

**GROUNDWATER MODELING FOR THE DOMINICAN
REPUBLIC**

PROJECT ID: CEEN_2018CPST_DR_002

by

Los Pumas

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A Capstone Project 30% Completion Report

Submitted to:

Fidel Perez

Instituto Nacional de Recursos Hidráulicos (INDRHI)

**Department of Civil and Environmental Engineering
Brigham Young University**

December 10, 2018

Executive Summary

PROJECT TITLE: GROUNDWATER MODELING FOR DOMINICAN REPUBLIC
PROJECT ID: CEEEn_2018CPST_DR_002
PROJECT SPONSOR: Instituto Nacional de Recursos Hidráulicos (INDRHI)
TEAM NAME: Los Pumas

The project will require the team to provide a groundwater model to the client. The areas of focus include Higüey and Baigüa, two areas on the southeastern side of the island. The team has begun to study the geology and hydrogeology of the Dominican Republic and collect pertinent datasets. An analysis of the data available has been made. This data has been found from reports performed in the Dominican Republic and from files sent to the team by INDRHI. Upon analyzing the data, the team determined what was needed for the model and what data was lacking. Collection of data will continue in January 2019, and the construction of the model will commence afterwards. A trip to the Dominican Republic in late January will allow the team to meet with the client and gain further insight into needs and resources. The model will contain aquifer boundaries, well locations, and water level measurements. A final report detailing the capabilities of the model, limitations of the model, and suggestions for improvement will also be delivered. The model and report will be finished before April 11th, 2019.

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Introduction

This project entails creating a groundwater model for the Higüey and Baigüa areas of the Dominican Republic. In Higüey, there are over pumping issues, as groundwater is used continuously for municipal water supply for cities and hotels. In Baigüa, overpumping is also an issue, as water is used for irrigation. Saltwater intrusion is a concern in these areas as well.

The project to create a groundwater model will give additional knowledge to what is occurring under the surface. It will give knowledge to officials in the Dominican Republic to best know how to utilize their groundwater resources.

The Los Pumas team has met on a weekly basis to discuss efforts in gathering data and understanding the scope of the project. The schedule details will be expounded in a later section. Various assumptions have been made about the exact location of the model, the type of model needed, and the data that is available.

The team expects to create a groundwater model that is easy to use by officials at INDRHI. It is expected to map groundwater in the selected areas, as well as show the pumping amounts and potential saltwater infiltration in the stated locations.

Schedule

Timeline For CEEEn-2018CPST-DR-002: GW-2		
Date	Item Accomplished/ Challenge faced	Summary
2-Oct-2018	Met with faculty advisor	Discussed the objective and scope of the project
3-Oct-2018	Received files from sponsor	We were given files with useful data to begin reading and collecting the needed information to create our model
8-Oct-2018	Completed our statement of work	Provided our sponsors with our plan, proposal, schedule, and other information regarding our plans to achieve our objective and scope for the project.
26-Oct-2018	The Dominican Republic suspended all nonessential international travel	The director and other INDRHI representatives could not come discuss project details with us in person as planned.
30-Oct-2018	Met with our graduate student lead	Discussed data types needed to build a useful groundwater model
11/2/2018-11/5/2018	Our faculty advisor was out of the country	We were unable to discuss our current challenges and determine the appropriate type of model to make
2-Nov-2018	Began a team scoreboard	We began scheduling out our time better and holding each other accountable for doing the assigned readings
7-Nov-2018	Met with sponsor and faculty advisors	Established that the model will be focused in Higüey and Baigüa. Determined that we will be making a MODFLOW model and then convert it into a SEAWAT model
16-Nov-2018	We were provided a useful 77 page document in Spanish.	The document was hard to read because of Spanish terms that we didn't know.
11/20/2018 - 11/25/2018	Thanksgiving Break	No work was accomplished over the break
3-Dec-2018	Completed reading the 77-page document	We met as a team and compared our notes from reading the document. Prepared data to share with our graduate student lead.
4-Dec-2018	Met with our graduate student lead	Discussed all the data that we have found and determined the data that we are still lacking

Assumptions & Limitations

A variety of assumptions have been made due to limited knowledge and data. In the gathering of data for the model, it has been assumed that various areas around Higuey and Baigua affect the targeted areas. Although this is true, the model will assume that the aquifer by the coast solely affects the area, which will set the analysis parameters.

It has also been assumed that the model that would best depict groundwater in the region is a MODFLOW model. The assumption has been made that after generating a MODFLOW model, seawater infiltration can be depicted by using a SEAWAT model.

There have been a variety of limitations in the progress of the project. It is mainly based in the access to data. There is limited data provided about groundwater modeling in the Dominican Republic. Much of this data is only available through reports, rather than original datasets. This data is not continuous. There are many times that studies are done of groundwater in the Dominican Republic, but then agencies will not look at it again for years, leading to inconsistent data. Most of the data is over 10 years old, leading to inaccurate depictions of seawater intrusion.

Another large limitation to the project is that most of the group has never been exposed to groundwater modeling. There is only one team member that has had experience with the modeling software. The rest of the team is willing to learn, but this lack of knowledge is a limitation to the project.

Design, Analysis & Results

The design process for the capstone project includes decisions regarding the kind of model that will be created for INDRHI. In meeting with the sponsor, Fidel, and faculty advisors it was decided that to design a MODFLOW model to track changes in groundwater, and later convert the model to a SEAWAT model to measure saltwater intrusion into the aquifers of the eastern coastal plain of the Dominican Republic, specifically around the areas of Higüey and Baigüa, shown in Figure 1. A number of data requirements are needed to create the model, such as locations of wells, average pumping rates, recharge rates, aquifer shapefiles, etc.

For 30% completion of our project, the team's goal was to determine the data requirements for the model and investigate data availability for those requirements. Fidel provided the team with a number of technical reports and data sources to review, from which data was gathered. The team has a variety of pertinent data that was able to be collected from scrutiny of Fidel's sources.

