## **GUAYANILLA, PUERTO RICO**

Rio Guayanilla Flood Risk Management Feasibility Study

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#### **IAFSM Conference**

March 12, 2020

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."









## AGENDA



**Project Background** 



What is being proposed?



How the Chicago District got involved..



**Other Project Considerations** 



**Planning Study Process** 



Life Safety



Hydrology & Hydraulics





# **Project Background**





### **Project Location**





## **Rio Guayanilla Watershed**



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Watershed Characteristics:

- Total watershed area: 96 sq km (37 sq mi)
- Total river length: 23 km (13.9 miles)
  - Project river length: 6.44 km (4 mi)
- Originates at an elevation of about 1,000 meters (3,280 feet) above msl and empties into Caribbean Sea
- One stream gage operated by USGS since 1981



## **Historic Flooding**

Historic Event	Date of Flood	Peak Discharge (cfs)	
Okeechobee Hurricane "San Felipe II Hurricane"	September 13, 1928	23,000	
Tropical Storm One	May 7, 1932	28,000	
Hurricane Hazel	October 13, 1954	18,000	
	May 6, 1958	11,600	
Hurricane Eloise	September 16, 1975	22,400	
Hurricane David & Hurricane Frederic	August 31, 1979	16,000	
Hurricane Debby	September 12, 1982	14,700	
Tropical Storm Isabel "1985 Flood Disaster in PR"	October 7, 1985	11,900	
Hurricane Georges	September 22, 1998	18,700	
	May 6, 2001	18,700	
Hurricane Ike	September 22, 2008	14,500	
Hurricane Sandy	October 26, 2012	23,800	
Hurricane Maria	September 20, 2017	USGS has not yet published data for Hurricane Maria (FY20	





## Why is the U.S. Army Corps of Engineers involved?





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#### **Study Authority:**

Section 722 of WRDA 1986 (PL 99-662) Bipartisan Budget Act of 2018 (100% Federally Funded)

#### **Study Partnership**

*Non-Federal Sponsor:* Department of Natural and Environmental Resources (DNER)



*Stakeholder:* Municipality of Guayanilla





# Planning Study Process

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Reduce economic damages



## **Previously Completed Work**









File Name

## **Final Array of Alternatives**

Measure Category	Measure Description	Alt 0	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
No Action	Existing & FWOP Conditions	Х						
Nonstructural Measures	Flood Warning System		Х	Х	Х	Х	Х	Х
	Removal of Impediments to Flow		Х	Х	Х	Х	Х	Х
Structural Measures	Levees/Floodwalls Single Line Protection				Х			Х
	Levees/Floodwalls Double Line Protection			Х		Х	Х	
	Bridge & Conveyance Modifications			Х	Х	Х	Х	Х
	Engineered Features & Bank Protection			Х	Х	Х	Х	Х
	Diversion Channel (North)					Х		
	Diversion Channel (South)			Х	Х			
	Rehabilitate Phase I (DNER Constructed)			Х	Х	Х	Х	Х
	Vegetation Control			Х	Х	Х	Х	Х
	Utility Relocation			Х	Х	Х	Х	Х
Nature-Based Measures	Staged Greenway Terraces						Х	Х
	Minor Nature Based Features		Х	Х	Х	Х	Х	Х
	Vegetation Control						Х	Х



## **Project Timeline**



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# Hydrology & Hydraulics

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## **Rainfall Data**

Storm Event	Rainfall (inches)*
2-yr, 24-hr	5.68
5-yr, 24-hr	8.04
10-yr, 24-hr	10.29
25-yr, 24-hr	13.82
50-yr, 24-hr	16.95
100-yr, 24-hr	20.38
200-yr, 24-hr	24.40
500-yr, 24-hr	30.38

\*Values taken from NOAA Atlas 14, at centroid of the watershed



\*Distributions created from Win TR-20





## **Hydrologic Challenges - Calibration**







## **Hydrologic Challenges - Calibration**







### **HEC-RAS Model Development**





### **HEC-RAS: Downstream Boundary Condition**

#### Estimated Relative Sea Level Change Projections - Gauge: 9759110, Magueyes Island, PR



Year



#### **BUILDING STRONG**<sub>®</sub>



Magueyes Island, PR



# What is being proposed?

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# **Project Considerations**



### **Existing Channel & Maintenance**











## **O&M: Vegetation Growth & Maintenance**







## **Construction Considerations**

- Local resources on the island
- Cost to import material
- Labor availability
- Construction Equipment Availability (no off-road dump trucks)





# Life Safety



## **Population at Risk**

- The estimated population at risk is nearly 9,000 as of 2017
- Inundation in homes and streets causes difficulty in evacuating which results in risk of life loss
- Older individuals are particularly vulnerable, as it takes longer to mobilize

Population Age 65+							
	Count	% of Total					
Total Population	8,800	100					
Age 65-69	546	6					
Age 70-79	861	10					
Ages 80+	462	5					
Total 65+	1,869	21					

Source: ACS 2013-2017 5 year estimates at Census.gov





## **HEC-LifeSim**



Hazard Communicated First to EPZ Warning Alert/Warning Protective Action Hazard Identified Received Initiated Issued Time Warning Warning Hazard Mobilization Communication Diffusion Issuance Time or PAI Delay Delay Time Delay

USACE's most rigorous approach for estimating potential life loss due to levee and dam breach.



#### LifeSim continued....





### LifeSim continued....





## Questions



https://www.lrc.usace.army.mil/Missions/Civil-Works-Projects/Rio-Guayanilla



