staff.
- Recycle all office paper and cardboard boxes.
- Recycle office materials, e.g. copier and printer cartridges.

Case Study: Hard Rock Café – Las Vegas, Nevada

Recycling containers have been placed throughout the restaurant and kitchen areas in order that materials can be separated during the day rather than after the close of business. All employees are expected to take part in the recycling program in order to ensure a direct impact on its success.

Results: Frequent sorting is more effective because it saves time, man-hours and ensures waste is handled only once. The program has diverted 75% of the facility's waste to recycling and reduced the number of weekly garbage pick-ups from seven to three days a week. Savings in waste hauling fees is USD 18,000 per year.

Additional information: http://ndep.nv.gov/recycl/reclvhr.htm

5.2.2 Waste Recovery

Composting

Much of the waste generated from food and beverage departments is biodegradable and can be composted rather than sent to a landfill. "Composting" can be defined as managing natural processes in a deliberate and organized way. Within the composting process bacteria helps convert complex organic matter into carbon dioxide, water, plant nutrient and humus. Experience has shown that plants grown using compost are less prone to pest attack and disease.

Organic wastes can be composted in a number of ways from backyard bins to large centralized facilities. At each level, the principles are the same even though composting rates, feedstock types, tonnages, control methods and composting systems are different. Common types of system include static piles, windrows, aerated piles, channels, rotary drums, large vessels and many kinds of hybrid systems.

The compost pile should be prepared away from public areas, with a gentle concrete slope and drainage channels leading to a leachate holding tank. The pile needs to be well aerated for effective composting since oxygen is vital. Large chunks of material such as wood chips are then added to the bulk and aeration starts the composting process. It usually reduces the bulk of the original material by 40 to 50%. Composted solid waste has great potential since it:

- reduces the amount of waste sent to landfill.
- reduces organic materials in the effluent treatment process.
- produces rich material for gardens and grounds.
- enhances the environmental profile of a tourism destination.

Case Study: Implementation and Demonstration of Composting Practices in Hotels - Hua Hin, Thailand

Composting options to deal with solid waste were introduced in five hotels in Hua Hin, Thailand, by the Canadian Universities Consortium Urban Environmental Management (CUC UEM) Project, funded by the Canadian International Development Agency (CIDA), and implemented in association with the Thailand Environment Institute (TEI). Technical assistance from Canadian experts provided hotel staff with classroom sessions and hands-on-training on composting practices. Composting was started in spaces around the hotels with the aim of producing good quality compost to be used for the hotels' grounds.

The project team assisted the hotels to establish source waste separation systems. Posters were produced to raise staff awareness about environmental duties/responsibilities. The manager of the Metthavalai Hotel, Cha Am, used proceeds from the sale of recyclable waste to support a revolving fund for the hotel staff to take low interest loans out of the fund for their personal purposes such as health care, children's education, and maintenance of their houses especially in the monsoons. The loans have created an incentive for staff involvement in waste management practices at the hotel.

Additional information:
http://www.ucalgary.ca/UofC/faculties/EV/designresearch/projects/cuc/tp/demo.htm

Combustion

When all other options have been considered, combustion or burning waste at high temperatures can be an effective way to deal with certain types of solid waste, especially where land is at a premium for land fill or composting purposes especially in small island states. The main residue from incineration is slag. The amount of slag generated depends on the ash content of the waste which must be disposed of properly in well-constructed landfill areas. Small-scale or non-professionally managed combustion operations are not recommended since hazardous gases can be produced if the wrong type of waste material is burned.

In any combustion situation, non-combustible material such as metals and glass must be removed to reduce the size of the treatment system and increase the system's energy efficiency. The combustion system should be designed to hinder, where possible, the formation of pollutants, especially NO_x and organic compounds, e.g. dioxins.

If possible, a combustion process should consider an energy recovery system with the possibility of reusing waste as fuel for energy production, while heat can be recovered in a boiler system and converted to hot water, steam or electricity.

Case Study: Fairmont Hotels & Resorts Green Partnership Program

Fairmont Hotels & Resorts, the largest luxury hotel company in North America, operates 39 properties in six countries – United States, Canada, Mexico, Bermuda, Barbados, Hawaii and the United Arab Emirates. It incorporated an aggressive, highly innovative environmental program in its daily activities in 1990. It has been recognized as the most comprehensive in the North American hotel industry, according to *National Geographic Traveler* magazine.

Waste Management: All Fairmont hotels & restaurants implemented comprehensive recycling programs using the 3 R's (reduce, reuse, recycle) with a target of reducing landfill waste by 50% and paper use by 20%. Where facilities exist, Fairmont annually diverts thousands of pounds of materials such as glass, aluminum, plastic, newspaper, cardboard and compost to recycling depots and donates used soaps and amenities to local shelters and charities.

Purchasing: Fairmont established corporate policies for the purchase of environmentally-friendly products including the elimination of hazardous chemicals and synthetic perfumes, conversion to unbleached craft and recycled paper and replacement of aerosol products with ozone-friendly alternatives. Partnerships were formed with local organic growers to purchase their products and with suppliers to eliminate/reduce excess packaging.

Other Program Activities:

- Diverting thousands of meals (untouched food) to people in need through partnerships with local shelters, food banks and soup kitchens.
- Donating thousands of used but serviceable items (including beds, furniture, amenities and linens) to shelters. The program also encourages other corporations to identify materials that may be useful to charitable organizations.
- Exploring ways to divert up to 50% of the current waste stream through industrial composting including vegetable peelings, coffee grinds, egg shells and other organic waste, resulting in a rich fertilizer used to grow herbs in organic herb gardens on the properties.

Additional information: Fairmont Hotel Vancouver, Department of Environmental Affair, E-mail: environment@fairmont.com

5.2.3 Disposal

There will always be residual waste which cannot be reduced, recycled or reused. The major disposal option for this waste is in a municipally or privately managed facility or in the case of remote and small island states on the facility's site itself. Operators of these facilities must ensure that the waste does not damage the environment or harm area residents by using accepted solid waste management landfill procedures.

More Information

For further case studies/good practices on waste management in the hospitality industry please see "Sowing the Seeds of Change - An Environmental Teaching Pack for the Hospitality Industry", a joint publication of UNEP, the International Hotel and Restaurant Association (IH&RA) and the International Association of Hotel Schools (EUHOFA International), page 98, 129-149.

PART II

Water Management

1. INTRODUCTION

As water supply becomes an evermore pressing issue in many parts of the world the tourism industry has a responsibility to conserve water whenever possible. Furthermore, access to clean and safe water will become an important determinant in the location of a tourism enterprise or ensuring the viability of existing operations. In addition, the need to deal with wastewater in a sustainable manner is now seen as essential for the ongoing potential of a tourism destination.

The scale of the challenge is significant. In the US, tourism and recreation consumes 946 million cubic meters of water per year (EPA, 2000), of which 60% is linked to lodging (mostly spent on guest consumption, landscape and property management and laundry activities), and another 13% to foodservice. In Europe, each tourist consumes 300 liters of freshwater per day, whereas luxury tourists can utilize up to 880 liters (EEA, 2002). Total yearly water consumption by tourism in Europe is estimated at 843 million cubic meters (EEA, 2001). If the order of magnitude of global water consumption is to be estimated, European averages could be taken as a conservative average (as water efficiency in Europe may be higher than elsewhere). In this case, the 692.5 million international tourists in 2001, staying for an average of seven days in their destinations, could consume up to 1,454 million cubic meters, and global tourism-related freshwater consumption (including domestic tourism at 6 times international volumes) would be in the order of 10 million cubic meters per year, around 3 times the actual volume of Lake Superior in the US (Great Lakes Information Network, 2003).

The problem is especially acute in Small Island Developing States. In sensitive environments such as islands, water is often available only in restricted quantities, as are low-impact energy sources such as hydroelectric power. Endemic species and unique ecosystems depend on the sustainable use of these critically scarce resources, as do the local communities. Resorts typically use large volumes of water - up to 800 liters/day/person in luxury hotels. This is often above the sustainable yield of local sources, with serious environmental and social consequences. In some cases, desalination of seawater is one of the few options left, with two serious potential impacts: air and noise pollution from diesel or gasoline generators and coastal impacts from hyper saline effluents.

