PRELIMINARY ENGINEERING REPORT

ROLLINS JAMAICA, LTD
WASTEWATER COLLECTION, TREATMENT & IRRIGATION DISTRIBUTION SYSTEMS
ROSE HALL, JAMAICA

INTRODUCTION

Rollins Jamaica, LTD is looking to construct and operate a wastewater collection, treatment & irrigation distribution system in Rose Hall, Jamaica (Figure 1). The following report gives a basic outline description of the three major components to the total system. Each of the three sections will contain estimated construction costs, operation and maintenance costs. A final section will provide an analysis of the costs versus the potential revenue from the collection and treatment of the wastewater and distribution of beneficial reuse water for irrigation.

The Rose Hall Plantation is located on the north coast of Jamaica between Montego Bay and Falmouth. Rose Hall includes an eight-mile stretch of beachfront on the Caribbean Sea along the Coastal Highway and rises into the adjacent hills. Currently, several hotels and resorts are located on the shore including the Ritz Carlton, Holiday Inn, Half Moon Hotel, Wyndham Hotel, and Sea Castle. The Wyndham Golf Course, Ritz Carlton Golf Courses and the Half Moon Golf course are located within Rose Hall. The community of Lillipun lies in the eastern end of the eight-mile stretch. The beachfront has a number of developable sites for future hotels, resorts, and commercial property.

Many of the existing hotel and resort properties have individual package wastewater treatment systems. These systems are in need of repair and/or expansion.

Rollins Jamaica, LTD has developed a water supply and distribution utility from various wells located in the hills above the coast. The water from the wells is stored in storage tanks and reservoirs also built by Rollins Jamaica, LTD.

As an additional utility to the water utility, Rollins Jamaica, LTD plans on building a wastewater collection, treatment, and irrigation distribution system. The treated effluent from the wastewater treatment facility would be pumped into an irrigation distribution system for beneficial reuse and sale to customers as irrigation water. It is estimated that the daily average flow from the existing hotels, resorts, and commercial establishments would be 350,000 gallons per day with a potential future flow of 1,000,000 gallons per day. The Rollins Jamaica, LTD would build, operate, and maintain a wastewater collection forcemain. The forcemain would extend along the eight-mile stretch of Coastal Highway. The wastewater customers would pump wastewater from a pump station that would be owned and operated by the customer into the forcemain to the

proposed wastewater treatment facility. The wastewater treatment facility would be located near the middle of the development, along the Coastal Highway, across from existing wastewater treatment lagoons.

The wastewater treatment facility would be an extended aeration system. The benefits of an extended aeration system include: ease of operation and maintenance, more capable in handling spikes in flow and contents without upsetting the biological treatment process than other types of treatment systems, and less solids generated that require disposal.

The effluent from the treatment facility would be collected in a basin where it would be pumped into a pressure distribution system for beneficial reuse as irrigation water. Rollins Jamaica, LTD would sell the effluent to the various hotels, resorts, and commercial properties along the Coastal Highway. The excess irrigation water not consumed would be stored in a reservoir located on the adjacent hillside. The stored water would be repumped into the system during peak usage.

COLLECTION SYSTEM

Wastewater flows will be pumped into a pressurized force main. These flows will be monitored through the use of Mag Meter devices at each customer's discharge point. The wastewater collection system has been designed such that it is capable of handling flow simultaneously from all discharge points. The pump rate peaking factor will be based upon the size of each customer's wet well and its capacity to equalize flow. For the calculations, a peaking factor of 1.5 has been assumed. Discharge points will be from pumping stations, which will be later specified by Rollins Jamaica, LTD, and shall be purchased and maintained by each wastewater customer. These stations shall be submersible or suction lift package stations capable of operating within a hydraulic head range of 4.5 to 43 feet. The stations shall be duplex stations outfitted with level sensing alarms and incorporate an odor control system. The majority of each station shall be below ground with the exception of any necessary above ground appurtances. It is recommended that these stations be supplied with an appropriate source of backup power in the event of a power loss. A typical layout of these stations can be viewed in Figure A.1 in Appendix A.

The collection system will consist of approximately 42,240 liner feet of 4-inch, 6-inch, and 8-inch PVC pipe. Construction costs assume that all road crossings will be bored with casing installed. All roads/driveways that are open cut shall be backfilled entirely with stone and returned to their previous state. Stream crossing are assumed to incorporate Best Management Practices (BMP) in order to minimize the effects of storm water runoff into streams. All installation shall be performed in accordance with local utility construction standards.

