

# Puerto Rico Water Resources and Environmental Research Institute

Watershed Symposium

Marzo 10, 2022

Dr. Walter Silva

Director and PI



PRWRERI

University of Puerto Rico

Mayagüez Campus

Mayagüez, P.R.

2022



## About Us

The Water Resources and Environmental Research Institute is one of 54 similar research centers in the States, DC, Puerto Rico, Virgin Islands, and Guam/Federated States of Micronesia.

It was established in 1964 by the Water Resources Research Act and presently operating under Section 104B of the Water Research and Development Act of 1984 (P.L. 98-242).

# Objectives

Plan, conduct, and facilitate competent research that foster...

- ▶ Entry of new research scientists into the water resources and environmental fields.
- ▶ Training and education of future water scientists, engineers, and technicians.
- ▶ Preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena.
- ▶ Dissemination of research results to water managers, professional community, and the public.





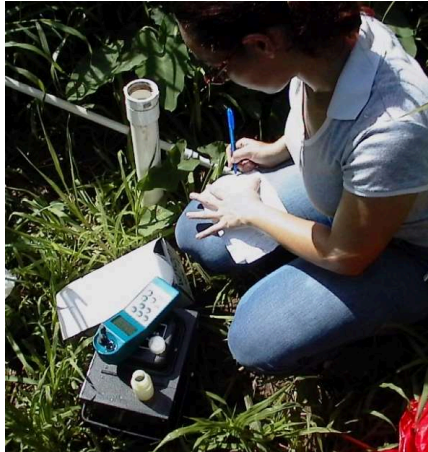
## PRWRERI Externally funded by...

- ▶ USGS
- ▶ USEPA
- ▶ USCoE
- ▶ USDA-NRCS
- ▶ FEMA
- PRASA
- PREQB
- PRDNER
- PRPB
- CARICOOS
- Municipalities
- Private citizens
- Private Professional Firms
- Commerce
- Industry

## WRRI 104B RESEARCH PROGRAM

### Research Interest

- ▶ 1. Natural disasters: Extreme events.
- ▶ 2. Water quality: TMDL's, health agents
- ▶ 3. Climatologic effects on water resources. Local & regional effects.
- ▶ 4. Definition, effects and prediction of droughts
- ▶ 5. Surface water: Urban runoff, river engineering.
- ▶ 6. Erosion and sediment transport.
- ▶ 7. Water supply and distribution systems.
- ▶ 8. Design of water treatment processes.
- ▶ 9. Groundwater
- ▶ 10. Storm and wastewater infrastructure for tropical areas.
- ▶ 11. Watershed and water sources management.
- ▶ 12. Aquatic ecosystems.
- ▶ 13. Development of education programs.
- ▶ 14. Strategies for reforestation and effects on Low Flows.
- ▶ 15. Estuaries and associated wetlands.
- ▶ 16. Use of sinkholes as drainage systems.
- ▶ 17 Economic solutions to water problems.



## Research Interest



**WATER AND WASTEWATER  
(W&WW) TREATMENT**



**SURFACE WATER QUALITY**



## 104B RESEARCH PROGRAM

# Atrazine and glyphosate monitoring in surface water bodies in the Western Region of Puerto Rico



### Scope

Develop and establish a database for water quality parameters including herbicides such as atrazine and glyphosate in different waters streams passing near or throughout crop and farm sites in the western region of PR.

### Tasks

Select and identify crop and farm sites with water streams to be monitored.

Establish a monitoring protocol and frequency.

Establish and develop appropriate techniques/protocols for the detection/quantification of our target contaminants (these substances will be atrazine and glyphosate).

