MATERIALS TESTING DATABASE AND WEB APP DEVELOPMENT PROJECT
Project ID: CEEn_2017CPST_010

by

MOR:
Jenny Blonquist
Micklane Farmer
Olivia Sorenson
Riley Vane

A Capstone Project Final Report

Submitted to

Jones & DeMille Engineering

Department of Civil and Environmental Engineering
Brigham Young University

18 April 2018

Executive Summary

PROJECT TITLE: Materials Testing Database and Web App Development Project
PROJECT ID: CEEn-2017CPST-010
PROJECT SPONSOR: Jones & DeMille Engineering
TEAM NAME: MOR (Micklane, Olivia, Riley)

Jones & DeMille Engineering (JDE) is one of Utah's top engineering companies. They offer a full-range of services including water resources, transportation, structures, environmental, and funding procurement. As part of its wide range of services, JDE has a materials testing lab that tests materials from across the state. They run hundreds of soil, asphalt, and concrete tests that provide crucial information to the engineers and contractors on civil engineering projects. The test results are then saved into project folders.

The client, JDE, tasked a team of three of their summer interns, MOR, to develop a web-based material testing geodatabase. This geodatabase will allow the Lab Manager and also Construction Managers in the field to look up material testing results. Instead of searching through project folders, they will be able to search for test results in the geodatabase by the name of the test, the location of the material, the project number, the project name, the date they were tested, and even more. This compilation of tests into a geodatabase will make finding old test results much more efficient and save a tremendous amount of time for JDE.

The project required the team to design a database in Excel, collect all test results saved by Jones & DeMille in the past several years to compile in the database (around 1000 tests results), gather coordinates for the location of the materials that were tested, and integrate the database with GIS. The team also needed to optimize the GIS compilation so that the Lab Manager could easily input future test results in the database and use the web application as needed. Additionally, the team developed new lab spreadsheets for different tests to be used in remote offices of Jones and DeMille. The project was carried out in accordance with Brigham Young University's (BYU) Civil Engineering capstone program. The project began January 8, 2018, and will close on April 18, 2018.

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Introduction

The client, JDE, tasked a team of three of their summer interns, MOR, to develop a web-based material testing geodatabase. This geodatabase will allow the Lab Manager and also Construction Managers in the field to look up material testing results. Instead of searching through project folders, they will be able to search for test results in the geodatabase by the name of the test, the location of the material, the project number, the project name, the date they were tested, and even more. This compilation of tests into a geodatabase will make finding old test results much more efficient for JDE.

The project had three main parts: design a database in Excel, collect all test results, and integrate the database into GIS.

For the first task, to design the database, team members met with Mark Rappleye (Lab Manager for JDE) to determine the types of materials tests that would be useful to include in the database. The main tests that the Lab Manager felt more important were Proctors and Gradations. If time were to permit, we could also include other less important tests, such as the California Bearing Ratio, Atterburg Limits, Sodium Soundness, Los Angeles Abrasion, Unit Weight, and others. It was also determined that the database needed to include: exact coordinates of the location where the material was obtained; the project number; the project name; the client of the project; the material sample number (the number assigned to a material when it arrives at the testing lab); a description of the material; the AASHTO classification of the material; which pit the material came from, or if the material is native; the data the material was tested; and the file name of the test results saved in PDF form in JDE's network.

Next, once the database had been designed, the team collected all test results saved by Jones & DeMille and added them in the database. This was the bulk of the project, taking nearly 3 months since there were around 1000 tests results to gather and find the necessary information about.

