

RESERVOIR MANAGEMENT
Project ID: CEE_n_2018CPST-DR-005

by

RBB Engineering
Riley Hales
Benjamin Grey
Briana Ihrke

A Capstone Statement of Work

Submitted to

Fidel Perez
Instituto Nacional de Recursos Hidráulicos

Department of Civil and Environmental Engineering
Brigham Young University

October 8, 2018

Introduction

PROJECT TITLE: RESERVOIR MANAGEMENT
PROJECT ID: CEEEn_2018CPST-DR-005
PROJECT SPONSOR: INDRHI
TEAM NAME: RBB Engineering

We have been asked to assist the Instituto Nacional de Recursos Hidráulicos (INDRHI) in coming up with and implementing improvements for the reservoir management system in the Dominican Republic. Our main contact in the Dominican Republic is Fidel Perez, and we will better be able to understand what he would have us do once we do a proper site visit and in person discussion. We will be making a site visit to the Dominican Republic January 20th - 29th, 2019.

For this project we have come up with three tasks that can improve the INDRHI reservoir management. The first task is to help store, display and share the data recorded in an easy to use way. The second task is to improve an already existing app and make it compatible with the data from the first task. Finally, the third task is to design a tool to display forecast changes in water level in each reservoir based fluctuating demands and forecasted inflows to the reservoir. These tasks are subject to change based on the needs and requirements of the INDRHI officials. Our deliverables will consist of the following three items: 1. An updated version of the Tethys Reservoir Management app, 2. A reservoir monitoring spreadsheet and 3. A system/tool in place for regular data transfer.

In order to better perform these tasks, weekly meetings will be held and goals will be evaluated. Our schedule currently consists of class from 4-6 every monday and team meetings Friday at 4pm to finalize and submit completed tasks. We are planning on contributing 135 hours during the current fall 2018 semester, and 405 hours during the upcoming winter semester. The reason for the sudden influx of hours is due to the understanding that the majority of the work will take place during the site visit and after, because of the information we will be receiving at that time.

Proposed Work Plan

The goal of this project is to assist INDRHI with managing its reservoirs. Our clients will deploy our solutions to the employees that work at the dams, reservoirs or other relevant stations around the country. The people that will use these tools will need to make daily operation decisions for their water resources. Usually, the users will not be engineers or have similar technical training. Consequently, we have made understanding the jobs and needs of the end users a primary concern to guide our decision making process. Based on prior work and assessments made with INDRHI, we will try to improve their management practices in three areas.

The first area centers on their data management system. The ability to collect, analyze, and share data is crucial to any management project. This will naturally be the first priority for the project since any other action will depend on the availability of data. The dams and other stations used by INDRHI record data about the reservoirs on a regular schedule. That data doesn't get shared in a way convenient for use in a tethys app. While visiting their facilities and inspecting their current computer infrastructure, we can make suggestions on improvements. The primary objective of the new system is to make the data automatically available to the improved reservoir management app.

The second area involves improvements to the existing app used to manage reservoirs called "Herramientas de Operaciones de los Embales." The primary goal of this section is to make the app compatible with the improved data management process from the first area. Ideally this is automated such that the user no longer needs to manually enter data. The app would always have access to the most available data so that the monitoring is close to real time. Additionally, the app needs improvements to the user controls and the display. The current app relies on the user to manually enter data for many time periods and variables. The improved user interface should automate that step to ensure accuracy, improve usability and streamline the interface. INDRHI has also requested that the improved app have better visual representations of the data rather than only primarily data tables. Some ways this may be accomplished include providing cross sectional views of reservoirs, adding graphs, or improving the map section of the app.

The third area is to design a tool to forecast changes in water level in each reservoir based fluctuating demands and forecasted inflows to the reservoir. This will most likely be handled by a spreadsheet to provide an additional method for managing reservoirs outside of a web app. A spreadsheet is ideal because it is easy to use, easier to edit than a web app, and doesn't require extra software and cost to use.