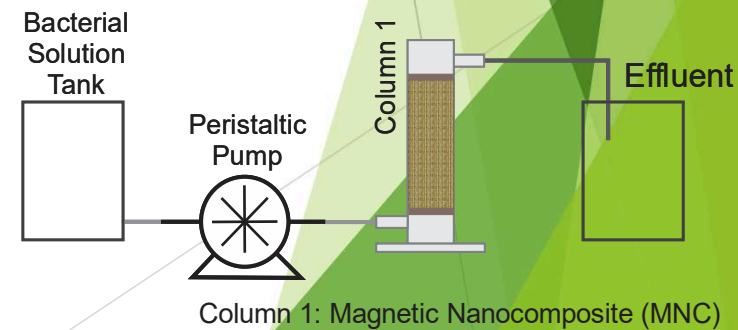
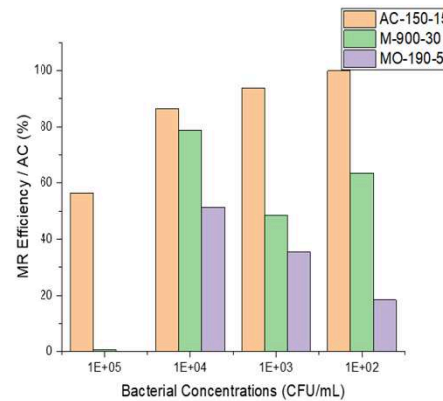
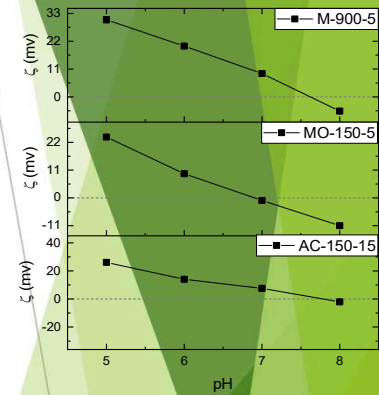
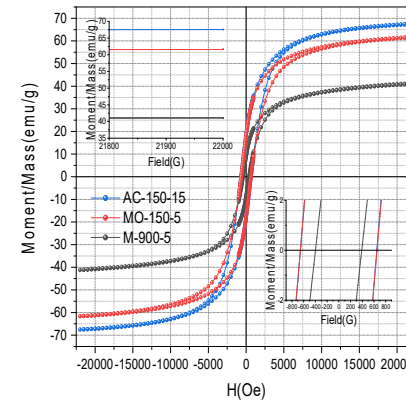
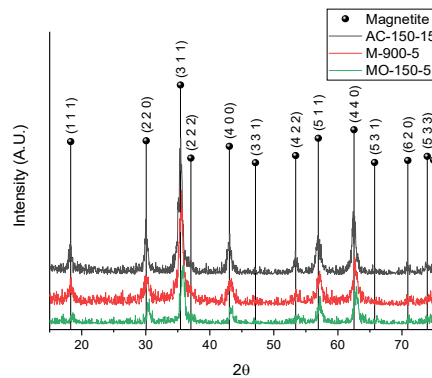
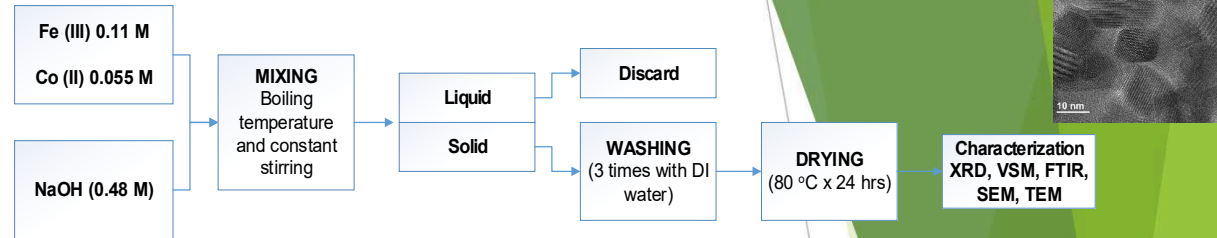
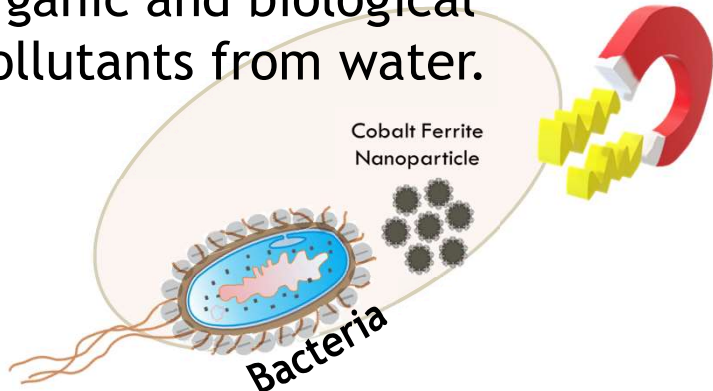
Train the people (graduate and undergraduate students) that will be executing the water sampling, monitoring and analyses.



