

NORTH UNION CANAL FEASIBILITY STUDY
CEEn-2016CPST-012

by

JDJ

Jake Nelson

Josh Reidhead

Daniel Schwicht

Jeffrey Schwicht

A Capstone project submitted to

Mark Christensen

J-U-B Engineers

Department of Civil and Environmental Engineering
Brigham Young University

January 21, 2017

Introduction

PROJECT TITLE: North Union Canal Feasibility Study
PROJECT ID: CEEEn-2016CPST-012
PROJECT SPONSOR: J-U-B Engineers
TEAM NAME: JJD

This proposal provides a three-phased work plan, a list of necessary equipment, tools, and data, a project schedule, a budget for time allocation, a performance standard, a list of outside consultants, and a summary of qualifications.

Work will be divided into three major phases. Phase 1 consists of information gathering by means of site visits, accessing public information, and communicating with canal owners. Phase 2 consists of data analysis. Information gathered in phase 1 will be combined to create a map of the canal and easements detailing current canal conditions, hydraulic capacities, and property ownership. Phase 3 is the design phase. A design for piping of the canal will be created, as well as at least one alternative design. Each design will include water flow estimates, cost estimates, and other values to facilitate comparison of benefits of different designs.

This project in phase 1 will require use of bicycles, a GPS-enabled camera, measuring tape, various resources already provided by J-U-B Engineers (maps, soils reports, survey data, flow data, etc.). In phase 2, a shapefile editing software such as ArcGIS will be required. Phase 3 will require a drafting software such as AutoCAD.

The project schedule will begin with proposal approval on December 6, 2016. Locating items using GPS will be completed by April 8, 2017. Piping final design, GPS layers, and feasibility report will all be submitted by April 10, 2017. On that day, the project summary will be presented.

The project will take an estimated total of 225 man-hours, with 18 hours for initial site visit, 25 hours for meetings, 168 hours for map creation and design, and 14 hours for project summary preparation and presentation.

Though not licensed professionals, our performance standard is to submit a timely, useful feasibility study of professional quality.

The study will involve J-U-B representatives Mark Christensen and Jocelynn Crowther, Capstone Project Manager Jake Nelson, as well as consultation with BYU professors Rollin Hotchkiss, Norman Jones, James Nelson, and Daniel Ames.

With experience in fluid flow and hydrology, surveying, AutoCAD, and ArcGIS, Schwichts' and Reidhead are qualified to prepare a feasibility study for the North Union Canal.

We are confident that our team is the best choice for the canal feasibility study, and we look forward to working with J-U-B Engineers.

Proposed Work Plan

We propose preparing the feasibility study in three phases:

Phase 1 will consist of information gathering. As noted in the RFP, some information has already been made available in PDF format along with some survey information. In the opening stages of creating the study, we will conduct an extensive site visit along the length of the canal to take pictures and record general conditions, to include the condition and location of all

- Hydraulic structures
- Canal or Road crossings
- Large cracks in the canal and
- Any existing obstacles along or in the canal.

Using the same techniques and tools, we will measure the dimensions of the canal in various locations, thus developing a detailed picture of the current canal conditions. By accessing public information and communication with the canal owners, we will develop a detailed map of all canal easements and a record of land ownership along the canal.

Phase 2 will consist of data analysis, with currently existing information and the information found in phase 1 being added to shapefiles, hydraulic calculations, and a collection of photographs showing the condition of the canal and easement, among other products.

Phase 3 will consist of design, which will follow naturally from conclusions drawn from our analysis. At least one canal piping design will be created, in addition to at least one plan alternate to piping the canal. As a part of both of these designs, a design for an automatic diversion structure to replace the existing structure at the head of the Lindon Reservoir III will be completed. Each of the designs will include calculations, drawings, and project phasing. Phase 3 will also include the creation of estimates showing water flow requirements to meet existing and future needs, water savings with piping design and alternative design(s), total construction cost and cost per phase associated with both designs, any environmental considerations, and recommendations for funding the project.

These phases are not as discrete and separable as they might seem. Analysis will doubtless show us something that we forgot to find in phase 1, and it would be difficult to conduct useful analysis without at least a general idea of what the end design might look like. As the work is conducted carefully, waste will be eliminated and efficiency maximized.