The table below outlines the estimated costs for construction of the collection system. All costs include materials and labor necessary for installation as well as all miscellaneous appurtances. A more detailed cost summary can be viewed in the Table A.2 in Appendix A.

TABLE 1

ITEM	COST
4-inch PVC	$130,459
6-inch PVC	$540,446
8-inch PVC	$305,250
TOTAL COST	$976,155

All costs in US Dollars

IRRIGATION SYSTEM

Due to the high quality of treatment at the wastewater treatment facility, the treated effluent from the plant will be made available to surrounding facilities to provide irrigation. This will provide a beneficial system for the reuse of the water as well as an additional source of revenue for Rollins Jamaica, LTD.

The primary design of the irrigation system is to utilize the effluent discharge from the plant for irrigation. A 90 horsepower booster station located at the wastewater treatment facility will pump the effluent into the system. Effluent from the wastewater treatment facility, not immediately consumed for irrigation will be discharged and stored in two reservoirs, Stable Lake and Nursery Lake. During times of peak irrigation demand any necessary additional irrigation water will be supplied from a booster station located near Stable Lake or supplied by gravity from Nursery Lake.

Stable Lake is a man-made reservoir located approximately 3,000 feet south of the Coastal Highway. The lake is situated at an approximate elevation of 165 feet MSL and has a storage capacity of 25 million gallons. Water will be pumped to the top of an earthen dam and drawn off the bottom through a 10 horsepower booster station.

Nursery Lake is a man-made reservoir located approximately 5,500 feet south of the Coastal Highway. The lake is situated at an approximate elevation of 455 feet MSL and has a storage capacity of 33 million gallons. Water will be pumped into the lake and then supplied to the system through gravity feed.

The booster stations located at the Stable Lake and the wastewater treatment facility, as well as the hydraulic head produced at Nursery Lake, will be capable of maintaining an average minimum static pressure in the system of 45 psi. Construction of the waterline will consist of approximately 53,240 linear feet of 6-inch and 12-inch diameter PVC pipe as well as all necessary appurtances. Rollins Jamaica, LTD will provide the necessary taps to the irrigation main and set the necessary meters. It will be the responsibility of the irrigation customer to connect to the meter.

Construction costs assume that all road crossings will be bored with casing installed. All roads/driveways that are open cut shall be backfilled entirely with stone and returned to there previous state. Stream crossings are assumed to be done with Best Management Practices (BMP) in use to minimize the effects of storm water runoff into streams. All installation shall be performed in accordance with local utility construction standards.

The table below outlines the estimated costs for construction of the collection system. All costs include materials and labor necessary for installation as well as all miscellaneous appurtances. A more detailed cost summary can be viewed in the Table A.2 in Appendix A.

TABLE 2

ITEM	COST
6-inch PVC	$677,180
12-inch PVC	$780,487
90hp Duplex Booster Station w/ backup generator	$214,000
10hp Duplex Booster Station w/ backup generator	$53,500
TOTAL COST	$1,725,167

All costs in US Dollars

WASTEWATER TREATMENT SYSTEM

The Plant is 1.0 million gallon per day (mgd) Extended Aeration Wastewater Treatment Plant. The proposed location of the Plant is south of the current wastewater lagoons located on the Coastal Highway (Figure 2). A Site Plan of the Plant is shown on Figure 2.

The Basis of Design for the Plant is based on the following criteria:

Influent Characteristics

Average Design Plant Flow	-	1.0 mgd
Peak Flow	-	2.5 mgd
Influent BOD_5	-	280 mg/l
Influent TSS	-	250 mg/l
Influent NH_3-N	-	20 mg/l
Influent Phosphorus	-	8 mg/l
Wastewater Temperature	-	20°C
Altitude	-	100 feet
Alpha Coefficient	-	0.85
Beta Coefficient	-	1.0

Number of Reactors	-	2
Reactor Dissolved Oxygen	-	2.0 mg/l

Effluent Requirements

BOD_5	-	30 mg/l
TSS	-	30 mg/l
NH_3-N	-	1 mg/l
Phosphorus	-	1 mg/l

Jamaica National Sewage Effluent Standards

BOD_5	-	20mg/l
TSS	-	30 mg/l
Nitrates (as Nitrogen)	-	30 mg/l
Phosphates	-	10 mg/l
COD	-	100 mg/l
PH	-	6-9
Fecal Coliform	-	1000 MPN/100 ml
Residual Chlorine	-	1.5 mg/l

The eight major components of the Plant are described below:

1) Micro Strainer Screen – Untreated waste enters the Plant at the Micro Strainer Screen (Screen) where plastic, rags, paper, and other nuisance items are separated from the waste stream by the Screen (see Figure 2, #1). The Screen contains a screw conveyer that removes the nuisance solids from the wastewater to a separate discharge point for removal and disposal. The Screen has 1/4 –inch openings with a head loss of 6 inches at peak flow. The Screen is equipped with an emergency bypass.

