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UNIVERSITY OF PUERTO RICO-MAYAGUEZ



***ASSESSING THE AWARENESS AND DIFFICULTIES OF
WATER QUALITY MONITORING IN RURAL AREAS:
THE CASE OF NON-PRASA COMMUNITIES IN
PUERTO RICO***

*10TH NATIONAL WATER QUALITY MONITORING
CONFERENCE: "WORKING TOGETHER FOR CLEAN WATER"*



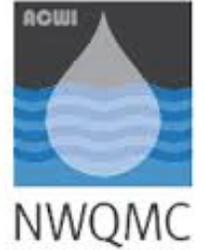
PUERTO RICO LOUIS STOKES



ALLIANCE FOR MINORITY PARTICIPATION



AGENDA



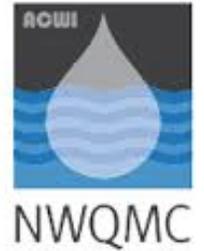
➤ Introduction

- Background Information of Puerto Rico
- Impact of Environmental Studies
- Regulation
- What is Non-PRASA
- Why a water quality monitoring project?

➤ Objectives and Goals

- Trustful Interactions
- Water Quality
- Training: Community & Students
- Identify deficiencies on water quality monitoring

INTRODUCTION



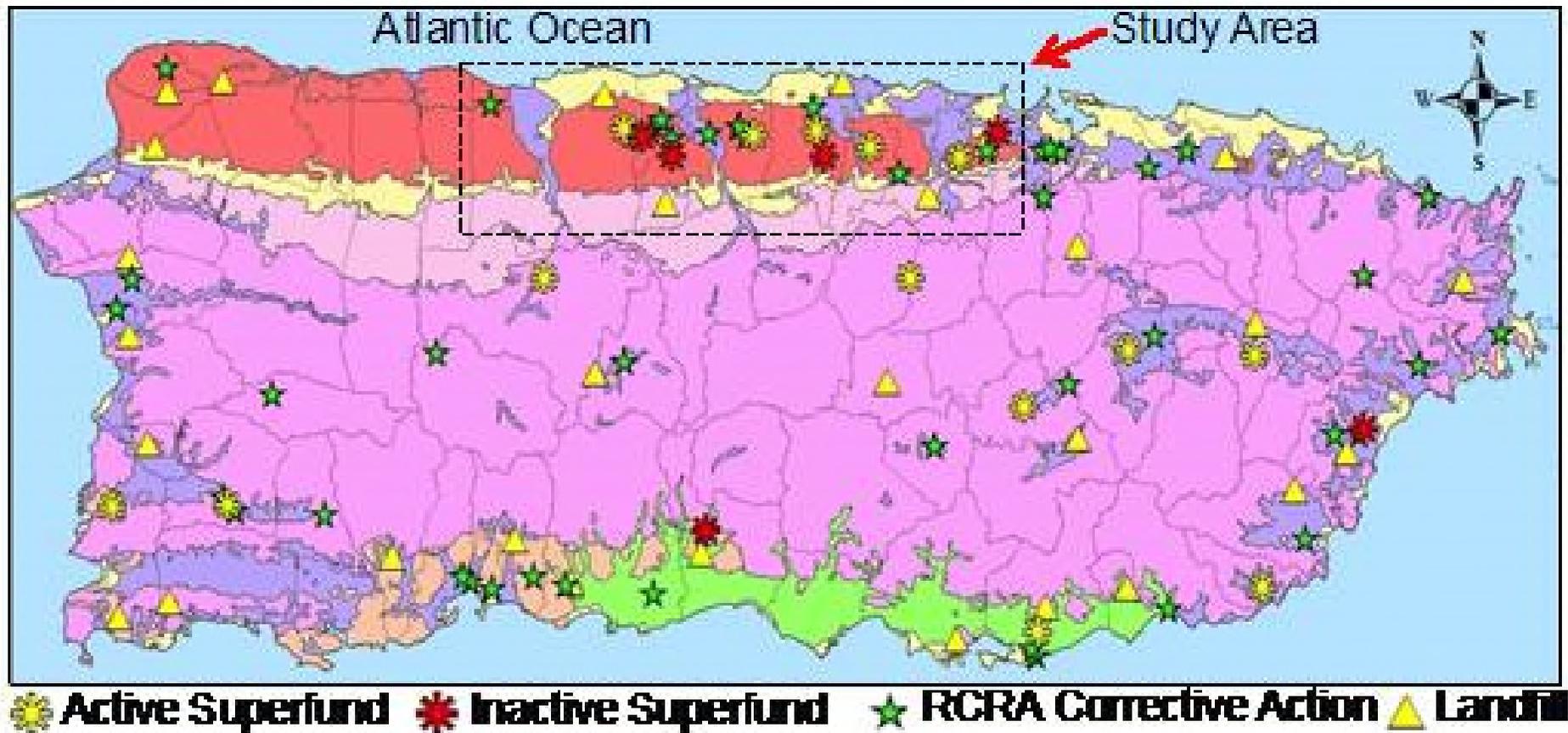
- **Background Information:** Puerto Rico is a Caribbean island and unincorporated U.S. territory with a landscape of green mountains, waterfalls and the tropical rainforest of El Yunque National Forest. It's known for its white-sand beaches and coral reefs, popular for snorkeling, diving, surfing and sailing. In San Juan, the capital and largest city, the Isla Verde area is known for its beach bars, nightclubs and casinos. (Google)



- Map of Non-PRASA systems distribution in Puerto Rico (Courtesy of Dr. Hwang)

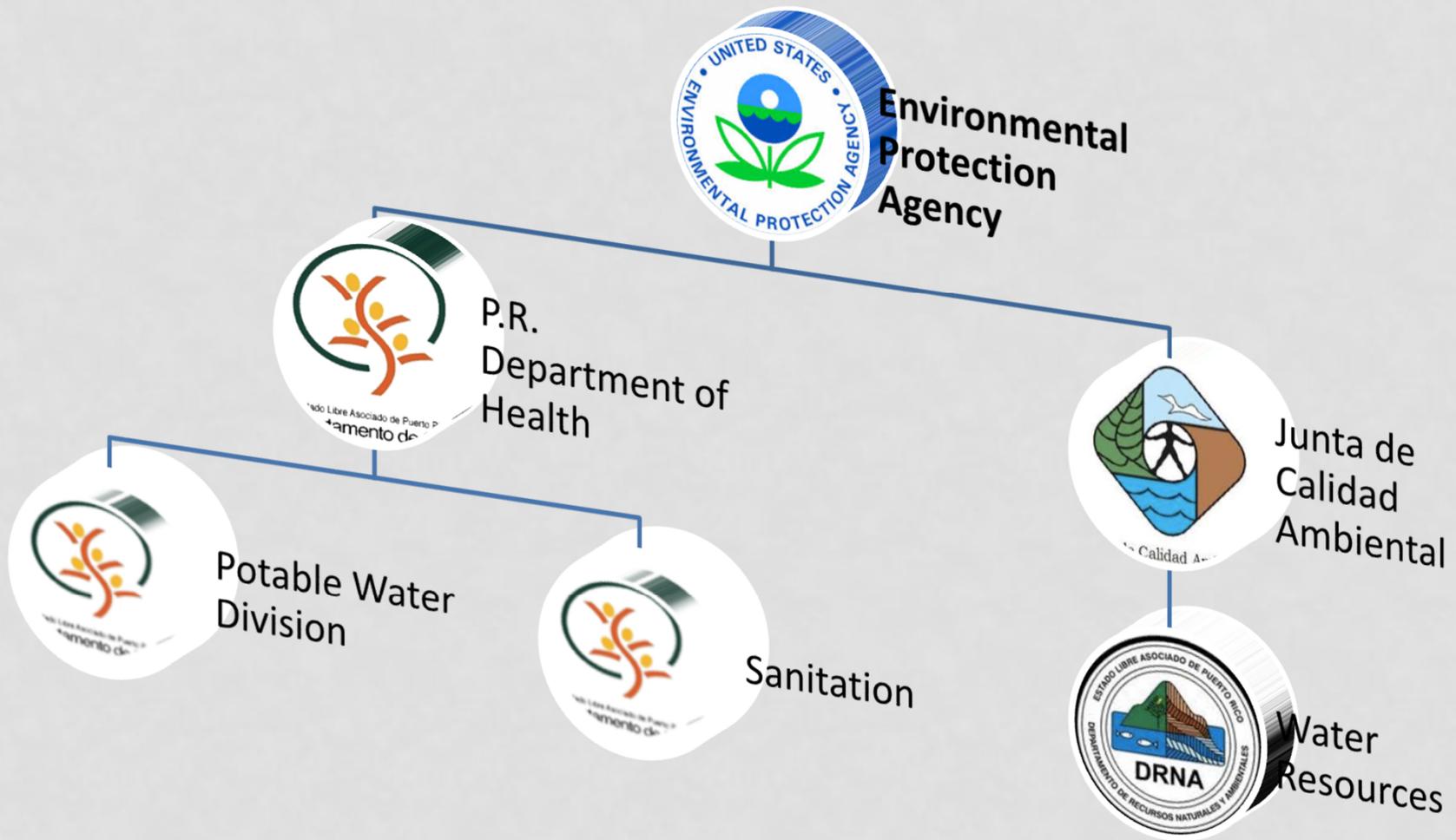
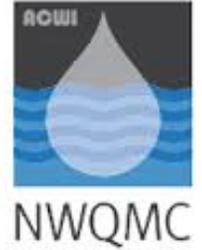
Impact

