

Form 9-1366  
(May 2018)

U.S. Department of the Interior  
U.S. Geological Survey  
Joint Funding Agreement

Customer #: 600000503  
Agreement #: 19MCJFA0407  
Project #:  
TIN #:  
Fixed Cost Agreement  Yes  No

FOR  
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 1st day of July of 2019, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the PUERTO RICO ELECTRIC POWER AUTHORITY, party of the second part.

- The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation **WATER RESOURCES INVESTIGATIONS (Sedimentation Survey of Lago Patillas, PR) – Scope of Work (SOW) in Attachment(s)**, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
- The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of \$0.

		by the party of the first part during the period
(a)	\$32,000.00	July 1, 2019 to June 30, 2020

		by the party of the second part during the period
(b)	\$48,700.00	July 1, 2019 to June 30, 2020

Total: \$80,700

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of \$0.

Description of the USGS regional / national program:

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between both parties.

- The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
- The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
- The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

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6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.
8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program, and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.  
The Parties acknowledge that scientific information and data developed as a result of the Scope of Work (SOW) are subject to applicable USGS review, approval, and release requirements, which are available on the USGS Fundamental Science Practices website (<https://www2.usgs.gov/fsp/>).
9. Billing for this agreement will be rendered **QUARTERLY**. Invoices not paid within 60 days from the billing date will bear Interest, Penalties, and Administrative cost at the annual rate pursuant the Debt Collection Act of 1982, (codified at 31 U.S.C. § 3717) established by the U.S. Treasury.

**U.S. Geological Survey (USGS)  
United States  
Department of the Interior**

**Commonwealth of Puerto Rico  
Puerto Rico Electric Power Authority (PREPA)**

**USGS Technical Point of Contact**

**PREPA Technical Point of Contact**

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U.S. Geological Survey  
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**USGS Billing Point of Contact**

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**U.S. Geological Survey (USGS)  
United States  
Department of the Interior**

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**Commonwealth of Puerto Rico  
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**Signatures**

By  Date 3-25-2019  
Name: David M. Sumner, Ph.D., PG  
Title: Director, USGS Caribbean-Florida Water  
Science Center


**Signatures**

By  Date July 1, 2019  
Name: Eng. José F. Ortiz-Vázquez  
Title: Chief Executive Officer

# Sedimentation Survey of Lago Patillas, Puerto Rico

## Problem Statement

Lago Patillas is a semi-hydraulic earth fill that impounds waters from Rio Grande de Patillas and Rio Marin (Figure 1). It was constructed in 1914 for the irrigation of croplands in the southern coastal plains of Puerto Rico. The reservoir has a drainage area of about 66.3 square kilometers and its normal pool elevation is 67.67 meters above mean sea level. As stated by Soler-Lopez (2010), the storage capacity was 17.64 million cubic meters (Mm<sup>3</sup>) in 1961 and 13.57 Mm<sup>3</sup> in 2007 (which represent a reduction of 23 percent). The spillway structure consists of three radial arm gates and has an elevation of 58.21 meters, above mean sea level.

 The last sedimentation survey made at Lago Patillas was conducted in 2016 by the Puerto Rico Electric Power Authority (PREPA; private consultant) and the results showed that the Lago Patillas storage capacity has decreased by 0.88 Mm<sup>3</sup> since the last survey made in 2007 [José Bermudez (PREPA); 2019; written comm.]. The 2016 survey also aimed to determine the reservoir storage at the new operating level of 64 m; the estimated storage capacity in 2016 at the lower operating pool level was 8.93 Mm<sup>3</sup>. On September 20, 2017, Hurricane Maria made landfall on the island of Puerto Rico and brought torrential rainfall and flooding. As stated by Gellis et al. (1993), runoff may contribute to transport large quantities of sediments to reservoirs, and hence, to the impairment of reservoir storage capacity.