This section consists of those tables, figures, and notes gathered which the team will use to create and analyze the model next semester. Data gathered thus far pertains to aquifer boundaries, hydrogeology, hydraulic conductivity, well locations, recharge, irrigation demand, and water quality.



Figure 1. Areas of study in the eastern coastal plain of the Dominican Republic.

Aquifer Boundaries

Knowing aquifer boundaries helps to delineate the scope of the project, as well as to partition areas studied into groups in accordance with the characteristics of the different aquifers. Figure

Fidel has also mentioned that he has shapefiles of the aquifer boundaries prepared that he can share for the model.

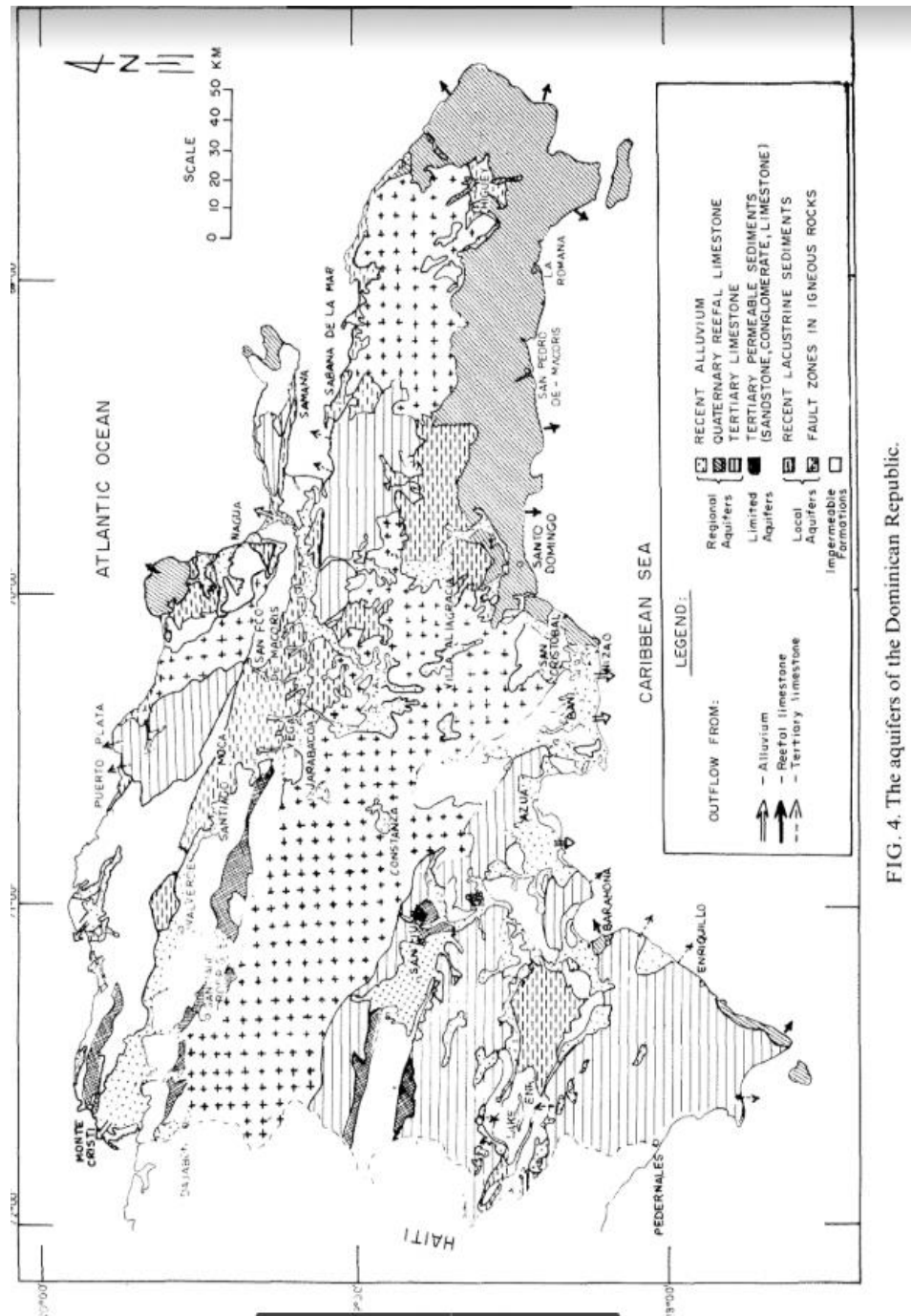


FIG. 4. The aquifers of the Dominican Republic.

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Hydrogeology

Observations about the hydrogeology of the region are provided in several of the reports. From the report “Planicie Costera Oriental Coastal Aquifer” published by Aquater in 2002:

“The entire coastal strip, with more or less heavily karstified reef limestones prevailing, can be generally classified as a highly permeable continuous aquifer. The inner sections... can be distinguished by the presence of a multilayered aquifer with medium to medium-high permeability, usually 1 or 2 orders of magnitude lower than those along the coastal strip.”

From the report “Aguas Subterráneas de la República Dominicana” published by Grusamar in 2007, Figure 3 presents a diagram of the hydrogeology of the eastern coastal plain of the Dominican Republic. The area of interest is comprised mostly of reefal limestone, alluvium, and quaternary deposits.