SUPERFUND SITES IN PUERTO RICO



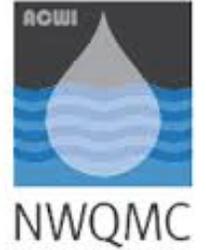
➤ PROTECT Study Area

REGULATION AGENCY



Introduction

NON-PRASA



- Puerto Rico had a total of more than 300 community-managed water distribution systems. These were not supplied by the Puerto Rico Aqueduct and Sewer Authority (PRASA) for potable water, and are thus known as Non-PRASA systems.
- At the present there are around 200 Non-PRASA communities left (mostly in the central area of the island), which still rely on their own water systems and commonly have no or limited disinfection processes

Community –
managed water
systems

Non-PRASA

Water Sources

Surface
Water

Ground
Water

Treatments

Disinfection

Filtration

Disinfection

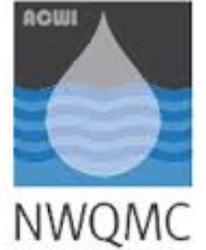
Government
Managed
System

PRASA



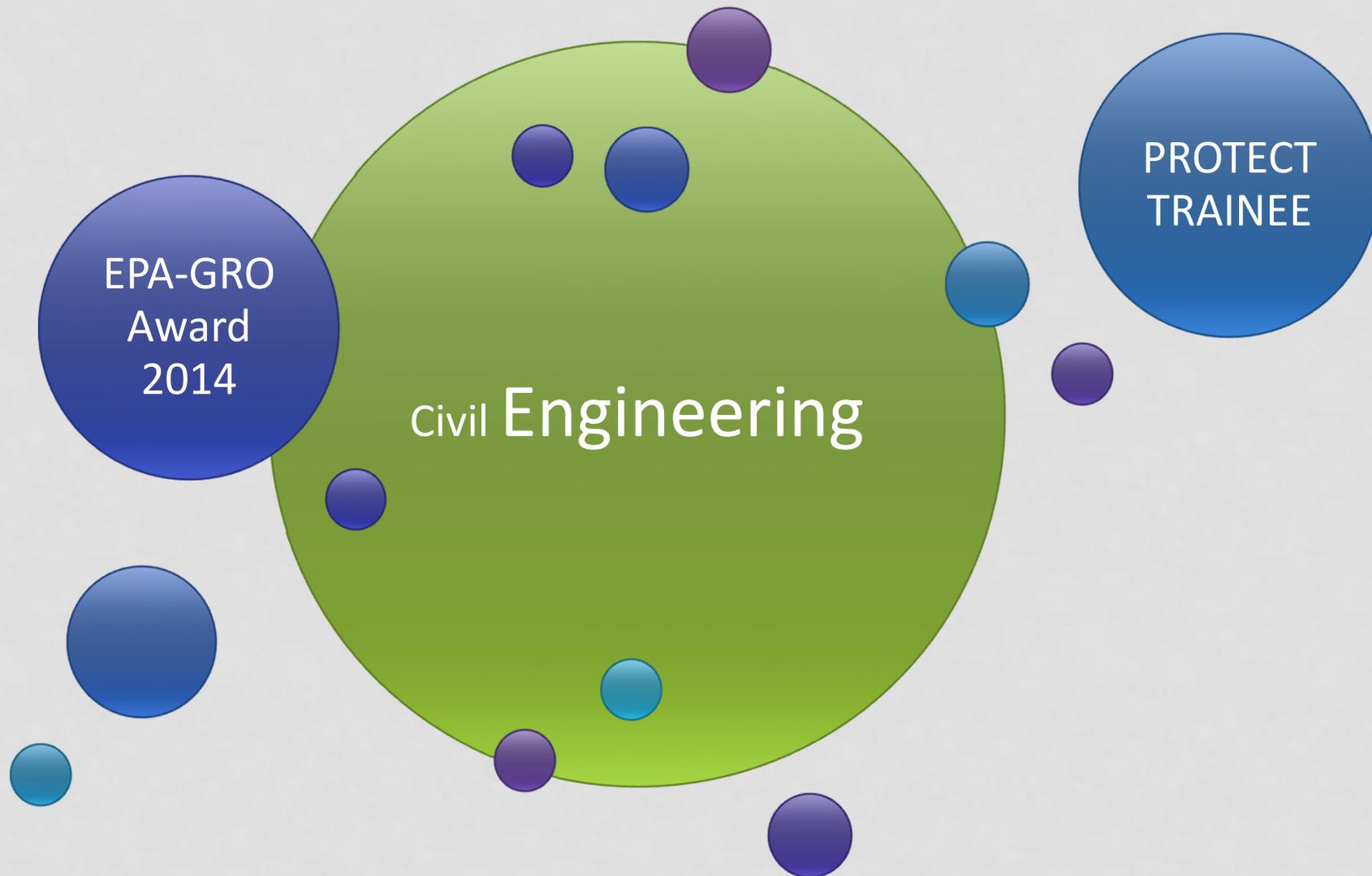
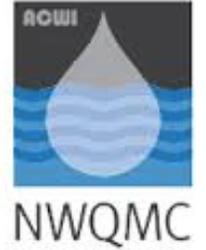
Autoridad de Acueductos
y Alcantarillados

ESTADO LIBRE ASOCIADO DE PUERTO RICO 5



- Title 40 CFR (Code of Federal Regulations)
- Puerto Rico does not have amendments or additional restrictions to the 40 CRF
- The Department of Health inspects and monitors compliance for potable water for AAA and community systems
- The EPA monitors and audits the Department of Health

PROJECT: WATER QUALITY MONITORING



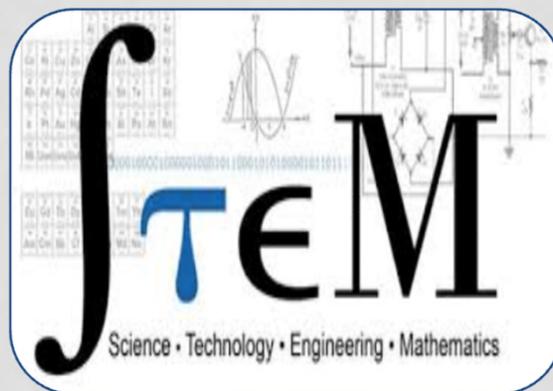
OBJECTIVES AND GOALS



1) Engage in trustful interactions between the community, academia and regulation agencies



2) Determine the water quality of the source water and tap water

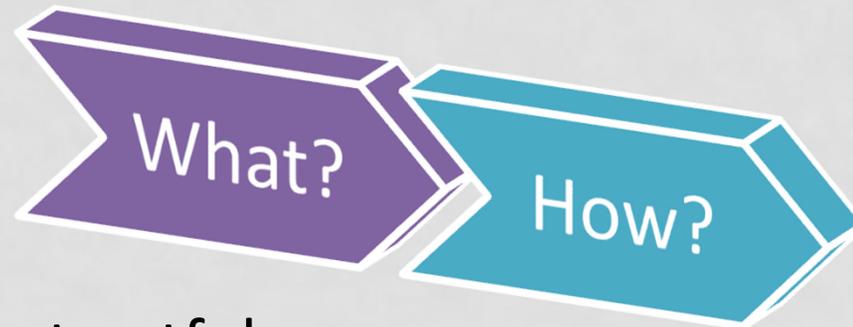
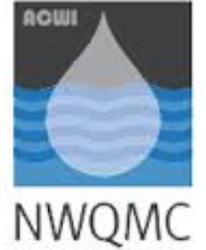


3) Training local community members and Engineering students in the STEM field



4) Identify deficiencies in the water quality monitoring process

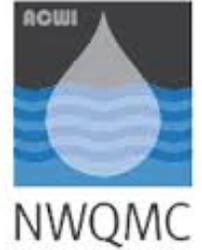
OBJECTIVES AND GOALS (1)



1. Engage in trustful interactions between the community, academia and regulation agencies
 - Honesty when talking to community members (IRB Compliance)
 - Meet my responsibilities though out the project (Community, Agencies, Academia)

Water Quality Project

OBJECTIVES AND GOALS (1)



Community

Compliance with schedule

Compliance with visiting procedures

Available

Delivery Compliance

Support anyway possible



Reclutamiento Hogares Participantes: Bo. Hatillo, Añasco P.R.
Fecha: 09/01/2015

Firme en el encasillado siguiente si le fueron entregados los siguientes documentos:

1. Hoja de Consentimiento Informado
2. Cuestionario de Participación
3. Agenda 2015 para Muestréos

FASE DE MUESTREO	FECHA
FASE 1	del 5 de septiembre de 2015
FASE 2	del 12 de septiembre de 2015
FASE 3	del 2 de octubre de 2015
FASE 4	del 10 de octubre de 2015
FASE 5	del 14 de noviembre de 2015
FASE 6	del 5 de diciembre de 2015

Universidad de Puerto Rico
Escuela Interdisciplinaria de Ingeniería
Departamento de Ingeniería Civil y Agrimensura

No. ID Participante: _____

Consentimiento de Participación

Por favor conteste las siguientes preguntas sobre su opinión de la calidad del agua en su hogar y alrededores:

- 1) ¿Cuánto tiempo lleva recibiendo agua de su pozo (agua subterránea)?
- 2) ¿Cómo se siente al beber el agua de su pozo principal? sí no
- 3) ¿Cómo se siente al beber el agua de su pozo principal? sí no
- 4) ¿Cómo se siente al beber el agua de su pozo principal? sí no
- 5) ¿Qué opinas de la calidad del agua? (ejemplo: buena, algunas veces buena):