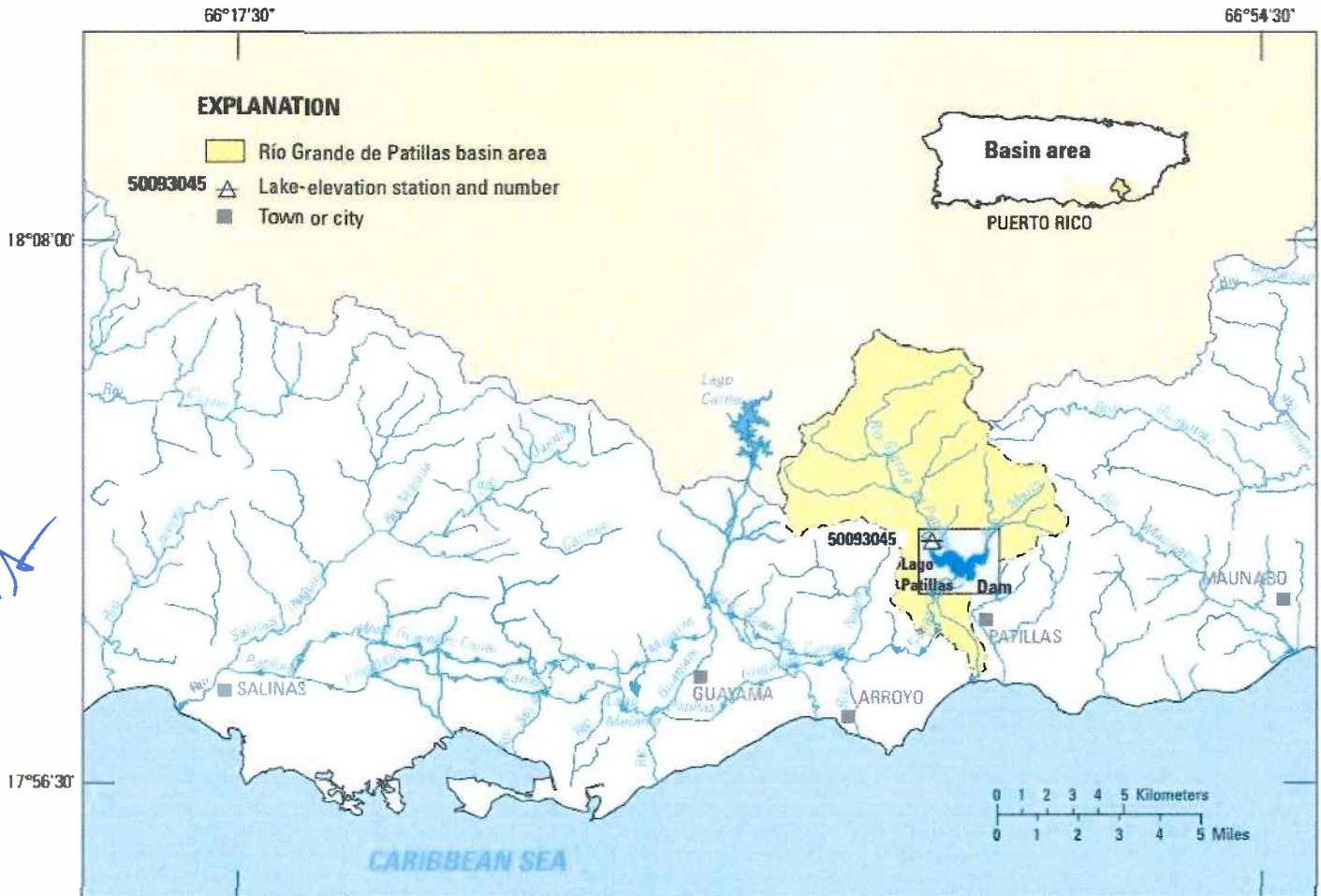
In 2018, high-resolution digital elevation maps generated using Light Detection and Ranging (LiDAR) techniques were released by the USGS based on topographic data collected in 2015. This new dataset provides more accurate information of the topography of Puerto Rico and was collected using the leveling network of Puerto Rico Vertical Datum 2002 (PRVD02). The

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**Prepared in:** February 2019  
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U.S Geological Survey, in cooperation with the PREPA, is proposing to conduct a bathymetric survey to provide an updated stage-volume relation for the Lago Patillas but also to update reservoir surface elevation and datum conversions. This sedimentation survey will provide valuable information in terms of potential sediment-influx caused by Hurricane Maria since the last sedimentation survey was conducted about a year before storm event.

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**Figure 1.** Location of Lago Patillas in the Río Grande de Patillas, Puerto Rico.

## **Objectives**

The objectives of the study are to determine the current (2019) storage capacity of Lago Patillas and to establish the reservoir surface elevation under a revised vertical datum – the Puerto Rico Vertical Datum 2002 (PRVD02). The USGS also proposes to conduct a bathymetric survey of Lago Patillas to map the bottom of the reservoir.

## **Scope**

 The study will generate the information needed to develop strategies to manage the water resources in Lago Patillas. It will provide an elevation-storage capacity relation along with mapping of the reservoir bottom, both of which are essential to management and utilization of the water resources of this reservoir and watershed. The study will also include the use of Global Navigation Satellite System (GNSS) equipment needed for the conversion from local mean sea level to PRVD02 (new vertical datum for control points).

## **Approach**

The tasks proposed in the bathymetric survey of Lago Patillas reservoir include:


- Use of GNSS equipment (survey-grade receiver) to establish Puerto Rico Vertical Datum 2002.
- Collect water depth data throughout the reservoir using a global positioning system (GPS) coupled to a transducer along predetermined navigation lines spaced at 50-meter intervals.

