Proposal for Extracting a Drip Irrigation System and Implementing a Micro-sprinkler Irrigation System on a 30-acre Almond Orchard

A Senior Project

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By

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Abstract

The purpose of this project was to develop a plan to remove a drip-irrigation system and implement a micro-sprinkler irrigation system into a 30-acre almond orchard located in Livingston, California. The reason for removing the drip-irrigation system and inserting a micro-irrigation system was due to the farm wanting to perform less labor when it comes to harvesting time but still conserve water. Through careful research certain choices were made in order to choose what equipment would be used in the new irrigation system. The data and research provided is based on the specific type of orchard and scale of the operation. The design and format of this project are focused towards the desires and goals of the farmer, Phil Schiber, in order to achieve the desired outcome. By creating this outline, any individual will be able to reference this design process and use it for creating his or her own micro-irrigation system.

Acknowledgments

Without the unconditional love of my parents, Phil and Sandra Schiber, I would not be where I am today and this project wouldn't be possible. Thank you for all of your continuous support and guidance in all of my endeavors. Thank you for encouraging me to pursue my goals within the agriculture industry and thank you for allowing me to be apart of the irrigation transition process. I hold the upmost respect and deepest gratitude for each of you, from the bottom of my heart, thank you.

I would also like to thank my Agriculture instructor and fourth Schiber sister, Beth Knapp. She may not be here today but I am forever grateful for all that she has done for me and would like to dedicate this project in honor of her. I wouldn't be where I am today and wouldn't be the person I am today without her.

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Chapter One

Introduction

"Almonds are California's number one agricultural export valued at 1.90 billion dollars and are also the U.S.'s number one specialty crop export (Almond Board of California 2009)." Almonds are a very important crop to society for food consumption however, almond growers are facing problems everyday to try and combat the restraints of labor costs and water conservation efforts. "California almonds use a about 1.1 trillion gallons of water each year which equates to taking a 10 minute shower each day for 86 million years (Slate)." Due to the lack of water currently in the central valley, the Schiber family almond ranch (P&S Ranch) faces a depleting well and little hope in sight. Their goal is to find a solution to save water but decrease labor costs and minimize stress on the Schiber family. The solution proposed is switching from drip-irrigation to a micro-sprinkler irrigation system in their 30 acres orchard.

Statement of the Problem

With depleting water availability in the central valley, the Schiber family is looking for a way to conserve water and at the same time, decrease labor when it comes harvest time. Phil Schiber has faced the same problem for many years when it comes harvest time. Drip lines lay directly on the ground in a line next to the base of the tree trunk. This makes it really difficult for the almond shaker to grasp onto the base of the tree without getting caught in the drip lines or ruining the drip lines. Because of this problem, Mr. Schiber has to hire workers and do strenuous hours of manual labor for weeks leading up

to harvest day. Thus, about a week's worth of labor is spent before harvest tying up drip lines to avoid the almond shakers and a week is spent after harvest untying the drip lines. With another system, he can avoid this problem entirely and focus on just harvest. The problem is that, they need a new system with less labor but still conserves water because drip-line irrigation isn't working for this farm.

Importance of the Project

This project is focused on finding a solution for the irrigation system on the Schiber farm. Every farmer needs to do their part to conserve water and that is very crucial to Schiber and his family. While conserving water, they want to minimize the amount of labor that goes into pre harvest and post harvest. By switching to micro-sprinkler irrigation, the valley will still benefit from minimal water use and the Schiber family will benefit as well by not having to worry about and perform the strenuous manual labor of tying up drip lines pre harvest. The family will also benefit by not having to pay for labor costs and can put that money into improving their ranch.

Purpose of the Project

The purpose is to develop a plan for removal of the drip irrigation system from the 30 acre almond orchard and implement a micro-sprinkler irrigation system in order to conserve water and minimize labor costs. This proposal was created for this specific 30 acre almond orchard based on the needs and requests of the farmer. This proposal plan for a new irrigation system will show the appropriate measures to implement a new and successful micro-sprinkler irrigation system.