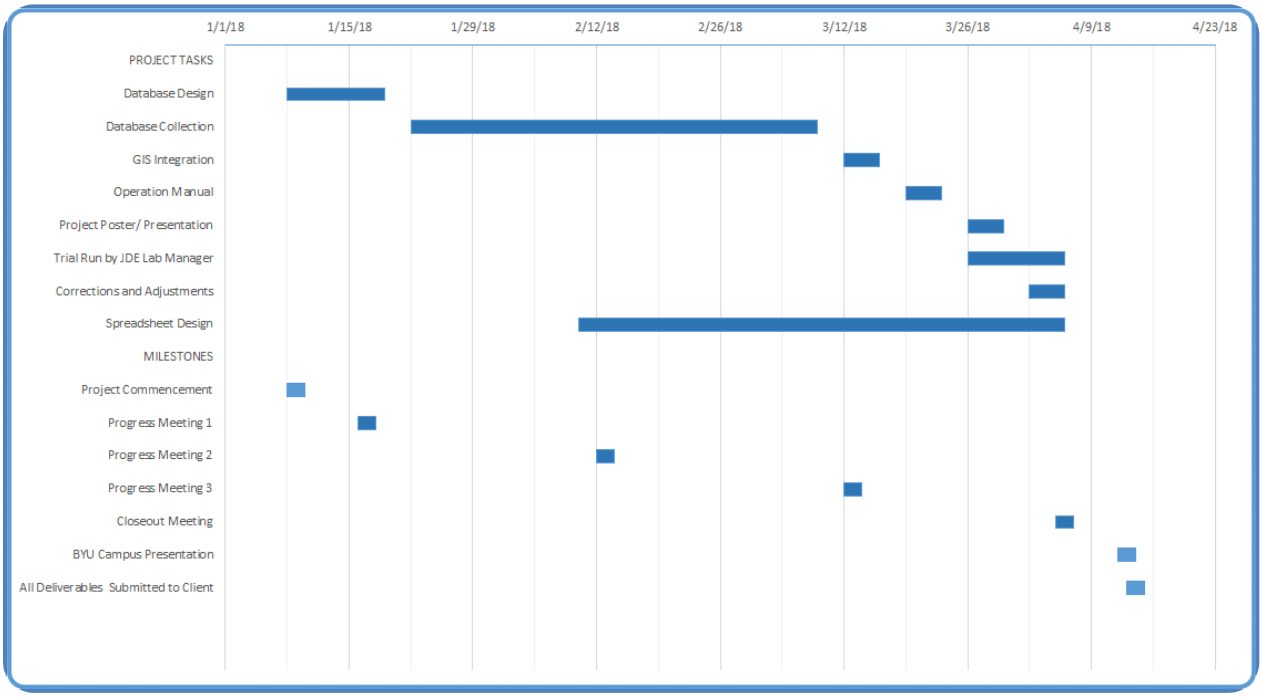
Finally, after all the information was gathered for every single test done by JDE, the team integrated the database with GIS. GIS Manager Adam Perschon (JDE) assisted in this. After the test results were imported into GIS, the team began to optimize the interface so that the Lab Manager could easily input future test results. This involved creating a user form in Excel.

After the bulk of the work was complete, the team was able to create worksheets for the Lab Manager to enter in test results. This will allow remote offices to enter in test results instead of sending them to the main office to be entered in. This makes the process of documenting test results more efficient and productive.

The project was carried out in accordance with Brigham Young University's (BYU) Civil Engineering capstone program. The project began January 8, 2018, and will close on April 18, 2018.

Schedule

The work plan accelerated faster than anticipated. As one can see from the timeline below, database collection was expected to last through the middle of March. MOR added spreadsheet designs with the extra project time they had. During the closeout meeting, the project was handed off to Adam Perschon to control what happens to the database in coming years. The newly designed spreadsheets were handed off to Mark Rappleye to distribute through the company as needed. The schedule that was created before the project began, below, has been followed almost exactly and all deliverables have been created on time and even ahead of schedule. This has allowed much room for corrections, adjustments and improvement to user-friendliness of deliverables.



Assumptions & Limitations

In the database collection phase of the project, there was a difficulty in finding locations for different pits that contractors provided samples from. In most cases, the pit was located and the correct coordinates were put in the database for the most accurate results. There were a few cases where team members used the location of the contractor's headquarters to as the latitude and longitude for the tests that were performed. This will not limit the lab manager from searching in the pit where the sample was obtained.

Design, Analysis & Results

The design of the spreadsheet for database collection was very straight forward. MOR met with Jones and DeMille to determine what criteria the database should categorize tests in. Each of these criteria were given a label at the top of the excel spreadsheet, and respective fields were filled out for each lab test that occurred between the years 2016 and 2017. To allow for easy entry of data in the future, a series of excel forms were created to make sure each test is filled in properly.

MOR team members have started developing new spreadsheets for lab tests in remote offices to enable them to enter data in at their locations. Currently tests are sent to Richfield to be entered in the lab software Geosystems, but with the development of new spreadsheets, those tests can be filled out in the remote offices too. Test sheets for a specific gravity, proctor, and gradations were developed.

Lessons Learned

There were several challenges encountered throughout the course of the project. The most challenging parts of the project were learning how to use FileShare (so team members could work remotely from the JDE network of files), coming up with consistent database development, determining pit locations, creating a user friendly database interface, and filling the time for the capstone project. All of the concerns and challenges have been resolved through communication with the client. Team MOR created a user-friendly form for data entry when the database is handed over to the client. Pit locations were determined, except in a few cases where company headquarter locations were used.