Observaciones sobre color, sabor, olor: _____

Si tiene alguna preocupación, explique: _____

- 6) ¿Cuántas personas viven en el hogar? _____
- 7) ¿Tiene pozo séptico? sí no
- 8) ¿Qué tipo de productos utiliza con regularidad para la limpieza de su hogar? _____
- 9) ¿Usa medicamentos por la tubería? sí no
- 10) ¿Usa aceites por la tubería? sí no
- 11) ¿Usa otros productos o artículos desechados por: _____
- 12) ¿Tiene algún inodoro sobre su calidad del agua? sí no
- 13) ¿Conoce los parámetros que se miden para conocer la calidad del agua? sí no
- 14) ¿Conoce personas/agencias que monitorean su calidad del agua? sí no
- 15) ¿Conoce quienes ofrecen mantenimiento en su sistema de distribución? sí no
- 16) ¿Conoce las labores de mantenimiento de su sistema de distribución? sí no
- 17) ¿Tiene algún ducto o inodoro que desconecte sobre su calidad del agua? _____
- 18) ¿Cada cuánto tiempo va para ver el agua que recibe en su hogar? _____
- 19) ¿Cuál es su edad? _____
- 20) ¿Es usted? Femenino Masculino
- 21) ¿Cuál es su grado de escolaridad más alto? _____
- 22) ¿Cuál es su oficio? _____

Muchas gracias por su participación.

Fecha: _____ ID_Punto Muestreo: _____ Iniciales del Investigador: _____

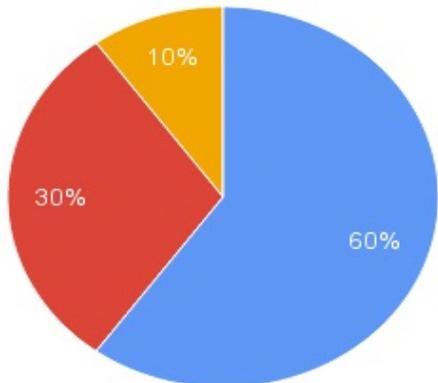


Entrega de resultados: Bo. Hatillo, Añasco P.R.
Fecha: 12/18/2015

A continuación se presentan los documentos entregados como evidencia del trabajo realizado con la comunidad del Bo. Hatillo, Añasco. En las imágenes se encuentra una ilustración de hoja de resultados y el material educativo. Firme en el encasillado siguiente si le fueron entregados los siguientes documentos:

1. Resultados

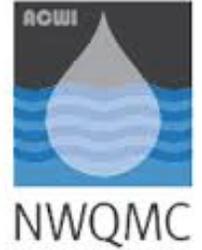
2. Material Educativo



● good ● mostly good ● not good

Water Quality Project

OBJECTIVES AND GOALS (1)



Agencies



EPA-Citizen Science workshop 2015

EPA- Region 4 Summer Internship (QAPP, SOPs, Laboratory and Analytical methods, etc...)

PR Department of Health:
Discuss concerns, monitoring logistics, systems treatment and compliance



Academia:
Radio Interviews
Conference Presentations (SRP 2015, PRLSAMP, UPRM Sigma, NWQMC, others...)

DÍA DE MONITOREO
(CALIDAD
DE AGUA
DE PUERTO RICO



- April 9th, 2016 Water Quality Monitoring Day @ Puerto Rico

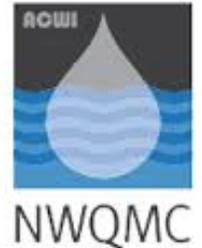
Water Quality
Project

SUMMER INTERNSHIP: EPA REGION 4



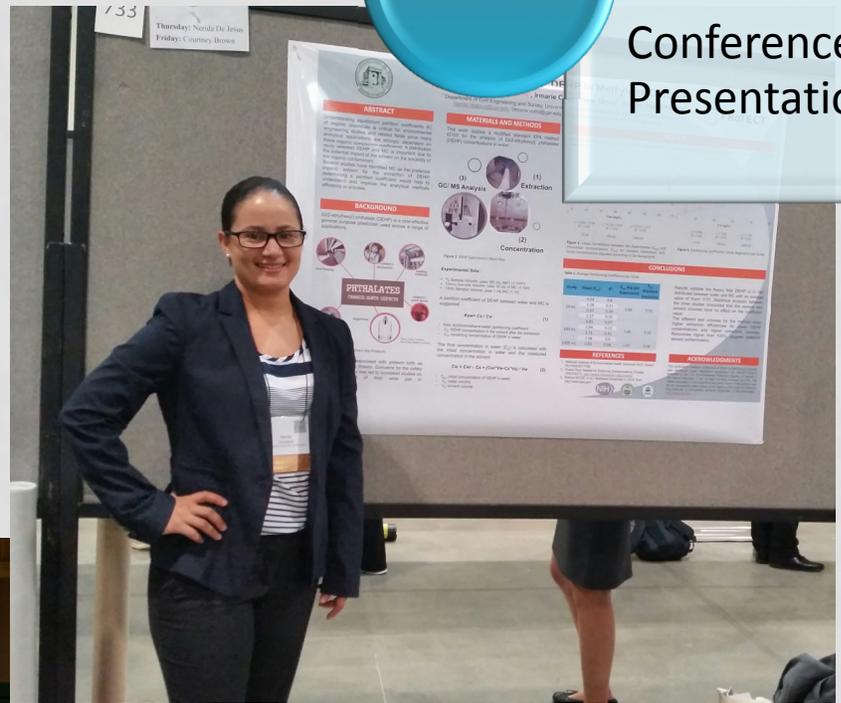
Water Quality Project

RESEARCH TRANSLATION: SRP (2015) PRISM (2016)

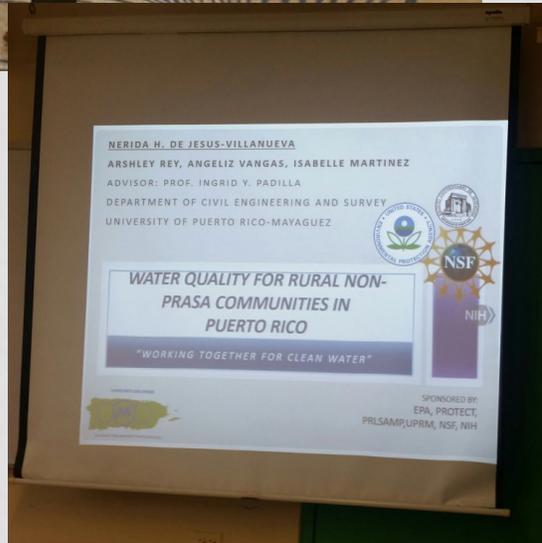


Academia

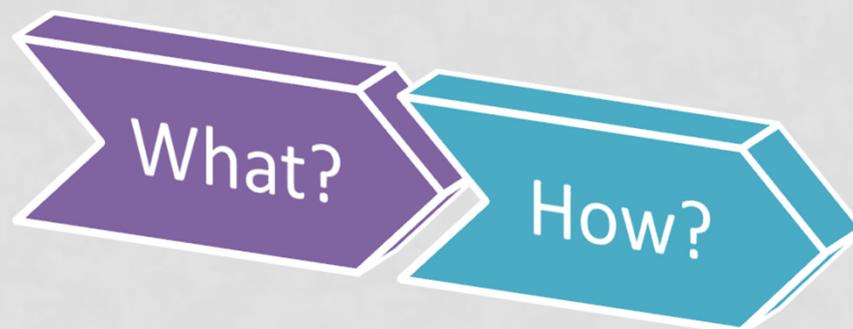
Conference Presentations



Conferences: SRP 2015,
SACNAS 2015, PRLSAMP
2016



OBJECTIVES AND GOALS (2)



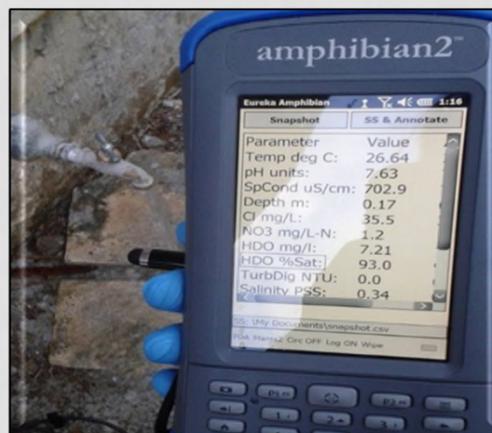
2. Determine the water quality of the source water and tap water
 - Generate a Project Plan
 - Determine Parameters and Methods to be used

Community



- Interact with community leaders
- Provide results
- Coordinate visits

Field Work



- Collect Water Sample

Laboratory Analysis



- Determine which methods could be done on budget

Project Plan



Site Location

BO. HATILLO AÑASCO

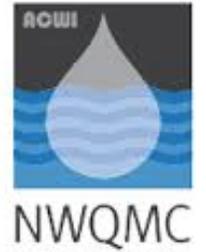


Figure 1. NON-PRASA Community in Bo. Hatillo, Añasco, Puerto Rico (Google Maps, 2016)