# 104B RESEARCH PROGRAM

## Synthesis and Characterization of Biopolymer-based Magnetic Nanocomposites for Water Disinfection

Identify an alternative approach, involving a magnetic nanocomposite with the combined capacity to remove inorganic, organic and biological pollutants from water.

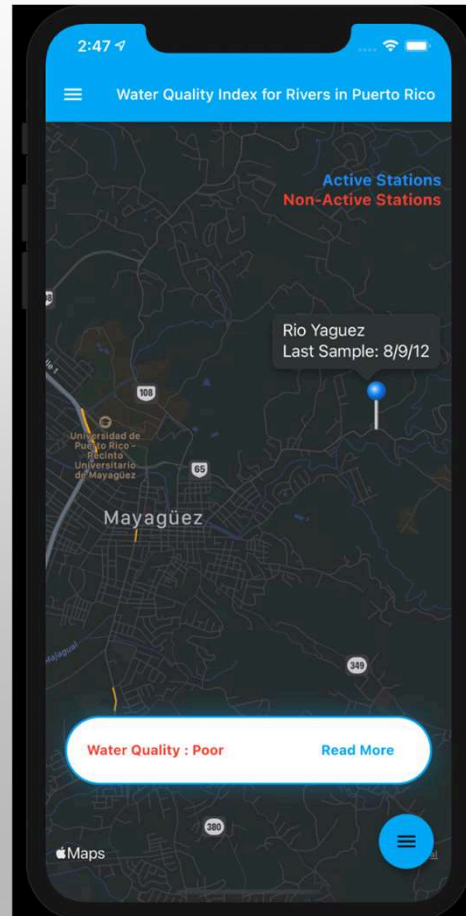




## 104B RESEARCH PROGRAM

# Water Quality Index for Surface Streams in Puerto Rico

WQI	Condition	Color Code
90-100	Good	GREEN
70-90	Moderate	BLUE
30-70	Average	YELLOW
15-30	Caution	ORANGE
0-15	Poor	RED



- ▶ Consider the 10 top pollution parameters.
- ▶ Water quality experts consulted using the Delphi method.
- ▶ Allows monitoring of WQ changes with time.

$$WQI = \left( 1 - N + \sum_{i=1}^n S_i^{-2.5} \right)^{-0.4}$$



## 104B Research Program

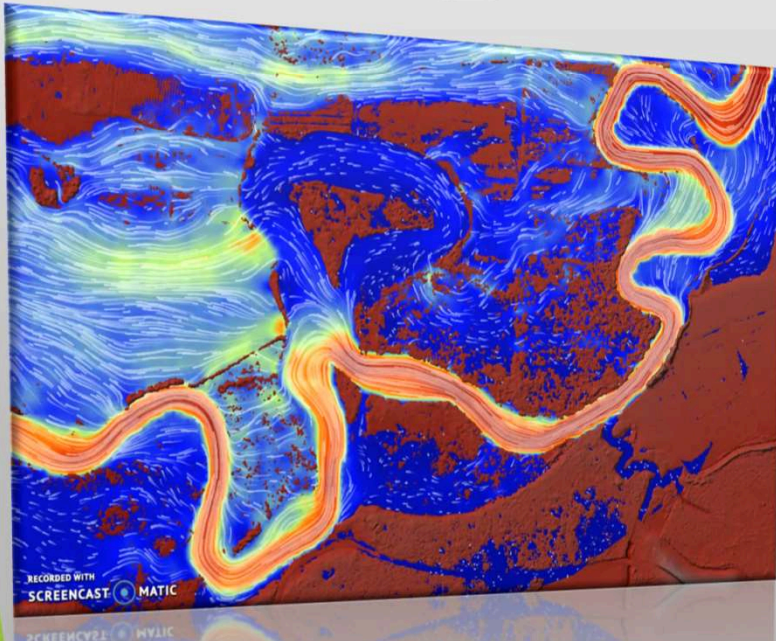


Field Demonstration of  
Removal of MS2  
Bacteriophage and *Bacillus  
subtilis* with a Solar-powered  
Engineered Experimental  
Drum Filtration and  
Disinfection (SEED) Unit

## Surface Water Quality

- Non-point pollutant sources identification
- Optimization techniques for waste allocation
- Pollutant transport simulation
- Pollution prevention

Research Interest (other topics)



Erosion and  
Sediment

Hydrologic/Hydraulic  
modeling

Research  
Interest



*Batis maritima*



*Sesuvium portulacastrum*



*Paspalum vaginatum*.