These project goals will evolve as our team better learns the needs of the end users and INDRHI officials. While we believe these areas are mostly likely to be beneficial and feasible, we anticipate revisions to these goals as the project unfolds. We will consider the project successfully complete upon implementation of our improvements to their reservoir management capabilities in these or other requested areas.

Schedule

Important Dates:

End of Semester Fall Semester:	December 13, 2018
Beginning of Winter Semester:	January 7, 2018
Trip to Dominican Republic:	January 20 – January 29, 2019
End of Winter Semester:	April 17, 2018

Project Schedule Overview:

Our project has been divided into two main work periods: pre-Dominican trip and post trip. The trip in January 2018 will allow us to visit with INDRHI officials. There will be able to make presentations regarding all work we have completed up to that point. We will also receive guidance as to how are project/progress will directly meet the needs of INDRHI. To prepare for our trip, we will be preparing all presentation material. Majority of this time pre-trip will be used making suggested app changes, creating a rule curve to monitor reservoir on a spreadsheet, collecting specific data from our INDRHI contact in order to develop the spreadsheet, and have the Tethys app reflect our data.

Post trip will consist of the majority of our project completion. We will take that time to create our final project meeting the proper specifications and instruction identified by INDRHI officials so that our project is most valuable to them.

Weekly Work Schedule:

(It is anticipated that three hours per team member will be contributed on average per week during the Winter Semester. During Fall it is anticipated nine hours will be contributed by each team member.)

Winter Semester Schedule:

Monday

- Class: 4pm-6pm (When available 2nd hour of class will be used for team meeting)

Tuesday

- N/A

Wednesday

- N/A

Thursday

- N/A

Friday

- Team Meeting: 4pm (Time used to finalize/submit any task regarding project details due the upcoming Monday)

Facilities, Tools, Data and Equipment

Our project heavily consists of analyzing large amounts of data and developing specific features to project this data in an online app as well in an offline spreadsheet. Specific tools needed for this aspect of the project includes python, java script, tethys, and VBA programming tools. A system will need to be developed that will help the INDHRI officials routinely send reservoir data to our development team. Tool and equipment needs for this aspect of the project will be determined and identified as an agreed upon process between INDHRI and our research team is decided. Data will also be gathered in order

Project Budget

Fall 2018 Semester

Total Team Hours: 135 hours

*Each team member is contributing three hours a week for fifteen weeks

Winter 2019 Semester

Total Team Hours: 405 hours

*Each team member is contributing nine hours a week for fifteen weeks

To be completed by January 18, 2018:

- Rule curve to reservoir monitor first draft
- Visually represent a cross section of the reservoir on Tethys app
- Visualize max/min levels on Tethys app
- View current levels on Tethys app
- Show how much water needs to be in the reservoir to meet rule curve first draft

To be accomplished between January 20 – January 29, 2019 Trip to the Dom. Rep.

- Present completed work
- Seek feedback and direction to take our project from INDHRI officials

To be completed by April 17, 2019

- Have final app completed according to specifications requested
- Have an agreed upon method of gathering and transferring data from INDHRI to app team in place and running
- Have an offline spreadsheet to predict future reservoir projections

Deliverables

1. Tethys Reservoir Management App Modifications including:
 - a. A visual representing a cross section of the reservoir
 - b. Visualize maximum and min levels
 - c. An updated view of current levels
2. Reservoir Monitoring Spreadsheet
 - a. Rule curve implemented to allow INDRHI to run simulations regarding reservoir levels and reservoir water usage
3. System/tool in place for regular data transfer

Performance Standards

Team will provide work for this Capstone project “as is” using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved and stamped by a qualified and relevant license professional engineer.