In order to achieve these plans, we will be meeting to work together several hours every week, in addition to working individually on our own parts of the project. Each Monday, Wednesday, and Saturday, we will meet from 0800-0900, 0800-0900, and 0800-0930 respectively. Each team member will work for about 3-4 hours each week on their own, and site visits will take place occasionally, but not on a weekly basis.

Schedule

- Extended Site visit with analysis of canal base – November 29th
- Proposal approval – December 6, 2016
 - Meeting with all parties to reconnect and update – December 14
 - Organization and analysis of data available – January 7th
 - Organizational Meeting to reconnect and update – January 14
- 1/4th of items located using GPS – January 21, 2017
- 1/2 of items located using GPS – February 4, 2017
 - Organizational Meeting to reconnect and update – February 14
- 3/4 of items located using GPS – February 18, 2017
- Conceptual designs completed – February 25, 2017
 - Organizational Meeting to reconnect and update – March 14
- Piping preliminary design completed – March 18, 2017
 - Organizational Meeting to reconnect and update if needed – April 3
- Locating items using GPS completed – April 8, 2017
- Piping final design completed – April 8, 2017
- GPS layers submittal – April 10, 2017
- Final piping design submittal – April 10, 2017
- Feasibility report submittal – April 10, 2017
- Project summary presentation – April 10, 2017

Facilities, Tools, Data and Equipment

- Phase 1
 - Bicycles, for traveling length of canal in extensive site visit
 - GPS-enabled camera, for easy upload of canal photos into shapefile
 - Measuring tape, for measuring canal cross sections, hydraulic structures, crossings, cracks and damage and obstacles
 - Various resources already provided by J-U-B Engineers
 - Maps
 - Soils reports
 - Reports and documents
 - Survey data
 - Flow data
- Phase 2
 - Shapefile editing software such as ArcGIS, for creating map including flow data, photographs, etc.
- Phase 3
 - Drafting software such as AutoCAD, for creating design drawings

Project Budget

■ Extended Site visit	18 man-hours
■ Meetings, to reconnect	5 man-hours * 5 meetings
■ Organize & Analyze Data	12 man-hours
■ GPS phase 1	12 man-hours
■ GPS phase 2	12 man-hours
■ GPS phase 3	12 man-hours
■ Conceptual Design	12 man-hours
■ Piping Prelim. Design	24 man-hours
■ GPS final phase	24 man-hours
■ Piping final Design	24 man-hours
■ GPS layers submittal	12 man-hours
■ Collaboration of Feasibility Report	24 man-hours
■ Project Summary Preparation	12 man-hours
■ Project Summary Presentation	2 man-hours

Total: 225 man-hours

Performance Standards

It must be understood at the outset that our student team will provide the work for this Capstone project “as is.” Our results cannot be construed as work provided by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved and stamped by a qualified license professional engineer. We will strive to provide a product that will be helpful and worthwhile, and we will do everything we can to ensure that J-U-B Engineers is pleased with the results of our work. We will consider ourselves to be successful in this project if we submit a useful, timely, and complete product in a professional format, after having learned and grown from our work.

Statement of Qualification

All members of the team have taken courses in environmental engineering, hydraulic and fluid flow theory, AutoCAD, ArcGIS, computational methods, soil analysis, statics, calculus, and differential equations.

Daniel Schwicht, graduating in April 2017, has emphasized in geotechnical and foundation engineering after early exposure through work as a soils lab and field technician. His geological understanding has also been bolstered through illustration work with consistent feedback from world-renowned geologist Ron Harris. His interests and experience in geology and soil behavior, including permeability through strata, stability, and settlement, qualify him for work on the canal feasibility study.

Jeffrey Schwicht, graduating in April 2017, has studied water resources and hydrology with special emphasis, qualifying him especially for the subject of the feasibility study. Additionally, due to his decade of experience in construction materials testing, quality assurance and quality control, Jeffrey has great insights into constructability, relations between contractors, consultants and owners, and a wide-angle understanding of construction paralleled by few college seniors.

Josh Reidhead, graduating in December 2017, is currently emphasizing water resources due to an early fascination with water in all forms. He has gained some practical knowledge in various Civil Engineering-involved disciplines while working closely with professionals in multiple internships. He loves learning, and is eager to stretch himself by tackling any new task.