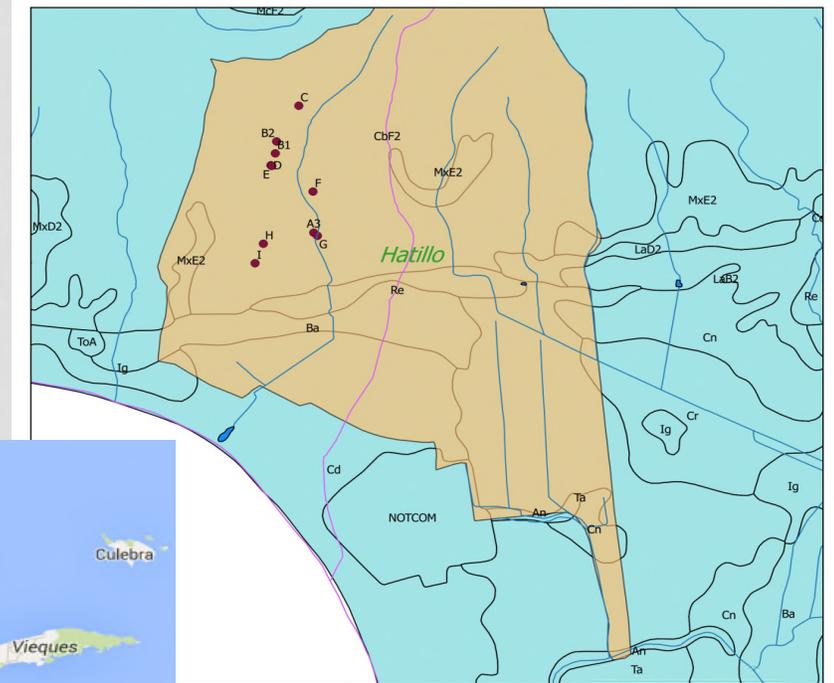


Figure 2. Location Map of the Sampling Points (Martinez, 2015).

Project Plan



PARAMETERS AND THEIR METHODS



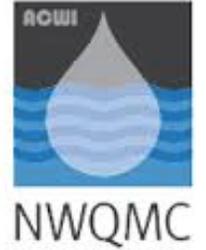
- ✓ Temperature
- ✓ Specific Conductivity
- ✓ Salinity
- ✓ pH
- ✓ TDS
- ✓ DO (HACH METHOD 8000)
- ✓ Chlorine (HACH METHOD 8167)
- ✓ Phthalates (DBP, DEP, DEHP) (EPA 35106)(EPA 8270D)
- ✓ VOCs (Chloroform) (EPA 551.1)
- ✓ An ion (EPA 300)
- ✓ Cat ion (EPA 300)
- ✓ Turbidity (EPA 180)
- ✓ Arsenic (HACH KIT 280000)
- ✓ Total Coliforms (HACH METHOD 10029)
- ✓ TOC (HACH METHOD 10129)
- ✓ Field (GW RULE 71 FR 65574)



Project Plan

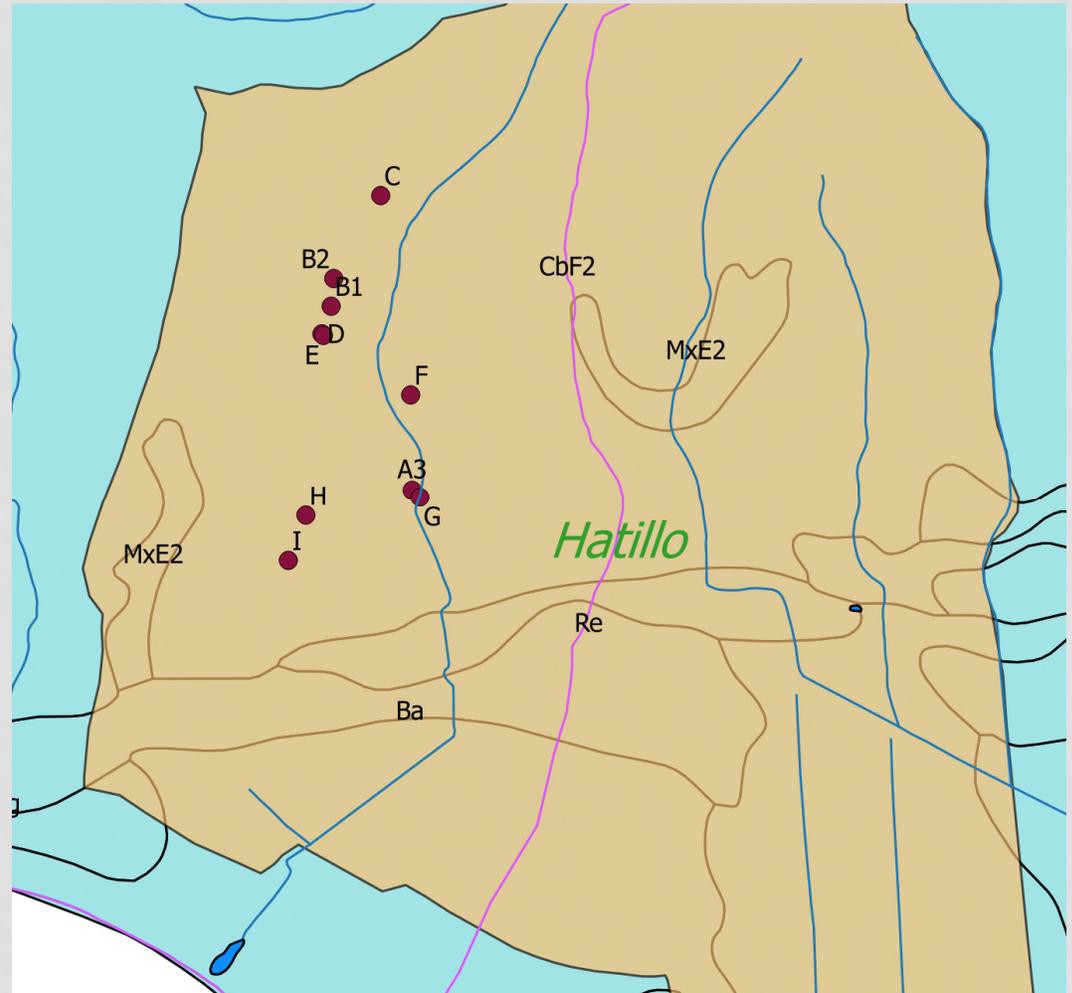


HOUSEHOLDS SELECTION



Total of Sites (9 points):

- Households= 7
- Pump (Ground Water)=1
- Tank (Treatment)=1

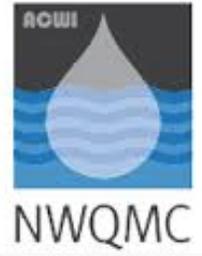


Project Plan



Sampling

FIELD WORK...