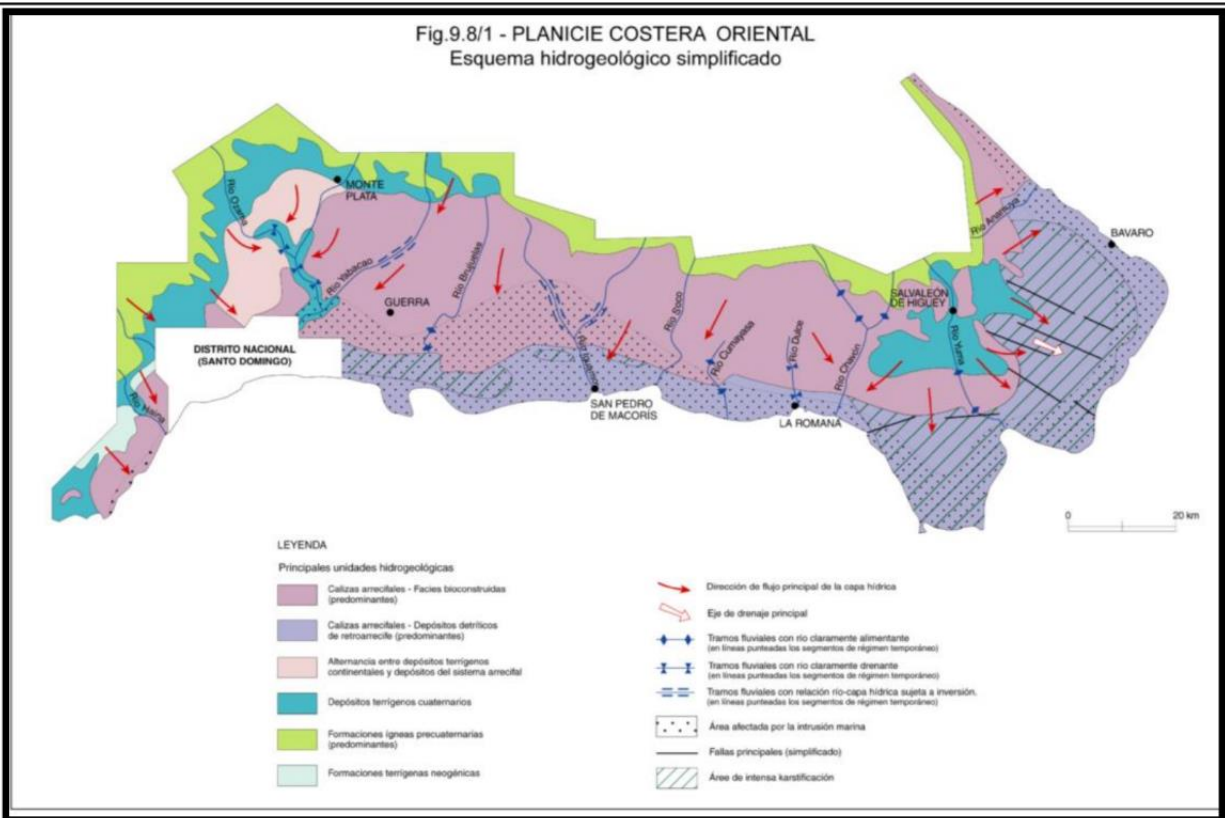


Figure 3. Hydrogeological diagram of the eastern coastal plain of the Dominican Republic.

Hydraulic Conductivity

The report “Aguas Subterráneas de la República Dominicana” published by Grusamar in 2007 also provides estimates of hydraulic conductivity, or transmissivity. This information describes

the ability of water to permeate into the aquifer, and is a parameter that will be used in the model. Both Table 1 provides valuable information about permeability in the region.

Table 1. Transmissivity of Wells in the Eastern Coastal Plain of the Dominican Republic.

Volumen F.5 Aguas Subterráneas en R.D.

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Pozo		Transmisividad				Coefic. de almacenamiento en descenso	Difusividad T/S m ² /sec
Código n	Nombre	Caudal m ³ /sec	en descenso m ² /sec	en subida m ² /sec	media m ² /sec		
1885	Guaymate 1	0.00632	9.15 x 10 ⁻⁴	9.29 x 10 ⁻⁴	9.22 x 10 ⁻⁴		
1589	La Matilla	0.01605	3.88 x 10 ⁻³	1.79 x 10 ⁻³	2.84 x 10 ⁻³		
1883	Los Llanos 3	0.00394	4.07 x 10 ⁻³	5.96 x 10 ⁻³	5.02 x 10 ⁻³		
1884	La Jarda 1	0.00234	8.83 x 10 ⁻⁴	1.86 x 10 ⁻³	1.36 x 10 ⁻³		
1882	Monte Plata 1 Monte Plata 1 (piez.)	0.00253	1.11 x 10 ⁻⁴ 3.69 x 10 ⁻³	1.04 x 10 ⁻⁴ 5.68 x 10 ⁻³	4.69 x 10 ⁻³	1.61 x 10 ⁻³	2.91
1881	San Rafael del Yuma 2	0.06418	6.37 x 10 ⁻²	8.61 x 10 ⁻²	7.49 x 10 ⁻²		
1592	San Cristóbal	0.00821	1.86 x 10 ⁻³	5.57 x 10 ⁻³	3.72 x 10 ⁻³		
1877	Yabacao 2	0.05180	9.77 x 10 ⁻²	9.55 x 10 ⁻²			

Tabla 3.7 Parámetros hidrogeológicos Planicie Costera Oriental.
Fuente: INDRHI-AQUATER, 2002.

Well Locations

Well location data is important to the model since those are access points where information about aquifer water levels and recharge can be measured. Several sources of well data have been provided by Fidel. In addition, a separate capstone group working on groundwater mapping will be able to provide well data that they have collected as part of their project.

Figure 4 provides locations of wells in the Dominican Republic and sorts them by aquifer, discharge, and depth. Figures 5 is a well analysis including coordinates, flow rate, and piezometric history of the well, provided by Fidel. Figure 5 shows one of 33 well locations in the eastern coastal plain for which this data is available.