List of Outside Consultants

Mark Christensen – Project Manager at J-U-B Engineers, Inc.
(801) 226-0393
mlc@jub.com

Jocelynn Crowther – Design Engineer at J-U-B Engineers, Inc.
(801) 226-0393
jcrowther@jub.com

Jake Nelson – Capstone Project Manager
(801) 857-7222
jake.nelson7@gmail.com

Rollin Hotchkiss – Hydraulics and Water Resources Professor, Department Chair, BYU
(801) 422-6234
rhh@byu.edu

Norman Jones – Seepage and Groundwater Modeling Professor, BYU
(801) 422-7569
norm@byu.edu

Daniel Ames – Water Resources and Geospatial Technology Professor, BYU
(801) 422-3620
dan.ames@byu.edu

James Nelson – Hydrology and GIS Professor, BYU
(801) 422-7632
jimn@byu.edu

Appendix A

Team Resumes

Joshua Reidhead

• 2502 East Stonebury Loop, Springville, Utah 84663 • 385.259.3966 • joshua.reidhead@gmail.com

Education

- Brigham Young University, Undergraduate in Civil Engineering. Exp. Grad. Dec. 2017

Work Experience

- CUWCD, Orem, Utah Asset Management Intern June

2016-Present

Working under Blake Buehler and Heath Clark, improving asset management system. Thus far, I have digitally created hundreds of existing assets; Documented hydrologic processes; written instructional and mechanical documents; and walked on water...technically.

- BYU Engineering, Provo, Utah Intern May

2016-June2016

Working with Barry Holman, I performed cost analysis on hundreds of thousands of dollars' worth of work orders. Barry works directly under Paul Greenwood, the Director of Engineering at BYU.

- CUWCD, Orem, Utah Assistant Lab Technician/Intern May 2015 - August

2015

Working under Mike Rau the Water Quality Director, I collected and tested samples of water that almost One Million people depended on daily, and helped them to retain their "Phase IV Excellence in Water Treatment" award from the Partnership for safe water. An award that only 15 other plants in the nation have attained, which demonstrates a quality of water far exceeding current EPA standards.

Built spreadsheets in excel VBA that are still in use to speed up data gathering and report making.

- Springville City, Springville Utah Part Time Intern May 2015 - July

2015

Under direction of Jeff Anderson, for a city of more than 32,000 residents, I Inspected contractor bids with Noah Gordon. I took aerial photos of, then analyzed the beginnings of a large apartment complex "Outlook Apartments" using GIS modeling with Michael Philp, Springville GIS analyst.

- Plush Carpet Cleaning, Provo Carpet Cleaning Professional June 2014 – August

2014

After one hour of training, with little to no supervision, I cleaned over 100 homes, to customers' satisfaction. I negotiated and was responsible for the invoices and dues for each. I completely restored multiple pump sprayers and several hand-buffers mechanically and electrically.

- BYU, Provo, Utah Laboratory Assistant May 2013 – June

2014

Working directly with Dr. Lon Cook, Various tests and lab procedures performed in search of treatments for eye diseases. Most specifically Macular Degeneration and other retinal disorders.

Saw firsthand the importance of teamwork in small and large group settings.

Worked together with other universities and research teams worldwide.

- Geneva Rock, Salt Lake City, Aggregate Quality Control May 2008-Nov

2008

Working under Victor Johnson, personally, took over 1000 samples of aggregate, performed tests, directly aiding in improving and protecting more than 13,000 Tons of aggregate material used for many different projects, including the construction of Bangerter Highway to 2700 West, Phase 2 which received prestigious awards from UDOT, and Nationally, the "Gold Winner" from ACPA.

Service and Achievements

- Proselyting Missionary Service in Southern California from May 2010 - May 2012 Supervised 18 men for 8 months during that time. Through weekly meetings, one on one interviews and written reports, held each accountable and provided encouragement in order to improve, stretch and reach goals as a team. Also reported weekly to my own supervisors. Daily personally taught and worked with people from many different cultures and backgrounds.

- Community Service at Provo Rehabilitation and Nursing Center

More than 120 hours between Feb. and Aug. 2012, interacting with patients. Spanish Liaison.

- Eagle Scout: Organized and directed 35 youth in preparing and packaging almost 800 Health Care Kits for victims of the Sri Lanka Tsunami in 2004.

Jeffrey Schwicht

971 North, 1000 West, Provo, UT 84606 (385)-275-8868 J.Schwicht@gmail.com

Objective Obtain a challenging EIT position that makes use of skills and experience in Materials Testing, Construction Inspection, and Project Design.

