

**BLUFFDALE STORMWATER POND ALTERNATIVES**  
**PROJECT ID: CEEN\_CPST\_014**

**by**

**Aspire Engineers**  
**Cody Valdivia**  
**Austin Nichalson**  
**Ridge Hainsworth**  
**Camila Turrini**

**A Capstone Project Final Report**

**Submitted to**

**Dan Tracer & Michael Fazio**  
**City of Bluffdale**

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

**April 11, 2022**

## Executive Summary

**PROJECT TITLE:** BLUFFDALE STORWATER POND ALTERNATIVES  
**PROJECT ID:** CEEEn\_CPST\_014  
**PROJECT SPONSOR:** City of Bluffdale  
**TEAM NAME:** Aspire Engineers

The city of Bluffdale plans on constructing a stormwater collection pond in a field east of the Springview Farms neighborhood, on land owned by the Utah state prison. The city has already designed a system of pipelines that will feed into the retention pond, and they have asked us to design a pipeline that will allow stormwater from the retention pond to drain into the Jordan River. The river is located roughly 1,500 feet from the retention pond, with several considerable obstructions in between. The stormwater pipeline alternatives must be able to cross the Jordan & Salt Lake Canal, railroad tracks of UTA and Union Pacific, and the Springview Farms residential development. Aspire Engineers examined several different alternatives to determine which alignment would best overcome these obstructions and meet the city's needs considering social, safety, environmental, and economic factors. We successfully designed a pipeline that will run underneath the rail lines and canal and around the perimeter of the residential development, eventually draining into the Jordan River.

**Table of Contents**

Introduction..... 5  
Schedule..... 6  
Assumptions and Limitations ..... 7  
Design, Analysis, & Results..... 8  
Related Issues ..... 13  
Lessons Learned ..... 15  
Conclusion ..... 15  
Recommendations ..... 16  
Appendix ..... 17

**List of Figures**

Figure 1: LiDAR data visualized in Autodesk ReCap..... 8  
Figure 2: Figure 2: DSM of the Region ..... 9  
Figure 3: Design to Drop below the Canal ..... 9  
Figure 4: Alignment Designs..... 10-12

## Introduction

For this project, the main objective was to design an efficient stormwater pipeline that would travel from a retention pond that the City of Bluffdale is designing to the Jordan River. The City of Bluffdale previously designed a path from the pond to the nearby Jordan & Salt Lake Canal, but this design was rejected because the Canal owners would not allow additional stormwater to empty into the canal.

For the new alignment to be designed by Aspire Engineers, the pipeline must successfully bypass the Jordan & Salt Lake Canal, railroad tracks of UTA and Union Pacific, and a fully occupied residential development. The starting elevation is approximately 4428 ft with a final elevation of approximately 4365 ft. The 63-foot elevation drop allowed us to plan for a gravity fed flow through a 2500-foot-long pipeline.

Some key factors that came into this design were minimizing expenses and providing a design that would work in a variety of scenarios. To design the pipeline, there were a few key phases we had to go through. First, we had to generate a digital surface map from LiDAR data that would allow us to determine necessary slopes and depths of our alignment for both design and cost estimating purposes. The next step was to design a route under the canal and to try and gain the maximum elevation afterwards to try and minimize the depth of our alignments. Finally, the last step in the process was to do a cost estimate that would give us a solid understanding of the financial aspect of every option so that we could determine the best possible option for the city of Bluffdale.

## Schedule

Week 1: Received and began working with LiDAR data

Week 2: Ran into LiDAR issues

Week 3: Team members were set back with illness, and some were out of town

Week 4: Overcame LiDAR problems

Week 5: Developed digital surface map. Chose 3 alignments

Week 6: Pipe design regarding slope. Met with sponsor

Week 7: Began cost estimations.

Week 8: Cost Estimations. Worked on design

Week 9: Finalized design of all alignment. Researched water permits.

Week 10: Finalized cost estimations. Worked on poster.

Week 11: Turned in poster. Presented in seminar.

Week 12: Turned in final report

## **Assumptions & Limitations**

One of our design challenges was crossing the railroad tracks, which presented us with limitations based on UTA and Union Pacific design requirements. We initially had some difficulty getting in contact with representatives from either organization; however, we found a set of standards on the Union Pacific website and were eventually told that adhering to those standards would most likely be sufficient for both agencies. Based on those standards, which can be found in the appendix, 103 feet of our pipeline had to be enclosed by ½-inch thick steel pipe with a minimum inside diameter of 28 inches. We also had to ensure that our pipeline would be installed with even bearing, slope to one end, and be positioned perpendicular to the tracks with the uppermost part of the casing at least 4.5 feet below the base of the railroad.

Our team also made assumptions and faced limitations based on the information we were given by our sponsors and the City of Bluffdale's *Storm Water Design Standards Manual*. We were given LiDAR data, which we assumed to be correct and up to date, as well as limitations of using 24-inch diameter pipe and designing the pipeline to endure a 100-year flood event. We found two main limitations from the city manual: deflections at pipe joints could not exceed 5% and manholes with 1-foot slumps had to be placed at the end of each line and at all changes in pipe direction or slope. Our pipeline also had to meet current AASHTO LRFD Bridge Design Specifications, with bearing capacities that satisfy AASHTO HL-93 live loadings.

Since we were not given any specific data for expected flow rates, we assumed said rates would result in flow velocities within the city standards of 3 ft/s to 15 ft/s and account for NOAA Atlas 14 precipitation data, the FEMA 100-year flood plain, and peak runoff flows as outlined in the city manual. We also assumed that the materials and pipes used for the HDP carrying pipe and the steel casing beneath the railroad would be compliant with the appropriate AASHTO standards and that all joints would meet corresponding ASTM standards. Our final assumption for this project was that all construction would meet any additional requirements as outlined in the city's current 14600 S. Storm Drain plans, specifically those found on drawings G4-G5 and D1-D8.

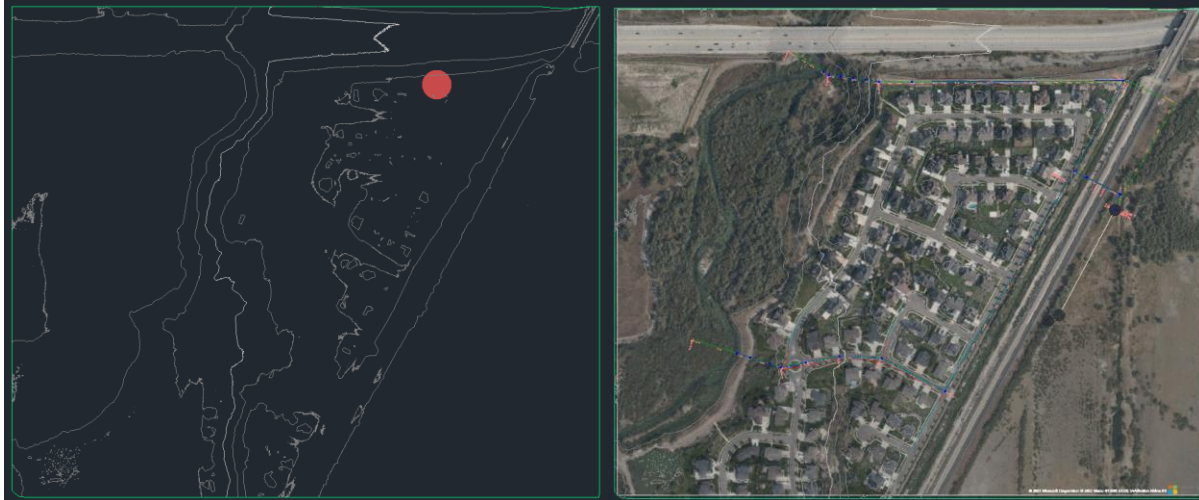
## Design, Analysis & Results

As we began the design process, first we needed to convert their LiDAR data into a usable format such as a DSM. In order to do this, we used Autodesk ReCap to read the elevation data. (See Figure 1)



