## PRESSURE ZONES ANALYSIS FOR JUB ENGINEERS Project ID: CEEn\_2016CPST\_006

by

MaRS Engineers McKell Sanderson Michael Freeman Spencer Stanley Ryan Harwell

A Capstone project submitted to

Mark Christensen JUB Engineers

Department of Civil and Environmental Engineering Brigham Young University

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## **Cover Letter**

The future plan for the city of Lindon calls for an expansion to the culinary water system with an additional minimum 900,000-gallon capacity. MaARS Engineers will use a pressure model to determine the most effective elevation of the future tank that will efficiently provide pressurized water to the community. To supply the extra water an additional well or well expansion will also be evaluated. MaArs Engineers will analyze possible locations of a future tank and well, effects on the current pressure zones, and also other possibilities of meeting the desired capacity.

#### **Contact Information:**

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|------------------|---------------------------------|
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## **Introduction**

# PROJECT TITLE:Pressure Zones Analysis for JUB EngineersPROJECT ID:CEEn-2016CPST-006PROJECT SPONSOR: JUB EngineersTEAM NAME:MaRS Engineers

Lindon's culinary water mainly originates from four wells spread throughout the city, with an additional amount from a mountain spring. This water is stored in three culinary tanks in two locations in the city. The future plan for the city calls for an expansion to the system with minimum 900,000-gallon capacity. The main purpose of MaRS Engineers is to assess and analyze possible locations of a future tank and its affect on the current pressure zones and also examine other possibilities of meeting the needed capacity.



Figure 1: Existing Culinary Water Supply Network of Lindon

MaARS Engineers has a qualified team that will ensure the most economical placement of the tank. We will use a pressure model of the city of Lindon to determine the most effective elevation of the future tank that will efficiently provided pressurized water to the community. City requirements, pressure zone requirements, and city needs will be considered in the final suggested action. Research will be conducted on whether an additional pump would be effective for the new design. Outside consultants who have experience with flow and pressure analysis will assist in the analysis of data. All work will be thoroughly reviewed and checked by outside consultants for quality and validity.

A monthly report will be given to JUB Engineers of the project status no later than the 2<sup>nd</sup> day of the following month between January and April. Final deliverables will include a reported summary of all sites considered and their individual costs and affects to pressure zones and a presentation to JUB Engineers of the final recommendation.

Our team will dedicate a minimum of eight hours weekly to ensure full completion with quality results by the anticipated due date. All deliverables will be available by April 10, 2017.



## **Proposed Work Plan**

This section reviews MaRS Engineers' anticipated procedure and criteria for this project.

The project will be approached in three stages as follows:

- 1. Site determination of location(s) of future culinary tanks and/or water pumps
- 2. Analysis of future culinary tanks or pumps on current pressure system
- 3. Structure and cost analysis of future system and final report

Each stage will be based on certain criteria that best suits the interests of JUB Engineers and the city of Lindon. Clients may submit additional criteria to be considered so long as the project scope is not significantly altered and the stage has not reached completion. The following criteria will be considered for the decision outcomes of each stage:

Site Determination Criteria

- Availability of land and existing water system, with special consideration given to land currently owned by the city of Lindon
- Minimal cost of site of new system
- Elevation of land that best meets pressure needs and proximity to future serviced pressure zones
- Minimal affect of future tank or pumps on community

Pressure System Analysis Criteria

- Accurate pressure model reviewed by consultants
- Minimal effect of future tank or pumps to existing pressure zones

#### Structure and Cost Analysis

- Visual appeal of future tank or pumps in community
- Minimal cost of future tank or pumps in a 25 year life span

The following points are the projected steps for each stage of the project. This is only a preliminary plan and adjustments will be made on a "as needed" basis depending on unforeseen scope changes requested by clients.