Statement of Qualification

Riley Hales:

BYU Hydroinformatics Lab – Research Assistant

April 2018 – Present

- Computational, global scale hydraulic modeling using custom geospatial software (Tethys)
- Researched funded by NASA, JPL, United Nations Group on Earth Observations (UN GEO)
- Developed app to predict, track endemic disease across Africa, recommend solutions
- Web App development in Python and Javascript – some HTML, CSS, Django, Visual Basic

Ben Grey:

Asset Management Intern, Central Utah Water Conservancy District, Orem UT September 2017 – May 2017

- Assisted in routine inspection documentation onsite at water treatment plants.
- Collaborated with 5 area/water treatment managers to update asset conditions in each managers' stewardship.

Bri Irhki:

Kimley Horn and Associates – Analyst May 2018 – September 2018

- Assisted the Land Development Department with creating and editing grading plans
- Put together Erosion Control Plans and Demolition plans for onsite and offsite improvements
- Worked with over 10 cities to retain permits and applications for grading plans
- Provided assistance on over 40 different projects ranging from small site to large site development

Appendix A

Riley Hales

480-252-4350
rileyhales1@gmail.com

665 N 500 E Apt 1
Provo UT 84606

rileyhales.com

Education

Brigham Young University - Provo, Utah

Graduation December 2019

- BS Civil and Environmental Engineering, **GPA 3.4**

Work Experience

BYU Hydroinformatics Lab – Research Assistant

April 2018 – Present

- Computational, global scale **hydraulic modeling** using custom geospatial software (Tethys)
- Researched funded by **NASA, JPL, United Nations** Group on Earth Observations (UN GEO)
- Developed app to predict, track endemic disease across Africa, recommend solutions
- **Web App** development in **Python** and **Javascript** – some **HTML, CSS, Django, Visual Basic**

BYU Geomatics (GIS and Surveying) Teaching Assistant

May 2017 – May 2018

- Personally **developed 13 lab assignments** and **Final Exam** to teach surveying and GIS skills
- Developed and presented in lab sections on GIS skills in **ESRI's ArcGIS** software package
- Responsible to grade assignments, input grades, teach review sessions

RCH Engineering PLLC – Founder

January 2018 – Present

- **Consultant** for IT services, website management, technology to Arizona businesses
- Produced **CAD** models and renderings of proposed building interior, exterior renovations
- Independently seek jobs, quote prices, **manage business relationships** with professionals

Kevin Rose Professional Cleaning Services

April-August 2014

- **Independent contracted** to clean homes, businesses, restaurants to professional standards
- Personally **represented the company** to business owner clients and managed their accounts
- Trusted with building keys, alarm codes, safe combinations, sensitive information

Volunteer/Service Experience

ASCE Officers- BYU Student Chapter (Networking Committee)

April 2018-Present

- Plan, coordinate networking events with engineering companies, students, BYU
- Volunteer service to local K12 schools and after school programs promoting STEM

BYU Concrete Canoe Team

August 2017-Present

- Participated in team that designed concrete mix to meet project standards and requirements
- Prepared, poured, cured concrete used in competition at regional and national ASCE competitions

Volunteer Missionary Service (Church of Jesus Christ of Latter-Day Saints) Jan-Dec 2015

- Unpaid, Full-time, representative of an international church and its practices in North Italy
- Responsible for daily interactions with diverse cultures, languages, religions, educations

Notable Achievements and Skills

- Computers: Python, Java, Visual Basic/VBA, Web Sites/Apps, Hardware Repair, Networking
- GIS and Geospatial modeling, especially ESRI products ArcGIS, arcpy, modelbuilder
- Ethical, Dependable, Team Player, Self-Motivated, Organizational skills
- Boy Scouts of America- Eagle Scout, 3 palms
- 5+ years experience in Food Service Management
- Multilingual- English, Spanish, Italian