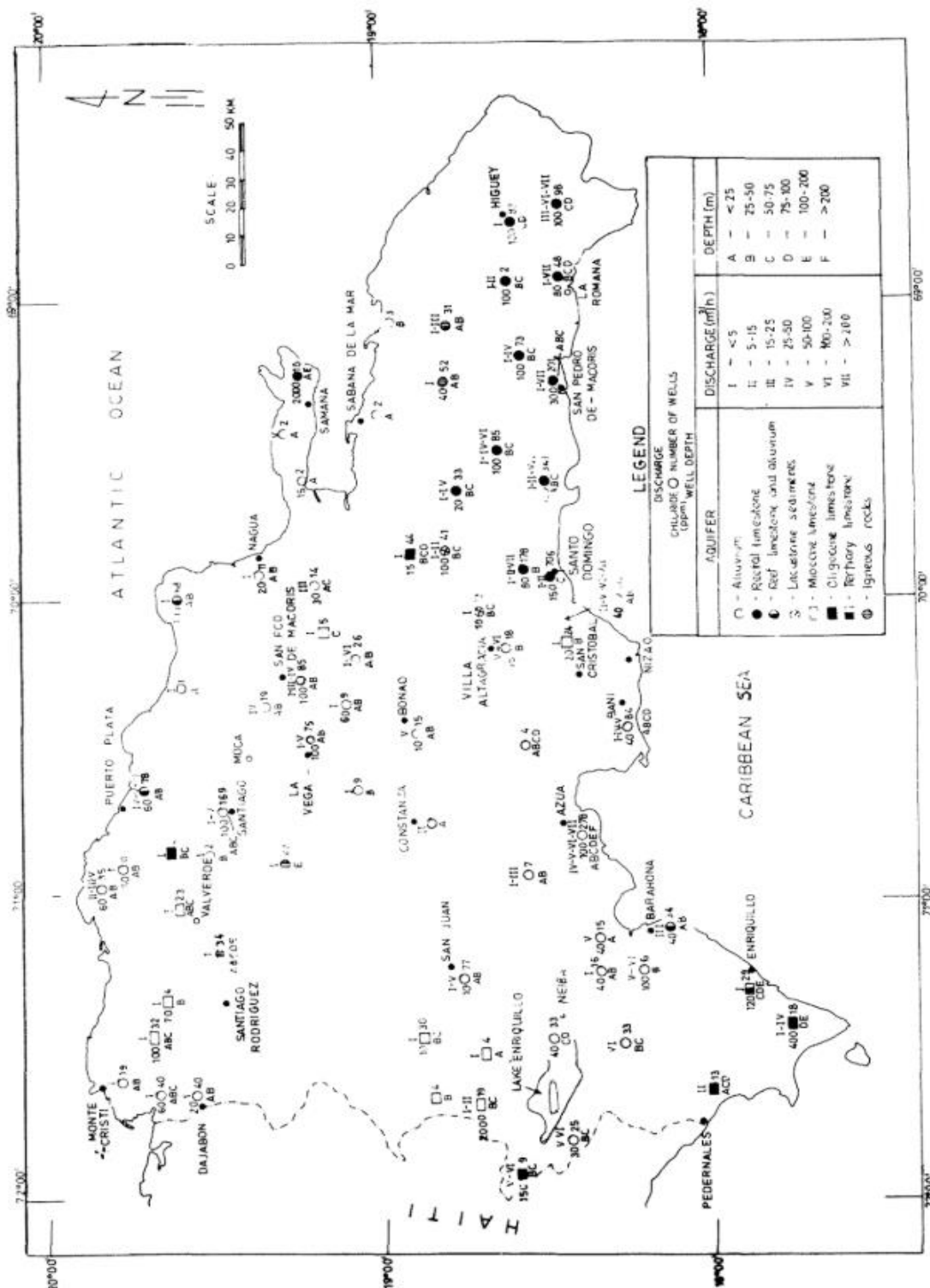
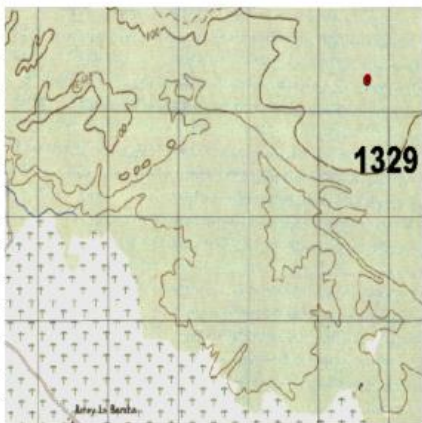


Figure 4. Well locations in the Dominican Republic, including aquifer, depth, and discharge information. Y. GILBOA (1980) The aquifer systems of the Dominican Republic / Les systèmes de nappes aquifères de la République Dominicaine, Hydrological Sciences Journal, 25:4, 379-393, DOI: 10.1080/02626668009491948.

Planicie Costera Oriental				SI 1329 Salvaleon de Higuey	
Municipio:	Salvaleón de Higuey	Coord. UTM Zona 19			
Paraje:	El 14 del Cuya	X (m)	Y (m)	Z (msnm)	
		547750	2058500	105	
Caudal (L/s):					
Caudal anual explotado (dam3)					
Propietario:	INAPA				
N°. Inventario:	1329				
Hoja Topográfica Escala 1:50000		Salvaleón de Higuey			