With the addition of spreadsheet design, MOR has developed a greater understanding of excel spreadsheet design and coding. Many challenges were encountered during spreadsheet design, but were resolved through countless hours of research and development. The spreadsheets design stretched the team, and helped them learn a valuable skills.

Conclusions

In conclusion, the client, JDE, tasked a team of three of their summer interns, MOR, to develop a web-based material testing geodatabase. This task had three sections: design a database in Excel, collect all test results, and integrate the database into GIS. The database development went as planned; there were some small challenges with developing the database and populating all the fields, but all of the challenges were resolved quickly with excellent teamwork. The excel database is completely up-to-date and ready to hand off to the Lab Manager. A user-friendly form has been developed for the use of this database to make new entries as efficient and easy as possible. The database has been integrated with GIS software to create a visually appealing and interacting web-application. This online map of test results is able to be searched by type of test, location, date tested, and much more.

These three sections of the task were completed efficiently by the team and allowed a lot of time to correct, adjust, and optimize deliverables. The team had extra time in the capstone project timeline to create new spreadsheets. These are complete and have been successfully given to Mark Rappleye to distribute to JDE's remote offices. This extra deliverable will help to improve the efficiency between JDE offices even more than the GIS database.

The team was able to keep to the schedule, and majorly over-perform with extra deliverables. Overall, the project went very smoothly, and any challenges were appropriately handled and quickly resolved.

Appendix A - Qualifications

Riley Vane

466 S 2550 W #3 • Springville, UT 84663
435.705.1189 • rileyvane@gmail.com

Summary

Civil Engineering student in senior-year classes. I have significant experience in construction, construction management and design experience spanning several years. I have been central to several transportation, water resources and on-site waste management projects spanning from funding acquisition to on-site engineering. I have a unique skill set acquired by rigorous formal training and a disposition for quality work.

Highlights

- Hydraulic Modeling
- Proficient in Civil 3D, ArcGIS & Excel
- Construction Management
- ACI and Density Gauge Certified
- Surveying and Material Lab Experience
- Construction Background

Accomplishments

- Primary construction manager for 5-mile pipeline consisting of on-site observation, quantities and spec inspection.
- Successful WaterSMART applicant for the piping of 3 miles of canal in San Juan County, Utah.
- Designed traditional and alternate on-site septic systems for various hotels and business complexes.

Experience

Construction Management & Engineering Design Intern

March 2016 to Current — **Jones & DeMille Engineering** - Richfield, UT

- Apply for USDA funding for water resources projects throughout Utah
- Model local water systems and perform drainage reports
- Revise construction drawings and maps for internal and client use
- Primary construction manager out of Springville, UT office
- Inspector contractor work and track units and hours

Floor Manager

March 2013 to June 2014 — **Sunroc Building Materials** - Springville, UT

- Supervised the performance of 10-12 employees at any given time
- Assist customers and finalize sales transactions
- Maintain company policy, address and resolve unsatisfied customer situations
- Responsible for store conditions upon closing and opening the business

Proselyting Missionary

May 2010 to May 2012 — **The Church of Jesus Christ of Latter-day Saints** – Barcelona, Spain

- Maintain all expenditures with saved funds to represent the LDS church internationally
- Communicate entirely in Spanish with native Spaniards and other Hispanic cultures
- Operate as leader to as many as 15 fellow missionaries in assisting and counseling their work

Education

Bachelor of Science; Civil Engineering (2018) — **Brigham Young University** - Provo, UT

- GPA – 3.2 (Estimate)
- Capstone Project (Ongoing) – Design a soils database for Jones & DeMille Engineering using an ArcGIS interface. This will be used to map out all soil tests performed in their materials lab, to be used company-wide.
- Engineering core classes in Transportation, Fluid Mechanics, Structural Analysis and Environmental Engineering.
- Software oriented classes for proficiency in Excel, AutoCAD, Civil 3D, ArcGIS and Revit.
- Design oriented classes include Hydraulics, Open-Channel Flow, Geometric Highway Design and Hazardous Waste Management.
- National Official Language Certificate - Spanish, Advanced level both orally and written, plus 2 years of immersed experience (Spain)

Micklane Farmer
633 Wymount Terrace, Provo, UT 84604
435-287-8026
micklanefarmer@gmail.com

Summary

A Brigham Young University Student studying Civil Engineering, with a broad range of experience from machine work, to business management, to construction management. Through many opportunities presented to me, I have been able to learn a basic knowledge of Civil Engineering practice, making me a valuable asset to those I am fortunate enough to work with.

