USDA / NRCS Engineering Internship

June – October 2019

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November 23rd, 2019

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Acknowledgments

This project was supported by Hispanic-Serving Institution's Education Program Grant no. 2015-38422- 24058 from the USDA National Institute of Food and Agriculture.

I wish to thank various people for their contribution to this project; Blair Bain for his patience and guidance, Dr. Lawrence Owens for the encouragement and opportunity, as well as Juan Alvarez, Lurana Strong, and the Visalia NRCS Office for their unwavering support.

Executive Summary

Rather than completing one overall major project, I was able to shadow Blair Bain, the Tulare County Engineer for the Natural Resources Conservation Service (NRCS) office in Visalia, California. During this internship I had the opportunity to contribute to a multitude of contracts; a variety that ranged from irrigation system creation/evaluation, to dairy projects that included concrete silage slabs, and to reservoir construction/analysis. To prepare me for the field, I was sent to California Polytechnic State University in San Luis Obispo shortly after my start date for a week's training to earn a certificate in Distribution Uniformity in Microirrigation Systems from the Irrigation Training and Research Center (ITRC). While the ITRC was able to instruct us about evaluating irrigation systems based on their distribution uniformity, Blair bridged the gap between their requirements and the NRCS standards and specifications. From there I was given the chance to expand my knowledge and learn about the ArcGIS system, how to operate Trimble survey equipment, and to create maps and designs through Civil 3D (an extension of AutoCAD).

Project Objectives

Since I didn't have a specific project to work towards, I kept my objectives open to the challenges NRCS faces on a day-to-day basis. As a Civil Engineering major whose interest is in hydraulics and water, this concept worked perfectly for me. It exposed me to how an engineer operates within the agency and how crucial water is to the Valley. Once I received training from the ITRC, we mainly focused on microirrigation systems. Between checking that no preexisting system was available, creating designs for producers, evaluating contracted designs, and giving implemented systems a final inspection, it kept us busy. Yet, as the summer went on, we ended up expanding my experience by concentrating on reservoirs and concrete silage slabs.

Thanks to the climate in the Central Valley, producers can farm almost year-round. Although, with the past and current drought issues, it is difficult for them to store enough water to meet crop irrigation demands. With reservoirs, the agricultural operation is better equipped for the seasonal changes that impact their environment. Otherwise, reservoirs are also used as a form of waste management. A reservoir can store wastewater while it waits to be sent to either a mixer (where it will be infused into the water to irrigate with) or a treatment line. To help ensure that the installation of these reservoirs don't cause problems due to infiltration, extra measures are taken to preserve the ground water. In California, this requires most reservoirs to be lined, even if the contents of the reservoir is freshwater for irrigation.

While reservoirs can cause a concern for the ground water table if not properly designed or installed, silage slabs are also a preventative measure against leachate. If manure is left on the soil unmanaged, the nutrients within it seep into the ground and cause an increase in the nitrate levels. High nitrate levels in drinking water are a public health concern. By implementing concrete silage slabs, a dairy gains better control of their waste management system by directing the runoff into a reservoir or other designated waste storage.

Project Approach

Due to the nature of this internship, the project approach varied depending on the agenda for the day. On a bigger scale, once the office approves of an application, it is up to the planners to communicate with the applicant as to their needs and wants. After determining what they require, i.e. new tractors, a transfer line, oiled roads, etc., then it is passed to the engineer for approval. In the early stages, the engineer will need to perform an Inventory and Evaluation (I&E) Inspection to double check the location in regard to the proposal. From there, every contract is unique and requires a different approach.

For reservoirs and concrete silage slabs, we bring Trimble survey equipment with us to take points using a Global Navigation Satellite System (GNSS). These points are exported into programs such as ArcGIS, AutoCAD, and Civil 3D to verify all components are constructed to meet NRCS standards and specifications. In reservoirs, several types of points are taken to compute the amount of soil required for the cut and fill through AutoCAD, whereas only four types of points are required for concrete silage slabs. The four required for a slab are any inlets, overall slopage, kick-ups for gutters, and perimeter corners to check overall size. With slabs, points are taken only after installation, but reservoir points are taken after the earthwork and again after the installation (especially for ones with embankment and liners).

Upon returning to the office after surveying a field we would export the points into the necessary programs and create as-built drawings (See Appendix 1). These as-built drawings can dictate how the slabs or reservoirs will be utilized within the dairy nutrient and waste management systems and/or Comprehensive Nutrient Management Plans (CNMP). Depending on the type of project, other objectives would also need to be reviewed at this stage. After a concrete silage slab is installed, it is essential to collect "bucket tickets"; papers stating how much water was applied, the amount of turns, and the time of arrival/application of the concrete. As for reservoirs, if they are installed where livestock or people can fall in, they can be required to include escape ramps, ladders, or fencing around the reservoir.