Guestrooms, kitchens, restaurants, laundries and gardens generate large volumes of wastewater which can result in disease and negative ecological impacts. There is an urgent need for hotels, guesthouses, restaurants and golf courses to better manage wastewater, protect the environment and meet a growing customer demand for environmentally-friendly facilities. This section of the manual examines technical and management oriented opportunities that provide a number of long-term benefits to tourism facilities and their destinations especially cost savings, greater operational efficiency, improved image and customer satisfaction.

This manual deals with two quite different situations. The first is concerned with facilities in urban areas connected to sewer systems that have water treatment operations. The other is in rural areas, remote sites and even urban facilities where there is not a central system for wastewater treatment. All facilities can conserve and reuse water as discussed in Chapter 4. For those not connected to a sewer system there are a number of other options discussed in Chapter 5.

Wastewater management and treatment activities which tend to be highly technical, require professional expertise to determine the most appropriate technological solution based on efficacy, costs, impacts, etc. This section of the manual is aimed at assisting decision-makers involved in the development of an overall water management and wastewater treatment plan. While expert advice will be required in the choice of overall systems many operational measures (outlined in the manual) can be implemented without technical assistance.

Figure 6 presents an overall view of the wastewater management process and how the manual deals with a series of major components. Wastewater management begins with developing an understanding of the nature of the water issues in a facility and examining a range of technical- and management-oriented approaches for dealing with this wastewater. There are four main water and wastewater management techniques that will be discussed in this manual namely water conservation, water reuse, engineered wastewater treatment systems and natural wastewater treatment systems. Once a facility is able to identify appropriate methods to address its water and wastewater problems a water and wastewater management plan comprising of operational structures and procedures, phasing process, budgeting, and staff training and involvement should then be developed. Based on this plan a monitoring program needs to be implemented in order to assess how well a facility is doing in managing its water situation.

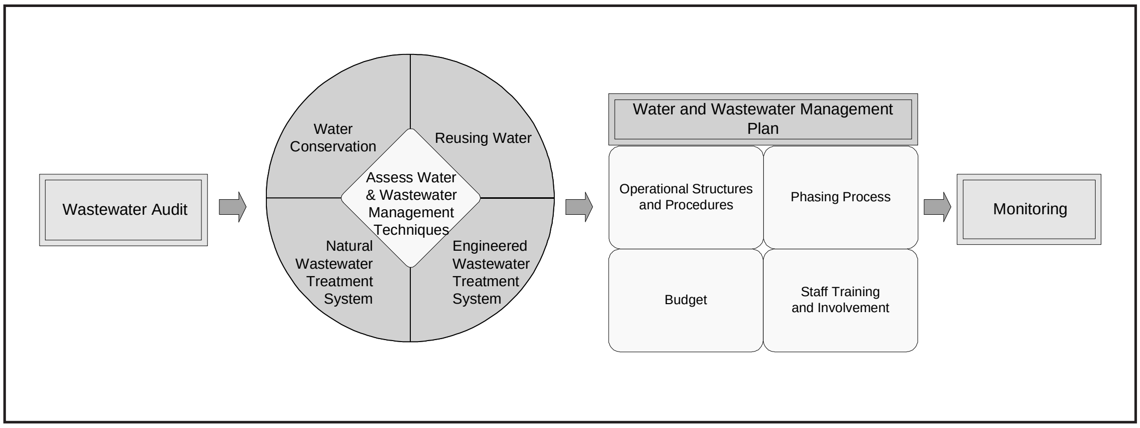

Figure 6: Water and Wastewater Management Process

2. THE NEED FOR SUSTAINABLE WATER AND WASTEWATER MANAGEMENT PRACTICES

If wastewater is discharged before it is properly treated, it can adversely affect the environment, public health and a destination's economic well-being. The cost of these negative impacts can be expressed in monetary, health and ecological terms. Figure 7 shows the effects of improperly treated wastewater on the quality of groundwater close to a tourism facility and, on a larger scale, the surrounding neighborhoods, its residents and land uses.

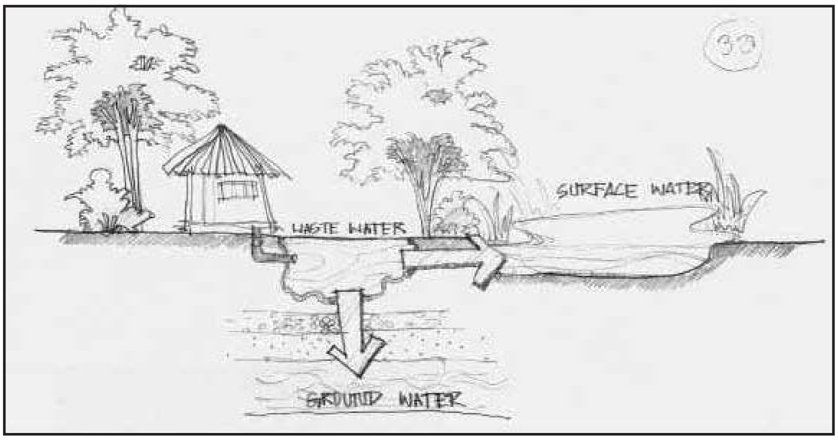

Figure 7: Widespread Impacts of Wastewater Contamination

There are a number of consequences of poorly treated wastewater which are discussed below.

2.1 Health Impact

Pathogenic bacteria, viruses and toxic algae cause diarrhea, shellfish poisoning and other diseases. Studies show bathing in polluted water causes gastroenteritis and upper respiratory diseases; eating polluted shellfish results in hepatitis, liver damage and in some cases death. Illness and mortality rates, due to ingestion of/or contact with contaminated water, should be a major consideration in the formation of a wastewater management process.

2.2 Impact on Marine Environment

Poorly treated wastewater significantly impacts marine environments:

- Suspended solids may cause excessive turbidity and shading of sea grasses, produce sedimentation, damaging benthic (bottom layer) habitats and affect anaerobic conditions at the sea bottom.
- High BOD (Biochemical Oxygen Demand) levels may cause severe oxygen depletion, especially in shallow and enclosed aquatic systems such as estuaries that are ideal breeding grounds for various marine species. BOD results in fish deaths and anaerobic conditions which release bad odors (hydrogen sulfide).

- Adverse nutrient levels cause algal blooms, resulting in the death of coral and sea grasses and eutrophication leading to severe oxygen depletion which kills living resources.
- Many toxic materials and suspected carcinogens and mutagens can concentrate in shellfish and fish tissue, putting humans at risk when they eat them.
- Metals in specific forms can be toxic to humans and various marine organisms, especially shellfish which is vulnerable, in areas with highly contaminated sediment layers.
- Fats, oil and grease that float on the water surface interfere with natural aeration. They are possibly toxic to aquatic life, destroy coastal vegetation and reduce recreational use of waters and beaches.

2.3 Impact on Groundwater and Water Resources

Improper disposal of wastewater can directly impact the quality of an area's groundwater and water resources and since their movements are dynamic, contaminants can spread far beyond the immediate pollution area. In developing countries, the presence of fecal matter in surface waters is common because of improper/incomplete treatment facilities. Fecal contamination of surface and groundwater sources has serious health implications for residents and tourists since fecal bacteria can cause diarrhea and dysentery.

2.4 Impact on Mountain Ecosystems

Mountains and hilly areas have fragile, weak ecosystems with a limited tolerance for human activity. Facilities in these areas rarely have proper wastewater treatment systems. Improperly treated wastewater can severely damage mountain ecosystems and cause:

- loss of flora and fauna.
- degradation of mountain slopes.
- eutrophication of mountain streams leading to loss of breeding habitats for a variety of freshwater fish species.
- fecal contamination of fresh water sources.

2.5 Loss of Tourism Income

Many destinations depend on pristine natural environments to attract tourists. When the environment has polluted water and unsanitary conditions, tourists tend to stay away and local residents and tourism facilities lose an important source of income.