Relevant Experience

Jones & DeMille Engineering, Richfield UT ***April-September 2016-2017***

Civil Engineering Intern. Primary responsibilities included project management, materials testing, construction management, and surveying.

Orem City, Orem UT ***September 2016-April 2017***

Civil Engineering Intern. Primary responsibilities included construction management, city inspections, Autocad Civil 3D design, surveying, and bid documentation.

Brigham Young University, Provo UT ***September 2017-Present***

Teaching assistant for Introduction to Transportation and Sustainable Infrastructure.

Randy's Engine and Machine, Richfield UT ***June 2014-August 2015***

Primary responsibility included CNC machine operator.

Education

Brigham Young University, Civil Engineering

Bachelors of Science, Anticipated graduation April 2018

Utah Valley University, Associates of Science

Associates of Science, August 2011-April 2012

References

Mark Rappleye, Jones & DeMille Engineering

Phone: 435-979-4229 Email: mark@jonesanddemille.com

Lyndon Friant, Jones & DeMille Engineering

Phone: 435-979-4558 Email: l.friant@jonesanddemille.com

Taggart Bowen, Orem City

Phone: 801-229-7316 Email: trbowen@orem.org

OLIVIA SORENSON

485 S State Street, Apt. 115, Provo, UT, 84606
olivia.sorenson@hotmail.co.uk
210-801-2958

EDUCATION

B.S. degree candidate, **Civil Engineering,** minor in Mathematics

- Brigham Young University, Provo, UT
- Expected graduation date: June 2018
- Cumulative GPA 3.65/4.0

EXPERIENCE

Seasonal Intern, Jones & DeMille Engineering, Richfield, UT May 17 – Sept 17

Under indirect supervision, conduct tests for soils, asphalt, and concrete

Create feasibility summaries to assist a third party in selecting projects

Use Civil 3D to sketch road plans; create cost estimates based on quantities

Teaching Assistant, Brigham Young University, Provo, UT Aug 16 - Present

Assist a 3 professors in their courses (statistics, soil mechanics, materials)
Grade coursework, hold office hours, lead exam reviews
Lead lab exercises for students (testing materials and analyzing results)

SKILLS

- AutoCAD, Revit, Civil 3D
- MS Excel
- GIS systems and equipment

AFFILIATIONS / AWARDS / ACTIVITIES

American Society of Civil Engineers

Student and National Membership, 14-Present

BYU Academic Scholarship; College of Engineering Scholarship

2014-2015, 2016-2017 and 2017-2018 academic school years

JENNY LEE BLONQUIST, EIT

1345 N 1020 E • American Fork, UT 84003• (801) 592-5665 • jenny@blonquist.com

EDUCATION

COLLEGE OF ENGINEERING, BRIGHAM YOUNG UNIVERSITY — **PROVO, UTAH**

Bachelor of Science in Civil and Environmental Engineering — April 2017
Masters of Science in Civil and Environmental Engineering — December 2018

• FE exam passed: August 2016

EXPERIENCE

GRADUATE RESEARCH ASSISTANT — **PROVO, UTAH**

• Develop a simplified probabilistic method of evaluating liquefaction potential for the cone penetration test. Research soil liquefaction with Dr. Kevin Franke.

YORK ENGINEERING — **MURRAY, UTAH**

Structural Engineering Intern — August 2016-February 2017

• Perform structural analysis and design of light framed construction projects.

CENTER FOR UNMANNED AERIAL SYSTEMS (C-UAS) AT BYU — **PROVO, UTAH**

Research Assistant — January 2016-Present

• Participate in progressing research of UAV applications in the Civil Engineering field.
• Generate and analyze data from 3D models that is used for technical papers using various modeling software.