Work Experience

Soils Inspector, Lab Technician, Engineering Intern
4/2015 to 8/2015 and 4/2012 to 12/2012 HDL Eng., Anchorage, AK
Monitored multiple projects simultaneously and worked with contractors across Anchorage Bowl and through much of South-Central AK while also conducting laboratory testing.
Created, revised, and finished professional technical drawings with AutoCAD and other programs.

Construction Special Inspector and Lab Technician
4/2014 to 8/2014 Northern Geotechnical Engineering, Anchorage, AK
Monitored progress and standard compliance on dozens of construction projects of various size across wide geographical area.
Ensured specification compliance and kept detailed records of work performed during construction, providing team of contractors, engineers, designers, and owners with rapid up-to-date feedback on construction progress.

Quality Control Manager
6/2013 to 8/2013 Ridge Contracting, Inc. Manokotak, AK
Ensured quality work and materials for 4.35 mile, six-million dollar road project in Bush Alaska for Western Federal Lands Highway Division.
Supervised two other Quality Control Personnel while also managing scheduling, timecards, hauling quantities, and traffic control for entire project over the season while working 14+ hour days, 7 days per week.

Military Experience

4th Year Army ROTC Cadet at Brigham Young University
12/2014 to Present, BYU Army ROTC, Provo, UT
Currently serving as Platoon Leader, with responsibilities including Flag Ceremonies, ROTC Fund-raising, and coordinating regular training for 45 cadets.
Planning to commission into UT National Guard and attend Engineer Officer Basic Training for three months, starting in May of 2017.

Education

Brigham Young University, Provo, UT. BS in Civil Engineering, April 2017

Skills

Certifications for testing Concrete, Soils, and Asphalt.
Experience with drafting software and Geographic Information Systems.
Fluent in Spanish of various regions due to two-year proselyting mission in Long Beach, CA. Two semesters of University German.
Literate in Microsoft Office, some experience in Visual Basic for Excel.
Clean Driving Record.

DANIEL SCHWICHT

dewschwicht@gmail.com | 385.204.3852

EDUCATION

- Brigham Young University, Seeking BS, Civil Engineering 2009 - present

RELEVANT EMPLOYMENT

- **Geology Illustrator** 2015
Brigham Young University, mentored by Dr. Ron Harris
 - Coordinating with Dr. Harris to illustrate geological concepts for his textbook
- **Geotechnical Engineering, Materials Testing and AutoCAD Intern** 2013 - 2015
Hattenburg Dilley & Linnell Engineering Consultants Anchorage, AK
 - Worked in certified lab, geotechnical drilling, and in field
 - Performed gradations (grain size), field and lab concrete tests, nuclear densometer tests, asphalt burn and rice tests, Atterbergs, etc.
 - Corrected and verified drawings in Autodesk, ArcGIS
- **Soils and Concrete Lab Technician** 2009
Anchorage Sand & Gravel, Anchorage AK
 - Executed industry-approved test methods for aggregate and concrete for in-house quality control and R&D lab
 - Assisted in research and development of concrete materials and methods for more favorable environmental impact and greater profitability

VOLUNTEER AND LEADERSHIP EXPERIENCE

- **Full-time Religious and Service Missionary** 2010 - 2012
Baltimore, MD
 - Two full years of unpaid, voluntary service
 - Developed contacts by word of mouth and referrals
 - Taught, sought out and performed community service
 - Trained other missionaries in teaching, contacting, etc.

AWARDS AND ACCOMPLISHMENTS

- **Benjamin B. Talley engineering scholarship** 2014
Society of American Military Engineers, Anchorage Alaska chapter
- **Eagle Scout** 2009
Boy Scouts of America, Great Alaska Council
 - Coordinated Eagle Scout service project landscaping at Blood Bank of Alaska
 - Organized and directed over 500 man hours of service
 - Solicited donations of construction materials and food

SKILLS AND CERTIFICATIONS

- Professional experience with Autodesk, ArcGIS, Excel, Word, and some Visual Basic (VBA)
- Troxler Nuclear Gauge Operator certified, HAZMAT certified, 2013
- American Concrete Institute (ACI) Concrete Strength Testing certified, 2013
- ACI Concrete Field Testing certified, 2013
- Spanish classes and translation experience, 2005 - 2012