Objectives of the Project

The objectives for this project are as follows:

- Discuss the importance of irrigation systems
- Discuss drip-irrigation systems
- Introduce the implementation of micro-sprinkler irrigation
- Introduce filtration systems, emitters, and pressure flows
- Identify the proper steps needs in order to implement a new irrigation system
- Illustrate the costs associated with putting in micro-sprinkler irrigation and removing drip irrigation
- Elaborate on the future of this farm in regards to this proposal

Definitions of Important Terms

- **Backflush**: "Backflushing reverses the flow through one filter at a time and uses the clean water from the other filters to remove the contaminants (University of California 2014)."
- **Drip Irrigation:** "a system of crop irrigation involving the controlled delivery of water directly to individual plants through a network of tubes or pipes (Dictionary)"
- **Filtration System:** "the act or process of removing something unwanted from a liquid, gas, etc., by using a filter (Merriam-Webster)."
- **Irrigation**: "to supply (land) with water by artificial means, as by diverting streams, flooding, or spraying (Dictionary)"
- **Micro-Sprinkler Irrigation:** "Micro-irrigation" means the application of small

quantities of water on or below the soil surface as drops or tiny streams of spray through emitter or applicators placed along a water delivery line. Micro-irrigation includes a number of methods or concepts such as bubbler, drip, trickle, mist or micro-spray, and subsurface irrigation (South Florida Water Management District 2014)."

- **Orchard**: "a planting of fruit trees, nut trees, or sugar maples; *also* **:** the trees of such a planting (Merriam-Webster)."
- **Sand Media Filter:** "a layer of sand or gravel used to expose sewage effluent, in its final stages, to air and the action of microorganisms (Dictionary)."

Summary

Finding a good balance between environmental concerns and personal concerns can be quite difficult when it comes to farming. Switching this orchard from a drip irrigation system to a micro irrigation system will solve both of these concerns. This proposal is the perfect solution for not only P&S Ranch but for many valley farms currently facing this same problem. With the ominous drought and time being a concern, many farmers and ranchers are looking for quick solutions for harvesting and irrigating. Implementing this change is the first step and a significant one in moving towards a more efficient farm.

Chapter Two

Literature Review

When it comes to making changes in an almond farmer's orchard, there are a lot of details to cover and questions to be asked before a big commitment is made. In this case of switching from a drip irrigation system to a micro-sprinkler irrigation system, you must look at the factors and costs that go into this operation. Switching irrigation systems takes a great deal of time and capital, thus the grower needs to be assured that this is ultimately the best decision for the operation and property. The grower needs to have some certainty that switching the irrigation system will lead to better outcomes in the end while still maintaining a profit from the production. This review of literature will cover the purpose of irrigation and the different components that go into implementing a new micro-irrigation system.

Purpose of Irrigation

Understanding the purpose of irrigation is the first step in understanding the purpose of switching from drip irrigation to micro-sprinkler irrigation. According to the International Commission on Irrigation and Drainage [ICID] irrigation is defined as, "Water application confined in time and space, enabling the water requirements of a crop at a given time of its vegetative cycle or to bring the soil to the desired moisture level outside the vegetative cycle. The irrigation of a field includes one or more watering per season" (ICID 2012). Almond trees require special attention especially when it comes to ensuring the crop has enough water for the trees to survive as well as thrive yet, not over watering. There are numerous ways to irrigate almond orchards but the two focused in

this project are drip and micro irrigation.

Micro-irrigation Systems

Micro-irrigation systems have been experimented with since about the 1860's but it wasn't until mid-1960 after the development and wide availability of low cost plastic pipe that really spurred the movement into this irrigation technique. Micro-irrigation is defined by the United States Department of Agriculture [USDA] Natural Resources Conservation Service [NRCS] as the frequent application of small quantities of water on or below the soil surface as drops, tiny streams, or miniature spray through emitters or applicators placed along a water delivery line (USDA 2013). Through this process, water flows through a low pressure pipe distribution network in a predetermined pattern decided by the farmer. Micro-irrigation possess many advantages both for the farmer and for the orchard itself. When managed properly, micro-irrigation will "provide soil, water, and nutrient conservation; minimized leaching of soluble salts; and a reduced applied water requirement." When combining all of these advantages, results have shown that these improve water use efficiency and economic returns. Micro-irrigation consists of drip irrigation, subsurface irrigation, bubbler, jet, mist, and spray systems.