MISSIONARY TRAINING CENTER INFORMATION TECHNOLOGY — **PROVO, UTAH**

Information Technology Desk Analyst — April 2015-September 2015

• Worked efficiently with Active Directory, computer imaging processes; managed inventory; fixed hardware of Dell computers, laptops, iPads, and managed MTC applications.
• Provided 1st tier technical computer support for over 2,500 employees and service volunteers
• Created trusting relationships by quickly responding to and fixing individuals' tech problem

GLOBAL ENGINEERING OUTREACH — **PROVO, UTAH / PERU**

Member of Tea Packaging Process team — August 2015-May 2016

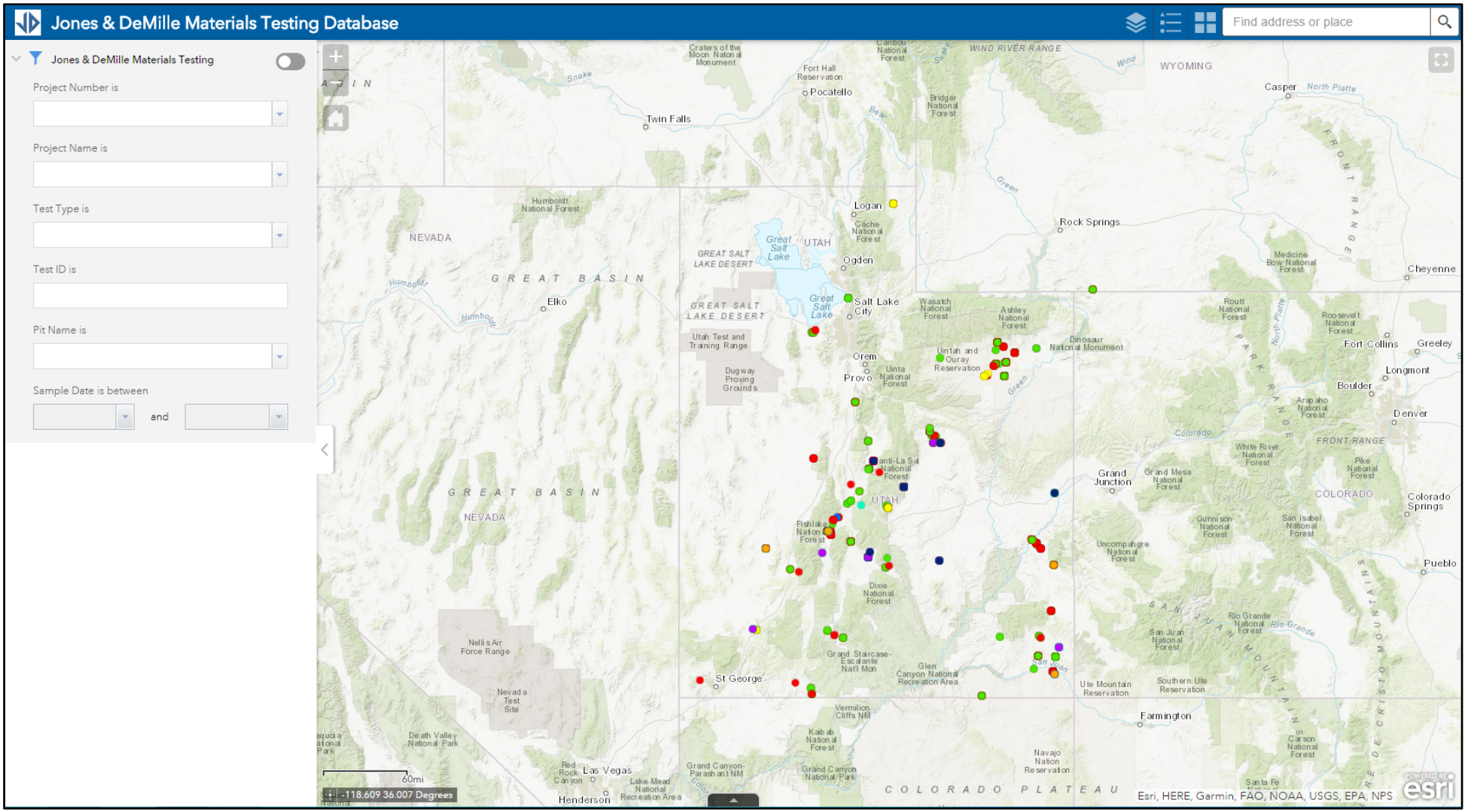
• Worked with a team consisting of different engineering disciplines to create and develop designs to increase the profitability of a Peruvian Community's business.

NEW YORK NEW YORK NORTH MISSION — **NEW YORK, NEW YORK**

Volunteer for the Church of Jesus Christ of Latter-day Saints — February 2013-August 2014

• Fluent in English and Mandarin.
• Experience in NX, Visual Basics, ArcGIS, Adobe Photoshop, Agisoft PhotoScan, Maptek I-Site, Cloud Compare, and AutoCad Civil 3D.