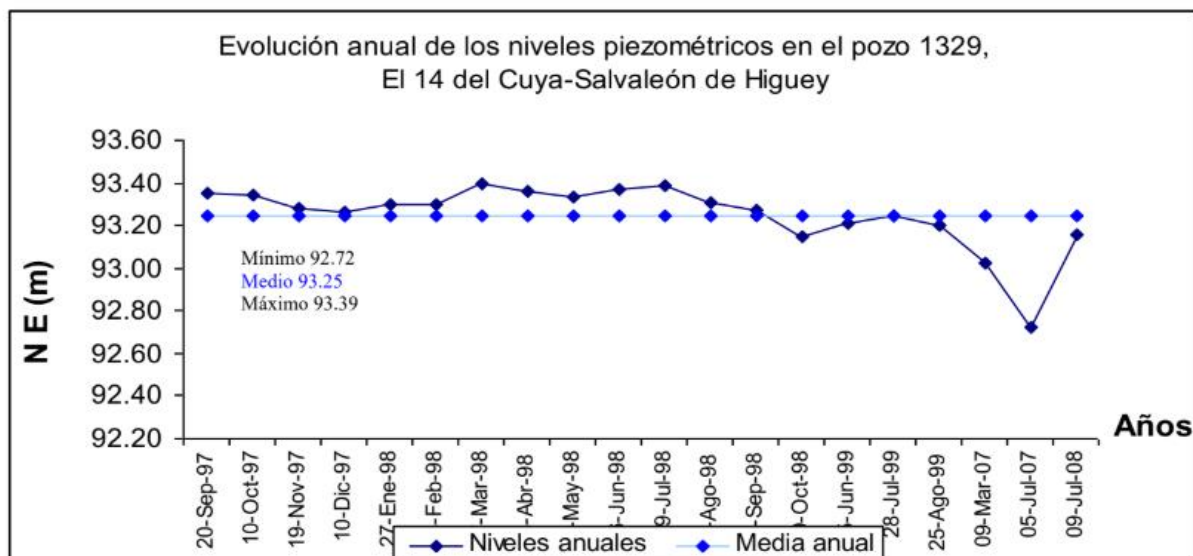


Figure 5. Well analysis for a well location in the eastern coastal plain of the Dominican Republic.

Recharge

Recharge data is necessary for the model to determine repletion of the aquifers. Table 2, published in the report “Aguas Subterráneas de la República Dominicana,” provides data about aquifer type, recharge, and usable potential for different areas of the Dominican Republic.

Table 2. Estimates of Recharge and Usable Potential for Different Areas of the Dominican Republic.

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<i>Zona</i>	Unidad hidrogeológica	Área (km²)	Tipos de acuíferos	Recarga (hm³/a)	Potencial aprovechable (hm³/a)
1	Planicie Costera Oriental	6.534	Aluvión y Caliza cuaternaria	1.465	921
2	Cordillera Oriental	3.127	Aluvión y roca volcánica	37	23
3	Los Haitises	1.823	Caliza Oligocena	432	272
4	Península de Samaná	651	Caliza y aluvión	51	32
5	Cordillera Septentrional y Costa Atlántica	4.774	Calizas y aluvión	292	184
6	Valle del Cibao	6.642	Aluvión	423	266
7	Cordillera Central	12.240	Rocas volcánicas, calizas y aluvión	289	182
8	Valle de San Juan	1.600	Aluvión	276	166
9	Sierra de Neiba	3.800	Caliza terciaria	175	114
10	Valle de Neiba	2.200	Aluvión y caliza	270	170
11-12	Sierra de Bahoruco y Península Sur	4.100	Caliza eocena-oligocena	253	64
13	Valle de Azua	560	Aluvión	103	43
14	Planicie de Baní	460	Aluvión	95	32
	TOTAL	48.511		4.161	2.469

Tabla 3.6: Recarga total y potencial aprovechable de los acuíferos de la República Dominicana.

Fuente: Rodríguez, H. y Febrillet, J.F., 2006. *Potencial Hidrogeológico de la Rep. Dom.* Boletín Geológico y Minero, Volumen 117.

Irrigation Demand

A number of wells have experienced overpumping, which leads to saltwater intrusion. It is important to know demand for water, especially irrigation demand, as the eastern coastal plain is largely agricultural. Table 3, from the report “Planicie Costera Oriental Coastal Aquifer” published by Aquater in 2002 gives water exploitation and water demand for agriculture as well as other uses. Figure 6, from the report “Aguas Subterráneas de la República Dominicana,” shows well distribution by use for the Dominican Republic.

Table 3. Water Exploitation and Estimated Water Demand for the Eastern Coastal Plain.

Use	Total Water Exploitation Year 1999 (10 ⁶ m ³ /year)	Estimated Water demand – Year 2010 (10 ⁶ m ³ /year)	Estimated Water demand – Year 2020 (10 ⁶ m ³ /year)
Civil	336	410 - 424	500 - 531
Industrial	170	174 - 256	190 - 281
Touristic	21	46	71
Agricultural	175	167-235	219 - 463
Total (min - max)	702	797-961	980 -1346

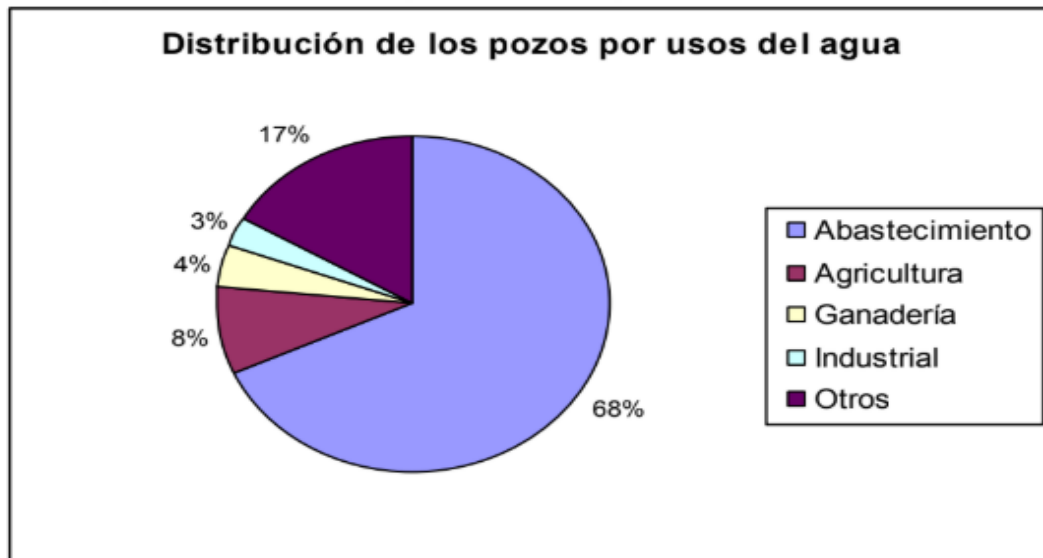


Fig. 5.2- Distribución de los pozos por usos de agua en la República Dominicana.
Fuente: Estudio Hidrogeológico, Fase II (INDRHI-EPTISA, 2004)

Figure 6. Well distribution by water use in the Dominican Republic.

