



Improvements to the Dr. Juan A. Rivero Zoo

Civil and Environmental Engineering Senior Design Project: WI-17 & SP-18

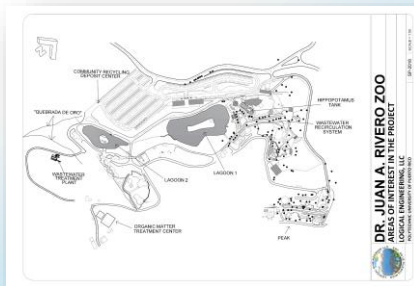
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Abstract

Logical Engineering, LLC was assigned by the Puerto Rico Department of Sports and Recreation to improve the wastewater treatment plant (WWTP) and to provide a recirculation system at the hippopotamus tank of the Dr. Juan A. Rivero Zoo in Mayagüez. Upon several site visits, the team encountered other problems at the facility and improvement alternatives were proposed. These include soil erosion control measures, the implementation of aeration systems at the existing lagoons, and an integrated solid waste management plan. The alternatives were evaluated considering environmental and economical feasibility aspects. The selected alternatives include: modification of the WWTP using a Moving Bed Biofilm Reactor (MBBR) system, installation of vermifilters for the hippopotamus tank wastewater recirculation system, a community solid waste deposit center, and segregation/processing of organic and inorganic materials.

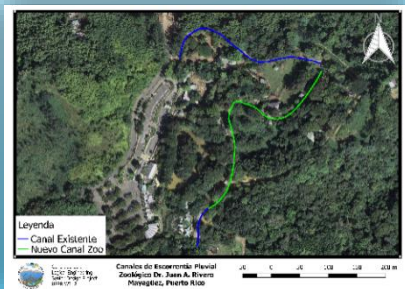
Objectives

- Retrofit the WWTP.
- Provide a wastewater recirculation system for the hippopotamus tank.
- Provide erosion control measures.
- Implement an integrated solid waste management plan.



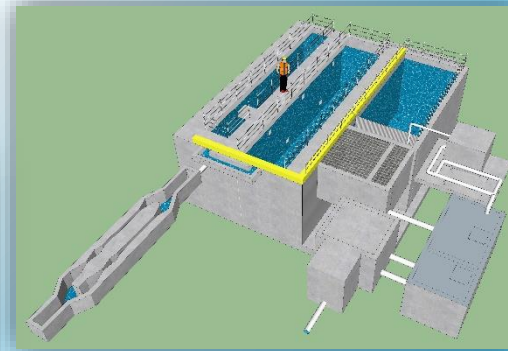
Runoff and erosion control

Additional channels will be constructed to divert stormwater runoff to the lagoons. Vetiver barriers will be planted at those areas with severe soil erosion problems.



Wastewater treatment plant retrofit

The existing WWTP will be modified by expanding the current equalization tank, transforming the existing clarifier into a MBBR, furnishing a solid separation and dewatering unit, and installing an UV radiation system. The existing lagoons will be converted into aerated lagoons to treat combined sewage and stormwater runoff. Vetiver plants will be used as buffers for the stormwater runoff that enter into the lagoons.



Integrated solid waste management plan

Solid wastes will be managed by separating the organic from the inorganic material. The organic matter will be treated in a continuous flow-through vermicomposting system. The inorganic material collected at the zoo and delivered by the community will be further segregated in to aluminum cans, plastic, glass, paper, and cardboard for the recycling program of the Mayagüez municipality.



Wastewater recirculation system for the hippopotamus tank

To reduce water consumption, a wastewater recirculation system was developed, consisting of two vermifilters and UV radiation. The vermifiltration system, designed to process 100,000 GPD, will be composed of sand, gravel, and soil with worms.



Costs, savings, and profits

	WWTP retrofit	Wastewater recirculation system for the hippopotamus tank	Runoff and erosion control	Integrated solid waste management plan	Service roads
Capital Costs *	\$180,058	\$37,668	\$95,652	\$142,772	\$24,700
Savings* (annual)	***	\$59,300.00	***	***	***
Profits* (daily)	***	***	***	\$9,900	***

* Estimated values

Conclusion

Innovative solutions, such as a MBBR system for the existing wastewater treatment plant, a vermifilter for the wastewater recirculation of the hippopotamus tank, vetiver barriers for erosion control, and a vermicomposting flow-through system to handle organic wastes, were selected and developed.