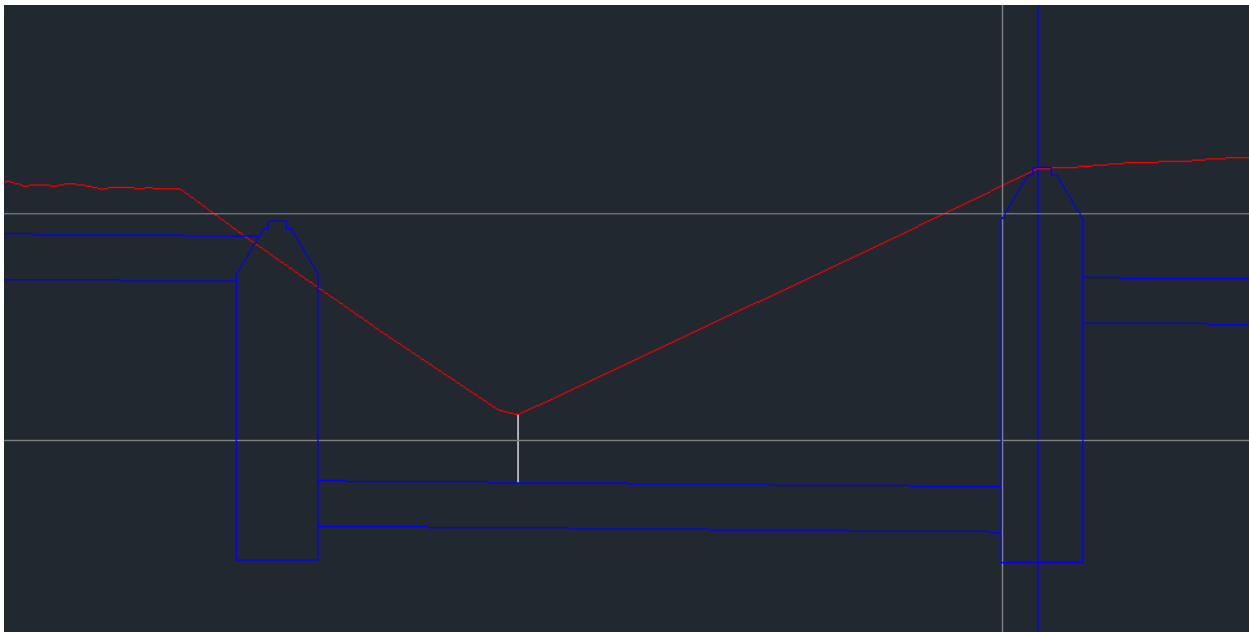
**Figure 1: LiDAR data visualized in Autodesk ReCap**

ReCap allowed us to export the data points into a point cloud that was readable by AutoCAD, which we then used to generate a surface. This surface map was combined with map data that we got from Microsoft's satellite imaging to determine the ideal routes for our alignments. (See Figure 2).



**Figure 2: DSM of the Region generated with Civil 3D (left) and DSM combined with satellite data(right)**

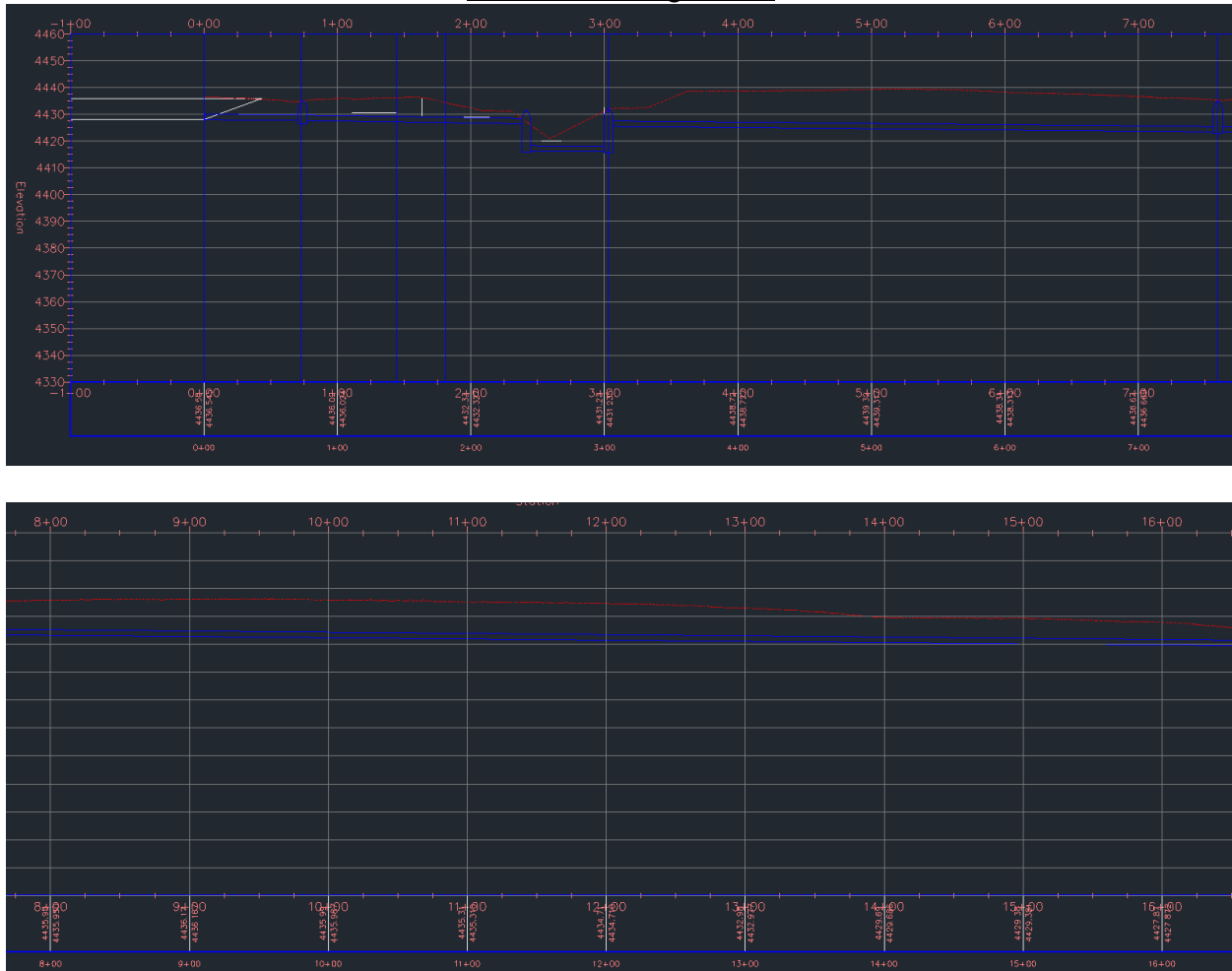
Once we were able to generate those maps, our design procedure required us to develop a way to get under the railroad and canal. Our first process had this whole section as one pipeline under both of these obstacles at a fixed elevation. One challenge, however, is that due to Union Pacific's standards, the deeper the pipeline is, the longer the steel casing around it needs to be. This also produced a large amount of head loss that made it challenging to generate enough energy to gain elevation after the canal