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- Update the elevation-storage capacity relation using Geographic Information System (GIS) tools.
- Generate map of the reservoir bottom, using derived 2015 LiDAR and bathymetric survey data.

### **Relevance and Benefits**

 The proposed study is consistent with the mission of the USGS of providing reliable scientific information to describe and understand the Earth; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life. The information resulting from the project will provide PREPA pertinent data about the historical and current (2019) storage capacities of Lago Patillas. The study will provide the necessary information to plan and develop strategies to enhance the water supply infrastructure of Puerto Rico, which is essential for social and economic stability and growth.

### **Products**

Project data will be published as a USGS Data Release within ScienceBase – the USGS public data-sharing platform - and will include spatial data of bottom contours and data points of water depth collected at Lago Patillas during a bathymetric survey. A USGS Scientific Investigations Map (SIM) will be published detailing all procedures and results. Bathymetric maps depicting the reservoir bottom along with a stage-storage capacity table and curves for 2019



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will also be generated. The total storage capacity for 2019 will be differentiated into live and dead storage and historical sedimentation surveys and the reservoir's projected useful life will be estimated.

### **Timeframe**

The proposed work will occur in the fourth quarter of federal fiscal year 2019, beginning on July 1, 2019 and ending on June 30, 2020. Below is a table summarizing the tasks and their proposed timeframes:

**Table 1. Proposed tasks schedule**



<b>Task</b>	<b>Proposed date</b>
GNSS / GIS pre-work	July 2019
Bathymetric data collection	August 2019
Data processing	September-November 2019
Preliminary results	December 2020
Report preparation and publication	January-June 2020

### **Personnel and project cost**

A hydrologist will be the project chief, responsible for the collection and processing of the bathymetric survey. A hydrologic technician will assist during the data collection. Table 2 shows a summary of the costs associated with the proposed project.

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**Table 2. Project cost**

	<b>Cost</b>
<b>PREPA</b>	\$48,700
<b>USGS</b>	\$32,000
<b>Total</b>	<b>\$80,700</b>

### References Cited

Soler-López, Luis, 2010, Sedimentation survey of Lago Patillas, Puerto Rico, March 2007, U.S. Geological Survey Water-Resources Investigations Report 2010-3128, 20, also available at: <https://pubs.usgs.gov/sim/3128/SIM-3128.pdf>.

Gellis, 1993, A.C., 1993, The effects of Hurricane Hugo on suspended-sediment loads, Lago Loíza basin, Puerto Rico: Earth Surface Processes and Landforms, v. 18, no. 5, p. 505-517

**Addendum I  
to the  
U.S. Department of the Interior  
U.S. Geological Survey  
JOINT FUNDING AGREEMENT 19MCJFA0407**

All payments made by PREPA for works or services performed under this Joint Funding Agreement will be charged to the following PREPA's budget accounts numbers:

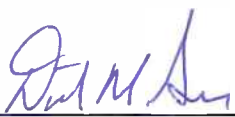
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Payment for Services under this Agreement will not be made until this Agreement is properly registered in the Office of the Comptroller of the Government of Puerto Rico pursuant to Law Number 18 of October 30, 1975, as amended.

Both parties acknowledge and agree that the Services may be provided to another entity of the Executive Branch which enters into an interagency agreement with PREPA or by direct disposition of the Office of the Chief of Staff. Such work will be performed under the same terms and conditions in terms of hours of work and compensation set forth in this Agreement. For the purpose of this clause, the term "entity of the Executive Branch" includes all agencies of the Government of Puerto Rico, as well as public instrumentalities, public corporations.

Pursuant to Memorandum No. 2017-001, Circular Letter 141-17, of the Office of the Chief of Staff of the Governor of Puerto Rico (*Secretaría de la Gobernación*) and the Office of Management and Budget (*Oficina de Gerencia y Presupuesto – OGP*), the Chief of Staff shall have the authority to terminate this Agreement at any time. If so directed by the Chief of Staff, PREPA will terminate this Agreement by delivering to the USGS a notice of termination (in accordance with the terms cited in the Joint Funding Agreement) specifying the extent to which the performance of the work under this Agreement is terminated, and the effective date of termination. Upon the effective date of termination, the USGS shall immediately discontinue all services affected and deliver to PREPA all information, studies and other materials property of PREPA. In the event of a termination by notice, PREPA shall be liable only for payment of services rendered up to and including the effective date of termination.

Signatures

By:  Date 5-13-2019  
David M. Sumner, Ph.D., PG  
Director, USGS Caribbean-Florida Water  
Science Center

By:  Date July 1, 2019  
Eng. José F. Ortiz Vázquez  
PREPA's Chief Executive Officer