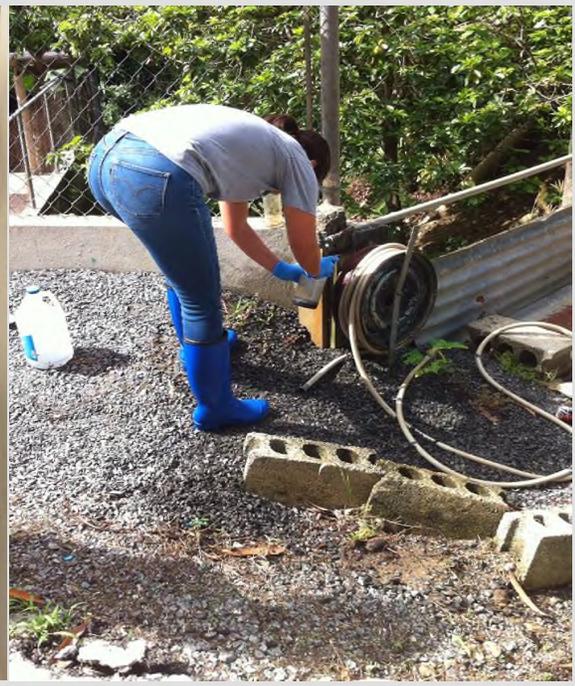
■ Chlorine Testing



■ Tank inspection



■ Data recording



■ Sample Collection

Project Plan

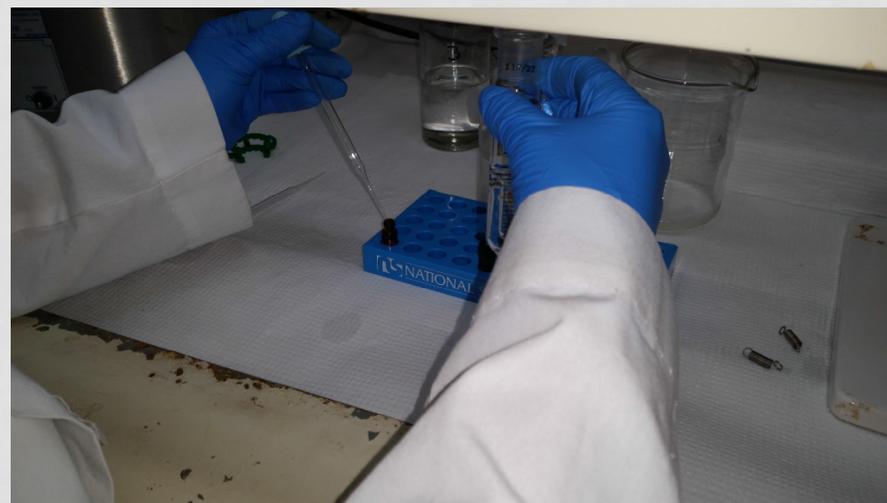




- Laboratory Process



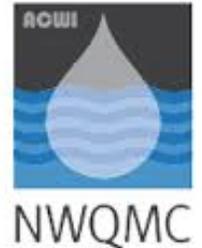
- VOCs extraction



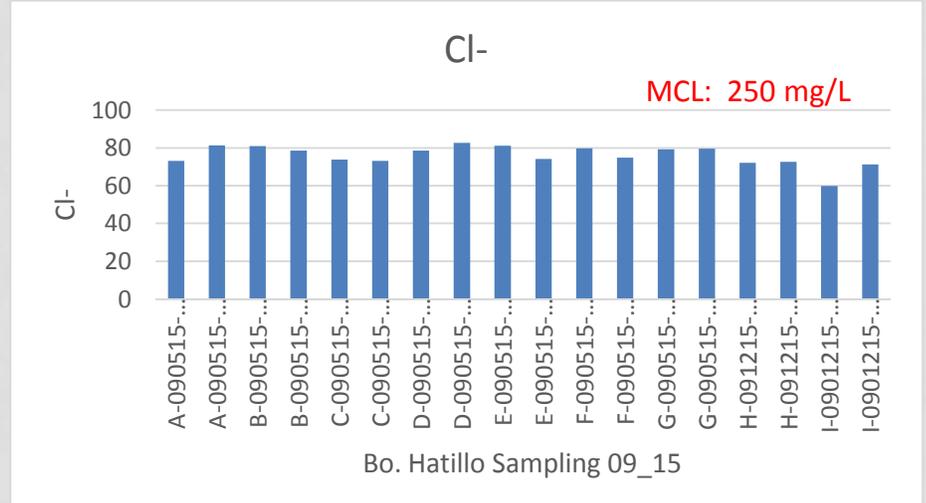
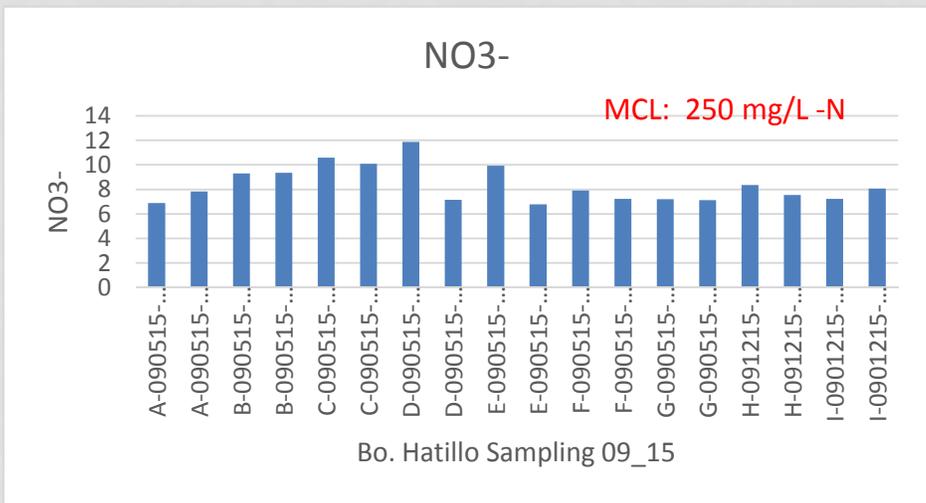
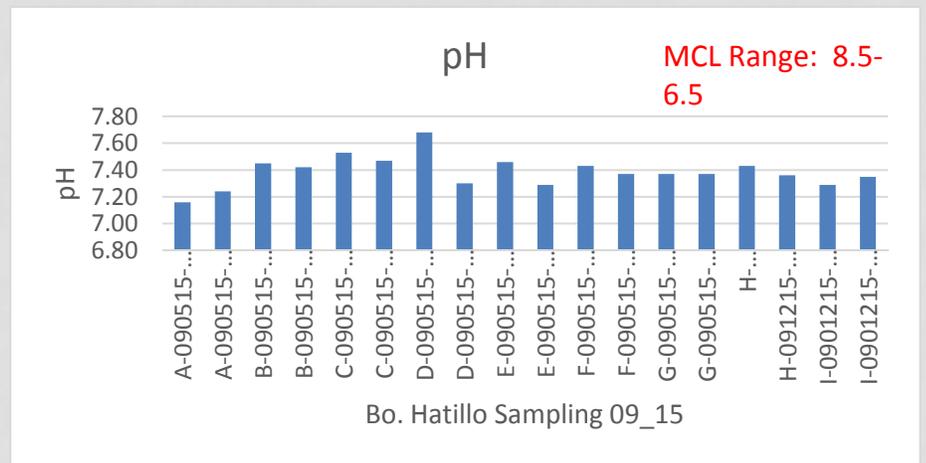
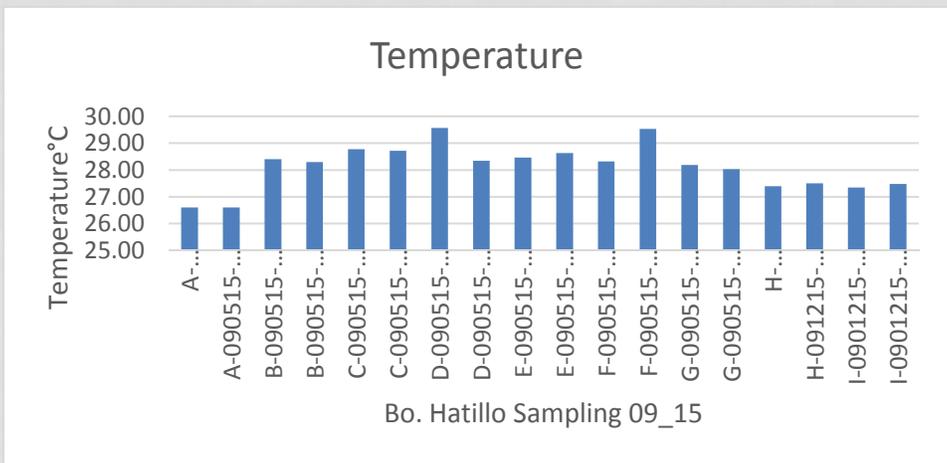
- Phthalates extraction