Case study: Bucuti Beach Resort in Eagle Beach, Aruba, Dutch Caribbean

Bucuti Beach Resort in Eagle Beach, Aruba, Dutch Caribbean, was a runner up for the Environmental Award of the International Hotel and Restaurant Association (IH&RA) in 2002. The 63-room resort utilizes light bulbs that help save energy, solar panels to heat water and a treatment facility that recycles water for garden use. Apart from using solar energy sources, Bucuti also promotes strict water saving measures as an energy saving strategy. "Saving water is the single most efficient way of saving energy, since water used in our resort is partially produced by desalination" says Mr. Ewald Biemans, Owner Manager of the Bucuti Beach Resort, http://www.bucuti.com/english/newsletter/releases/281002.htm

3. THE NATURE OF WASTEWATER

Once water is used for any domestic, commercial or industrial purpose, it carries impurities and is called wastewater as has been noted. Unless properly treated, it can be harmful to both the environment and human health. Typically, the major form of wastewater generated by a tourism facility is domestic sewage from bathing and toilet flushing. Wastewater is also produced by laundry, cooling/heating and kitchen functions. Table 2 outlines wastewater sources and contaminant of wastewater generated at tourist facilities.

Source of Wastewater	Possible Contaminants
Kitchen/restaurant	food scraps, tissue paper, detergents and other cleansing agents
Toilets and washrooms	fecal matter, soap and detergents, tissue paper, etc.
Housekeeping/maintenance	dirt, rags, detergents and other cleaning chemicals, bilge wastewater in marinas
Laundry	detergents and cleaning chemicals
Grounds	organic materials, suspended and dissolved solids and other substances picked up as water travels on the ground

Table 2: Common Sources of Wastewater at a Typical Tourism Facility

3.1 Wastewater Characteristics

Wastewater can be classified according to physical, chemical and biological properties.

Physical Characteristics

Wastewater's physical characteristics include:

- Total solids are all organic and inorganic solids present in wastewater (floating, colloidal, suspended and dissolved).
- Odors are usually caused by gases produced by anaerobic (absence of atmospheric oxygen) decomposition of organic matter. Unpleasant odors are one of the first indications that wastewater treatment is not effective.
- The temperature of wastewater is an important parameter because of its impact on chemical and biochemical reaction rates and aquatic life of the water body into which wastewater is discharged. Increased temperature enhances the activity of microorganisms in water.
- Colloidal and suspended impurities give wastewater turbidity. Color is caused by colloidal suspension, dissolved materials or decomposing organic compounds.

Chemical Characteristics

Wastewater can contain pollutants chemically classified broadly as organic or inorganic.

Organic Matter:
The amount of dissolved oxygen in water sources is an important factor; a higher concentration signifies better water quality. Animal and plant materials need dissolved oxygen for decomposition. In domestic effluent, 75% of suspended solids and 40% of

solids are organic (from plants and animals). Organic compounds are normally composed of carbon, hydrogen, oxygen and nitrogen and, in some cases, sulfur, phosphorus and iron. Organic matter often enters wastewater in the form of proteins, carbohydrates, fats, oils and urea. Present in small quantities are a large number of synthetic organic substances such as detergents, organic priority pollutants, e.g. benzene and other volatile organic compounds, solvents and pesticides.

Inorganic Matter:
Inorganic matter in the form of metals or minerals is geological or synthetic in origin. Concentrations of various inorganic constituents can greatly affect the beneficial use of wastewater. Some parameters are:

- pH levels indicate hydrogen ion concentration which can affect wastewater treatment capabilities.
- Chloride content, often associated with fecal contamination, indicates the need for urgent treatment.
- Alkalinity in wastewater results from the presence of hydroxides, carbonates and bicarbonates from elements such as calcium and magnesium. Water with high alkaline, termed ‘hard’ water, is an important parameter in the chemical treatment of wastewater because it is known to interfere with detergent use.
- Compounds of nitrogen and phosphorus, when released into water bodies without treatment, encourage algae growth leading to eutrophication.

Biological Characteristics
Microorganisms are responsible for the biological treatment of wastewater where some are pathogenic (known to cause disease) and others can be used as pollution indicators. Bacteria, fungi, algae, protozoa and viruses are the main types of microorganisms that can cause diseases such as typhoid, paratyphoid fever, dysentery, diarrhea and cholera. Pathogens enter wastewater primarily through human and animal excreta. Contamination of wastewater is measured by the quality of organisms and by the density of contamination (for instance, the concentration of bacteria per unit of volume).

4. WATER CONSERVATION AND REUSE

4.1 Determining the Nature of the Problems

Before an effective water and wastewater management plan can be designed, tourist facility providers must conduct an audit to determine the type and amount of wastewater being generated and to assess water use, reuse and treatment practices being followed.

Issues that should be addressed to help identify problems include:

- Assess current wastewater treatment practice before water is discharged whether to:
  - On-site treatment facility
  - Municipal treatment facility
- Identification of where wastewater is generated within a tourism facility
- Determine whether discharged wastewater quality meets effluent standards (if they exist)
- Identify whether on-site wastewater treatment is used for non-potable applications (if applicable)
- Assess complaints from customers and residents about reclaimed wastewater quality, e.g. kind and nature of odors or other suspended impurities

Once the situation has been assessed, a range of approaches and techniques to deal with wastewater can be considered. This work must be done by a water quality and wastewater engineer.

4.2 Conservation of Water

The more water used by a facility the more wastewater is generated. Optimizing water consumption can help minimizing wastewater and also reduce the energy required to treat the water. The following is a list of questions on water usage that a facility should consider in order to be able to develop priority areas of actions in dealing with water use conservation.

- Have any water saving practices been taken for the last twelve months?
- Is water use monitored?
- Is the water system regularly checked for leaks or surges in consumption?
- Are staff encouraged to save water?
- Are guests encouraged to save water?
- Does the tourism facilities have any water intensive activities e.g. swimming pool, garden and laundry services?
- Have the water efficiency equipment been used?

There are two major ways to minimize water consumption in most facilities.

- Reducing water loss:
  Overall water consumption can be reduced by following good water management practices by regularly repairing equipment, fixing leaky taps, turning off equipment when not in use and replacing faulty/old equipment. To facilitate these tasks, leak detection instrumentation is commercially available. The flow rates of conventional faucets vary from 10-15 liters per minute. A leaky faucet, dripping one drop per second, can waste 135 liters of water daily. Flow

valves can be adjusted on faucets and should be checked regularly for leaks. Aerators can be screwed to the faucet head to reduce water consumption and increase the amount of air in the water flow.

- Installation of water efficiency equipment:
  Facility managers should consider installing commercially available devices such as ultra low flush toilets, spray nozzles, urinals, faucet aerators and low flow showerheads to reduce overall water consumption. Other water-saving faucet devices include infrared and ultrasonic sensors, water spigots and pressure-reducing valves. Although they are expensive, they can save a great deal of water.

Within each area of the facilities there are a number of practices that can reduce the amount of water used in operations.

Kitchen and Food Preparation

Dishwashing is a major water-consuming/wastewater generating activity. Water use and discharge can be reduced by: educating staff to hand-scrape plates before loading, filling each rack to maximum capacity, recycling final rinse water and keeping flow rates as low as possible.

Guestrooms

Installing proper devices and encouraging guests to conserve water will reduce consumption and discharge.

Toilets

Water use and the amount of wastewater discharge can be reduced by making improvements to toilets/flush mechanisms. There are three major types of toilets and one modified system:

- Gravity flush toilets are the most common types with water efficiency options including improved maintenance and retrofitting.

- Flush valve toilets use water line pressure to flush water into the sanitary sewage system. Valves can be inserted to reduce flush volumes by 2-4 liters per flush and units replaced with ultra low (6 liters per flush) flush valve mechanisms to maximize water savings.

- Pressurized tank system toilets are the most modern and efficiently designed toilets currently available but are expensive to install.