For microirrigation or pipeline contracts, we first evaluate the design in question (See Appendix 2). In order to so, we run calculations by hand before programming them into the Excel trickle system design sheet provided to double check the most critical path. It accounts for all the perceived losses in a system (i.e. friction, length, and elevation), confirming the system will be efficient. Once we're ready to visit the field, we bring tape measures, tally counters, and eventually the final inspection and evaluation kit. At the beginning, we bring the tape measure and tally counter to account for the spacing between and number of air vents, valves, and risers installed. After checking that a pipeline was laid/implemented correctly, the approval is made to backfill, where the soil that was removed to input the main/sub/transfer line can be reinserted into the trench. Once the backfill is completed a producer usually takes the next step and runs water through the system. While the system is in operation, a final evaluation and inspection takes place where we test the average Gallons Per Minute (GPM) and pressure to verify all components are constructed to meet NRCS standards and specifications. This closes out the contract unless a producer would also like to install soil moisture sensors to keep them updated on the health of their crop by managing applied water within the plant root zone.

If a producer wants to include soil moisture sensors then we will revisit the field in the future to confirm their location, updated working version, and overall operation. Using WaterGraph, I can assess these sensors to determine if they're operating efficiently by exporting the system's data and comparing it with the irrigation history provided by the farmer. Back at the office, I can use this information in compliance with Waterright and develop an irrigation schedule for the season for the producer to keep.

