**Residual Waters Maintenance Plan**

**Use of Biodigestor**

**Arenal Springs Resort & Spa.**

**Introduction**

This document presents the maintenance plan for the treatment of used waters, including soapy and greasy water generated by Arenal Springs Resort & Spa.

In this plan we identify the main types of generated wastes and describe the treatment used in order to dispose of them in an adequate manner.

Two waste product types are identified in this plan:

1. **Solids**: grey waters produced from guest rooms and common areas.
2. **Liquids**: Restaurant, guest rooms and common areas.

The first are stored in septic tanks for each room until the moment of their transfer to treatment plants. Common area waters are discharged at once. The latter flows through the piping continually.

**2. Water Treatment Description**

Greasy waters and grey waters from public areas are transported by gravitation to the preliminary treatment unit. The grey waters of the guest rooms are carried to the unit through a special tank designed for this purpose.

This unit consists of three sedimentation processes, in which the water falls during the first process; constant movement is applied in order to suspend the solid substances, thereby allowing the liquids to pass through to the final compartment.

 The solid waste retained in the compartments is collected when the quantity warrants, treated and then used as fertilizer for the gardens and grassy areas.

**3.** **Treatment System Description**

**3.1 Injection of Waste Products**

 The system includes two forms of injection of waste products.

**A- Gravitational**: Greasy and soapy waters, as well as grey waters enter through gravitational pull through 4” pipe lines without any curves or joints in order to avoid future obstacles generated by obstructed pipelines.

**B- Hauling:** Black waters from guest rooms and tour buses (as long as they are not treated with chemicals that affected water treatments) as injected into the system before reaching the preliminary tanks.

**3.2 Preliminary Tanks:**

These are three tanks in one, each of which measure 8 cubic meters and are joined together so that the water passes through the first to the last, achieving the sedimentation of the solid waste and permitting the water to flow through to the biodigestor in a uniform manner to favor its treatment.

**3.3 Digestor**

The digester has an extension of 25 meters and 2.5 meters in diameter. It is located 1 meter underground and 1.5 meters above ground. It is filled to an 80% capacity and the remaining 20% is used to store the gas. Once it fills, the gas is transported through a duct above the bag. It is estimated that under these conditions we will have liquid retention for 45 days, then obtaining the end result of water and gas.

**4**. **By-Products.**

1. **Water**: considering that the water will contain some solids and fecal coliforms, it will be submitted to a series of four large filters and microorganisms are introduced at this stage. It then passes through an oxygenation lagoon with plants in order to permit an exchange of water and the plants are nourished by the nutrients still present in the water. Later, it receives radiation through ultraviolet lights. Next, it passes through very fine filters with hydroponic plants which have the same purpose of the oxygenation lagoon. Finally the water fills a tank with fish and plant life, in order to obtain a greater retention and serve as a very sensible biological indicator.
2. **Gas**: The type of gas produced is propane, which is used in the kitchen and for lighting.

**5. Contingency Plan:**

If we were to have any problem with this system, we would use the drains through which all of our waste products circulated and our septic tanks, which would allow us to store the waters until our system were repaired.