- The lid system is a completely passive water conservation system that attaches itself to the top of the toilet tank - after flushing, users wash their hands with clean water which drains into the tank below by diverting water before it enters the holding tank, water is used twice. For additional information on this system please see http://www.greenculture.com/pr/ws.html#cp.

Showerheads

Showerhead replacement and modification is an effective way to conserve water. Most conventional showerheads use 11-25 liters of water per minute at a standard water pressure rate of 60 psi. However, new standards require showerheads to use a flow of no more than 9.5 liters per minute. Showerheads should be checked regularly for leaks; flow restrictors and temporary cut-off valves can be installed to lessen water use and reduce the amount of wastewater treated by a facility. In addition guests and staff can be encouraged to take shorter showers.

Laundry

Washing machines should be filled to capacity to reduce the number of loads thereby saving water. When machines are not full, settings should be adjusted to lower water level. Installing a water filter to remove impurities can optimize machine performance. Recycling rinse water for the next pre-wash cycle is recommended, if space is available for storing the water in a small tank.

For additional information on products/ technologies in your region:
http://www.greenculture.com

Case Study: Forte Hotels - Jumeria Beach, Dubai, UAE

The ozone washing system installed at the Forte Grand Jumeria Beach in 1996 has produced several environmental benefits. Ozone in the system is used as detergent thus eliminating the need for chemicals. Energy requirements are reduced because the system uses cold water, which is filtered and recycled, drastically reducing the volume of wastewater produced. The payback period was about 16 months.

Additional information: Mr. Janaka Wijayawardhana (Chief Engineer),
E-mail: engin@lemeridien-jumeria.com

4.3 Reusing Wastewater

Wastewater can be a valuable resource for tourism facilities. The reuse of wastewater can ease the demand on limited fresh water supplies and improve the quality of streams and lakes by reducing discharged effluent. Wastewater may be reclaimed and reused for crop and landscape irrigation, groundwater aquifer recharge or recreational purposes. Water reclamation for drinking is technically possible but this reuse is not particularly appealing to the public. Normally reused water can be employed for non-potable purposes, e.g. flushing toilets and urinals. Reused water or gray water can be marked with a blue dye to ensure it is not used for potable purposes, e.g. drinking, showering or washing.

Case Study: Minneapolis City Center Marriot Hotel - Minnesota, USA

The 538-room Minneapolis City Center Marriot Hotel, Minnesota inaugurated laundry gray water and cold water reuse systems. The gray water reuse system obtains the last rinse water from one wash load, filters and transfers it to a holding tank where it is heated to 140^{0}F using a steam heat exchanger. The gray water is then used as first wash water for the next wash load.

The cold water reuse system obtains water from the discharge of water-cooled condensers, water-cooled heat pumps and heat exchanger on the dry cleaning machine. The water is held in a cold water storage tank and used as a cold water supply for the washing machines. Both these systems allow water to be used twice before being discharged.

Additional information**:** Ms. Barabara Brodell, E-mail: barbara.brodell@mariott.com

Reuse takes place when water or wastewater is used again in a facility before discharge into a treatment system (Figure 8). Reclamation is the process of treating wastewater to achieve a certain quality of water which can be reused. These commonly adopted water conservation techniques require technical skill and expertise; the technology is universally available and widely accepted.

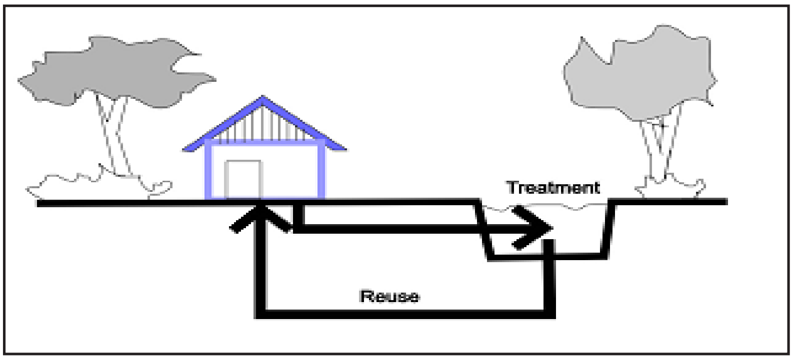

Figure 8: Wastewater Reuse within a Tourist Facility

An important step in successful wastewater reclamation and reuse is source separation. Wastewater, generated from various sources, has different characteristics and potential reuse capabilities and should be separated into different streams with separate collection tanks for each source of wastewater generated. Wastewater can be separated in the following ways:

- Wastewater from bathrooms, sinks and kitchens has less toxicity, good reuse potential, requires minimal treatment and can be separated into one stream.
- Wastewater from toilets and laundries contains more toxicity, requires treatment prior to reuse and can be separated as another stream.

In an existing facility this kind of separation is difficult and requires major plumbing and structural retrofitting. When designing a new facility this type of separation can be seen as cost effective.

There are several wastewater reclamation processes and techniques that can be employed and which are displayed in Table 3 (adapted from Metcalf and Eddy (1991) “Wastewater Engineering Treatment, Disposal and Reuse”; McGraw-Hill International Ed., New York).

Solid/Liquid Separation

Process	Applications
o Sedimentation	Removal of particles from wastewater larger than 30 μm. – typically used as a primary treatment approach
o Filtration	Removal of particles from wastewater larger than 3 μm. - typically used downstream of sedimentation (conventional treatment) or following coagulation/flocculation
o Oil and grease removal	Removal of oil and grease from wastewater - flotation process may also be used

Biological Treatment

Process	Applications
o Aerobic treatment	Removal of dissolved and suspended organic matter from wastewater
o Oxidation pond	Reduction of suspended solids, BOD, pathogenic bacteria and ammonia from wastewater
o Nutrient removal	Reduction of nutrient content of reclaimed wastewater
o Disinfection	Protection of public health by removal of pathogenic organisms

Advanced Treatment

Process	Applications
o Activated carbon	Removal of organic compounds
o Air stripping	Removal of ammonia nitrogen and some volatile organics from wastewater

Chemical Coagulation and Precipitation

Process	Applications
o Lime treatment	Use of lime to precipitate cations and metals from solution
o Membrane filtration	Removal of colloids and micro-suspended impurities
o Reverse osmosis	Removal of dissolved salts and minerals from water - also effective for pathogen removal

Table 3: Unit Processes and Operations in Wastewater Reclamation

Establishing Wastewater Reuse Program

In order to establish a wastewater reuse program at a facility the following actions should be followed.

- Identify the need for wastewater reuse by thinking about these questions.
  - Is sufficient wastewater being produced to be economically reused?
  - Is the availability of freshwater a major concern? It can be a problem at facilities on islands and remote areas where wastewater reuse could augment freshwater and groundwater resources.
  - Is there a reuse potential for treated wastewater? Do non-potable reuse options such as gardening and landscaping exist?
  - Does the present wastewater treatment infrastructure require major retrofitting to install a reclamation scheme?
  - Is the retrofitting economically feasible?

- Given the technical nature of wastewater reuse a wastewater engineer or water conservation and reuse expert should be hired to:
  - Identify conveyance and storage requirements for wastewater reclamation and reuse.
  - Assess existing treatment infrastructure and the amount of retrofit required to install a wastewater reclamation system.
  - Estimate the cost of retrofitting, installation, operation and maintenance by using cost benefit analysis in order to assess the payback period.

- Identify the treatment required to implement the reuse options. Geographic, climatic and economic factors dictate the appropriate degree and form of wastewater reclamation.

- Check local reuse standards. In many developing countries where standards are unavailable, World Health Organization (WHO) guidelines for microbial and viral removal requirements can be used. Potential health risks associated with wastewater reclamation and reuse relate to the extent of direct exposure to reclaimed water and the adequacy, effectiveness and reliability of the treatment system. Protection of human health should be a major consideration in a wastewater reuse program.