Demonstration project using recommended flat salt species for Puerto Rico as vegetative erosion protection method at the coastal area of Boquerón Wildlife Refuge (BWR) in Cabo Rojo, Puerto Rico.

# Coastal Erosion Control

Using halophytic plants to help coastal landowners prevent soil erosion

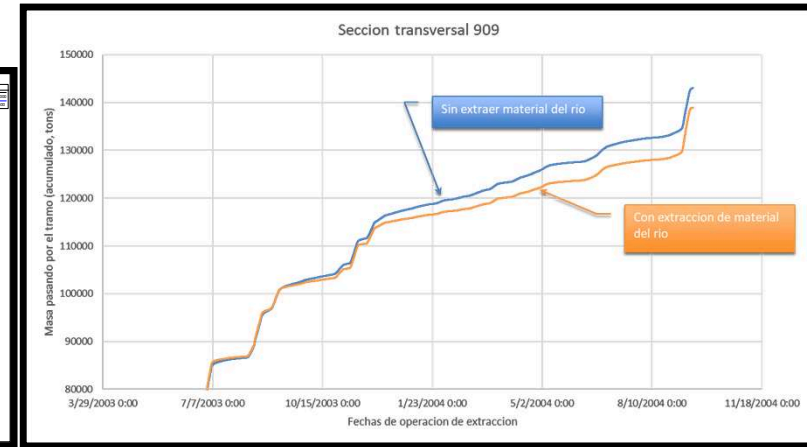
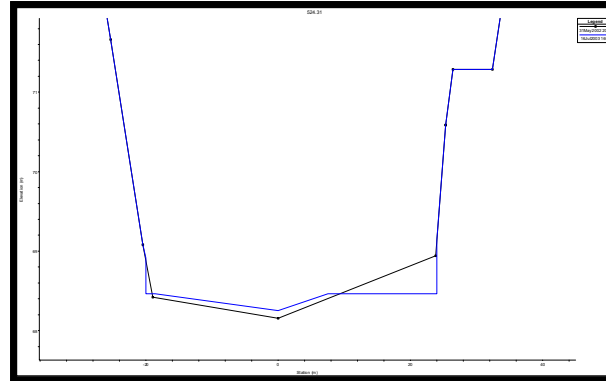
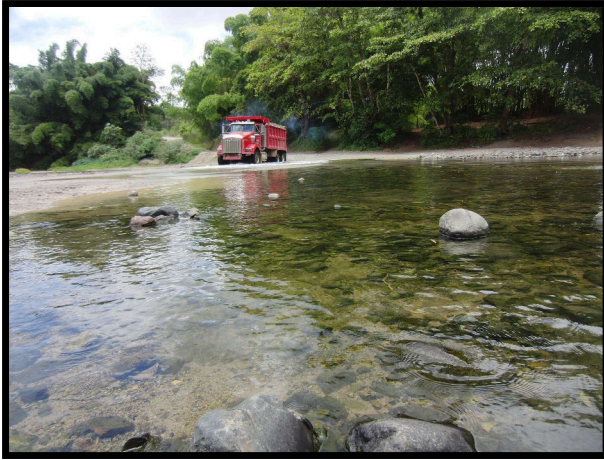
USDA-NRCS Caribbean, Conservation Innovation Grants



Río Grande de Loíza, San Lorenzo

# Dredging and River Mining Operations:

Extracción de materiales del Río Loíza en San Lorenzo, Puerto Rico



## Modeling of dredging for sustainable river mining

# Dredging and River Mining Operations

Extracción de materiales del Río Loíza en San Lorenzo, Puerto Rico



*Dredging and River  
Mining Operations*



*Modelación Hidráulica para la Extracción Sostenible de Agregados para Construcción provenientes de ríos aluviales  
X Seminario: La Sostenibilidad un Punto de Encuentro, Institución Universitaria Colegio Mayor de Antioquia,  
Medellin, Colombia, 2018.*