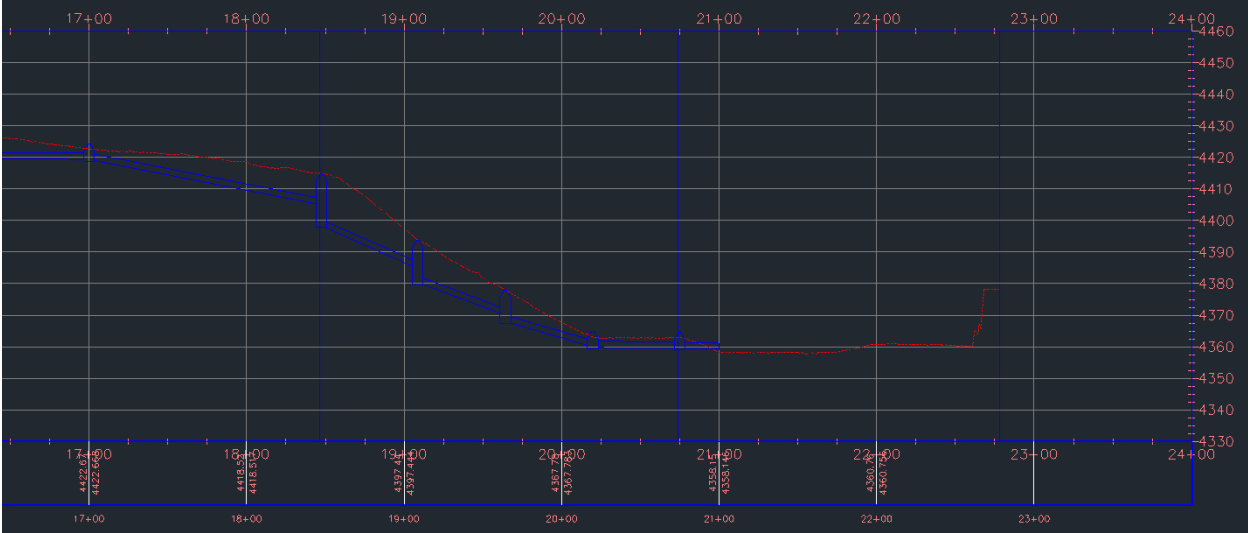


**Figure 3: Design to Drop below the Canal**

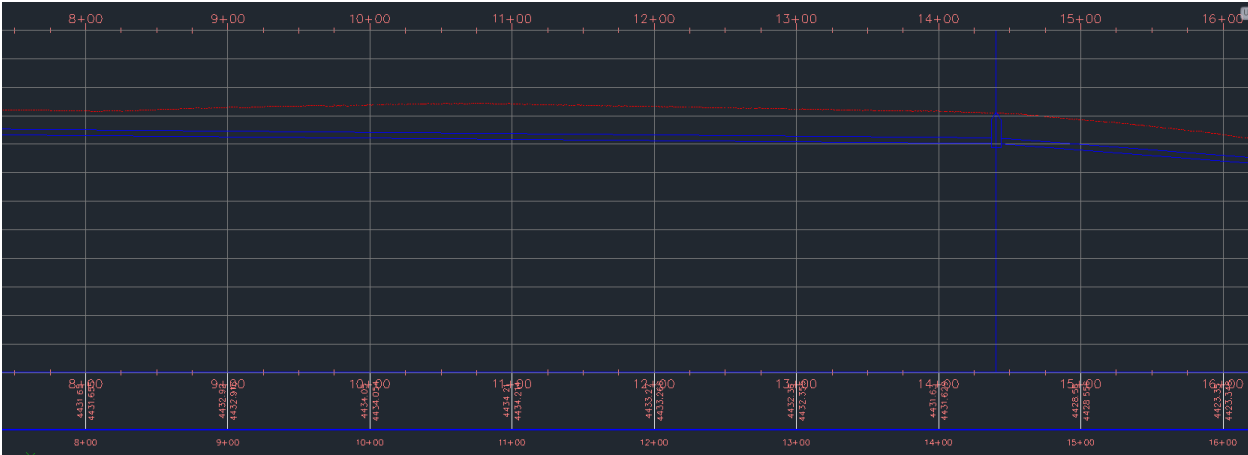
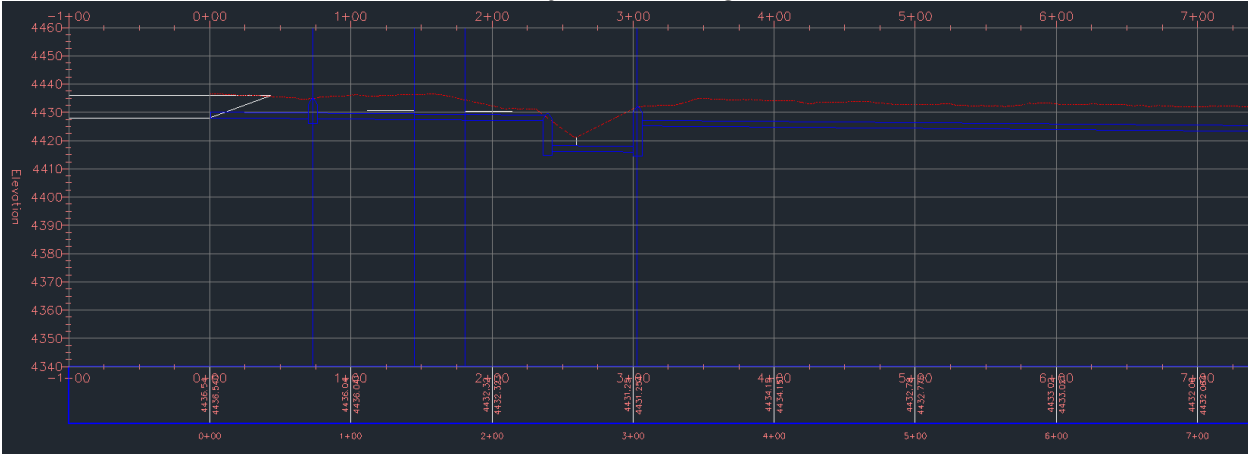
This was the most challenging part of the design process, as the majority of the alignment goes under a surface that is 4400 ft high. This is already 12 ft above the height of the starting point, which makes for very large excavation costs. We determined that if we followed the minimum depth under the railroad, the steel casing could be short enough that we could drop down with a manhole just before the canal and then experience minimal head loss before filling another manhole up to the below the hydraulic grade line at that point before continuing on (See Figure 3).

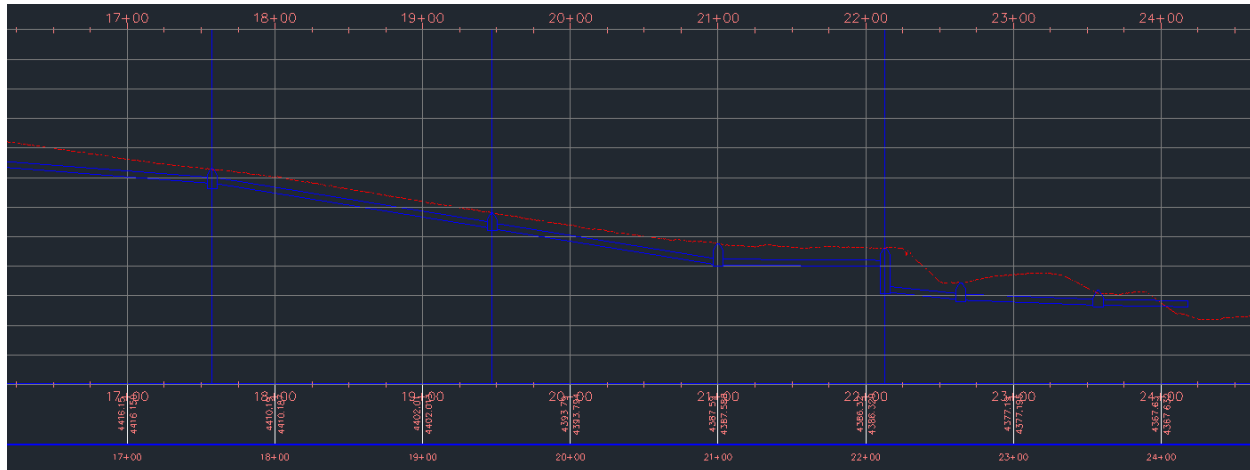
**North Path Alignment**





**Gray Wulff Design**





The cost estimate was developed by first defining the major tasks associated with the given project. We decided to include general construction tasks and conditions such as "Move on Site," "Clear and Grub," "Clean Up," etc. in order to get a more accurate estimate. For the majority of the specified tasks, we referenced Utah County Construction databases (Ralph L. Wadsworth Construction database) and quotes submitted in the past two years to determine a reasonable cost/ unit. For the tasks that we were unable to simply look up, we used the production rates of construction crews and equipment to determine the number of days it would take to complete a task. The material costs for a given task were all based on quotes given by contractors in the Utah County area. In most cases, the cost of material included the equipment and labor prices as well. Once the duration and pricing for each task was determined, we were able to multiply them and solve for a total cost associated with each task. In order to make the estimate more realistic, costs such as profit markup (12% being standard for most construction companies), trucking and environmental fees, mobilization and demobilization were accounted for. Overall, the cost difference between the Gray Wulff and North Trail alignments came out to be fairly minimal (roughly \$120,000 difference). Both alignments carried significant yet even costs associated with boring the pipe under the railroad and canal, installing manholes to access the pipe from various locations, and repairing the road/ walkways. Although additional excavation, backfill materials, labor, and time associated with laying the pipe increased the total cost of the Gray Wulff alignment, the primary difference in cost came in the amount of linear feet of pipe that would need to be installed. With profit markup included, both alignments easily surpassed the million dollar mark in terms of total cost.

## Related Issues

This project presents several social, environmental, and economic issues. The construction phase of this project will manifest the prevalent social impacts. The alignment we looked at that ran through the middle of Springview Farms, along W. Gray Wulff Drive, especially raised social and safety concerns since it would require construction along one of the main roads within the neighborhood, impeding access to several homes. In order to run pipe down this alignment, we would need to tear out all or part of the road in order to have enough room to excavate deep enough to bury the pipeline. The associated noise disruption, dust buildup, and road closures would surely inconvenience Springview Farms residents. Our proposed alignment, which runs along the outskirts of the development and is not as close in proximity to the majority of homes in the neighborhood, will significantly decrease the duration and prevalence of these social impacts. Construction along this alignment will close down a pedestrian pathway that runs along the perimeter of Springview Farms; however, we believe the social impacts of this closure to be minimal.

The predominant safety issues related to this project will also occur during the construction phase but can be largely avoided by implementing safe practices. After construction has concluded, most notably as the excavation and trenches are backfilled and the ground is once again brought to grade, the prevailing safety issues should be mitigated.