#### Site Determination Steps

- 1. Approximate required head for future tank.
- 2. Determine the existing open land available to match or exceed that value.
- 3. Visit each site and determine the effect of the future tank in the community.
- 4. Obtain information about each site's cost, soil, and possible tie-in to existing system
- 5. Rate each land according to best fit
- 6. Submit results to JUB Engineers

#### Pressure System Steps

- 1. Obtain date of existing pipe network, elevations, and pressures
- 2. Research and obtain pressure system model software
- 3. Run analysis of best land options determined by JUB Engineers
- 4. Analyze data on changes to pressure zones



- 5. Assess the needs for pumps or pressure zone changes per option
- 6. Run analysis based on new additions, if any
- 7. Meet with JUB Engineers to discuss results and pressure model

#### Structure and Cost Analysis Steps

- 1. Research relevant city codes for new system
- 2. Research efficient and reliable tank and pump options and cost
- 3. Obtain information for construction and maintenance fees
- 4. Analyze cost of different systems
- 5. Compare future system options and determine our recommendation

The final recommendation will be determined based on conditions that best meets the needs of the client. Meeting these proposed conditions will signify the successful completion of the project. They are as follows.

#### Final Recommendation Criteria

- Least amount of impact on existing pressure zones and system
- Most efficient system in transporting water to the city
- Most cost efficient in construction and maintenance over a 25-year period
- Appeal to the public eye

A final report and presentation will be provided for JUB Engineers at the conclusion of the project. The final report will be organized about each site considered and will contain information regarding each of the three project phases criteria. Calculation results will be included in the report with a description of how the calculated values were obtained. Pressure data will also be given to JUB Engineers that will work with their existing software.



## <u>Schedule</u>

MaRS Engineers will begin work on this project within the second week of January, 2017. It is anticipated that each group member will work eight hours each week and will typically meet between the hours of 3pm-6pm on Wednesdays and Fridays until job completion. However, as we have schedules that are influenced by scholastic events, we are not expected to work specifically during these hours so long as the eight hour minimum requirement is met on an individual basis. We are required to meet for at least one hour each week as a team to discuss project goals and assignments.

To give JUB Engineers an idea of the project process and timeline, we have provided a project calendar that describes the anticipated completion date of each phase of the project. All dates are subject to change based on change orders requested by JUB Engineers. The final date for all deliverables is non-negotiable; no final product may be expected before this date.

| DATE               | MILESTONE  |
|--------------------|--|
| JANUARY 11         | Initial Site Visit   |
| JANUARY 25         | Site Analysis Complete, Plausible Sites Determined, Analysis given to JUB Engineers for review |
| FEBRUARY 1         | Anticipated Due Date of JUB Engineers review   |
| <b>FEBRUARY 27</b> | Pressure Zone Analysis Complete  |
| MARCH 1            | Meeting with JUB Engineers for Pressure Zone Model   |
| MARCH 15           | Structural Design and Analysis Complete  |
| MARCH 24           | Cost Analysis Complete   |
| APRIL 7            | All Deliverables Finalized   |
| APRIL 10           | Deliverables and Presentation Ready and Available  |

We request one review from JUB engineers between January 25 and February 1, 2016, of the possible sites analysis. We also request a meeting with JUB Engineers on March 1, or a time suitable for them within a week of this date, to review the finalized analysis of the pressure zone model.

Undetermined future dates will be scheduled with consultants and clients as needed throughout the project timeline on a "as needed" basis.



## **Facilities, Tools, Data and Equipment**

The majority of the project will be completed on the CAEDM computers on BYU campus. These computers have all the necessary programs and software needed gather and analyze hydraulic data. When applicable, personal computers will back up the CAEDM computers and analyze data using Microsoft Excel, MathCad and other programs.