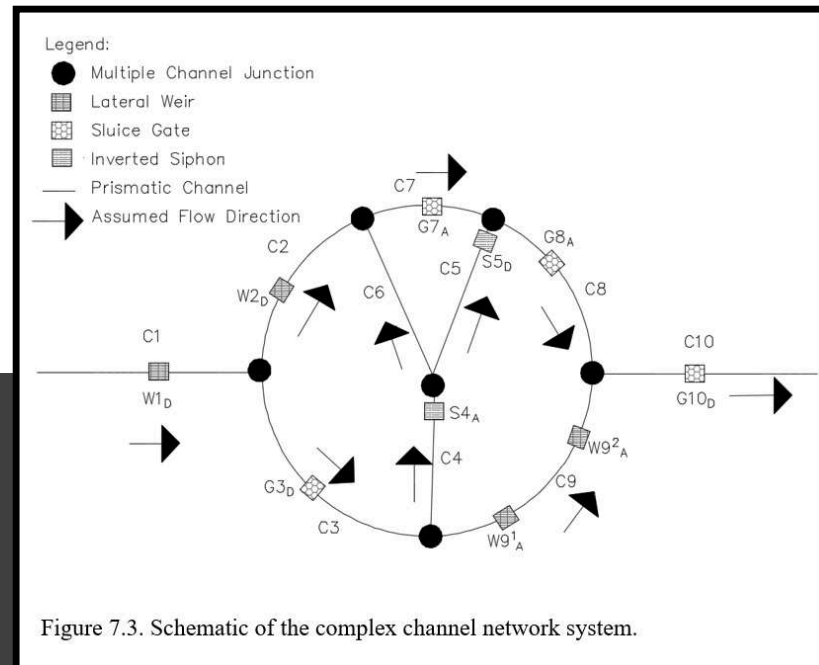


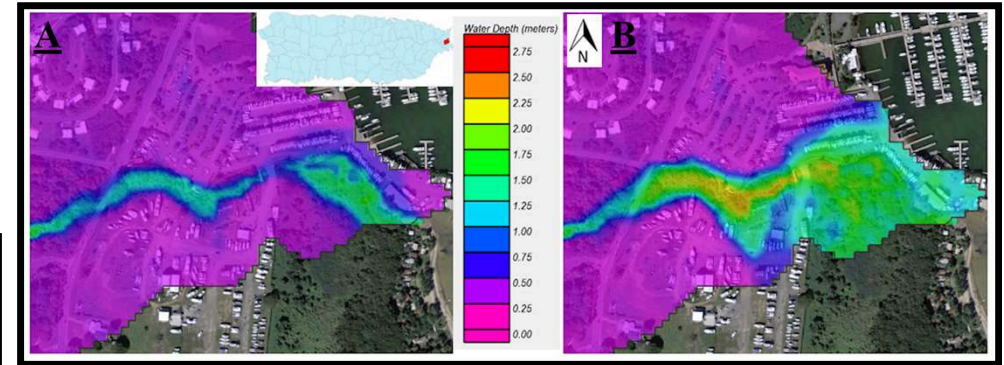
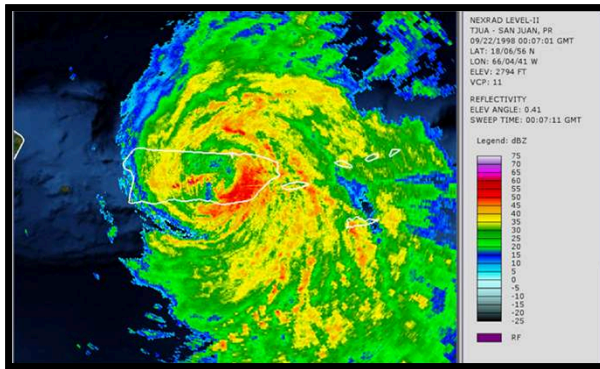


## Field survey at Lajas Valley Irrigation System

- ▶ Algorithm to analyze and design hydraulic structures within a channel system, such as lateral weirs, sluice gates and inverted siphons.
- ▶ Applied to irrigation systems or channel networks.

## Hydraulic Modeling of complex channel irrigation systems





Maximum flood depth for the different flooding scenario at the Demajagua River watershed.

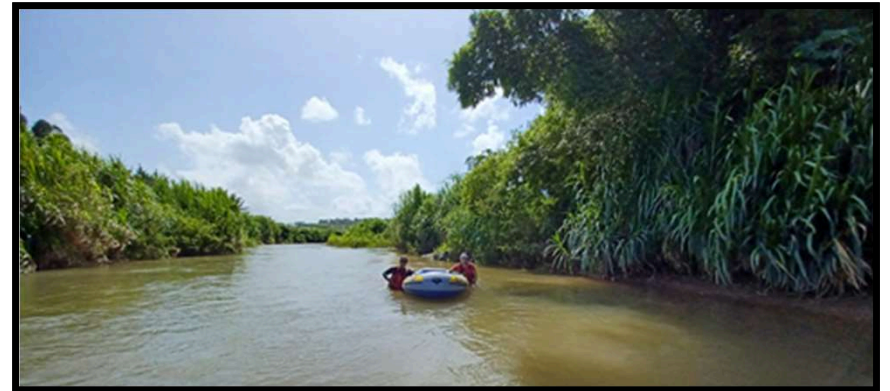
A) Without storm surge inland penetration.