Without a well-designed stormwater system, stormwater runoff can cause significant environmental consequences. Runoff in areas in and around this project will pick up sediments, trash, debris, and other pollutants as it runs along the ground. Since water cannot be absorbed into groundwater through paved roads, sidewalks, or houses, uncontrolled stormwater would increase both the volume and flow rates of runoff into the Jordan River and the Jordan & Salt Lake Canal. This would lead to pollution of both the river and the canal, damage their ecology, and cause more frequent flooding, all of which could lead to other issues concerning safety and health factors. The presence of our stormwater pipeline and other connected stormwater infrastructure relieves many of these issues.

We designed our pipeline with numerous manholes, placed in strategic locations where buildup of waste and debris could lead to pollution overflowing into the Jordan River. Each of these manholes includes a 1-foot slump to collect pollutants carried by the stormwater. If city maintenance follows best practices, these slumps will be cleaned out frequently enough to mitigate negative environmental impacts. Bluffdale's construction best management practices delineate additional erosion and sediment controls that will further assuage any negative environmental impacts. The city might consider looking into

ways to reduce the loss of groundwater recharge caused by the presence of stormwater infrastructure.

The main concerns of building our proposed pipeline regarding the railroad, correctional facility land, elevation drop, and canal are primarily economic and design factors. The primary cost for this project dealt with boring the pipe under the railroad and canal, as well as the cost per linear foot to install the piping from the retention pond to the Jordan River. In an attempt to reduce the total cost, we ran the pipe at a depth closest to grade as permissible by Bluffdale City Standards. By doing so, we were able to save on costs linked to the time and labor it would take to excavate, as well as limit the amount of backfill material required to bring the trench back to grade.

However, in order to significantly reduce costs associated with the project, we would recommend the following: a pump of sorts to be utilized, and the retention pond being built closer to the Jordan River. By utilizing a water pump, this would allow constant water pressure through the pipe which would eliminate the need for multiple manholes. It would also allow the entirety of the pipe design to run just below the frost line. Additionally, if the retention pond was designed closer to the Jordan River, possibly on the East side by the Jordan River Parkway Trail, roughly 75% of all associated costs could be eliminated. More specifically, there would be no need for boring or an inverted siphon, the linear feet of pipe installation could be reduced by hundreds of thousands of dollars, and the overall duration of the project could be cut in half. Not only would this result in huge economic savings, but social issues such as disrupting the adjacent neighborhood be completely eliminated.

## **Lessons Learned**

We learned that projects will often not go according to plan, and unforeseen problems will likely arise. It is important to get started early because these problems may prevent you from finishing on time. Luckily, we worked hard in the beginning and were able to address these problems early enough to give ample time to solve them.

Another thing we learned is the benefit of having multiple opinions. We each brought a different viewpoint to the project and our design received contributions from each member. Our mentors and sponsors also offered insights that were unique to their area of expertise. While working on real life projects we will be sure to get opinions from multiple people of multiple disciplines.

## **Conclusions**

This project has taught us a myriad of lessons. One being the number of permits that are required to perform a task of any size. While researching we found that permits were required for putting water into the river, permits for land use, permits to go under a rail line and many others. There is possibly other permits that we have not yet been made aware of. All of these permits take time to fill out and to get approved from the respective party.

We all learned a great deal about cost estimating as it was a large part of our project. We learned how what may seem like a minor issue in design can actually generate large differences in cost, and that cost will almost always be the limiting factor of a design

ArcGIS and AutoCAD Civil 3D were used heavily in the design of our pipeline. Through hours of time spent with them, we learned the synergistic nature of the two and how we can effectively use them in tandem to complete tasks.

We are grateful for this capstone project that allowed us to learn these things.

## **Recommendations**

Given our findings, we would recommend that the city consider the North Path Alignment for their pipeline, as it will be somewhat cheaper to implement, it will cause the least disturbance to current residents, and it will avoid the existing utilities that the Gray Wulff route would encounter.

Another thing that would be useful to consider would be an inverted siphon design to drop below the canal. This would not currently be an option given the city's current restrictions. This design would have sharper deflections and changes in slopes without manholes, with the intent to create a pressure system that drops down and is able to maintain an energy grade line high enough that our pipeline could be at a shallower point after crossing the railroad and canal.

Finally, due to the depth of this pond in relation to the elevation after crossing the railroad and canal, it would be very challenging to create a shallow design. It may be beneficial to consider locating the pond at another location that would allow easier access to the Jordan River.

**Appendix**

Cody Valdivia’s Resume..... 16  
Ridge Hainsworth’s Resume..... 17  
Austin Nichalson’s Resume..... 18  
Camila Turini’s Resume ..... 19  
Union Pacific Standards ..... 20  
Gray Wulff Cost Estimate..... 22  
North Trail Cost Estimate ..... 24

Cody L. Valdivia

185 E 300 N Apt. 21, Provo, UT 84606  
Cell: (951) 445-2762 | E-mail: valdiviaclv@gmail.com

About Me

---

I love working with people. I am a great leader, and I thrive under high pressure. I pride myself on my attention to detail and dependability. I am a quick learner and love finding new ways to solve problems. For these reasons, I am confident that I will be a valuable asset to any workplace.

Technical Skills

---

**Engineering Software:** AutoCAD, Civil3D, Revit, and SolidWorks

**Microsoft Tools:** Word, Excel (Including Visual Basic), PowerPoint, and Outlook

**Language Skills:** Fluent in Portuguese; Basic Comprehension of Spanish

Work History

---

**Brigham Young University Physical Facilities** – Provo, UT Aug. 2021 – Present  
*Drafter*

- Accurately and efficiently prepared architectural plans utilizing Revit and Bluebeam
- Trained other employees on effective use of Revit

**BYU ASCE Student Chapter** – Provo, UT Apr. 2021 – Present  
*Technology Leadership Chair*

- Designed and maintained website that increased effective communication to 300 student members

**Robinson Bradford LLC** – Murrieta, CA Mar. 2019 – Aug. 2019  
*Legal Secretary*

- Utilized MS Excel and MS Word to produce legal documents and analyze timecard data
- Performed basic accounting for financial records to document eight years of expenditures

**Brasília, Brazil Mission** – Federal District, Brazil Mar. 2017 – Mar. 2019  
*Financial Secretary*

- Directed Mission finances for 8 months with over 140 Missionaries and 70 properties
- Designed new organizational process with Excel to prioritize billing
- Oversaw a budget of over \$300,000 and paid off over a year of previously unpaid bills
- Produced extensive reports for regional headquarters and accounted for a year of expenditures

**Robinson Bradford LLC** – Murrieta, CA (See Description Above) Aug. 2016 – Feb. 2017

Education History

---

**Brigham Young University** – Civil Engineering GPA 3.9 Projected Graduation – Apr. 2023

**Mount San Jacinto College** – Dual Enrollment Course Introduction to Drafting II

## Ridge Hainsworth

---

**Current Address:**

7826 S. Chisum Way

Meridian ID 83642

**Phone:** (208) 501-4778.

**Email:** ridgehainsworth@gmail.com

### Education

---

**Brigham Young University**

- Enrolled in Civil and Environmental Engineering Program (graduating December 2022)
- Minor in Business
- Received instruction in CAD, GIS, Excel, Word

### Work Experience

---

**Angle Engineering, Soil Technician**

May 2020 – Aug. 2020

- Conducted in lab and on sight soil tests
- Gathered soil samples from field locations

**Woody's Sheet Metal, Sheet Metal Fabricator**

May 2017 – Aug. 2018

- Fabricated custom sheet metal orders.
- Developed skills in AutoCAD and other computer software

**Big D Builders Inc., Steel Construction Worker**

June 2012 – Oct. 2014

- General construction labor
- Operated heavy machinery

**Hainsworth Laundry Company, Assistant Regional Manager**

Oct. 2016 – Jan. 2017, June 2019 – Aug. 2019

- Maintained laundry machines across southern Idaho
- Collected and reported all financial data from region

### Volunteer Work

---

**Church service mission in the Dominican Republic**

Oct. 2014 – Oct. 2016

- Learned Spanish
- Taught English
- Provided Community Service

**Austin D. Nichalson**

austindnichalson@gmail.com • (208)-339-7453 • linkedin.com/in/austin-nichalson

**EDUCATION**

---

**BS, Civil and Environmental Engineering** Graduation Date: April 2022  
*Brigham Young University* Provo, UT

- Steel-Bridge Design & ASCE Member
- GPA: 3.35
- Relevant Coursework: Structural Steel Design, Geometric Design of Highways, Seepage & Slope Stability, Urban Transportation Planning, Construction Scheduling and Cost Control

**PROFESSIONAL EXPERIENCE**

---

**Ralph L. Wadsworth** September 2020 - Present  
*Commercial Estimator* Draper, UT

- Modeled and performed independent takeoffs for 30+ commercial projects such as: airport expansion, water treatment facilities and tanks, parking garages, roadway expansion, and high-end resorts.
- Supported the chief and lead estimators in preparing final bid proposals by performing data entry in B2W database and managing proposals from local vendors, suppliers, and contractors.
- Analyzed and reviewed construction plans and documents from over 15 developers and contractors in the Northern Utah area.
- Cultivated and strengthened company relationships with 50+ construction and engineering firms in order to competitively acquire work proposals.