Case Study: The Cities of Calvia and Rimini

The city of Calvia in the Balearic Islands in Spain, and the Italian balneary of Rimini on the Adriatic Sea are both located in the Mediterranean biodiversity conservation hotspot, and heavily dependent on tourism. Both experienced over-development in tourism facilities and environmental degradation in the 80s, but faced the challenge with often radical measures. In the case of Calvia, a Local Agenda 21 process managed by the municipality led to closing and even implosion of hotels, expansion of sewage systems, landscape renovation and creation of additional protected areas. The establishment of an environmental levy on hotel room sales in 2001, with extensive public awareness and marketing campaigns, provided important resources for environmental management – in spite of significant resistance from tour operators and tourists.

In Rimini, effluents with high organic content and coastal eutrophization from fertilizers led to algal blooms and heavy fish mortality in 1985, with ensuing odors and visible pollution causing occupancy rates to fall around 25%. The tourism industry then led local authorities to engage agribusinesses to reduce use of fertilizer and hotels to improve wastewater management. Regular monitoring guaranteed compliance with stricter regulations. Awareness and marketing campaigns gradually led to image improvement and the tourism flows were re-established by the end of the decade. The image of both destinations today is associated with their leading efforts towards sustainable tourism (UNEP, Tourism and Local Agenda 21, 2003)

Case Study: Club Med Lindeman Island, Queensland, Australia

Club Med Lindeman Island took the entire environmental process to heart when they decided to build the resort because of its World Heritage location. The Great Barrier Reef Marine Park Authority considers Lindeman as a benchmark in how a resort can care for an island and its delicate environment. All waste is sorted and treated and transported from the island. The resort's wastewater is treated and used to irrigate the island's nine hole golf course which is fertilized with the waste sludge – dried, mulched and mixed with grass clipping. And when the island's original course was expanded Club Med only used areas of land which were already degraded by previous pastoral use.

The resort's dam and the wastewater holding pond have had a very positive effect on the island's wildlife by providing a habitat for birds such as the Eastern Swamp Hens, Black Ducks and a number of migratory species. Extensive planting of native flora around the resort has increased food supplies for the birds.

Additional information: Queensland Ecotourism at
http://www.qttc.com.au/ecotourism/home.asp

5. WASTEWATER TREATMENT SYSTEMS

The primary objective of wastewater treatment systems is to protect the natural environment and public health. Potential pollutants need to be eliminated from wastewater before it can be safely disposed/reused. Zero discharge of wastewater is technically possible but very costly. The bulk of wastewater remains to be disposed of after the treatment processes have been completed. Wastewater can be disposed of in a municipal system or on-site (if conditions are appropriate). In urban areas, where land availability is an issue in setting up treatment system, most facilities are committed to the municipal treatment system. While in remote areas such as mountains and island locations, where no centralized system exists, on-site wastewater treatment systems are required. This section will look at different types of on-site wastewater treatment systems, which can range from simple septic tanks to tertiary level treatment systems for wastewater reclamation and reuse, and to using natural features, either land-based or water-based, to treat wastewater before disposing to natural receptors e.g. surface water and groundwater bodies or land surfaces.

5.1 Engineered Wastewater Treatment System

Engineered systems mimic the natural systems of water purification. Engineering principles are applied to the separation of pollutants from wastewater. They can be operated either as centralized or on-site wastewater systems. On-site wastewater treatment systems are used primarily in facilities in remote locations as illustrated in Figure 9. The selection of these types of treatment processes can be restricted by:

- Discharge limits
- High capital costs of treatment plants
- Limited operation and maintenance capabilities

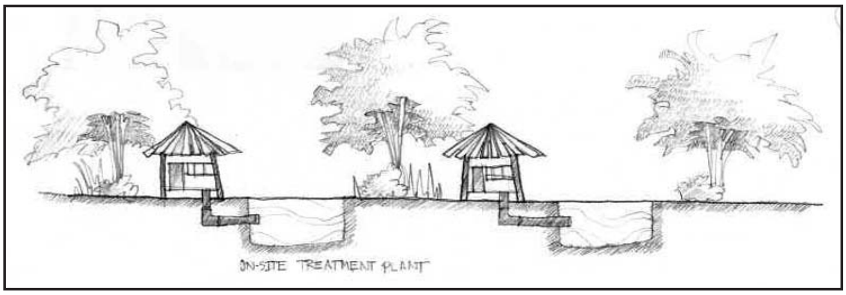

Figure 9: On-Site Wastewater Treatment Systems

A variety of treatment systems can be used but a common treatment system consists of a septic tank for partial treatment and a subsurface soil disposal field for final effluent disposal. In cases of land scarcity, conventional disposal fields can be replaced by re-circulating granular media filters.

Septic tanks are prefabricated tanks that serve as combined settling and skimming tanks and an anaerobic digester. Most septic tanks are made of concrete or fiberglass and should be watertight and leak-proof to ensure proper wastewater treatment.

Operationally, effluent flows into the vault through inlet holes in the center of the vault chamber. Before entering the vault chamber, effluent usually passes through a screen on the inside of the vault. The screen must be removed and cleaned periodically to avoid clogging. Solids from the incoming wastewater settle and form a sludge layer at the bottom of the tank. Grease and other light materials float on the surface where a scum layer is formed where floating material accumulates. Settled and skimmed wastewater flows from the clear space between the scum and sludge layers for additional treatment and/or disposal. The organic matter retained at the bottom undergoes anaerobic digestion and converts to gases such as carbon dioxide, methane and hydrogen sulphide. The digested bottom layers, along with accumulated solids, effectively reduce the volume of the tank and need to be pumped periodically. Figure 10 illustrates a typical septic tank and soaking pit system.