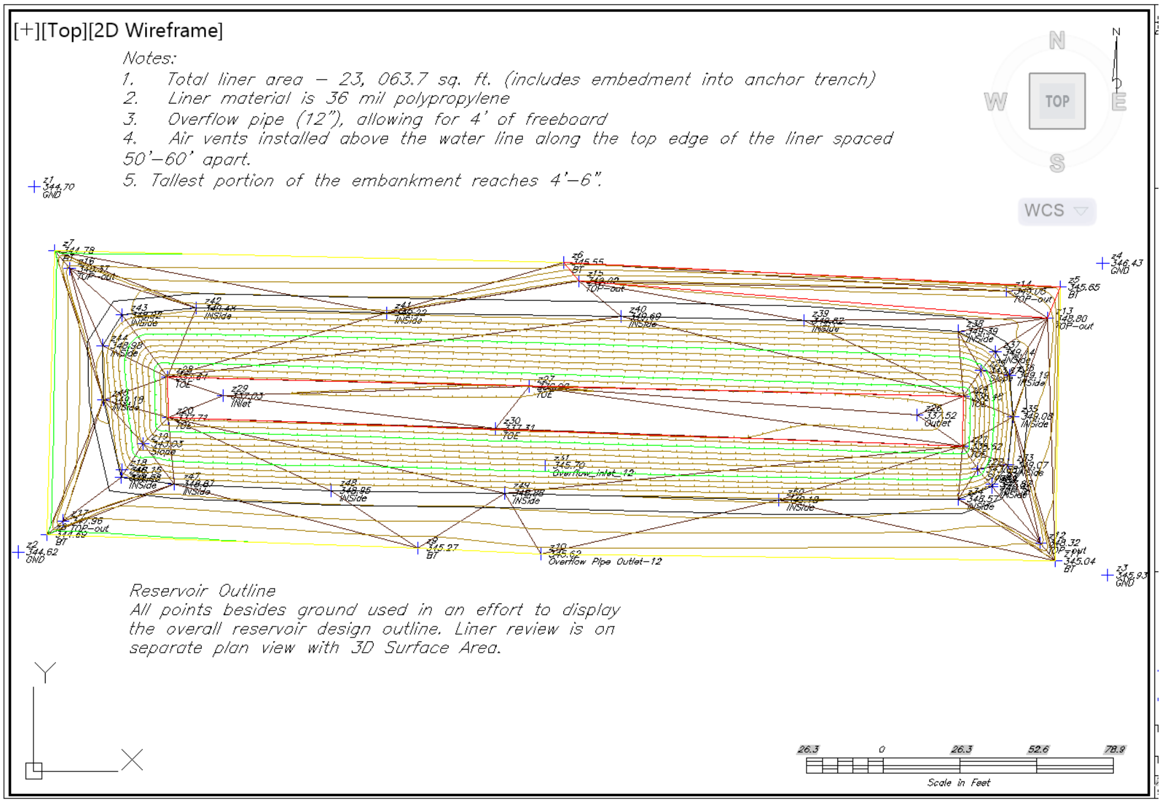
Project Outcomes

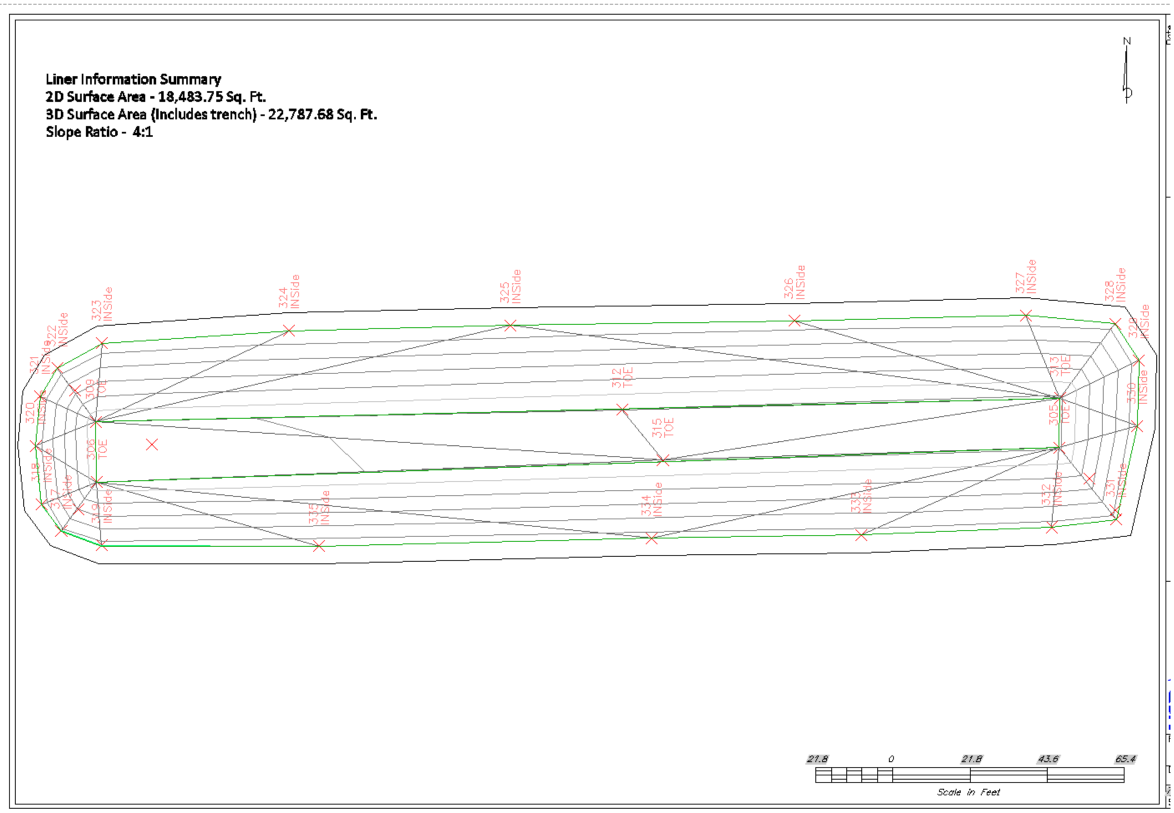
Upon completion of my internship, I can conduct field visits on my own, assist in open contracts, and compile reports for my supervisor to review. In these field visits, if needed, I can properly assemble, use, and export data with survey equipment. Once I return from the field or start working on an application, I can use the following programs as deemed necessary; AutoCAD, ARCGIS, Civil 3D, Excel, Trimble, Watergraph, and Wateright. I also leave with an understanding of NRCS values, standards, and practices, and how to communicate with a producer and their contractors should a problem arise.

Conclusions

Becoming an intern for NRCS in Tulare County has been a rewarding experience. Through learning NRCS practices, standards, and requirements, I leave with a better understanding of how critical conservation is to our communities. By experiencing day-to-day workloads, I have learned how to survey, create, evaluate, and compile projects for a wide variety of contracts. These skills have furthered my interest in Civil Engineering alongside strengthening me as a future engineer. It has given me the opportunity to explore agriculture and my community in a different perspective, one I am profoundly grateful for, and I look forward to applying what I have gained to all my future endeavors. My time spent with the NRCS office in Visalia, California has been wonderful and I hope to work again with the USDA.

Appendix One





Appendix Two