---

**Missionary Training Center** May 2019 - September 2020  
*Security Field Training Officer* Provo, UT

- Managed and trained 8+ on-shift officers to ensure that every essential security responsibility was completed effectively in order to maintain the safety of all personal on MTC property.
- Collaborated with department heads of the MTC in order to successfully implement incident reducing protocols.

---

**Brigham Young University** May 2017 - April 2019  
*Site Technician* Provo, UT

- Executed over 300 independent construction/ landscaping tasks that contributed to the preservation and beautification of Brigham Young University property.
- Coordinated with project engineers and managers in order to ensure the completion of various construction operations.
- Gained certification in heavy machinery operation by performing over 250+ hours of work.

**VOLUNTEER WORK**

---

**Church of Jesus Christ of Latter - Day Saints** October 2014 - October 2016  
*Full-Time Volunteer* Tokyo, Japan

- Managed the acquisition and preservation of significant records to the Tokyo South Mission.
- Oversaw the handling and distribution of important amenities and packages to over 200+ missionaries.
- Led and instructed weekly English classes to groups of over 20+ native Japanese speakers.

**SKILLS**

- 
- |                     |                        |
|---------------------|------------------------|
| ▪ Tekla             | ▪ Revit                |
| ▪ PlanSwift         | ▪ BlueBeam             |
| ▪ SketchUp          | ▪ B2W                  |
| ▪ Smartsheets       | ▪ Microsoft Excel/ VBA |
| ▪ AutoCAD/ Civil 3D | ▪ Microsoft Programs   |

**Camila J. Turrini**

camila.turrini4@gmail.com • (661) 289-0103 • [linkedin.com/in/camila-turrini4](https://www.linkedin.com/in/camila-turrini4)

---

**EDUCATION:**

**BS, Civil and Environmental Engineering**, *Brigham Young University*, Provo, Utah

**Mathematics Minor**, Anticipated graduation in 2022, 3.52 GPA

- Relevant Courses:
    - Engineering Mechanics
      - Statics, Dynamics, & Materials
    - Drafting with CAD Apps
    - Sustainable Infrastructure
    - Geomatics
    - Metals, Woods, & Composites
    - Concrete, Masonry, & Asphalt
    - Structural Analysis
    - Global Leadership
    - Newtonian Mechanics
    - Computer Science
    - Elementary Linear Algebra
- 

**SKILLS:**

**Technical:** Experienced in Revit, AutoCAD, Civil3D, Bluebeam, SAP2000, ArcGIS, Excel, Microsoft Word, Google Docs

**Language:** McAllen Capitán Spanish Interpreting Award, California State Seal of Biliteracy, 5 years of Spanish education

**Memberships:** ASCE National Chapter, ASCE BYU Student Chapter, Structural Engineering Institute, American Concrete Institute, Precast/Prestressed Concrete Institute, BYU Women in Civil Engineering, BYU Society of Hispanic Professional Engineers

---

**PROFESSIONAL EXPERIENCE:**

**Design Drafter**, BYU Physical Facilities Engineering and Design, *Brigham Young University*, 2/2021 – present

- Designs solutions to meet construction work order requests using Revit, compiles architectural sheets
- Consults with architects and project managers to take projects from cost estimate through construction
- Models existing conditions of buildings to maintain and support BYU and Church properties

**Warehouse Manager**, BYU Store Order Fulfillment Team, *Brigham Young University*, 8/2019 – 12/2020

- Processed and fulfilled customer orders by collecting, charging, and packaging merchandise
  - Monitored pricing, inventory levels, and product details, including cataloguing any changes
  - Handled incoming and outgoing communication with customers and problem-solving strategies
- 

**LEADERSHIP EXPERIENCE:**

**Women in Civil Engineering Club Liaison Publicist**, *Brigham Young University*, Provo, UT, 4/2021 – present

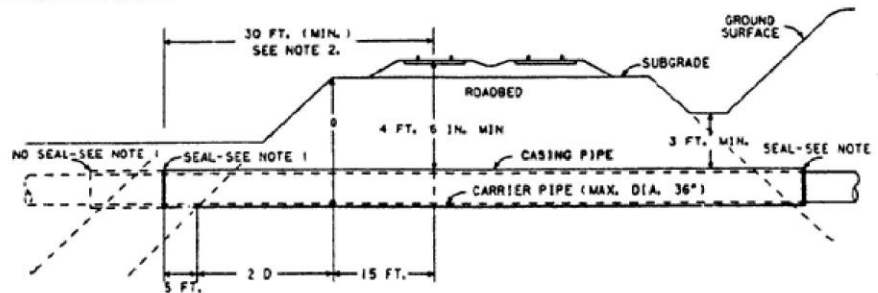
- Promotes club activities to freshmen and new students in the program during college seminar
- Coordinates with WCE secretary and officers from other BYU engineering clubs to recruit new members
- Motivates officers to align goals, coordinate events, and encourage participation by men and women

**Full-time Volunteer Representative**, *Church of Jesus Christ of Latter-day Saints*, McAllen, TX, 1/2018 – 7/2019

- Prepared and taught lessons in Spanish, provided community service to over 400 families
- Collaborated with and advised the president in weekly counsels, coordinated a tour for the new president
- Trained incoming volunteers, supervised 16 leaders, led training conferences for over 170 volunteers

## Union Pacific Standards

For Non-flammable Substances



NOTE: 1. SEAL NOT REQUIRED IF CASING ENDS ABOVE GROUND WHERE DRAINAGE IS AVAILABLE.  
2. CASING TO EXTEND AT LEAST 30 FT. FROM CENTERLINE OF TRACK, WHERE RAILROAD TIMETABLE SPEEDS ARE GREATER THAN 25 M.P.H.,  $2D + 20$  FT. IF GREATER WILL APPLY.  
3. ALL HORIZONTAL DISTANCES TO BE MEASURED AT RIGHT ANGLES FROM CENTER LINE OF TRACK

1. Scope: Pipelines included under these specifications are those installed to carry steam, water, or any nonflammable substance which from its nature or pressure might cause damage if escaping on or in the vicinity of railroad property.
2. Installation: Pipelines under railroad track and right of way shall be encased in a larger pipe or conduit installed as indicated in Fig. 2.  
The casing pipe or conduit is the essential feature of the plan. Some of the other features as described in following paragraphs are optional in certain cases.
3. Carrier Pipe: Carrier pipe inside the casing under the railroad track and right of way shall be of good construction approved by the chief engineer of the railroad.
4. Casing Pipe: Casing pipe and joints may be of any conduit construction approved by the railroad's chief engineer and shall be capable of withstanding the load of railroad roadbed, track and traffic; also shall be constructed so as to prevent leakage of any matter from the casing or conduit throughout its length under track and railroad right of way. The casing shall be installed so as to prevent the formation of a waterway under the railroad. Casing shall be installed with even bearing throughout its length and shall slope to one end. Wall thickness of the casing must be no less than that specified in the attached steel casing pipe wall thickness chart. The inside diameter of the casing shall be no less than 2 inches greater than largest outside diameter of carrier pipe, joints or couplings.
5. Cathodic Protection: Where cathodic protection is used on the carrier pipe, a flush test box constructed specifically for this purpose will be provided with test wires attached to casing wall and carrier pipe, as shown in Fig. 2.
6. Seals: The ends of the casing shall be suitably sealed to outside of carrier pipe against the intrusion of foreign material which might prevent ready removal of the carrier pipe.
7. Depth of Casing: The top of the casing pipe shall be below the frost line, and its closest point shall not be less than 4.5 feet below base of railroad rail. On other portions of the railroad right of way where casing is not directly beneath any track the depth from the surface of the ground and from bottom of ditches to top of casing, shall not be less than 3 feet. Where it is not possible to secure the above depths, special construction shall be used as approved by the railroad's chief engineer.