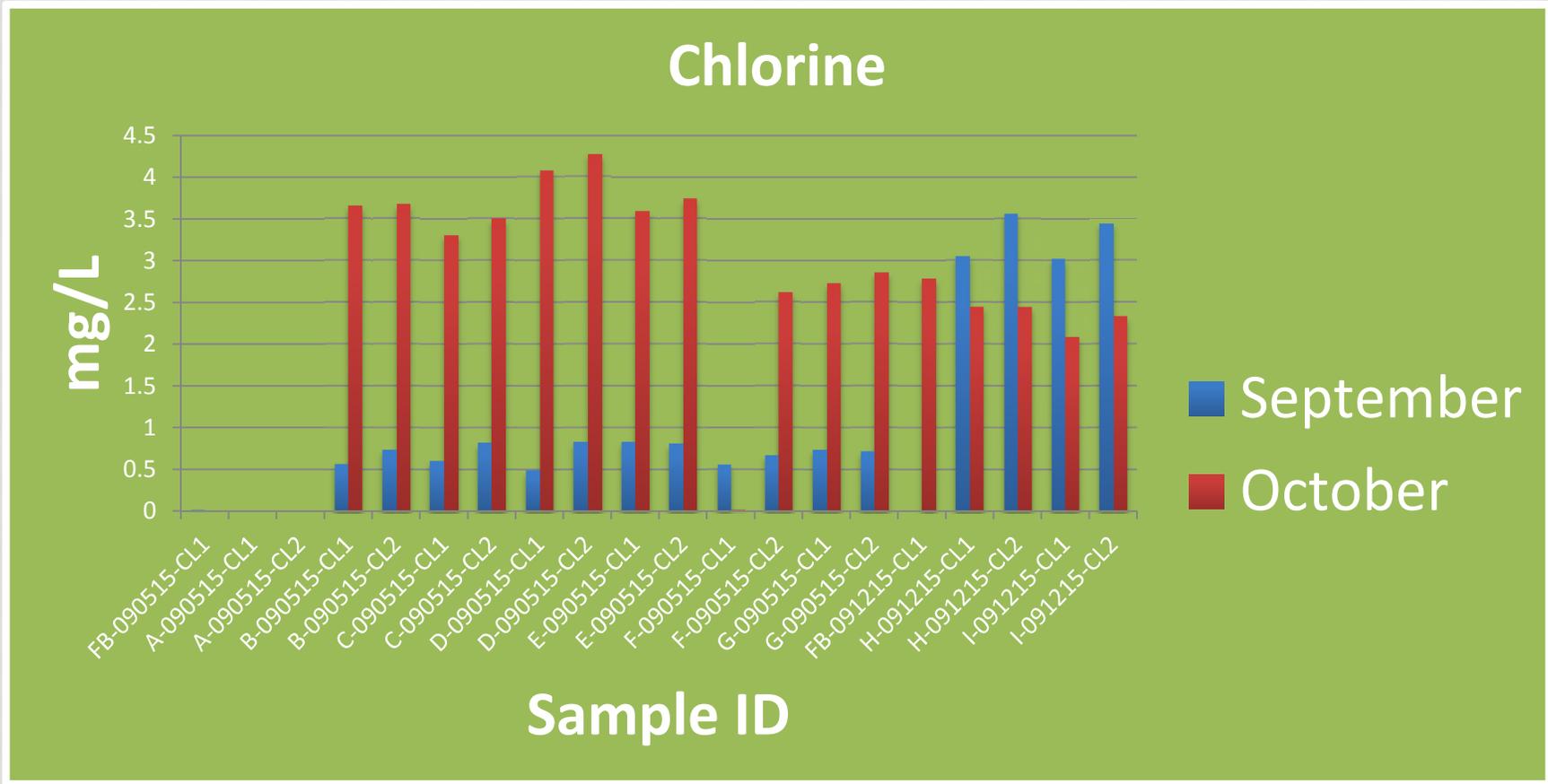
Analysis

DATA



September 2015 Results

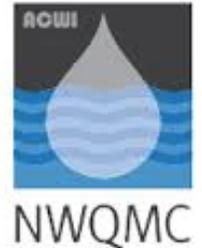




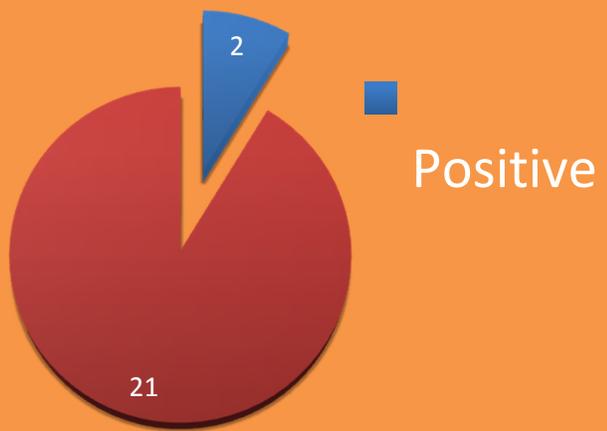
- Data from September and October 2016

Analysis

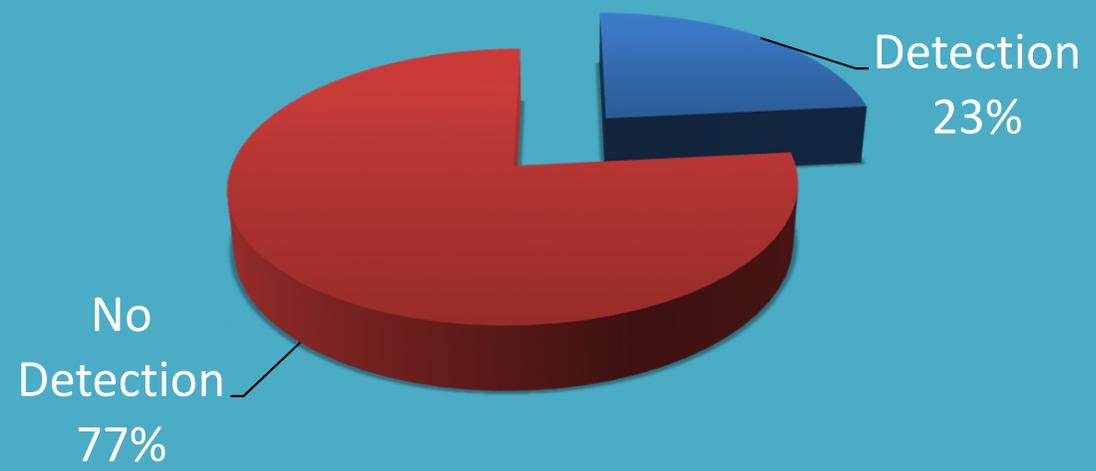
DATA



Total Coliforms



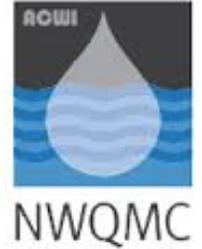
Total Arsenic



- Data from September and October 2016

Analysis

DATA



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Sample ID	Temperature (Celsius)	SpC (microSiemen/cm)	Sal (ppt)	TDS (mg/L)	COND Sal	DO (mg/L)	pH (units)	ORP (mV)	Cl- (mg/L)	NH4+ mg/L-N	NH4Total mg/L-N	NO3- mg/L-N	Total Coliforms (Colony/100mL)	Ecol (Colony/100mL)	Chlorine Result (mg/L)	TOC Result (mg/L)	Turbidity (NTU)	Arsenic Value (ppb)	Phthalates (mg/L)			Chloroform (ppm)
																			DEP	OBP	DBP	
A-032115-SONDE	26.4	685.95	0.355	0.4408	17.25	1.38	7.255	913.5	54.43	10	10.22	2.63	0	0								
A-042515-SONDE	26.37	685.45	0.35	0.439	25.55	2.03	7.3	965.5	55.35	7.71	7.86	2.9	0	0					0.00026104	0.00026512	0.00071724	15.58966311
B-042515-SONDE	27.6	692.75	0.36	0.4437	29.2	2.3	7.42	956	59.75	15.65	15.89	3.33	0	0					0.00084631	0.00062883	0.00088548	0
A-090515-SOND	26.6	694.1	0.36	0.44395	32.8	2.625	7.2	987.5	77.195	9.555	9.63	7.36	0.5	0.5	0	1.7	0.035	5	0.0003	0.0003	0.0008	5.251504078
B-090515-SOND	28.35	526.65	0.265	0.33705	80.3	6.28	7.435	966	79.775	16.75	17.075	9.325	0	0	0.655	7.2	0.07	5	0.0005	0.00043696	0.000905	5.144799887
C-090515-SOND	28.74	0.2	-0.02	0.00015	72.65	5.62	7.5	964.5	73.445	13.465	13.795	10.35	0	0	0.715	10.45	0.045	10	0.00031826	0.00055768	0.00169443	5.535878639
D-090515-SOND	28.955	524.35	0.17	0.3356	58.15	4.54	7.49	479.85	80.6	16.59	16.59	9.52	0	0	0.66	0.3	0.275	10	0.00011145	0.00028309	0.0008931	*
E-090515-SOND	28.545	699.05	0.36	0.4474	84.4	6.525	7.375	965.5	77.62	16.08	16.36	8.355	0	0	0.82	7.75	0.055	10	0.00027633	0.000709	0.00128059	0
F-090515-SOND	28.925	699.4	0.36	0.4476	87.85	6.735	7.4	966	77.27	16.64	16.955	7.575	0.5	0	0.615	0	0.02	30	0.00032573	0.00045652	0.00138426	0.057275848
G-090515-SOND1	28.11	699.3	0.36	0.4475	74.75	5.745	7.37	533.9	79.36	16.5	11.415	7.16	0	0	0.73	1.2	0.025	0	0.0003602	0.00055938	0.00332121	*
H-091215-SOND1	27.445	694.9	0.36	0.4447	80.7	6.365	7.395	977.5	72.31	15.675	15.94	7.945	0	0	3.305	0	0.11	0	0.00045472	0.00102521	0.0046254	46.10764264
I-090215-SOND1	27.415	315.65	0.155	0.202	81.5	6.44	7.32	939.5	65.525	14.17	14.375	7.645	0	0	3.23	0	NDIV/DI	0	0.00034967	0.00039878	0.00328368	38.42995109
A-100315-SOND1	26.655	746.1	0.39	0.46255	43.75	3.48	7.25	493.5	84.715	10.905	11.035	11.675	0	0	0	1.35	0.09	10	0.00016457	0.00038964	0.00035	19.56984296
B-100315-SOND1	27.47	754.95	0.39	0.48315	61.95	4.88	7.195	OVERRANGE	88.63	13.785	13.94	6.825	0	0	3.665	0.3	0.155	10	0.00025399	0.00053174	0.00606176	22.4305679
C-100315-SOND1	28.475	756.4	0.39	0.4841	65.4	5.06	7.33	951.5	89.475	10.885	11.06	12.305	0	0	3.405	1.4	0.145	0	0.00038378	0.00064442	0.00282291	19.44449917
D-100315-SOND1	27.855	755.5	0.39	0.48355	67.35	5.275	7.235	OVERRANGE	87.3	13.01	13.165	6.675	0	0	4.175	1.6	0.2	0	0.00018816	0.000493	0.00166263	19.35695165
E-101015-SOND1	28.55	745.2	0.39	0.4769	58.2	4.5	7.41	OVERRANGE	93.55	15.71	16.01	18.97	0	0	2.675	0.45	0.175	0	0.00044897	0.00140399	0.00180301	*
F-101015-SOND1	28.325	422.85	0.215	0.2706	67.45	5.24	7.445	990	45.64	15.985	15.895	18.25	0	0	2.82	1.15	0.52	0	0.00032852	0.00093245	0.0017924	0.000130718
G-100315-SOND1	28.075	755.4	0.39	0.48345	55.2	4.305	7.255	493.57	85.195	11.315	11.455	11.555	0	0	3.665	4.35	0.1	0	0.00039868	0.00082314	0.00163613	17.86535155
H-101015-SOND1	29.31	743.5	0.38	0.4758	61.75	4.205	7.355	OVERRANGE	90.635	14.16	14.31	20.19	0	0	2.45	3.05	0.2	10	0.00025225	0.00095027	0.0013843	3.070273489
I-100315-SOND1	27.925	567.1	0.29	0.36295	69.9	5.47	7.44	OVERRANGE	69.88	16.995	17.32	20.525	0	0	2.21	2.4	0.195	0	0.00043776	0.00113297	0.00126196	0.001014009
A-020216-SOND1	26.605	715.3	0.34	0.45785	65.95	5.145	7.275	755.5	32.05	0	0	1.4										
B-020216-SOND1	27.07	717.25	0.34	0.459	93.05	7.16	7.46	777.5	34.4	0	0	1.3										
C-020216-SOND1	27.66	717.75	0.34	0.45905	94.5	7.2	7.54	819.5	29.4	0	0	1.4										
D-020216-SOND1	27.565	719.4	0.345	0.4603	88.2	6.735	7.405	823.5	31.15	0	0	1.35										
E-020216-SOND1	27.77	720	0.345	0.46025	90.85	6.915	7.335	824.5	28	0	0	1.35										
F-020216-SOND1	28.175	719.2	0.34	0.46035	93.3	7.04	7.465	825.5	27.85	0	0	1.4										
G-020216-SOND1	27.225	717.35	0.34	0.45915	92.95	7.135	7.515	825.5	26.1	0	0	1.4										
H-020216-SOND1	27.42	717.7	0.34	0.45915	90.15	6.91	7.505	830.5	26.15	0	0	1.45										
I-031716-SOND1	26.99	717.35	0.34	0.4591	89.4	6.91	7.49	836	26.15	0	0	1.45										
B-031716-SOND1	26.825	699.25	0.335	0.44745	88.25	6.82	7.56	NDIV/DI	40.4	0	0	1.3			0.52	11.45						
C-031716-SOND1	27.015	699.85	0.34	0.447825	88.5	6.81	7.555	NDIV/DI	40.15	0	0	1.3			0.51	2.95						
F-031716-SOND1	27.46	700.6	0.34	0.44765	89.2	6.76	7.53	NDIV/DI	38.15	0	0	1.3			0.51	5.5						
G-031716-SOND1	27.75	702.15	0.34	0.4494	91.7	6.97	7.575	NDIV/DI	37.4	0	0	1.2			0.545	0						
J-031716-SOND1	26.995	701.75	0.365	0.4487	90.3	6.955	7.54	776	36.8	0	0	1.2			0.555	7.35						
B-032816-SOND1	26.79	698.85	0.335	0.44725	90.9	7.025	7.56	856.5	38	0	0	1.1			0	4.6						
C-032816-SOND1	27.685	358.6	0.33	0.2294	97.05	7.39	7.645	439	36.15	0	0	1			0	2.1						
F-032816-SOND1	28.15	615.1	0.29	0.39315	95.85	7.235	7.63	512.5	37.2	0	0	0.95			0	2.8						
G-032816-SOND1	27.555	698.35	0.33	0.44325	94.9	7.24	7.62	599	37.15	0	0	0.9			0	0						
J-032816-SOND1	27.125	696.1	0.33	0.44545	94.05	7.225	7.59	594	36.65	0	0	0.95			0	0.2						
B-033016-SOND1	27.27	699.8	0.335	0.44785	95.7	7.33	7.635	666	36.85	0	0	1.05			2.075	0						
C-033016-SOND1	27.225	703.05	0.34	0.4499	97.15	7.45	7.71	747	36.15	0	0	1.15			0.25	2.15						
F-033016-SOND1	27.115	700.9	0.335	0.44815	93.85	7.21	7.67	785	36.5	0	0	1.15			6	0						
G-033016-SOND1	27.45	588.5	0.28	0.37635	94.4	7.21	7.71	799	35.45	0	0	1.2			0.905	0.25						