- Multiple shapefiles, contour maps, SHX, DBF, SBX, PRJ, CPG and SBN Files have been provided by JUB Engineering. Many of these files will be imported into different water modeling systems to analyze the pipes and flows. ArcMap, EPA Net and other modeling systems will be looked into in determining which modeling software to use.
- Utah Water Parcel maps will be used to determine reasonable areas to build a new tank and well. These will also be used in determining what areas are feasable to buy and for what cost.
- A water pressure model will be used to analyze the pressure zones and export the data. JUB Engineering will be able to import this data into their personal modeling system.
- For considering the cost analysis the Rocky Mountain energy schedule and pricing will be used. This information can be gathered on Rocky Mountain Energy's main website.



## **Project Budget**

The typical hourly rate for each engineer at is \$60/hr. Hours to be charged include travel to and from site visits, individual work, team meetings, meetings with sponsors, and meetings with consultants. MaRS Engineers are expected to work no less than 8 hours per week. The project manager's rate is \$80 per hour. They are anticipated to work an average of 1-2 hours per week. Consultants will be charged separately for their expertise at \$120/hr. We anticipate to meet with outside consultants for at least one hour each week during the duration of the project.

The project is anticipated to take 14 weeks. The estimated charge for completed design and all deliverables is \$23,000. This estimate includes all engineer and consultant fees, printing for reports and presentation posters, and the time for the final presentation to JUB Engineers.

A breakdown of the fees per project milestone is shown below. The calendar timeline layout necessary for each milestone is laid out in the "Schedule" section of this proposal.

| COMPLETION       | MILESTONE   |
|------------------|---|
| FEE AND          |   |
| (TOTAL HOURS)    |   |
| \$180 (3)        | Initial Site Visit  |
| \$6320 (100)     | Site Analysis Complete, Plausible Sites Determined, Analysis given to |
|                  | JUB Engineers for review  |
| \$0 (0 HOURS)    | Anticipated Due Date of JUB Engineers review                          |
| \$8200 (130)     | Pressure Zone Analysis Complete                                       |
| \$300 (5)        | Meeting with JUB Engineers for Pressure Zone Model                    |
| \$2000 (30)      | Structural Design and Analysis Complete                               |
| \$1500 (22)      | Cost Analysis Complete  |
| \$4250 (65)      | All Deliverables Complete and Submitted                               |
| <b>\$280 (4)</b> | Presentation Ready and Available                                      |



## **Deliverables**

There are key deliverable requirements that will be completed before April 10<sup>th</sup> 2017. These deliverables are requested by JUB Engineers and capstone personnel.

- A monthly status report will be provided each month summarizing the progress and current status of the project.
- A final report of all site considerations and their respective future system, along with summary of their phase criteria and pressure calculations.
- Pressure analysis data that will work with JUB Engineers' existing software.
- A presentation of the final recommendation will be given to JUB Engineers at a time convenient for them no more than two weeks beyond the project completion date.
- A poster-report with design alternatives will be submitted along with a presentation to the capstone committee.

The monthly status report will document challenges, solutions, and progress. The report will be given to JUB Engineers and other capstone personnel no later than the 2<sup>nd</sup> day of the following month for the months between January and April. These reports answer the following four questions:

- What challenges have your team encountered in your Capstone project?
- What actions did your team decide to do to overcome these challenges?
- Is there any progress in overcoming these challenges?
- Is the project currently on schedule?

While completing these questions, a summarization of the current status of the project will be provided within the monthly report. In doing so, challenges that negatively impact the project will be addressed. This report will be concluded with a brief summary of the team's plan to stay on schedule.



## **Performance Standards**

MaRS Engineers 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**

Michael Freeman has experience leading people and is selected as our team lead and the main communication liaison between JUB Engineers and MaRS Engineers. Collaboration of project assignments among the team members will mainly happen in a weekly meeting. Weekly goals and assignments specific to timely needs will be distributed under Michael's direction. Email and txt will methods of communication throughout the week as needed.