Appendix B – Materials Testing Web Map


Jones & DeMille Materials Testing Database
Find address or place
Jones & DeMille Materials Testing
Project Number is
Project Name is
Test Type is
Test ID is
Pit Name is
Sample Date is between
and
Craters of the Moon National Monument
Fort Hall Reservation
Pocatello
Twin Falls
Caribou National Forest
WIND RIVER RANGE
WYOMING
Casper
North Platte
Bridger National Forest
Rock Springs
Cheyenne
Medicine Bow National Forest
Humboldt National Forest
NEVADA
GREAT BASIN
Elko
Logan
Cache National Forest
UTAH
Great Salt Lake
GREAT SALT LAKE DESERT
Ogden
Salt Lake City
Wasatch National Forest
Ashley National Forest
Routt National Forest
Roosevelt National Forest
Fort Collins
Greeley
Longmont
Boulder
Denver
Arapaho National Forest
FRONT RANGE
Utah Test and Training Range
Dugway Proving Grounds
Orem
Provo
Uinta National Forest
Uintah and Ouray Reservation
Dinosaur National Monument
Manti-La Sal National Forest
Grand Junction
Grand Mesa National Forest
White River National Forest
Pike National Forest
COLORADO
Colorado Springs
Pueblo
Fishlake National Forest
Gunnison National Forest
San Isabel National Forest
Uncompahgre National Forest
Dixie National Forest
Rio Grande National Forest
San Juan National Forest
Nellis Air Force Range
Nevada Test Site
St George
Grand Staircase-Escalante Natl Mon
Glen Canyon National Recreation Area
Ute Mountain Reservation
Southern Ute Reservation
Farmington
Vermilion Cliffs NM
Kaibab National Forest
Carson National Forest
Death Valley National Park
Las Vegas
Red Rock Canyon
Lake Mead National Recreation Area
Henderson
Grand Canyon-Parashant NM
Grand Canyon National Park
Navajo Nation Reservation
COLORADO PLATEAU
Santa Fe
60mi
-118.609 36.007 Degrees
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS
esri