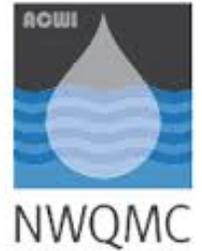
- Average results of data for 2015

Project Plan



Report Back

REPORT BACK



2014 EPA Greater Research Opportunity (GRU) Beca para Estudios Ambientales Subgraduados

Reclutamiento Hogares Participantes: Bo. Hatillo, Añasco P.R.
Fecha: 09/01/2015

Firme en el encasillado siguiente si le fueron entregados los siguientes documentos:

1. Hoja de Consentimiento Informado
2. Cuestionario de Participación
3. Agenda 2015 para Muestreos

EVENTO	MUESTREOS DE AGUA EN SISTEMA NON-PRASA	Es una declaración de trabajo que se realizó el 1 de agosto de 2015 en el Bo. Hatillo, Puerto Rico para evaluar la calidad del agua en el sistema de agua potable.
ORGANIZADORES	UNIVERSIDAD DE PUERTO RICO RECINTO UNIVERSITARIO DE MAYAGUEZ DEPARTAMENTO DE INGENIERIA CIVIL Y AGRIMENSURA	

FASE DE MUESTREO	FECHA
FASE 1	sábado, 5 de septiembre de 2015
FASE 2	sábado, 12 de septiembre de 2015
FASE 3	sábado, 2 de octubre de 2015
FASE 4	sábado, 10 de octubre de 2015
FASE 5	sábado, 14 de noviembre de 2015
FASE 6	sábado, 5 de diciembre de 2015

4. "Brochure" Informativo de : El Agua Potable en el Hogar



2014 EPA Greater Research Opportunity (GRU) Beca para Estudios Ambientales Subgraduados

Entrega de resultados: Bo. Hatillo, Añasco P.R.
Fecha: 12/18/2015

A continuación se presentan los documentos entregados como evidencia del trabajo realizado con la comunidad del Bo. Hatillo, Añasco. En las imágenes se encuentra una ilustración de hoja de resultados y el material educativo. Firme en el encasillado siguiente si le fueron entregados los siguientes documentos:

1. Resultados

2. Material Educativo

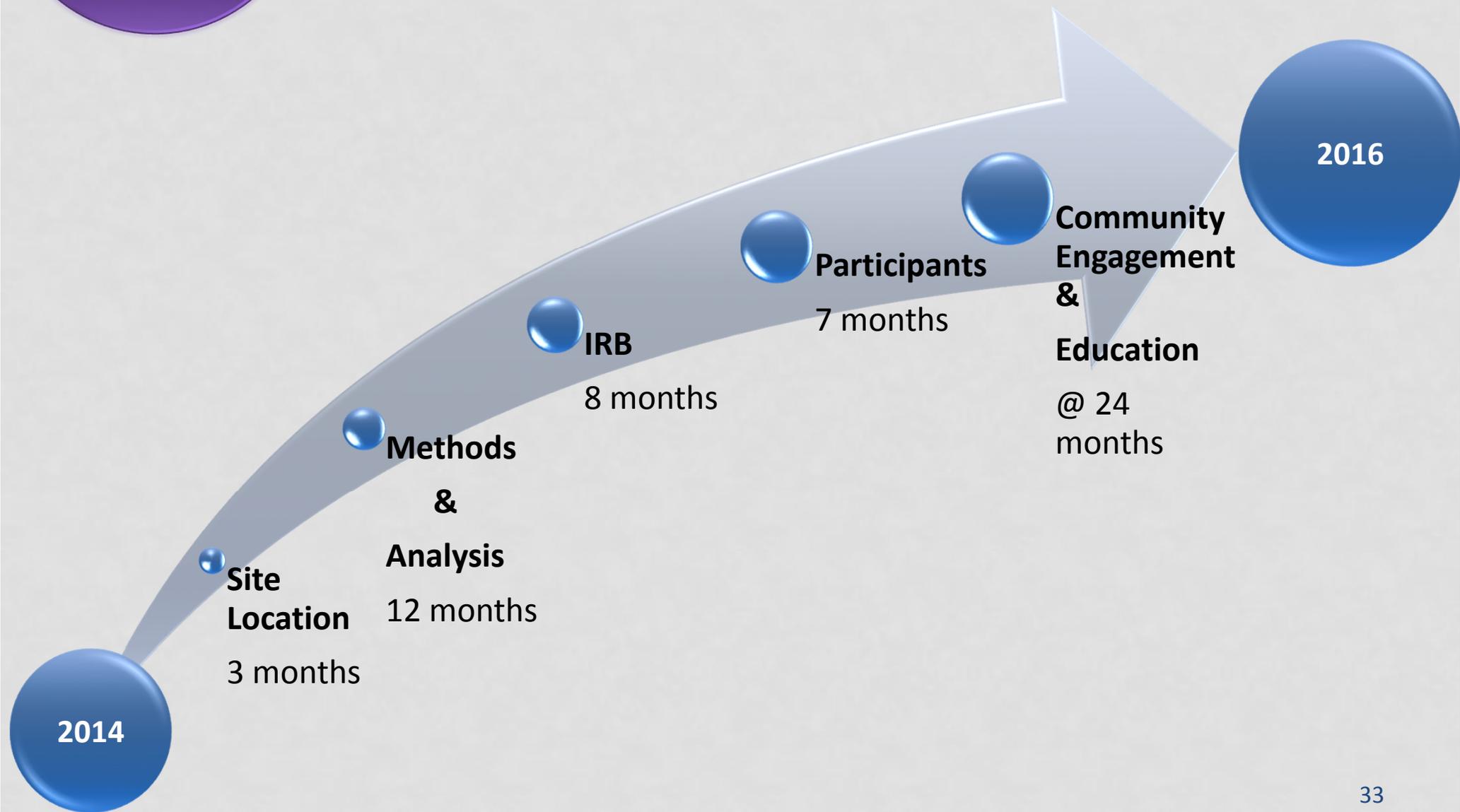
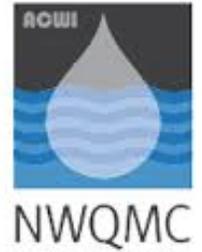