8. Length of Casing: Casing shall extend at least 30 feet or  $2(D)+20$  feet, (where "D" equals depth of the bottom of the casing below railroad subgrade), whichever is greater, each side from (measured at right angles to) centerline of outside track. The casing is to extend beyond the limit of the railroad right of way as required to obtain the specified length. If additional tracks are constructed in the future, the casing shall be correspondingly extended at the utility's expense.
9. Jacking Pits: Jacking pits shall be a minimum of 30 feet from the centerline of track.
10. Shut-Off Valves: Where warranted by special local conditions and when mutually agreed to by the railroad company and the owner of the pipeline, accessible emergency shutoff valves shall be installed within effective distances at each side of the crossing.
11. Location: Pipelines shall, where practicable, be located to cross tracks at approximately right angles thereto and said crossing shall not be closer than 150 feet to any portion of any railroad bridge, building, or other important structure. Pipelines and casing pipe shall be at least 16 feet (vertically) from aerial electric wired and shall be suitably insulated from underground conduits carrying electric wires on railroad right of way.
12. Topography: Where practicable, pipelines shall be located where the ground surface slopes downward away from the railroad tracks. Also, when large capacity pipes are located where the ground surface ascends above the railroad roadbed, there must be sufficient adjacent opening under the tracks to carry off the material in event of rupture.
13. Restoration of Right of Way: Upon completion of the pipeline installation work all rubbish, excess materials, temporary structures and equipment are to be removed and the railroad's right of way cleaned and restored to the satisfaction of the railroad's chief engineer or his authorized representative. Disturbed areas shall be seeded or otherwise protected to control erosion as specified by the chief engineer of the railroad.
14. Approval of Plans: Plans for a proposed pipeline shall be submitted to and meet the approval of the chief engineer of the railroad or his authorized representative before work is begun and all work on railroad right of way, including the supporting of the track or roadbed, shall be subject to his inspection and direction. All costs incurred shall be borne by the utility.

**Steel Casing Pipe Wall Thickness Chart**

Minimum Thickness	Diameter Of Casing Pipe
1/4" (0.2500")	12" or less
5/16" (0.3125")	over 12"-18"
3/8" (0.3750")	over 18"-22"
7/16" (0.4375)	over 22"-28"
1/2" (0.5000")	over 28"-34"
9/16" (0.5625)	over 34"-42"
5/8" (0.6250")	over 42"-48"

This chart is only for smooth steel casing pipes with minimum yield strength of 35,000 psi.

[https://www.up.com/real\\_estate/utilities/pipeline/pipespecs/index.htm](https://www.up.com/real_estate/utilities/pipeline/pipespecs/index.htm)

[https://www.up.com/cs/groups/public/@uprr/@realestate/documents/digitalmedia/img\\_up\\_reus\\_pipelinespe\\_cs\\_fig2.gif](https://www.up.com/cs/groups/public/@uprr/@realestate/documents/digitalmedia/img_up_reus_pipelinespe_cs_fig2.gif)

Gray Wulff Line Cost Estimate								
Task #	Tasks:	Quantity	Cost/ Unit	Units	# of Days/ Weeks/ Months		Total:	
1	Move on Site/ General Overhead:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Equipment/ Other:							
	Mobilization/ De-Mobilization	1	\$ 5,000.00	EA	1	Day(s)	\$ 5,000.00	
	Equipment Gas/ Oil/ Generator Cost	1	\$ 7,500.00	EA	1	LS	\$ 7,500.00	
	Miscellaneous Items/ Materials	1	\$ 5,000.00	EA	1	LS	\$ 5,000.00	
	Insurance	1	\$ 750.00	EA	1	LS	\$ 750.00	
Profit Markup (12% of Total Cost)	1	\$ 132,038.16	LS	1	LS	\$ 132,038.16		
	<b>Total Cost:</b>						<b>\$ 150,288.16</b>	
2	Clear and Grub:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
	Dozer Operator	1	\$ 315.00	Day	5	Day(s)	\$ 1,575.00	
	Front End Loader Operator	1	\$ 270.00	Day	5	Day(s)	\$ 1,350.00	
	Excavator Operator	1	\$ 270.00	Day	5	Day(s)	\$ 1,350.00	
	Dump Truck Drivers	2	\$ 225.00	Day	5	Day(s)	\$ 2,250.00	
	Laborer(s)	2	\$ 180.00	Day	5	Day(s)	\$ 1,800.00	
	Superintendent	1	\$ 315.00	Day	5	Day(s)	\$ 1,575.00	
	Equipment/ Other:							
	Dozer w/ Rakes (John Deere 650: 20,000 lbs +)	1	\$ 1,980.00	Week	1	Week(s)	\$ 1,980.00	
	Front End Loader (Hitachi ZW50)	1	\$ 834.00	Week	1	Week(s)	\$ 834.00	
	Excavator w/ "thumb" attachment (8000 - 10000 lb)	1	\$ 1,150.00	Week	1	Week(s)	\$ 1,150.00	
	Dump Truck (3YD)	2	\$ 950.00	Week	1	Week(s)	\$ 1,900.00	
Dump Fee (501 - 1000 lbs.)	30	\$ 22.00	EA	1	LS	\$ 660.00		
	<b>Total Cost:</b>						<b>\$ 16,424.00</b>	
3	Locate Existing Utilities/ Underground Items:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
	Utilities Locator	1	\$ 2,500.00	Day	1	Day(s)	\$ 2,500.00	
Equipment/ Other:								
GPR Equipment	1	\$ 1,000.00	Day	1	Day(s)	\$ 1,000.00		
	<b>Total Cost:</b>						<b>\$ 3,500.00</b>	
4	Setup Barricades/ Temporary Fencing:							
	Materials:							
	Temporary Fence Rental (6' x 12')	40	\$ 40.00	Month	3	Month(s)	\$ 4,800.00	
	Barricades Rental (6' x 12')	20	\$ 50.00	Month	3	Month(s)	\$ 3,000.00	
	Labor:							
	Laborer(s)	4	\$ 180.00	Day	2	Day(s)	\$ 1,440.00	
	Superintendent	1	\$ 315.00	Day	2	Day(s)	\$ 630.00	
Equipment/ Other:								
	N/A	0	\$ -	N/A	-	N/A	\$ -	
	<b>Total Cost:</b>						<b>\$ 9,870.00</b>	
5	Excavation (Includes: Asphalt removal/ Sawcutting/ Boring Pits):							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
	Laborer(s)	2	\$ 180.00	Day	10	Day(s)	\$ 3,600.00	
	Excavator Operator	2	\$ 270.00	Day	10	Day(s)	\$ 5,400.00	
	Dump Truck Drivers	4	\$ 225.00	Day	10	Day(s)	\$ 9,000.00	
	Front End Loader Operator	2	\$ 270.00	Day	10	Day(s)	\$ 5,400.00	
	Superintendent	1	\$ 315.00	Day	10	Day(s)	\$ 3,150.00	
	Equipment/ Other:							
	Excavator (8000 - 10000 lb)	2	\$ 1,150.00	Week	2	Week(s)	\$ 4,600.00	
	Excavator Breaker (CAT 304)	1	\$ 750.00	Week	1	Week(s)	\$ 750.00	
	Dump Truck (3YD)	4	\$ 950.00	Week	2	Week(s)	\$ 7,600.00	
Dump Fee (501 - 1000 lbs.)	30	\$ 22.00	EA	1	LS	\$ 660.00		
Front End Loader (Hitachi ZW50)	2	\$ 834.00	Week	2	Week(s)	\$ 3,336.00		
Concrete/ Asphalt Saw	1	\$ 292.00	Week	1	Week(s)	\$ 292.00		
	<b>Total Cost:</b>						<b>\$ 43,788.00</b>	
6	Bring Trench to Grade/ Compact (Add Backfill Material):							
	Materials:							
	6" Crushed Stone Backfill	316.16	\$ 22.05	TON	1	LS	\$ 6,971.36	
	Labor:							
	Laborer(s)	4	\$ 180.00	Day	4	Day(s)	\$ 2,880.00	
	Front End Loader Operator	1	\$ 270.00	Day	4	Day(s)	\$ 1,080.00	
	Superintendent	1	\$ 315.00	Day	4	Day(s)	\$ 1,260.00	
	Equipment/ Other:							
	Front End Loader (Hitachi ZW50)	1	\$ 834.00	Week	1	Week(s)	\$ 834.00	
	2020 Wacker Neuson RT5C-2 Compactor	1	\$ 660.00	Week	1	Week(s)	\$ 660.00	
Plate Compactor (14")	1	\$ 356.00	Week	1	Week(s)	\$ 356.00		
Material Delivery Fee/ Environmental Fee	15	\$ 55.00	EA	1	N/A	\$ 825.00		
	<b>Total Cost:</b>						<b>\$ 14,866.36</b>	