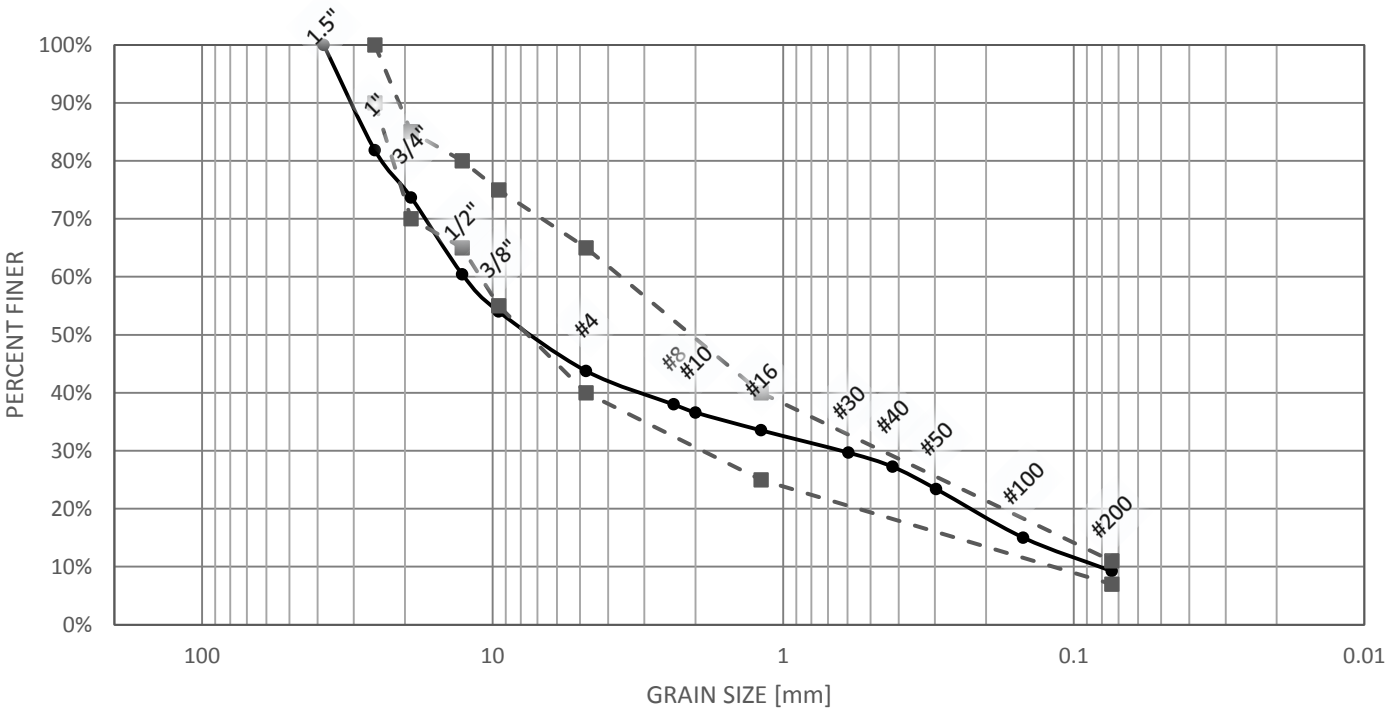
Appendix C – Materials Testing Reports

PARTICLE SIZE DISTRIBUTION REPORT

AASHTO T27 and T11, ASTM C117 and C136

CURVE NUMBER: 18-S-104

Jones & DeMille Engineering
1535 South 100 West
Richfield, Utah 84701
(435) 896-8266



SIEVE	PERCENT FINER	SPEC [%]	PASS?
1.5"	100.0%		
1"	81.8%	90-100	**X**
3/4"	73.7%	70-85	
1/2"	60.4%	65-80	**X**
3/8"	54.0%	55-75	**X**
#4	43.8%	40-65	
#8	38.0%		
#10	36.6%		
#16	33.5%	25-40	
#30	29.7%		
#40	27.2%		
#50	23.4%		
#100	15.0%		
#200	9.2%	7-11	

SPEC: UDOT 3/4-in UBC

GRAIN DIST. [%]	
COBBLE	0.0%
GRAVEL	63.4%
SAND, COARSE	9.4%
SAND, FINE	18.0%
FINES [SILT,CLAY]	9.2%

COEFFICIENTS [mm]		[in]
D_{90}	30.48	1.200
D_{85}	27.27	1.073
D_{60}	12.47	0.491
D_{50}	7.26	0.286
D_{30}	0.63	0.025
D_{15}	0.15	0.006
D_{10}	0.08	0.003
C_U	153.74	
C_C	0.40	

ATTERBERG LIMITS:
LL: 0 *(ASTM D*
PI: 0 *4318)*

SOIL CLASSIFICATION:
USCS: GP-GM *(D 2487)*
AASHTO: A-1-a (0) *(M 145)*

PREP. METHOD:	oven dry
SAMPLED:	3/1/2018
RECEIVED:	3/2/2018
TESTED:	3/13/2018
TESTED BY:	MR
TECH. NO:	0

MATERIAL DESCRIPTION:
UTBC - Item #25

REMARKS:

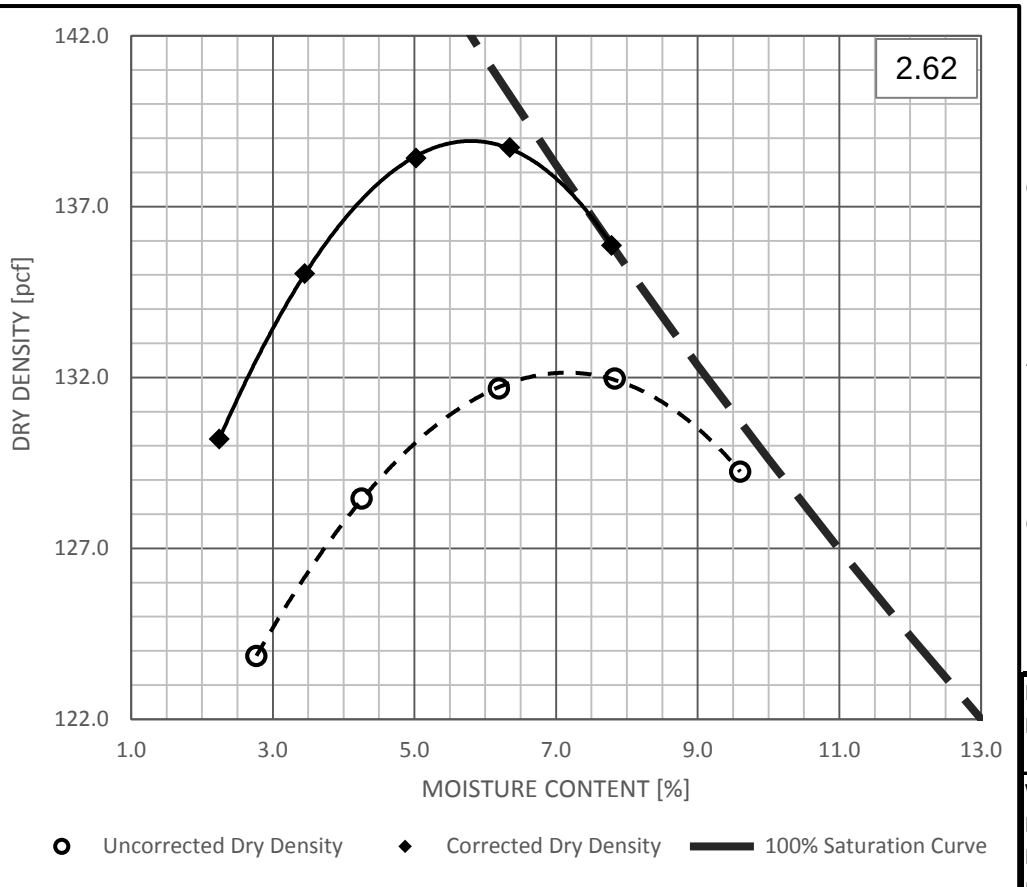
PROJECT #: 1801-085 **CLIENT:** UDOT/ CIVCO
PROJECT: Millcreek Drive - Instersection Imp.
LOCATION: Nielson's Moab Pit
SAMPLE NUMBER: 18-S-104