- Report from Spring Semester 2015

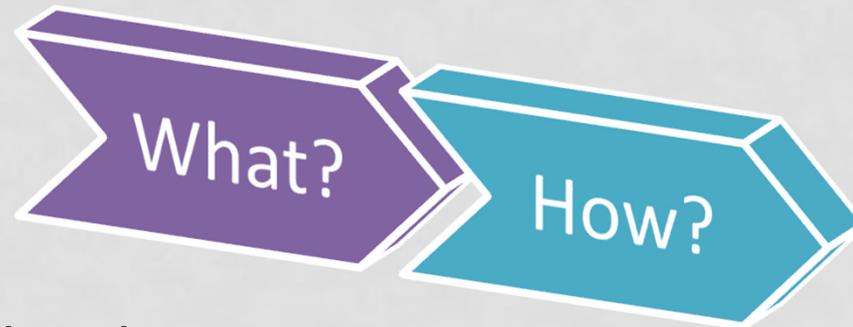
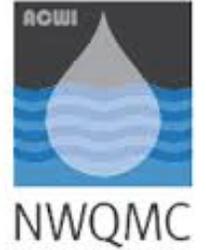
- Report from Fall Semester 2016



RESEARCH TRANSLATION & COMMUNITY ENGAGEMENT

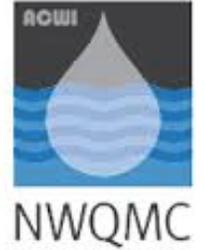


OBJECTIVES AND GOALS (3)



3. Training local community members and Engineering students in the STEM field
 - Community Awareness
 - Student Training on Water Quality Monitoring (STEM Field Support)

OBJECTIVES AND GOALS (3)



- April 23th, 2016 Community Workshop

OBJECTIVES AND GOALS (3)



- Positive Interactions and Academia Presence

OBJECTIVES AND GOALS (3)

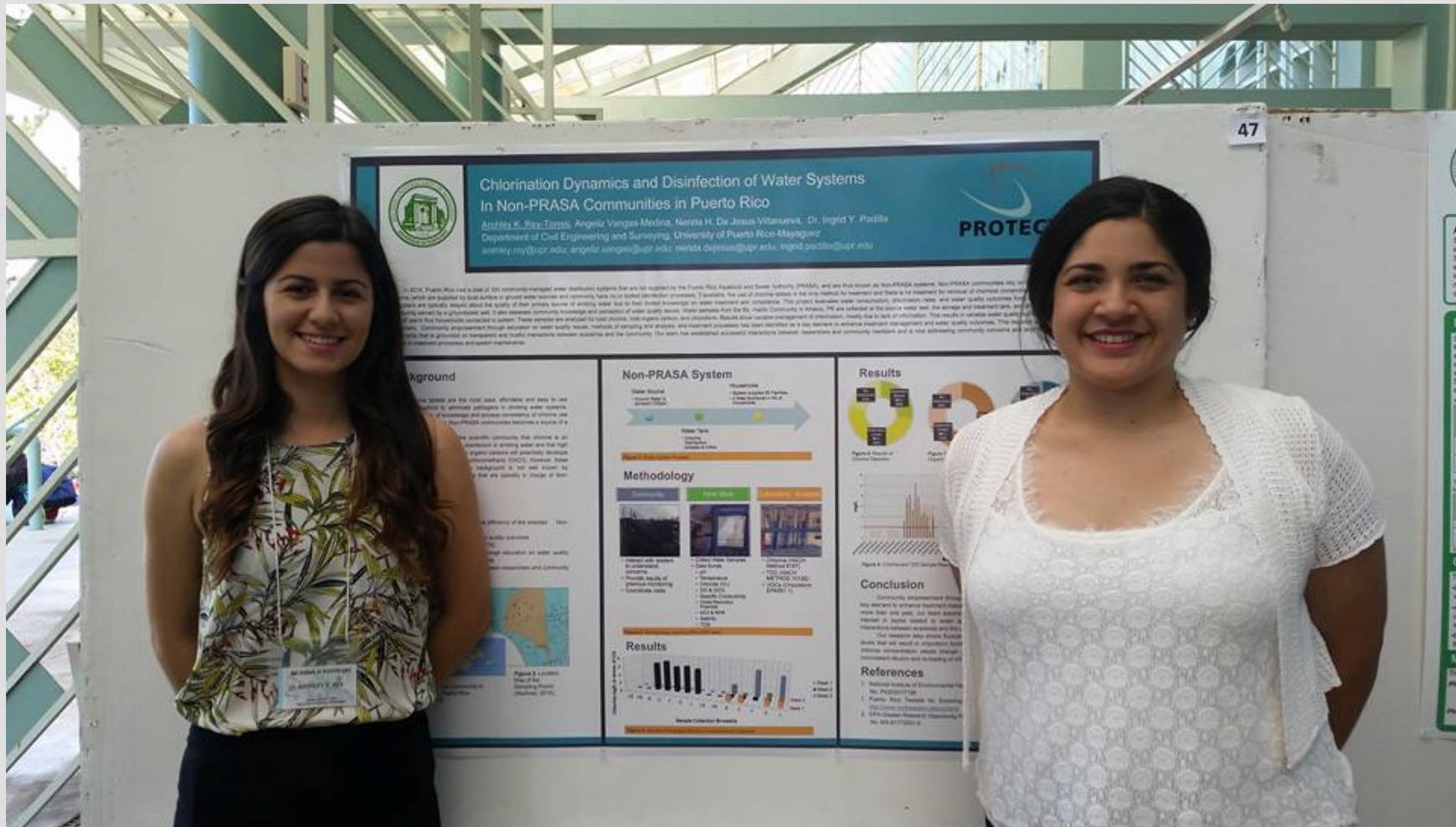


- Long days and Hard Work

OBJECTIVES AND GOALS (3)



- Dedication and Education



- Scientific Poster Presentations

Water Quality
Project

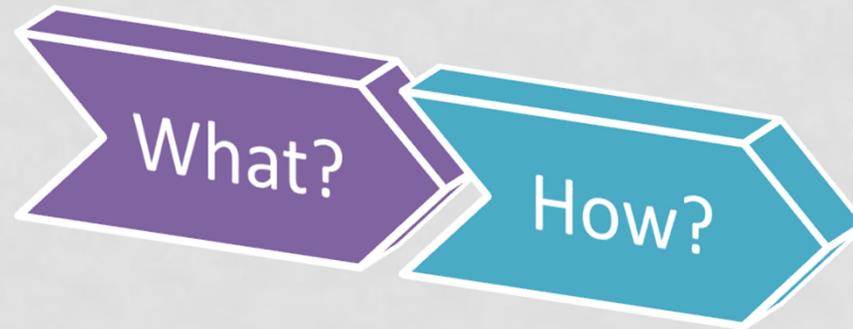
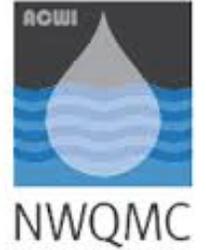
OBJECTIVES AND GOALS (3)



- Arshley Rey Internship Opportunity at EPA Region 2



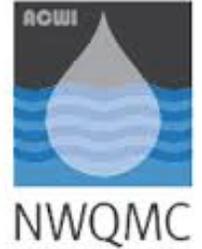
OBJECTIVES AND GOALS (4)



4. Identify deficiencies in the water quality monitoring process
 - Observations and Experience



OBJECTIVES AND GOALS (4)



- **EPA & PR Department of Health**
 - Limited Resources
 - Lack of Communication (segmented)
 - Organization and Priorities are not aligned with the public concerns
- **Communities**
 - Lack of education and sense of urgency
 - Limited resources
 - Poor government support
- **Academia**
 - Limited Resources
 - Limited opportunities for students at undergraduate level
 - Coordination or collaboration between agencies or other institutions

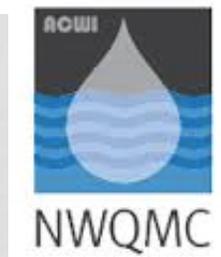
PROJECT DEDICATION



In Honor of Santiago De Jesus
(1963-2015)

“ Thank you Papi”

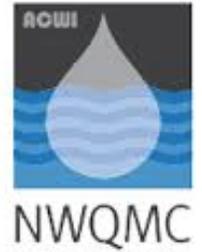
REFERENCES



1. This publication “Water Quality for Rural Non-PRASA Communities in Puerto Rico” was developed under Assistance Agreement No. MA-91772001-0 awarded by the U.S. Environmental Protection Agency to Nerida H. De Jesus-Villanueva. It has not been formally reviewed by EPA. The views expressed in this document are solely those of the authors and do not necessarily reflect those of the Agency. EPA does not endorse any products or commercial services mentioned in this publication. <http://www.epa.gov/>
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QUESTIONS ?



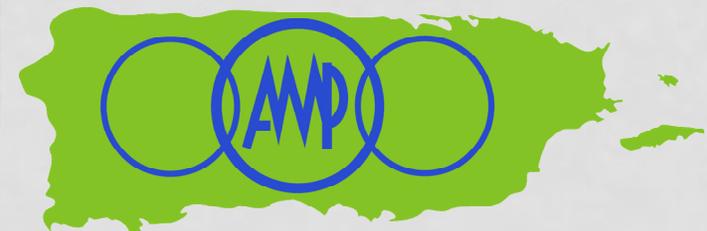
Award No.1400868

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PUERTO RICO LOUIS STOKES



ALLIANCE FOR MINORITY PARTICIPATION 45