Gray Wulff Line Cost Estimate							
7	<b>Lay Pipe:</b>						
	<b>Materials:</b>						
	24" PVC Piping	2303.905	\$ 252.28	LF	1	LS	\$ 581,229.15
	<b>Labor:</b>						
	Superintendent	1	\$ 315.00	Day	5	Day(s)	\$ 1,575.00
	<b>Equipment/ Other:</b>						
	(Equipment/ Labor included in materials cost)	0	\$ -	N/A	0	N/A	\$ -
	<b>Total Cost:</b>						<b>\$ 582,804.15</b>
8	<b>Boring:</b>						
	<b>Materials:</b>						
	Auger Bore 28" Casing .500" Wall Under UPRR	83.235	\$ 1,221.00	LF	1	LS	\$ 101,629.94
	Auger Bore 28" Casing .500" Wall Under County Canal	31.86	\$ 1,840.00	LF	1	LS	\$ 58,622.40
	<b>Labor:</b>						
Superintendent	1	\$ 315.00	Day	7	Day(s)	\$ 2,205.00	
	<b>Equipment/ Other:</b>						
	(Equipment/ Labor included in materials cost)	0	\$ -	N/A	0	N/A	\$ -
	<b>Total Cost:</b>						<b>\$ 162,457.34</b>
9	<b>Install Manholes:</b>						
	<b>Materials:</b>						
	4' Man Hole (10' Deep)	10	\$ 4,302.00	EA	1	LS	\$ 43,020.00
	<b>Labor:</b>						
	Laborer(s)	4	\$ 180.00	Day	20	Day(s)	\$ 14,400.00
Excavator Operator	1	\$ 270.00	Day	20	Day(s)	\$ 5,400.00	
Superintendent	1	\$ 315.00	Day	20	Day(s)	\$ 6,300.00	
	<b>Equipment/ Other:</b>						
	Excavator (8000 - 10000 lb)	1	\$ 1,150.00	Week	3	Week(s)	\$ 3,450.00
	<b>Total Cost:</b>						<b>\$ 72,570.00</b>
10	<b>Backfill/ Compact/ Bring to Grade (Existing Native Material):</b>						
	<b>Materials:</b>						
	Native Existing Soil	1945.61	\$ -	CY	1	LS	\$ -
	3/8" Natural Sand - Screened	1264.65	\$ 6.75	TON	1	LS	\$ 8,536.36
	<b>Labor:</b>						
	Laborer(s)	5	\$ 180.00	Day	7	Day(s)	\$ 6,300.00
	Front End Loader Operator	2	\$ 270.00	Day	7	Day(s)	\$ 3,780.00
	State Approved Compactor (Test)	1	\$ 500.00	Day	1	Day(s)	\$ 500.00
	Superintendent	1	\$ 315.00	Day	7	Day(s)	\$ 2,205.00
		<b>Equipment/ Other:</b>					
Front End Loader (Hitachi ZW50)	2	\$ 834.00	Week	1.5	Week(s)	\$ 2,502.00	
2020 Wacker Neuson RTSC-2 Compactor	2	\$ 660.00	Week	1.5	Week(s)	\$ 1,980.00	
Plate Compactor (14")	2	\$ 356.00	Week	1.5	Week(s)	\$ 1,068.00	
4000 Gallon Water Truck	2	\$ 2,500.00	Week	1.5	Week(s)	\$ 7,500.00	
Material Delivery Fee/ Environmental Fee	63	\$ 55.00	EA	1	Week(s)	\$ 3,465.00	
	<b>Total Cost:</b>						<b>\$ 37,836.36</b>
11	<b>Install Road/ Sidewalk:</b>						
	<b>Materials:</b>						
	Asphalt Paving - 4" Compacted	11466.7	\$ 2.11	SF	1	LS	\$ 24,207.39
	Road Base - 6"	11466.7	\$ 3.94	SF	1	LS	\$ 45,229.60
	Curb & Gutter	40.0	\$ 6.37	LF	1	LS	\$ 254.80
<b>Labor:</b>							
Superintendent	1	\$ 315.00	Day	1	Day(s)	\$ 315.00	
	<b>Equipment/ Other:</b>						
	(Equipment/ Labor included in materials cost)	0	\$ -	N/A	0	N/A	\$ -
	<b>Total Cost:</b>						<b>\$ 70,006.80</b>
12	<b>Landscaping:</b>						
	<b>Materials:</b>						
	Tree(s)/ Shrub(s)/ Sod Replacement	1	\$ 18,825.00	LS	1	N/A	\$ 18,825.00
	Mineral Mulch 4.8 oz WB	1	\$ 18,993.00	LS	1	N/A	\$ 18,993.00
	Imported Topsoil - 12" Depth	1	\$ 20,325.00	LS	1	N/A	\$ 20,325.00
<b>Labor:</b>							
Laborer(s)	2	\$ 180.00	Day	3	Day(s)	\$ 1,080.00	
Superintendent	1	\$ 315.00	Day	3	Day(s)	\$ 945.00	
	<b>Equipment/ Other:</b>						
	Tracked Skid Steer	1	\$ 237.00	Day	3	Day(s)	\$ 711.00
	Mobilization Fee	1	\$ 2,500.00	EA	1	N/A	\$ 2,500.00
	<b>Total Cost:</b>						<b>\$ 60,879.00</b>
13	<b>Cleanup:</b>						
	<b>Materials:</b>						
	N/A						
	<b>Labor:</b>						
	Laborer(s)	4	\$ 180.00	Day	3	Day(s)	\$ 2,160.00
Dump Truck Drivers	2	\$ 180.00	Day	3	Day(s)	\$ 1,080.00	
Superintendent	1	\$ 315.00	Day	3	Day(s)	\$ 945.00	
	<b>Equipment/ Other:</b>						
	Dump Truck (3YD)	2	\$ 325.00	Day	3	Day(s)	\$ 1,950.00
	Dump Fee (501 - 1000 lbs.)	10	\$ 22.00	EA	1	N/A	\$ 220.00
	Tracked Skid Steer	1	\$ 237.00	Day	3	Day(s)	\$ 711.00
	<b>Total Cost:</b>						<b>\$ 7,066.00</b>
<b>TOTAL:</b>							<b>\$ 1,232,356.16</b>

North Trail Line Cost Estimate								
Task #	Tasks:	Quantity	Cost/ Unit	Units	# of Days/ Weeks/ Months		Total:	
1	Move on Site/ General Overhead:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Equipment/ Other:							
	Mobilization/ De-Mobilization	1	\$ 5,000.00	EA	1	Day(s)	\$ 5,000.00	
	Equipment Gas/ Oil/ Generator Cost	1	\$ 7,500.00	EA	1	LS	\$ 7,500.00	
	Miscellaneous Items/ Materials	1	\$ 5,000.00	EA	1	LS	\$ 5,000.00	
	Insurance	1	\$ 750.00	EA	1	LS	\$ 750.00	
	Profit Markup (12% of Total Cost)	1	\$ 118,410.95	LS	1	LS	\$ 118,410.95	
<b>Total Cost:</b>							<b>\$ 136,660.95</b>	
2	Clear and Grub:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
	Dozer Operator	1	\$ 315.00	Day	5	Day(s)	\$ 1,575.00	
	Front End Loader Operator	1	\$ 270.00	Day	5	Day(s)	\$ 1,350.00	
	Excavator Operator	1	\$ 270.00	Day	5	Day(s)	\$ 1,350.00	
	Dump Truck Drivers	2	\$ 225.00	Day	5	Day(s)	\$ 2,250.00	
	Laborer(s)	2	\$ 180.00	Day	5	Day(s)	\$ 1,800.00	
	Superintendent	1	\$ 315.00	Day	5	Day(s)	\$ 1,575.00	
	Equipment/ Other:							
	Dozer w/ Rakes (John Deere 650: 20,000 lbs +)	1	\$ 1,980.00	Week	1	Week(s)	\$ 1,980.00	
	Front End Loader (Hitachi ZW50)	1	\$ 834.00	Week	1	Week(s)	\$ 834.00	
	Excavator w/ "thumb" attachment (8000 - 10000 lb)	1	\$ 1,150.00	Week	1	Week(s)	\$ 1,150.00	
	Dump Truck (3YD)	2	\$ 950.00	Week	1	Week(s)	\$ 1,900.00	
Dump Fee (501 - 1000 lbs.)	30	\$ 22.00	EA	1	LS	\$ 660.00		
<b>Total Cost:</b>							<b>\$ 16,424.00</b>	
3	Locate Existing Utilities/ Underground Items:							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
Utilities Locator	1	\$ 2,500.00	Day	1	Day(s)	\$ 2,500.00		
Equipment/ Other:								
GPR Equipment	1	\$ 1,000.00	Day	1	Day(s)	\$ 1,000.00		
<b>Total Cost:</b>							<b>\$ 3,500.00</b>	
4	Setup Barricades/ Temporary Fencing:							
	Materials:							
	Temporary Fence Rental (6' x 12')	40	\$ 40.00	Month	3	Month(s)	\$ 4,800.00	
	Barricades Rental (6' x 12')	20	\$ 90.00	Month	3	Month(s)	\$ 3,000.00	
	Labor:							
	Laborer(s)	4	\$ 180.00	Day	2	Day(s)	\$ 1,440.00	
	Superintendent	1	\$ 315.00	Day	2	Day(s)	\$ 630.00	
Equipment/ Other:								
	N/A	0	\$ -	N/A	-	N/A	\$ -	
<b>Total Cost:</b>							<b>\$ 9,870.00</b>	
5	Excavation (Includes: Asphalt removal/ Sawcutting/ Boring Pits):							
	Materials:							
		N/A	0	\$ -	N/A	0	N/A	\$ -
	Labor:							
	Laborer(s)	2	\$ 180.00	Day	8	Day(s)	\$ 2,880.00	
	Excavator Operator	2	\$ 270.00	Day	8	Day(s)	\$ 4,320.00	
	Dump Truck Drivers	4	\$ 225.00	Day	8	Day(s)	\$ 7,200.00	
	Front End Loader Operator	2	\$ 270.00	Day	8	Day(s)	\$ 4,320.00	
	Superintendent	1	\$ 315.00	Day	8	Day(s)	\$ 2,520.00	
	Equipment/ Other:							
	Excavator (8000 - 10000 lb)	2	\$ 1,150.00	Week	1.5	Week(s)	\$ 3,450.00	
	Excavator Breaker (CAT 304)	1	\$ 750.00	Week	1	Week(s)	\$ 750.00	
	Dump Truck (3YD)	4	\$ 950.00	Week	1.5	Week(s)	\$ 5,700.00	
Dump Fee (501 - 1000 lbs.)	30	\$ 22.00	EA	1	LS	\$ 660.00		
Front End Loader (Hitachi ZW50)	2	\$ 834.00	Week	1.5	Week(s)	\$ 2,502.00		
Concrete/ Asphalt Saw	1	\$ 292.00	Week	1	Week(s)	\$ 292.00		
<b>Total Cost:</b>							<b>\$ 34,594.00</b>	
6	Bring Trench to Grade/ Compact (Add Backfill Material):							
	Materials:							
	6" Crushed Stone Backfill	287.50	\$ 22.05	TON	1	LS	\$ 6,339.42	
	Labor:							
	Laborer(s)	4	\$ 180.00	Day	4	Day(s)	\$ 2,880.00	
	Front End Loader Operator	1	\$ 270.00	Day	4	Day(s)	\$ 1,080.00	
	Superintendent	1	\$ 315.00	Day	4	Day(s)	\$ 1,260.00	
	Equipment/ Other:							
	Front End Loader (Hitachi ZW50)	1	\$ 834.00	Week	1	Week(s)	\$ 834.00	
	2020 Wacker Neuson RTSC-2 Compactor	1	\$ 660.00	Week	1	Week(s)	\$ 660.00	
Plate Compactor (14")	1	\$ 356.00	Week	1	Week(s)	\$ 356.00		
Material Delivery Fee/ Environmental Fee	15	\$ 55.00	EA	1	N/A	\$ 825.00		
<b>Total Cost:</b>							<b>\$ 14,234.42</b>	