Water Quality

Since the goal is to calibrate the model to observe saltwater intrusion, data regarding salinity is important. Figure 7 was provided by Fidel from an INDRHI study, and delineates saltwater intrusion. The report “Aguas Subterráneas de la República Dominicana” also divides the eastern coastal plain into four sectors, then gives the hydro-chemical and saline properties of the water in each.



Fig. 3.4: Intrusión marina en la República Dominicana.
Fuente: Boletín Geológico Minero, 117, 2006. Potencial Hidrogeológico de la Rep. Dom.

Figure 7. Saltwater Intrusion in the Dominican Republic

In meeting with the student graduate lead, it has been determined that the data presented in this section will be beneficial in the construction of the MODFLOW model. Further analysis of the data will take place next semester as the model begins to be built and gaps of needed data are identified. A few gaps in data have been identified where additional information needs to be collected about stream networks and specification of the aquifers pertaining to the areas of Higüey and Baigüa. Fidel should be able to provide this data .

Lessons Learned

The challenges and corresponding resolutions encountered from September to December 2018 include the following:

- The distance barrier between our sponsor and the team initially made it difficult to communicate. After a couple weeks of communicating with the sponsor through the faculty advisor, the team determined it would be more successful to have direct communication with the sponsor. The team now has his contact information and can discuss matters with him directly, making it quicker and easier to get questions answered and obtain data from him.
- The project began with little knowledge of the scope and how to obtain necessary data. Some preliminary documents were provided regarding terrain and other basic information on the Dominican Republic. Initially, the team began reading these documents with little direction of the overall goal. After recognizing that better direction and a clear scope of the project was needed, the team met with the faculty advisor, graduate student lead, and emailed the sponsor. By talking to all sources, the team was provided with a clear scope and direction in how to obtain data needed for the model.
- Half of the documents provided were in Spanish. Although all members of the team speak Spanish, they are not familiar with the technical terms used in the documents. This made the reading very challenging to accomplish. Therefore, a list of technical terms in Spanish was compiled and a Quizlet to study the terms was created. Every week during team meetings, the team would test each other on the terms. In addition, the team set December 1st as the deadline to have the 77-page Spanish document completed. By doing this, it was ensured that the whole team participated in the reading and had a good understanding of the data that was available before meeting with the graduate student lead again.
- With few pertinent deadlines, it was difficult to spend time researching with busy schedules. Initially, among midterms and other projects, little time was spent reading. To solve this problem, a scoreboard was created. This scoreboard held each team member accountable for completing the assigned readings. Deadlines were set each week. During weekly meetings, the hours each team member spent reviewing the documents was recorded. By scheduling out time, the team was able to dedicate the necessary time each week to studying the topic and finding important data.

Conclusions

In the first 30% of the project, the team learned about the potential challenges that come with creating a groundwater model in the Dominican Republic and how to overcome them. Data will be hard to retrieve. As reports were reviewed that depict previous studies of groundwater in the Dominican Republic, it was realized they are mostly reports and not data sets. The shapefiles and other data that is needed is not always available. Continued communication with Fidel and the visit to the Dominican Republic in January will likely lead to obtaining the needed data.

Upon having this data, a MODFLOW model can be generated to depict the groundwater in the southeastern part of the island. This model will need data on well locations, recharge rates, aquifer boundaries, water quality, and water demands. After the MODFLOW model is finished, it can be used to create a SEAWAT model, depicting seawater intrusion in the area. These models will be beneficial to INDRHI as they further analyze their groundwater resources.

Recommendations

There are a few recommendations the team would have for the sponsor, el Instituto Nacional de Recursos Hidráulicos (INDRHI). It is suggested to share shapefiles for the Higuey and Baigua areas. Having shapefiles provided will make the model building process more accurate due to actual data, rather than inputting data and creating shapefiles, leading to potential human error.

Further, as we commence in the creation of the model, the team needs to know which aquifers correspond with Higuey and the study area. This is needed in pinpointing what data is necessary and usable for the model. The more data that is inputted into the model, it will lead to greater detail and accuracy of the groundwater in the study areas.

Appendix A

Aubrey Hebdon

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EDUCATION

Brigham Young University (BYU)

Provo, UT

B.S. Civil Engineering

April 2019

- GPA: 3.81/4.00
- Related coursework: Hydraulics, Fluid Mechanics, Environmental Engineering, GIS, AutoCAD
- Recipient of BYU's half-tuition scholarship (3 years)
- 1st place winner for technical paper in the Rocky Mountain Conference, 2018
- Clubs/Organizations: ASCE (Historian), Concrete Canoe, Women in Engineering, BYU Women's Ultimate Frisbee Club

EXPERIENCE

Research Assistant

Provo, UT

BYU Department of Civil and Environmental Engineering

Sep 2016 – Present

- Oversaw testing, data collection and analysis of the effects of steel fibers in concrete bridge decks
- Led a team onsite of a bridge deck pouring while collecting and preparing concrete samples
- Performed 50+ flexural strength, compression and split tension tests on concrete samples using a UTM
- Authored a report for the Utah DOT on all data and findings regarding TSMR fibers