2) Anaerobic Reactor – The wastewater enters the Anaerobic Reactor (Reactor) where phosphorus is removed. The phosphorus removed from the wastewater is incorporated into the sludge mass (see Figure 2, #2). Submersible mixers within the Reactor keep the wastewater mixed while maximizing anaerobic conditions. The reactor is divided into 3 chambers allowing for greater flexibility in series or parallel operation. The waste stream leaves the Reactor through slide gates and flows into the Oxidation Ditches. The Reactor has a hydraulic detention time of 1.5 hours at 1.0 mgd. The total volume of the Reactor is 62,000 gallons.

3) Oxidation Ditches – The waste stream enters the two-Oxidation Ditches (Ditches) where oxygen is added to the wastewater (see Figure 2, #3). Each Ditch contains two large rotors, which oxygenate the wastewater in each ditch, resulting in denitrification. Denitrification removes nitrogen from the wastewater. The Oxygen Ditches can be operated in parallel or series depending on the flow conditions.

A loading rate of 14.0 lbs of BOD_5/1,000 cubic feet at average design conditions was utilized to provide a hydraulic detention time of approximately 21.3 hours in each of the two Ditches. The average loading of 200 mg/l BOD_5 and 20 mg/l NH_3-N was selected for the design. To meet oxygen conditions requirements for a standard oxygen requirement of 103.2 lbs of oxygen per hour was selected for each reactor. This is based upon a BOD_5 removal of 1.5 lbs of O_2/lb BOD_5 and oxygen requirement for nitrification of 4.6 lb O_2/lbNH_3-N. The actual oxygen requirement was then converted to standard conditions. The total daily oxygen requirement is 4,955 lbs/day. Volume of each Ditch is 444,298 gallons.

4) Clarifiers – The waste stream enters the clarifiers where the solids are segregated and removed from clarified effluent (see Figure 2, #4). The decanted effluent leaves the Clarifiers and enters Pump Station #1. The decanted effluent is then pumped to the wet well adjacent to Pump Station #1. The pump station pumps the decanted effluent into the irrigation system for beneficial reuse. The volume of each Clarifier is 166,500 gallons.

5) Return Activated Sludge Pumps - The Return Activated Sludge (RAS) is pumped by the RAS pumps back into the Oxygen Ditches to ensure a viable biomass is maintained in each ditch (see Figure 2, #5). The Waster Activated Sludge (WAS) is sent to the Aerobic Digester.

6) Aerobic Digester – The WAS is pumped to Aerobic Digester (Digester) that provides sludge stabilization by aerobically treating the remaining degradable organic components of the wastewater (see Figure 2, #6). The Digester will also provide additional sludge thickening and allow for decanted water to be returned to the headworks of the Plant. After digestion, the sludge will go to the Sludge Drying Beds. The Digester has a volume of 64,575 gallons.

7) Sludge Drying Beds – The Sludge Drying Beds (Beds) allow the sludge from the Digester to be dried (see Figure 2, #7). The Beds contain an under drain, which captures water from the sludge and returns it to the headworks of the Plant. A concrete-retaining wall surrounds the Beds. Upon drying, the sludge will be land applied on Rose Hall Jamaica, LTD's land for agricultural beneficial reuse. After drying, the sludge is expected to meet US EPA's Class B for land application. The proposed sludge drying beds are 20 feet by 100 feet in area. There will be eight drying beds based on the volume of sludge generated each day from the Digester.

8) Ultraviolet Light Disinfection – The decanted effluent flows from the Clarifiers and goes through Ultraviolet (UV) lamps that disinfect the effluent prior to being pumped into the irrigation system. The UV lamps transfer electromagnetic energy from its arc lamps to an organism's genetic material (DNA and RNA). When UV light penetrates the cell wall of an organism, it destroys the cell's ability to reproduce. The design criteria for the UV systems are as follows: TSS –

30 mg/l, UV transmittance @ 253.7 nm is 56%, and 200 fecal coliform/100 ml sample. The one bank UV unit contains four lamps per lamp module and eight UV lamp modules.

9) Pump Station #1 – The clarified effluent from the Clarifiers are pumped to the irrigation system for beneficial reuse (see Figure 2, #8).

Additional technical information is contained in Appendix B.