B) Considering storm surge inland penetration.

CARICOOS

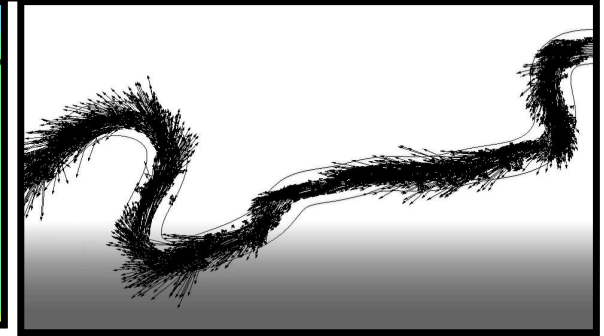
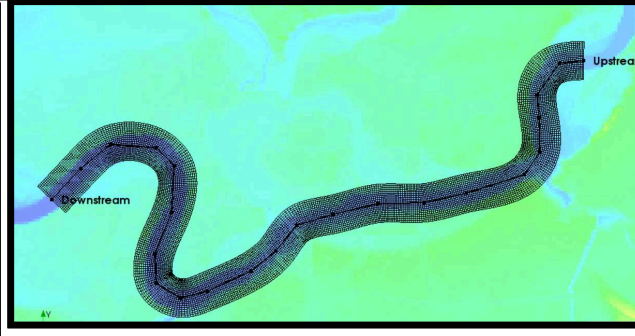
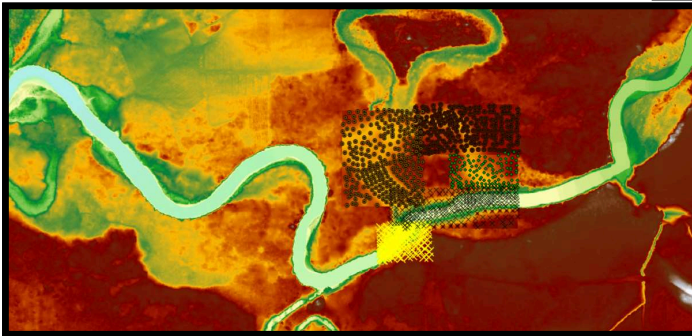
## Dynamic Modeling of Surface Runoff and Storm Surge during Hurricane and Tropical Storm Events

- ▶ Determined coastal flood levels caused by the combination of storm surge and surface runoff.
- ▶ Coupled: A Waves Nearshore model and the Advanced Circulation (ADCIRC) with a 2D hydrologic model Gridded Surface Subsurface Hydrologic Analysis (GSSHA) using radar precipitation.
- ▶ The method was applied to delineate the flood zone affected by Hurricane Georges (1998) in the east coast of Puerto Rico.



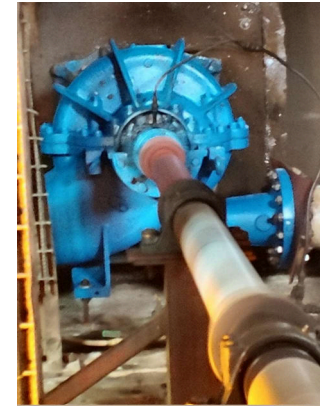
## Meander evolution in watershed flood plains

- ▶ The project objective is to study meander migration in the lower valley of the Añasco river by using field data and state-of-the-art movable boundary models capable of simulating meander evolution.