Structural Engineering Intern

Salt Lake City, UT

Dunn Associates

May 2018- July 2018

- Designed a structural model for 3 buildings using RAM Concept and RAM Structural Systems
- Drafted 15+ structural details using Revit

Teaching Assistant

Provo, UT

BYU Department of Civil and Environmental Engineering

Dec 2016 – April 2018

- Taught challenging concepts in simple ways, leading to a superior understanding of Statics and Mechanics of Materials principles
- Managed the grading of 150+ homework assignments on a monthly basis
- Tutored students individually and in groups to improve their knowledge and confidence

Personal Home Renovations

Holladay, UT

Self Employed

Feb 2016 – Sep 2016

- Assisted in the planning and preparation for the completion of a house
- Worked independently and collaboratively on the installation of floors, lights, outlets, and doors

LEADERSHIP, SERVICE and AWARDS

Historian for ASCE Student Chapter

Provo, UT

Brigham Young University

Dec 2017 - Present

- Documented 200+ ASCE events and prepared the ASCE annual report
- Represented BYU at the national ASCE leadership conference (RYMC)
- Collaborated weekly with other ASCE officers to organize and prepare weekly activities

Concrete Mix Design Assistant

Provo, UT

BYU Concrete Canoe Club

Sep 2017 – April 2018

- Worked directly with mix design captains to plan and prepare concrete mixes
- Prepared and performed compression tests on strategically designed concrete mixes

Religious Volunteer

Osorno, Chile

Religious Group

July 2014 – Jan 2016

- Adapted to an international environment by working with local leaders, learning the Spanish language and immersing myself in the culture
- Oversaw the care and safety of 18+ women as well as prepared weekly meetings to inspire and motivate volunteers

Logan Stewart Bennett

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EDUCATION

Bachelor of Science in Civil and Environmental Engineering

Brigham Young University

Provo, UT

December 2019

- GPA: 3.92
- Networking Chair for BYU ASCE
- Member of Tau Beta Phi
- Member of Golden Key National Honor Society

(April 2018—Present)
(September 2017—Present)
(September 2016—Present)

EXPERIENCE

Brigham Young University

Traffic Analysis Head Research Assistant

Provo, UT

January 2018 – Present

- Developed a methodology for analyzing 167 highway incidents to determine performance measures of incident management teams and lead to program optimization
- Utilize UDOT resources, including PeMS, iPeMS, and Numetric databases to determine user cost of incidents
- Primary author on report describing methods and results, as well as presenting research progress in meetings with UDOT

Nebo Credit Union

Collections Officer/Teller

Springville, UT

April 2015 – January 2018

- Gathered information on accounts and worked with over 100 members weekly to provide solutions to their specific needs
- Performed analysis on various high-stake situations and made judgement calls and took action with known information
- Gained knowledge of fair and lawful practices and specific policies of institution to guide work of protecting assets
- Professionally represented the credit union while working with people to solve financial problems

Payson City Pool

Lifeguard

Payson, UT

Summers of 2010 – 2012

- Supervised, advised, and assisted pool patrons in preventing dangerous situations and becoming aware of safety concerns
- Collaborated with a large team of lifeguards on work that required teamwork and precision
- Kept a safe and clean environment for all patrons and consulted patrons on improved safety practices

SKILLS

- Programs: ArcGIS, Microsoft Office
- Spanish proficiency
- Versed in VBA
- Customer service skills
- Leading team coordinating activities
- Written and verbal communication skills
- Teaching both large and small groups
- Safety trained

LEADERSHIP & SERVICE

BYU ASCE Student Chapter

Networking Co-Chair

Provo, UT

April 2018 – Present

- Coordinate efforts with a team of 13 other leaders to provide service and leadership opportunities to 250+ members
- Lead a team of 4 individuals and delegated responsibilities in the preparation and planning of networking events
- Organized the semi-annual networking dinner to allow for twice the amount of companies and students while minimizing costs

International Language Program

Volunteer English Teacher

Zhongshan, China

February 2017 – June 2017

- Prepared fun and interactive English lessons for various groups of first graders, using creative teaching methods
- Monitored children's progress and improvised to keep control and provide an environment conducive to learning
- Developed a more globally and culturally aware state of mind

The Church of Jesus Christ of Latter-day Saints

Full-time Volunteer

Neuquén, Argentina

March 2013 – March 2015

- Responsibilities included: prospecting, teaching, counseling, community service, and assisting local leadership
- Lead a group of 8 representatives to meet the objectives of the organization and accounted results to regional president
- Studied and became fluent in the Spanish language while being familiar with the Argentinian culture

ACTIVITIES & ACHIEVEMENTS

- American Society of Civil Engineers (ASCE): student chapter member (2015—Present)
- Institute of Transportation Engineers (ITE): student chapter member (2017—Present)
- Boy Scouts of America: Eagle Scout Award (August 2012)
- DECA Chapter President (2011 & 2012), leading ethics team to 3rd place at state and competing in Nationals two years running

Samantha K. Lau

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EDUCATION

Bachelor of Science in Civil Engineering

Brigham Young University

Provo, UT
December 2019

- GPA: 3.45
- President of the American Society of Civil Engineers (ASCE) (April 2018-Present)
- Student Liaison for the Institute of Transportation Engineers (ITE) (Dec. 2017-Present)
- Secretary & Treasurer for the American Railway Engineering and Maintenance-of-Way Association (AREMA)
- Member of Groundwater Modeling Capstone Team for the Dominican Republic

EXPERIENCE

Union Pacific Railroad

Engineering Intern

Omaha, NE

May 2018 – August 2018

- Researched potential part rebuilds and coordinated with companies to create a list of potential vendors for Supply Department
- Modeled an equipment survival prediction program to estimate failure for Maintenance of Way equipment in Microsoft Excel
- Gathered and compiled additional information to update over 500 equipment part descriptions for company online database
- Fostered communication skills by working with executives, employees in the office and in field locations