JONES AND DEMILLE ENGINEERING INC.
Richfield, Utah

CHECKED BY: Mark Rappleye
POSITION: Lab Manager

COMPACTION TEST REPORT

CURVE NUMBER: 18-S-104



UNCORRECTED	1	2	3	4	5	6
WM+WS [g]	10817.0	11043.0	11244.0	11328.0	11306.0	
WM [g]	6487.0	6487.0	6487.0	6487.0	6487.0	
WW+T#1 [g]	965	861.3	887.1	961.2	1035.3	
WD+T#1 [g]	945.4	836.7	849.8	909.3	966.2	
TARE #1 [g]	237.8	258.4	247.7	246.6	246.6	
MOIST. [%]	2.8	4.3	6.2	7.8	9.6	
DD [pcf]	123.8	128.5	131.7	132.0	129.2	

ROCK CORRECTED RESULTS (AASHTO 224-4)		UNCORRECTED	
Maximum Dry Density =	138.9 pcf		132.1 pcf
Optimum Moisture =	5.8 %		7.2 %

PROJECT #: 1801-085 **CLIENT:** UDOT/ CIVCO

PROJECT: Millcreek Drive - Instersection Imp.

LOCATION: Nielson's Moab Pit

SAMPLE NUMBER: 18-S-104

JONES AND DEMILLE ENGINEERING INC.

Richfield, Utah

1535 South 100 West
Richfield, Utah 84701
(435) 896-8266

COMPACTION TEST:
AASHTO: T-180
ASTM: D 1557

ATTERBERG:
LL: _____ *(ASTM D*
PI: _____ *4318)*

CLASSIFICATION:
USCS: _____ *(D 2487)*
AASHTO: _____ *(M 145)*

PREP. METHOD:	air dry
RAMMER TYPE:	automatic
WEIGHT [lb]:	10
DROP [in]:	18
LAYERS NO:	5
BLOWS:	56
MOLD SIZE: [cf]	0.075
MATERIAL PASS: [in]	3/4
% > 3/4 in:	26.3%
SPECIFIC GRAVITY:	2.62
SAMPLED:	3/1/2018
RECEIVED:	3/2/2018
TESTED:	3/13/2018
SAMPLED BY	JB
TESTED BY:	MR

MATERIAL DESCRIPTION:
UTBC - Item #25

REMARKS:

CHECKED BY: Mark Rappleye

POSITION: Lab Manager

Jones and DeMille Engineering
Lab Manager
1535 S 100 W
Richfield, UT 84701
(435) 896-8266

Specific Gravity of Coarse Aggregate

(AASHTO T85) (ASTM C-127)

Date:	4/13/2018
Client:	Wellington City
Project:	Price River EWP
Project Number:	1703-357
Location:	
Sample Number:	18-S-066
Material Description:	Riprap

Sample	Dry Weight	SSD Weight	Weight in Water	Specific Gravity Oven Dry	Specific Gravity (SSD)	Specific Gravity (Apparent)	Absorption
	2015.8	2100.3	1251.2	2.37	2.47	2.64	4.19

Tested By: Mark R
Lab Manager: Mark R