## Meander evolution in watershed flood plains

- ▶ Localized study at PRASA's raw water intake in Añasco River.
- ▶ On going project



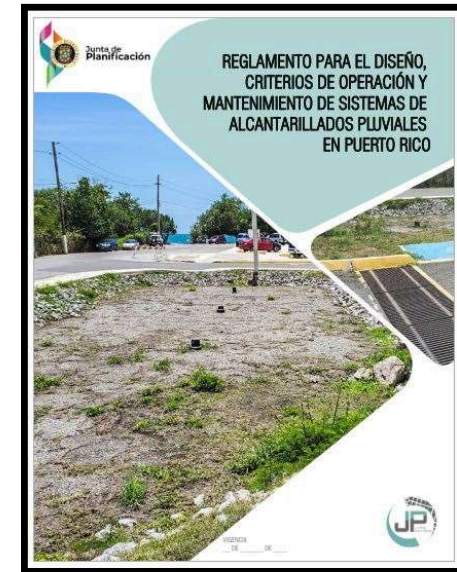
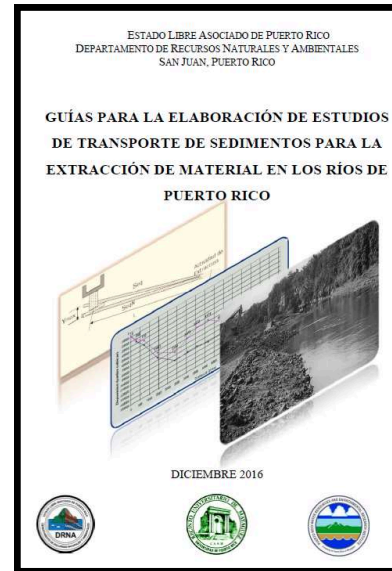
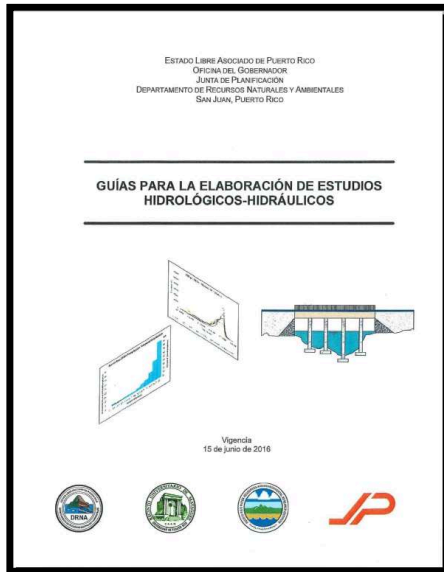
## Alternativas para controlar presiones en sistemas de bombeo del Rio Añasco y Rio Culebrinas

- Proponer medidas de protección contra presiones transitorias durante el arranque y la parada de las bombas en los sistemas de abasto de aguas crudas ubicados en el Río Grande de Añasco y el Río Culebrinas.
- El proyecto incluye tres sistemas de bombeo que suplen aguas crudas a las plantas de Miradero, Montaña y Culebrinas.

## Other Topics

- Multi-objective optimization for decision making.
- Sustainable watershed management.
- Renewable power generation
- Solar distillation technology

Research Interest



## Contributions of PRWRERI to water resources regulations in Puerto Rico

- ▶ Guías para la Elaboración de Estudios Hidrológicos - Hidráulicos
- ▶ Guías para la Elaboración de Estudios de Transporte de Sedimentos para la Extracción de Materiales de los Ríos de Puerto Rico
- ▶ Reglamento para el Diseño, Criterios de Operación y mantenimiento de Sistemas de Alcantarillados Pluviales en Puerto Rico

# Request for Proposals

The Puerto Rico Water Resources and Environmental Research Institute (PRWRERI) has issued the Request for Proposal for the Water Resources Research Institutes 104b Program for Fiscal Year 2022.

The deadline for submitting your application is April 13, 2022, at 4:30 pm.

This year, three projects will be funded.

Each award is expected to be maximum of \$22,000.

For more information contact us at [prwreri@upr.edu](mailto:prwreri@upr.edu).

Access the full RFP below:

<http://prwreri.uprm.edu/documents/PRWRERI104b.pdf>

**PUERTO RICO  
WATER RESOURCES AND ENVIRONMENTAL  
RESEARCH INSTITUTE  
REQUEST FOR PROPOSAL  
FY 2022**

**U.S. Geological Survey  
STATE WATER RESOURCES RESEARCH INSTITUTE  
PROGRAM**

**under Section 104B of the  
Water Resources Research Act of 1984, as Amended**



**APPLICATION PACKAGE  
CLOSING DATE: APRIL 13, 2022, 11:59 PM**



# Contact us

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[Walter.silva2@upr.edu](mailto:Walter.silva2@upr.edu)
  - ▶ <http://prwreri.uprm.edu>

# THANK YOU