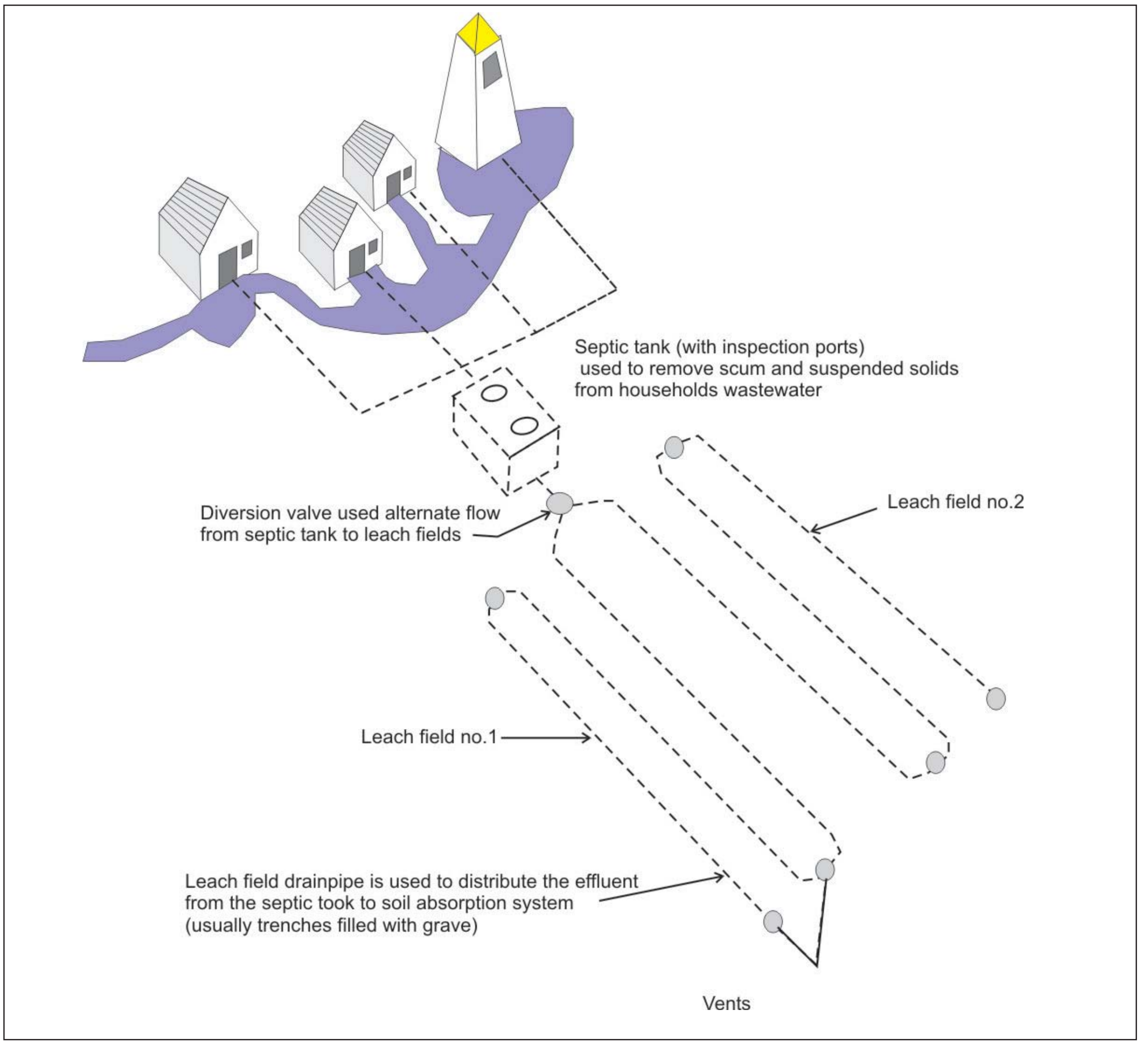

Figure 10: Septic Tank Soaking Pit System

Case Study: Perkin Lenca Hotel – Province of Morazan, El Salvador

The owners (a US-Salvadoran partnership) of the largest hotel in El Salvador's remote, North-Eastern Morazan Province, were looking for an appropriate environmental-friendly solution to treat their wastewater in a relatively small area. After extensive research they decided to implement two independent systems each consisting of a two-chambered septic tank ($24m^2$) for the separation of solids, with the overflow running through a line of five tanks. The tanks are filled with gravel and planted with a variety of local water species found in the surrounding ravines and gullies. The water from each system is used to irrigate a variety of trees. During normal and low use periods, the plants in the bottom two tanks require external watering, given the excessive consumption of the plants in the first three tanks. The system is designed to expand from the present seven cabins, plus other facilities to twenty-one cabins. Maintenance consists of a once-a-month introduction of natural enzymes, the cutting-back of mature plants, and a loosening of the root-mass every sixty days. After four years of implementation, there is no sediment build-up in the system and the only adjustment has been to separate the grey water from the kitchen (which does carry grease) through a separate filter.

Additional information: Ronald Brenneman, E-mail: info@perkinlenca.com, http://www.perkinlenca.com

5.1.1 Levels of Wastewater Treatment

Wastewater can be treated by physical, biological or chemical processes. There are four levels of wastewater treatment: preliminary, primary, secondary and tertiary as illustrated in Figure 11.

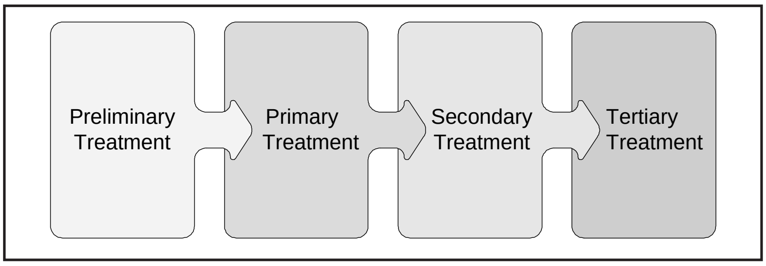

Figure 11: Levels of Wastewater Treatment

Preliminary and primary treatment methods remove about 60% of total suspended solids and 35% of biochemical oxygen demand (BOD).

A number of different methods of analysis have been developed to determine the organic content of wastewater. Laboratory methods commonly used to measure gross amounts of organic matter in wastewater (typically greater than 1 mg/L) include biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total organic carbon (TOC) (Metcalf and Eddy, 1991).

The most widely used parameter of organic pollution in both wastewater and surface water is the 5-day Biochemical Oxygen Demand (BOD_5). This determination involves the measurement of dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. The BOD_5 test results are used (Metcalf and Eddy, 1991):

- To determine the approximate quantity of oxygen that is required to biologically stabilize the organic matter.
- To determine the size of wastewater treatment facilities.
- To measure the efficiency of different treatment processes.
- To determine compliance with wastewater discharge permits.

Secondary treatment removes more than 85% of suspended solids and BOD. These treatment levels do not remove dissolved inorganic. When more than 85% of total solids and BOD must be removed, or when nitrogen and phosphorous concentrations must be reduced, tertiary treatment methods are used.

Tertiary processes can remove more than 99% of all impurities from wastewater, producing water quality almost up to drinking standards. Tertiary treatment can be expensive (often double the cost of secondary treatment) and is used only under special circumstances.

Most countries have national and regional discharge limits for the disposal of effluents. The type of wastewater treatment method used generally depends on the size of a tourist facility. For example, a small roadside cafeteria or bed & breakfast facility will probably not have effluent treatment; a larger establishment will have at least a septic tank to treat wastewater prior to disposal. Location is another factor especially in remote areas where there are seldom any municipal standards or enforcement of disposal standards.

5.1.2 Preliminary Treatment

Preliminary wastewater treatment is defined as the removal of wastewater constituents that may cause maintenance or operational problems during treatment. Floating objects, e.g. driftwood, rags and plastic, and coarse suspended matter such as grit, need to be removed. Screens are common applications in most treatment facilities. At tourist facilities, things like tissue paper or plastic bags must be eliminated before they reach the wastewater stream. Oil and grease removal applications are also common in tourist facilities. Grit removal can be used as part of wastewater treatment.

Screening and Comminuting

Screening and comminuting is used for the removal of debris such as rags and floating objects where screens provide a physical barrier to the flow of wastewater and block unwanted materials. Screens, classified as coarse, medium and fine, are available in bars, racks or rotating drums. Comminution grinds the screened material into a pulp before it flows into the wastewater stream.

Grit removal

For removal of coarse suspended material such as sand, broken glass, silt and pebbles which may wear down or clog pumps and other mechanical devices, a settling chamber is provided where grit settles. Aerated grit chambers use the shearing action of air bubbles provided by air diffusers to strip the inert grit of much of the organic material adhering to the surface, assisting the settling of grit particles.

Flotation process

To remove large quantities of oil and grease, compressed air is forced into the wastewater from below. This encourages non-soluble oil and grease to float to the surface and to be skimmed off.

5.1.3 Primary Treatment

In primary treatment, a portion of suspended solids and organic matter is removed from wastewater. This removal takes place by physical methods such as sedimentation or settling. Settleable solids must be removed to decrease the load on further treatment processes. Usually the process is carried out in settling basins where quiescent conditions are provided to wastewater to encourage settling of solids. Sedimentation can be enhanced by adding chemicals such as alum which assists floc formation. This process is called coagulation and flocculation. The settled solids, known as sludge, need to be periodically drained and disposed of in a proper manner, either in municipal landfills or other recommended sites. Sedimentation can also be enhanced by using physical structures, e.g. tubes and plates, to accelerate settling.

5.1.4 Secondary Treatment or Biological Treatment Process

Secondary treatment is directed primarily at removing biodegradable organics and suspended solids. Biological processes are used to convert finely divided, dissolved organic matter in wastewater into inorganic carbon dioxide gas (escapes in the atmosphere) and settleable biological and organic solids (eliminated in sedimentation tanks). There are two types of biological processes – aerobic and anaerobic.

Aerobic Processes

Two main types occur in the presence of oxygen:

- Suspended growth processes are when the microorganisms responsible for the conversion of organic matter are in a state of suspension. An activated sludge process is the most common type of suspended growth aerobic process. Wastewater is treated in a tank where the microbial population is maintained in suspension by constant agitation. Aeration is provided by mechanical surface aerators or diffused air using aerators placed at the bottom of the reaction tank. The soluble organic content is converted to carbon dioxide which escapes as gas and solids which separated from wastewater in a secondary settling tank placed downstream from the aeration tank.

- Aerobic attached growth processes are usually used to remove organic matter in wastewater and to achieve nitrification, e.g. trickling filters and rotating biological contractors.