Oldcastle Materials

Civil Engineering Intern

Omaha, NE

May 2017 – August 2017

- Lead project manager for 3 projects, generating \$10,000+ in revenue by efficient scheduling, communicating, and preparing
- Critical team player in a competitive bid for the Nebraska State Letting, leading to a winning bid of a \$4.3 million project
- Proactively created essential supervisor safety binders and training for completion of a successful corporate safety audit
- Garnered applicable real-world engineering skills by sampling/performing various quality control tests on city asphalt projects

Sami's Swim School

Business Entrepreneur

Omaha, NE

May 2010 – August 2017

- Created a sustainable business plan, developed a competitive marketing strategy, and launched an effective business website
- Retained 65% of clientele annually, with over 150 new students taught and trained overall
- Engaged each student by establishing a customized lesson schedule and having personalized instruction
- Developed an employee with personalized training, scheduling, and monthly personal evaluations

Brigham Young University

Transportation Engineering Teaching Assistant—Civil Engineering

Provo, UT

September 2018 – Present

Geomatics Teaching Assistant—Civil Engineering

August 2017 – December 2017

American Heritage Teaching Assistant

August 2015 – April 2016

- Taught 3 interactive classes of 27 students weekly, regularly provided office hours to individually mentor and instruct students
- Evaluated students' computations and scholastic writing skills, effectively graded and provided constructive feedback
- Collaborated with faculty weekly to individually synthesize and teach required class material for 60-80 university students

Brigham Young University

Research Assistant—Civil Engineering

Provo, UT

August 2016 – December 2016

- Essential team member on innovative "Isotruss" research and carbon composite structural development and applications
- Analyzed, researched, and created new effective ways to perform critical research development aspects

SKILLS

- Programs: ArcGIS, AutoCad, Microsoft Office
- Customer and subcontractor relations
- Scheduling and time management
- Written and verbal communication skills
- Teaching and mentoring
- Financial management
- Spanish proficiency
- Technical writing

LEADERSHIP & ACTIVITIES

Full-Time Volunteer Service

The Church of Jesus Christ of Latter-Day Saints

Bakersfield, CA

August 2013 – February 2015

- Instructed and taught individuals from different cultures in their native tongue of Spanish while emphasizing their own culture
- Worked individually with women volunteers with focus on training, conflict resolution, teamwork, and skill development
- Collaborated with other volunteers to train, teach, and present various knowledge and training to large diverse groups

Additional Engineering Activities

- Society of Women Engineers (SWE): freshman mentor to new female engineering students
- WTS/UDOT Mentorship Program: accepted into mentorship program among female engineering students across Utah

SAUL RAMIREZ, E.I.T.
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EDUCATION

Brigham Young University, Ira A. Fulton School of Engineering GPA 4.00 June 2019
M.S. Civil Engineering- Water Resources Emphasis

- National Hispanic Scholarship Fund Award Recipient – Full Tuition
- Current Courses: Ground Water Modeling, Hydrologic Modeling, Culvert Design, D.R. Well Model
- Skills: Modflow, HEC-1/HMS, GSSHA, HY-8, SRH 2-D, Civil 3D, ArcMap, Python, Matlab, Excel

WORK HISTORY

U.S. Army Corps of Engineers (40,000+ Employees, Public and Military Engineering) Jul 2018 – Present
Hydroinformatic Engineering Research Consultant Vicksburg, MS

- Analyze and interpret 100 years of environmental data involving EMDs and HHTs
- Use Python, Matlab, and Visual Basic to create and debug hydrology applications
- Develop comprehensive project timelines as well as plans to keep the project on schedule and on budget
- Presented research results at multiple conferences, publishing multiple conference papers

Kimley-Horn and Associates (3,000+ Employees, 80 Offices, Design Consulting Firm) May – Aug 2017
Water Resources Intern Mesa, AZ

- Assisted engineers in designing grading, sewer, water, and drainage construction plans
- Analyzed precipitation data and hydraulics for an NFL stadium's off-site improvement plans
- Corrected red line drawings for single-family land development and commercial projects on AutoCAD
- Engineered a traffic count database that saved 300+ labor hours for company

Suntec Concrete (1,000+ Employees, 3 Offices, Structural Concrete Construction) Jun – Aug 2016
Project Engineer Phoenix, AZ

- Directed survey team in setting control lines and outlining formwork using total station
- Managed project assets, schedule projections, and work flow plans under supervision of Project Manager
- Constructed footings, structural walls, columns, and post-tension decks using 4,000 psi concrete

LEADERSHIP

Brigham Young University Jan 2016 – Present
Teaching Assistant Provo, UT

- Lead recitation sessions to over 80 students focusing economic feasibility of development
- Quantified and analyzed environmental and social impacts of projects

BYU American Society of Civil Engineers Jan – Dec 2017
Chapter Publications Officer Provo, UT

- Organized service and networking opportunities for over 800 BYU civil engineering students

BYU American Society of Civil Engineers Aug 2015 – May 2017
Mix Design Team Captain for Concrete Canoe Provo, UT

- Managed material team in designing floatable concrete- earning 1st place award in speed category

BYU Global Engineering Outreach Sep – Oct 2015
Water Distribution Lead Blanding, UT

- Oversaw teams of students installing water lines and solar panels for communities in the Navajo Nations

The Church of Jesus Christ of Latter-day Saints Aug 2013 – Jul 2015
Full-Time Volunteer Representative Oaxaca, Mexico

- Provided service for hundreds of people; meeting 50 new people every day
- Wrote legal memoirs in Spanish, managing communication with Microsoft Office products

PERSONAL

Interests: UAVs, ground water modeling, jiu-jitsu, soccer, basketball, hiking, photography and scuba diving