North Trail Line Cost Estimate							
7	<b>Lay Pipe:</b>						
	<b>Materials:</b>						
	24" PVC Piping	1990.395	\$ 252.28	LF	1	LS	\$ 502,136.85
	<b>Labor:</b>						
	Superintendent	1	\$ 315.00	Day	4.5	Day(s)	\$ 1,417.50
<b>Equipment/ Other:</b>							
(Equipment/ Labor included in materials cost)							
	0	\$ -	N/A	0	N/A	\$ -	
<b>Total Cost:</b>							\$ 503,554.35
8	<b>Boring:</b>						
	<b>Materials:</b>						
	Auger Bore 28" Casing .500" Wall Under UPRR	83.69	\$ 1,221.00	LF	1	LS	\$ 102,185.49
	Auger Bore 28" Casing .500" Wall Under County Canal	30.885	\$ 1,840.00	LF	1	LS	\$ 56,828.40
	<b>Labor:</b>						
Superintendent	1	\$ 315.00	Day	7	Day(s)	\$ 2,205.00	
<b>Equipment/ Other:</b>							
(Equipment/ Labor included in materials cost)							
	0	\$ -	N/A	0	N/A	\$ -	
<b>Total Cost:</b>							\$ 161,218.89
9	<b>Install Manholes:</b>						
	<b>Materials:</b>						
	4' Man Hole (11' Deep)	10	\$ 4,402.00	EA	1	LS	\$ 44,020.00
	<b>Labor:</b>						
	Laborer(s)	4	\$ 180.00	Day	20	Day(s)	\$ 14,400.00
Excavator Operator	1	\$ 270.00	Day	20	Day(s)	\$ 5,400.00	
Superintendent	1	\$ 315.00	Day	20	Day(s)	\$ 6,300.00	
<b>Equipment/ Other:</b>							
Excavator (8000 - 10000 lb)							
	1	\$ 1,150.00	Week	3	Week(s)	\$ 3,450.00	
<b>Total Cost:</b>							\$ 73,570.00
10	<b>Backfill/ Compact/ Bring to Grade (Existing Native Material):</b>						
	<b>Materials:</b>						
	Native Existing Soil	2211.56	\$ -	CY	1	LS	\$ -
	3/8" Natural Sand - Screened	1150.01	\$ 6.75	TON	1	LS	\$ 7,762.56
	<b>Labor:</b>						
	Laborer(s)	5	\$ 180.00	Day	7	Day(s)	\$ 6,300.00
	Front End Loader Operator	2	\$ 270.00	Day	7	Day(s)	\$ 3,780.00
	State Approved Compactor (Test)	1	\$ 500.00	Day	1	Day(s)	\$ 500.00
	Superintendent	1	\$ 315.00	Day	7	Day(s)	\$ 2,205.00
	<b>Equipment/ Other:</b>						
Front End Loader (Hitachi ZW50)							
	2	\$ 834.00	Week	1.5	Week(s)	\$ 2,502.00	
2020 Wacker Neuson RTSC-2 Compactor							
	2	\$ 660.00	Week	1.5	Week(s)	\$ 1,980.00	
Plate Compactor (14")							
	2	\$ 356.00	Week	1.5	Week(s)	\$ 1,068.00	
4000 Gallon Water Truck							
	2	\$ 2,500.00	Week	1.5	Week(s)	\$ 7,500.00	
Material Delivery Fee/ Environmental Fee							
	63	\$ 55.00	EA	1	Week(s)	\$ 3,465.00	
<b>Total Cost:</b>							\$ 37,062.56
11	<b>Install Road/ Sidewalk:</b>						
	<b>Materials:</b>						
	Asphalt Paving - 4" Compacted	9284.0	\$ 2.11	SF	1	LS	\$ 19,599.51
	Road Base - 6"	9284.0	\$ 3.94	SF	1	LS	\$ 36,620.14
	<b>Labor:</b>						
Superintendent	1	\$ 315.00	Day	1	Day(s)	\$ 315.00	
<b>Equipment/ Other:</b>							
(Equipment/ Labor included in materials cost)							
	0	\$ -	N/A	0	N/A	\$ -	
<b>Total Cost:</b>							\$ 56,534.66
12	<b>Landscaping:</b>						
	<b>Materials:</b>						
	Tree(s)/ Shrub(s)/ Sod Replacement	1	\$ 16,825.00	LS	1	N/A	\$ 16,825.00
	Mineral Mulch 4.8 oz WB	1	\$ 15,993.00	LS	1	N/A	\$ 15,993.00
	Imported Topsoil - 12" Depth	1	\$ 15,325.00	LS	1	N/A	\$ 15,325.00
<b>Labor:</b>							
Laborer(s)	2	\$ 180.00	Day	3	Day(s)	\$ 1,080.00	
Superintendent	1	\$ 315.00	Day	3	Day(s)	\$ 945.00	
<b>Equipment/ Other:</b>							
Tracked Skid Steer							
	1	\$ 237.00	Day	3	Day(s)	\$ 711.00	
Mobilization Fee							
	1	\$ 2,500.00	EA	1	N/A	\$ 2,500.00	
<b>Total Cost:</b>							\$ 50,879.00
13	<b>Cleanup:</b>						
	<b>Materials:</b>						
	N/A						
	<b>Labor:</b>						
	Laborer(s)	4	\$ 180.00	Day	3	Day(s)	\$ 2,160.00
Dump Truck Drivers	2	\$ 180.00	Day	3	Day(s)	\$ 1,080.00	
Superintendent	1	\$ 315.00	Day	3	Day(s)	\$ 945.00	
<b>Equipment/ Other:</b>							
Dump Truck (3YD)							
	2	\$ 325.00	Day	3	Day(s)	\$ 1,950.00	
Dump Fee (501 - 1000 lbs.)							
	10	\$ 22.00	EA	1	N/A	\$ 220.00	
Tracked Skid Steer							
	1	\$ 237.00	Day	3	Day(s)	\$ 711.00	
<b>Total Cost:</b>							\$ 7,066.00
<b>TOTAL:</b>							\$ 1,105,168.83