  - Trickling filter

  A trickling filter consists of a bed of coarse material to which microorganisms are attached and through which wastewater is percolated. The filter media consists of rock (rock size – 85-100 mm, rock layer depth – 1-3 m) or a variety of plastic packing materials. Trickling filters are usually circular; wastewater is distributed over the top of the bed by a rotatory distributor.

  - Rotating biological contractors (RBC's)

  The RBC process consists of a series of closely-placed disks (3-3.5 m in diameter) mounted on a horizontal shaft and about 40% of the surface area is immersed in wastewater. The disk rotation is generally between 1.5-2 rpm. As the disks rotate, they alternatively absorb oxygen from the air and organics from wastewater. RBCs are designed to operate in stages and can achieve secondary effluent quality standard or better. By increasing the number of stages, it is possible to achieve nitrification along with removal of organics.

Anaerobic Processes

This process carried out in the absence of air is used to treat high strength wastewater. There are two types – attached growth and suspended growth. The most commonly used is a wholly mixed anaerobic suspended growth process called anaerobic digestion process. The high strength organic material is converted biologically, under anaerobic conditions, into a variety of end products including methane and carbon dioxide. The slow process, carried out in an airtight reactor, has a high retention time in a reaction tank. This is a delicate process where optimum conditions of alkalinity, pH, Volatile Fatty Acids (VFA) and temperature must be maintained for microorganisms to grow properly.

5.1.5 Tertiary Treatment or Advanced Wastewater Treatment Process

In many areas of the world, wastewater discharge quality criteria (or effluent) are becoming stricter. In addition to organic matter and suspended solids, permit requirements may include removal of nutrients, e.g. ammonia, nitrates and phosphates, specific toxic compounds, e.g. metals (mercury and arsenic) or volatile organic compounds (VOC's) in pesticides and other harmful chemicals. Tertiary wastewater treatment is required to achieve removal of nutrients. With the need to reuse wastewater, advanced treatment must be provided at tourist facilities.

Removal of nitrogen and its compounds

Nitrogen in wastewater is usually found in the form of ammonia and organic nitrogen (urea and amino acids). Removal of nitrogen can be accomplished biologically or chemically. Nitrogen, in the form of ammonia, can be removed chemically from wastewater by raising the pH to convert the ammonia ion into ammonia gas and stripped from the water by passing large quantities of air through the water. Currently, biological nitrogen removal is popular because it is inexpensive and convenient. Biological nitrogen removal is accomplished by nitrification, converting ammonia to nitrate, accompanied by de-nitrification to reduce nitrate to nitrogen gas.

Removal of phosphorus

Biological phosphorus removal is done by stressing microorganisms to acquire more phosphorus than required for cell growth. Physical processes include dual media filtration to remove low quantities of phosphorus and ultrafiltration or reverse osmosis to remove high quantities of phosphorus. Ten percent of phosphorus is removed by chemical processes, e.g. precipitation using iron and aluminum salts.

Case Study: Green Island Resort in Queensland, Australia

Green Island Resort is Australia's first 5-star ecotourism resort. It is known for its best environmental management especially water and disposal of waste. Implementation of efficient procedures for water management is an important component of the day-to-day management of the resort. The high cost of importing water from 20 kilometres away by barge from the mainland calls for optimum harvesting of rainfall. The architecture of resort buildings is designed to allow direct infiltration of runoff on to the land surface and deep percolation to the underlying aquifer. Grey water from the island's sewerage treatment plant is recycled and reused for toilet flushing, landscape irrigation and as a reserve for fire fighting.

The tertiary treatment sewerage plant has been designed to handle both the resort's effluent and grey water. Sludge residue from the treatment plant is pumped on to a barge each month and transported to the mainland for processing. Liquid effluent from the treatment plant is discharged to the sea through an outfall pipeline with special care taken on the coral environment surrounding Green Island.

Additional information: Green Island Resort at http://www.ozhorizons.com.au/qld/cairns/green/green.htm

5.2 Natural Wastewater Treatment Systems

Systems which use natural features such as soil, vegetation, aquatic flora and fauna for the treatment of wastewater are defined as natural systems. These systems are less costly but require large areas of land not usually available in most tourism facilities.

Several simple alternative treatment methods exist if land is readily available and technical expertise is limited. They include land treatment, subsurface disposal and constructed wetlands. In the natural environment, physical, chemical and biological processes occur when water, soil, plant microorganisms and the atmosphere interact. Natural treatment systems are designed to take advantage of these processes to provide wastewater treatment.

5.2.1 Land-Based Systems

An alternative to advanced wastewater treatment processes, secondary effluent can be applied directly to the ground and polished effluent obtained by natural processes as wastewater flows over vegetation and infiltrates the soil. Land treatment can provide moisture and nutrients for vegetation growth, such as corn or grain for animal feed. It can also recharge/replenish groundwater aquifers. However, large areas of land are required and the feasibility of this treatment may be limited by soil texture and climate. Figure 12 shows three different land-based natural treatment systems: slow rate, overland flow and rapid infiltration (adapted from Metcalf and Eddy (1991) "Wastewater Engineering Treatment, Disposal and Reuse"; McGraw-Hill International Ed., New York).

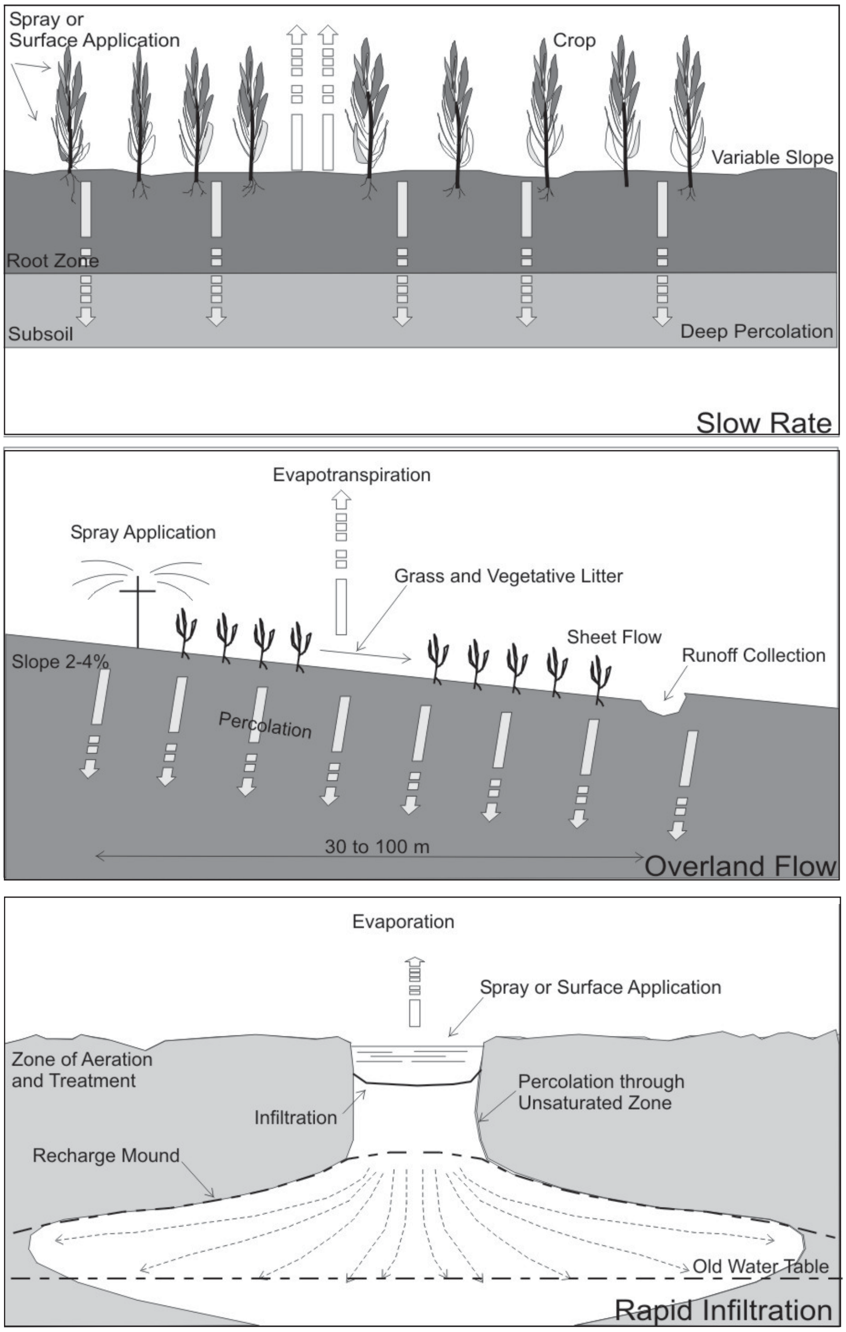

Figure 12: Examples of Land-Based Treatment Systems

5.2.2 Subsurface Disposal Systems

In sparsely populated suburban or rural areas, it is generally not economical to build sewage collection systems and a centrally located treatment plant. Instead, a separate subsurface disposal system can be provided for each facility. This type of treatment system is particularly appropriate in remote areas where tourist facilities (hotels and guesthouses) exist.