#### Michael J. Freeman:

- Education:
  - Senior in the Civil Engineering Program. Relevant classes taken include Hydraulics and Fluid Flow Theory (CEEn 332), Hydrology (CEEn 431), and currently taking Hydraulic Engineering (CEEn 433).
- Work History:
  - Grew up working on a farm building fences and monitoring irrigation ditches. Worked for Freeman Machine as a Cabinet-Maker and Machinist assistant. Received an Eagle Scout in 2009. Currently is the leading student S.O. at Provo MTC Security in charge of training and hiring new officers.
- Project Assignments:
  - o Team Lead
  - Elevation and Contour Maps.
  - Monthly status reports.
  - Sponsor Communication liaison.

#### Spencer Stanley:

- Education:
  - Senior in the Civil Engineering Program. Relevant classes taken include Fluid Flow Theory (CEEn 332), and Hydrology will be taken concurrently with the project.
- Work History
  - Currently employed at Acute Engineering doing timber structure and steel moment frame design. Duties also include truss and steel submittal reviews, engineering addendums, and creating spreadsheets for design purposes.
  - Previously employed with BYU Physical Facilities doing electrical design, drafting, and CAD modeling.
- Project Assignments
  - $\circ$   $\,$  Final documentation and calculation book compilation  $\,$
  - o Graphics designer
  - City code expert



### Ryan Harwell:

- Education:
  - Senior in the Civil Engineering Program. Relevant classes taken include Fluid Flow Theory (CEEn 332).
- Work History
  - Research for BYU engineering
  - Project Assignments
    - o Pressure model expert
    - Cost evaluation

List of outside consultants and recent publications:

- McKell Sanderson: Project Mentor. BYU Environmental Management Manager.
- Dr. A. Woodruff Miller: Ph.D. Civil Engineering, Stanford University, 1975
  - Hansen, Carly, Gus P Williams, and A Woodruff Miller. "Regional Scale Application of Remote-Sensing Chlorophyll Detection Models and Analysis of North-Central Utah Region." North American Lake Management Society (NALMS) 33rd International Symposium. San Diego, CA: North American Lake Management Society, 2013.
  - Miller, A Woodruff and Walid Sabbah. "Updated Water Budget for the Western Aquifer Basin and Potential for Agricultural Development in the West Bank, Palestine." Conference on Water Crisis and Agricultural Development in Palestine. Conference Proceeding, Tulkarm, Palestine, May 2012.
- Dr. M. Brett Borup: Ph.D. Structural Engineering,
  - Borup, Michael Brett. "Evaluation of the TMDL for East Canyon Reservoir Using Remote Sensing." <u>Environmental Science and Technology 2012.</u> Vol. 1. Houston, TX: American Science Press, 2012: 145-149.
  - Borup, Michael Brett and Victor N. A. Narteh. "Mapping and Modeling Chlorophyl-a Concentrations in Utah Lake Using Landsat-7 ETM+ Imagery." <u>Environmental Science and Technology 2012.</u> Eds. George Sirial and Jihua Hong. Vol. 1. Houston, TX: American Science Press, 2012: 150-155.
- Dr. E. James Nelson: Ph.D. Civil Engineering, Brigham Young University, 1994.
  - Rangel-Peraza, Jesus Gabriel, Oliver Obregon, Everett James Nelson, Gus P Williams, Jose De Anda, and Jerry Miller. "The Use of Digital Elevation Models (DEM) for Bathymetry Development in Large Tropical Reservoirs." <u>Bathymetry</u> and Its Applications. ISBN 978-953-307-959-2. Intech, 2012.



## Appendix A

Figure 1 provided by JUB Engineers.

Resumes of MaRS Engineers are provided in the following pages.



## **Spencer Stanley**

(801) 349-9568 - spencer.f.stanley@gmail.com

## Objective

Showing qualifications to work on the Pressure Zones project from JUB Engineers.