Briana Ihrke

(408) 500-8003

Provo, Utah

Ihrke.Bri@gmail.com

Education

Brigham Young University - Civil Engineering

Estimated Graduation Date: April 2020

- GPA: 3.5
- Minor in Mathematics

Work Experience

Kimley Horn and Associates – Analyst

May 2018 – September 2018

- Assisted the Land Development Department with creating and editing grading plans
- Put together Erosion Control Plans and Demolition plans for onsite and offsite improvements
- Worked with over 10 cities to retain permits and applications for grading plans
- Provided assistance on over 40 different projects ranging from small site to large site development

Anderson Engineering – Engineering Technician

May 2017 – August 2017

- Assisted the Structural Engineering Department with dimensional analysis of towers
- Performed annual condition assessments of cell phone towers.
- Provided the Environmental Engineering Team with photo documentation and biological assessment of hazardous waste sites.
- Organized and digitized archived Utah Voluntary Cleanup Program documents.

Volunteer Experience

The Church of Jesus Christ of Latter-day Saints – Volunteer Representative

July 2014 – Dec 2015

- Worked 12+ hour/day, 6 days a week).
- Learned how to set goals, and make and execute plans.
- Taught and created lesson plans for ESL class
- Positively represented an organization of over 16,000,000 members

Skills

- Comfortable with 3D LIDAR scanning
- Proficient in AutoCAD and Civil 3D
- Fluent in Spanish

Benjamin Laddie Gray

(817) 550-7511 • benjaminlgray1@gmail.com

» Education

Bachelor of Science, Civil Engineering, *Brigham Young University*

December 2019

- GPA 3.42/4.00
- ASCE member - 2 years

Provo, UT

» Professional Experience

Construction Intern, *Geneva Rock, Orem UT*

May 2017 – Present

- Prepares bid estimates, attends pre-bid meetings, and assists project manager through project lifespan.
- Assists construction crews regularly to develop an understanding of horizontal construction projects. u.

Asset Management Intern, *Central Utah Water Conservancy District, Orem UT*

September 2017 – May 2017

- Assisted in routine inspection documentation onsite at water treatment plants.
- Collaborated with 5 area/water treatment managers to update asset conditions in each managers' stewardship.

Intern, *Jones and Associates Consulting Engineers, Ogden UT*

May 2017 – September 2017

- Site inspector for two new subdivision projects in the city of Perry and Wellsville.
- Surveyed, using GPS unit, all storm drains and sewer utilities in South Weber and Washington Terrace.
- Organized and reduced the entire GIS database for the city of Washington Terrace.

Teachers Assistant, *Sustainable Infrastructure, Provo UT*

December 2016 – May 2017

- Responsible for maintaining 80 student grade calculations and updates using excel and school software.
- Developed student understanding of political, social, and economic factors regarding infrastructure projects.

Owner/Operator, *Laddie's Lawn Service, Arlington, TX*

April 2015-December 2015

- Built a client base from 0-50 by providing reliable and superior lawn services.
 - Acted as CFO by preparing payroll, tax statements, and financial analysis of the company.
 - Supervised, trained, and evaluated 3 employees.
-

» Leadership Experience

Volunteer Coordinator, *2016 National Student Steel Bridge Competition*

February 2016 – June 2016

- Enlisted, trained, and managed 44 volunteers.
- Oversaw weekly committee meetings reviewing goals, deadlines, and address upcoming tasks.
- Delegated responsibilities amongst committee members and followed-up to ensure effective results.

Volunteer Representative, *LDS Church, Denver CO*

April 2013- April 2015

- Led groups of 28+ volunteers focused on reaching specific personal and team goals.
 - Trained volunteers on problem solving, goal setting, planning, teamwork, and effective communication.
-

» Skills/Accomplishments

- Extensive experience using ArcMap, ArcCatalog, Excel VBA programming, and Trimble Business.
- Exposure to AutoCAD, Revit, EPANet, and AutoCAD Storm Drain design.
- Experience in land surveying using a total station and GPS unit.
- 2nd Place - Mystery Design Competition Rocky Mountain Regional Conference 2016
- Fluent in Spanish
- Eagle Scout Award - 2010