A subsurface disposal system consists of a buried field and either a leaching field or seepage pits. A septic tank serves as a settling tank and sludge storage chamber. Although sludge decomposes anaerobically, it eventually accumulates and must be pumped periodically. Floating solids and grease are trapped by a baffle at the tank outlet; settled sewage flows into the leaching field or seepage pits. A leaching field includes several perforated pipelines placed in shallow trenches. The pipes distribute the effluent over a substantial area as it seeps into the soil. If the site is too small for a conventional leaching field, deeper seepage pits may be used instead of shallow trenches. Both leaching fields and seepage pits must be placed above a seasonally high groundwater table.

5.2.3 Wetlands

Wetlands are land areas with water depths typically less than 2ft which support the growth of emergent plants such as cattail, bulrush, reeds and sedges. Vegetation provides a surface for attachment of bacterial films, aids in the filtration and adsorption of wastewater constituents, transfers oxygen into water columns and controls the growth of algae by restricting sunlight penetration.

Constructed wetlands are man-made systems aimed at simulating the treatment process in natural wetlands by cultivating emergent plants on sand, gravel or soil. Constructed wetlands have proven to be a promising treatment option as they require low investment, operation and maintenance costs. The system typically consists of parallel basins with relatively impermeable bottom soils or subsurface barriers, emergent vegetation and shallow water depths of 0.33-2ft. Pretreated wastewater is applied continuously to these systems; treatment occurs when water flows slowly through stems and roots of emergent vegetation.

Other available aquatic systems use floating aquatic plants (water hyacinth and duckweed) and aquaculture (production of fish and other aquatic organisms).

Constructed Wetlands for Wastewater Treatment, Cannon Beach, Oregon, USA

The City of Cannon Beach is a resort community and during the tourist season the population swells from a permanent size of 1,200 to many times that number. Therefore wastewater treatment design would have to be able to accommodate these large fluctuations in wastewater flows, and to meet the water quality standards set by the Oregon Department of Environmental Quality with minimal disturbance to the existing wildlife habitat. Confrontation led to a City commitment to pursue a biological solution instead of more high-tech treatment units to upgrade the treatment system.

The Cannon Beach treatment system consists of a four-celled lagoon complex followed by two wooded wetland cells which serve as a natural effluent polishing system. The fifteen acres of wetlands are primarily red alder, slough sedge and twinberry, including the remnants of an old growth spruce forest. These wetlands act as a natural filter to complete the treatment process, and the wildlife is not disturbed. The system has been a success. Performance of the system has exceeded expectations as the effluent has met its monthly permit requirements. In addition because of this achievement the City received higher funding provided by EPA (Environmental Protection Agency).

Additional information: Office of Water, United States Environmental Protection Agency (EPA) at http://www.epa.gov

Conclusion

This manual has outlined how to introduce solid waste, water and wastewater management measures in a facility. A facility can start with small improvements and gradually increase its commitment to implementing a fully integrated Environmental Management System (EMS).

First, the nature of the problem within a facility must be determined. Using an audit system or a comparable approach, a facility can determine immediately the nature and extent of the problems and potentials. Facilities can look at a range of technical, administrative and operational procedures to deal with the situation.

A management plan dealing with solid waste, water and wastewater issues should be developed. It can take the form of a simple chart or series of actions agreed to by management and staff. The document should be user-friendly and allow all stakeholders to view their responsibilities within the overall process.

Staff at all levels should be aware that measures in a solid waste, water and wastewater management plan must have the full support of a facility's management and, at larger operations, head office management. This is especially important as staff changes occur. Within this process, there should be recognition that the adoption of the management plan involves a change in the attitude of management and staff to better manage a facility's solid waste and wastewater output. If seen as strictly a public relations exercise, it will become obvious to staff that there is no real commitment to better practices.

The plan becomes a permanent record of initial problems, examined options and, most importantly, the process put in place to deal with the facility's solid waste, and water and wastewater management. Plans should include the following components.

Operational Structures and Procedures

There must be clearly articulated decision-making structures, responsibilities and procedures for implementing solid waste, water and wastewater management practices. The plan should clearly outline levels of responsibility, especially when training occurs, to ensure employees know what their roles are regarding solid waste, water and wastewater within a facility. There should be incentives for supporting the management plan and penalties for not following the plan.

Phasing Process

The implementation of better solid waste, water and wastewater management procedures may occur over a period of time, due to budgetary considerations and the need to train and re-orient staff. Small gains achieved by initial steps are important in the overall process to ensure a higher level of environmental responsibility.

Budget Items Supporting a Solid Waste and Water and Wastewater Management Plan

While in many cases there may be an economic return on better solid waste, water and wastewater management practices, there will be initial and ongoing costs. The inclusion of a budget within the overall plan ensures management and staff takes solid waste, water and wastewater management seriously and have the resources to carry out the plan. Failure to provide the necessary financial resources sends a negative message to staff about management's commitment to better waste management practices.

Staff Training and Involvement

The plan must articulate how staff will be trained. Staff should be kept informed of the plan's progress and recognition/awards should be given to those who contribute to its success. Management can present letters of appreciation to staff for good ideas, and/or introduce profit-sharing schemes linked to savings achieved through better solid waste, water and wastewater management processes.

Monitoring

It is essential that a plan includes methods on how success/failure will be assessed. A process, which everyone understands, must allow for regular monitoring through the use of indicators. Monitoring can be carried out by staff or, for larger facilities, by an outside contractor/specialist. The advantage of contracting out is that the specialist may suggest improved procedures leading to higher levels of efficiency and cost-savings.

Integration with other Environmental Management Strategies

To achieve a comprehensive approach, the solid waste, water and wastewater management plan must be integrated with other strategies within a facility. With the development of a plan, a facility can assume a long-term commitment to environmental responsibilities.

This manual addresses a number of technical and operational issues. Some methods require significant changes in design and operation; others can be easily implemented to achieve immediate savings and measure of environmental protection.

As mentioned in the Introduction, managing solid waste, water and wastewater are essential to achieving an overall environmental management system in a facility. There are important connections between sustainable solid waste management and water and wastewater management. Other dimensions, in particular, energy consumption and the use of materials and design in construction and operation, must be dealt with before an overall environmental management system can be put into place.

It is hoped this manual will assist facilities to become better stewards of their operations and the environment.

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- are cleaner and safer;
- make efficient use of natural resources;
- ensure adequate management of chemicals;
- incorporate environmental costs;
- reduce pollution and risks for humans and the environment.

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- **The International Environmental Technology Centre (Osaka)**, which promotes the adoption and use of environmentally sound technologies with a focus on the environmental management of cities and freshwater basins, in developing countries and countries in transition.

- **Production and Consumption (Paris)**, which fosters the development of cleaner and safer production and consumption patterns that lead to increased efficiency in the use of natural resources and reductions in pollution.

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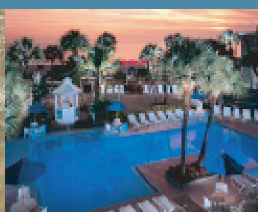

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