## Education

#### BS, Civil and Environmental Engineering (Emphasis on Structural)

Brigham Young University, Provo, Utah

- Anticipated graduation date April 2017
- Relevant coursework steel design, reinforced concrete design, transportation

## **Professional Experience**

#### Structural Engineer Intern

Acute Engineering, Orem, Utah

- · Structural design for timber frames, steel frames, retaining walls, footings/foundations
- Risa 3D, StruCalc, Retain Pro, Excel and VBA coding, Simpson design software
- · Provide engineering addendums/letters to clients on structural issues
- · Review accuracy of submittals from manufacturers on structural designs

#### Electrical Engineering Technician/Designer

BYU Physical Facilities, Provo, Utah

- Designed and drafted for over \$2,000,000 total project worth on 90+ projects
- Created electrical BIM model of 220,000 sq. ft. building using Revit software
- · Estimated cost for lighting and power for remodels weekly
- · Coordinated with engineers, architects, and interior designers on project specifications
- Programmed a spreadsheet for electrical computations
- · Created 30+ pages of training and drafting standards for electrical division

## Volunteer and Leadership Experience

#### Full time Volunteer

The Church of Jesus Christ of Latter-day Saints, Milwaukee, Wisconsin

• Contacted hundreds of people monthly and presented for groups daily (10-12 hour days)

#### Section Leader/Squad Leader

BYU Marching Band, Provo, Utah

- Responsible for the execution of quality music and marching of the section (32 members)
- Performed for up to 65,000 football fans and in bowl games (Miami Beach, Royal Purple)

## January 2014 - November 2015

November 2015 - Present

\*References available upon request

June 2011 - June 2013

August 2013 - December 2015



## Michael Freeman

Provo, Utah, 490 South Freedom Blvd | 435-979-0732 | michaeljamesfreeman91@gmail.com

#### Job Objective

 Gain a greater insight in many different sides of Civil Engineering, Apply strong communication, and interpersonal relation skills, in a challenging but creative environment.

#### Education

Civil Engineering Program (IRA A. Fulton College), BYU, Graduate in Fall 2017 (GPA-3.6)

#### Skills & Abilities

#### DEDICATION

 Assisted the local farmers with fieldwork that took a great deal of effort and time. Can work efficiently until the job is completed correctly the first time.

#### COMMUNICATION

 As an LDS Missionary, have taught many people including: farmers, politicians in DC, and international people from Africa and most European countries.

#### LEADERSHIP

- Worked as a Supervising Senior Officer training and hiring new officers for BYU Police stationed at the Provo MTC.
- District Leader and Zone Leader over 8 to 32 missionaries in Washington DC.
- Eagle Scout: Can organize, communicate and work with people to get a specific job completed.

#### TECHNICAL SKILLS

 Proficient at Excel, Microsoft Word, and VBA Coding, Has had experience with Auto-Cad, Revit, extracting data from hydrologic websites

#### Experience

#### SECURITY | BYU POLICE |

 First on scene leader at any emergency until the Police or EMTs arrive. Requires good communication/people skills and to be calm and aware in any confrontation. Senior officer over the training, hiring new officers and technical communication.

#### AUTISTIC NURSE | ACUMEN |

Involved in interviewing and training new employees. Requires patience and firmness to care for these autistic men.

#### MACHINIST ASSISTANT | FREEMAN MACHINE |

· Operated the drill, guided machinery and cleaned parts. Assisted machinist on CNCs and Lathes.

#### CARPENTER-CABINET MAKER | FREEMAN MACHINE |

Worked with the machinery in building and finishing of custom European grade cabinets. Installed and helped design these
custom cabinets into older non-uniform homes.

#### CONSTRUCTION WORKER | PRIVATE JOB - GARY HONE |

Worked in the construction of a retirement home. Starting with the in laying concrete through the end finishes.

## MARCH 2012-CURRENT

MARCH 2013-CURRENT

#### utistic men

#### 2013-2015

2008-2009

#### 2003-2010, 2012-2015