Drip System Irrigation

Drip irrigation [DI] is defined by the USDA/NRCS as "a method of micro irrigation wherein water is applied at the soil surface as drops or small streams through emitters" (USDA 2013). The typical discharge rates are usually less than two gallons per hour for single-outlet emitters and three gallons per hour per 3.3 feet for line source emitters

(USDA). As technology in agriculture increased so did the array of methods to irrigate. Drip irrigation started to become increasingly popular in almond orchards during the last 40 years due to the increase in understanding of irrigation methods and availability of plastic materials. Drip irrigation is very significant in today's society because water conservation is currently a very important issue in California. Drip systems waste less water due to the fact that they are so efficient. It uses less water since water is delivered only to the area of the tree that needs it (Alliance for Water Efficiency 2010). Figure 1 shown below, displays an accurate depiction of what a typical almond orchard drip irrigation system looks like.

Figure 1. USDA/NRCS: Success Stories

Micro-Sprinkler Irrigation System

Micro-sprinkler irrigation is defined by the USDA/NRCS as, "the application of water by a small spray or mist to the soil surface, where travel through the air becomes

instrumental in the distribution of water (USDA 2013).” This irrigation system works at a low pressure and applies water at a higher rate compared to drip irrigation. Like drip irrigation, micro-sprinkler is considered to be a low-pressure system between 15 to 30 psi (Alliance for Water Efficiency 2010). This allows for Micro-sprinkler systems to use less than one gallon per hour but utilizes a larger soil surface area than drip systems because the micro-sprinkler system sprays outward onto the trees, root system, and soil, rather than drip down directly into the soil (USDA 2013). This system allows for a high application rate and easy visual inspection for clogging problems when viewing the orchard for issues. Micro-sprinkler is delivered through tubing to a series of nozzles attached to the risers as shown in Figure 2. The water is then sprayed in a 360-degree motion onto the soil and trees in order to irrigation the trees and provide them with nutrients to grow.

Figure 2. Water Changers Photo Gallery
Photo Courtesy of Almond Board of California

Filtration Systems

When it comes to irrigation of almond orchards, many factors must be taken into consideration, specifically involving filtration systems. Choosing the right filtration systems is necessary in order to have an effective working irrigation system. Media filters trap sediment and potentially harmful particles that may enter the irrigation system. These systems are called sand media filters because it is filtered by the use of sand and the filtering media. The sand media lays on top of gravel with an under drain designed to deliver constant back flush (Scheuber 2011). The size of the porous media is very important in order to prevent clogging. If the porous media is too small, the system will require unnecessary frequent back flushing. These filters are often constructed so that they can be backwashed automatically as needed. "Sand media filters are most effective for organic materials because they can collect large quantities of such contaminants before backwashing is necessary" (USDA 2013). Water quality, types and size of sand media, flow rate, and allowable pressure drop should be considered when choosing the performance of a certain filter.

Flow rate is the most important to consider when choosing the type of irrigation system because the system needs to be able to produce enough pressure in order to irrigate and get the water to the crop. For drip irrigation systems, a smaller and less powerful filtration system can be used because it requires less pressure to get the water from the irrigation system into the drip lines and onto the trees. For micro-sprinkler irrigation systems, a more powerful filtration system with a higher pressure will be required. This system will need to supply enough pressure in order to get the water from the irrigation system through the lines and out of the sprinkler nozzle head. A media

filtration system set up is shown on the next page in figure 3.

Figure 3. Fresno valves, media filters
Photo courtesy of Fresno Valves

Emitters and Pressure Flow

Emitters are what deliver water direction to the root zone in quantities that approach the consumptive use of the plants. The many different types of micro-irrigation emitters can be grouped into above or below ground, drippers, and micro sprinklers (UCDavis). When choosing a certain emitter, it really comes down to soil type and preference by the farmer. There are many different types of emitters for micro-irrigation systems but the two that this project will be dealing with are drip tape/built-in dripper and micro-sprinkler head. Drip tape emitters have built-in outlets on the lateral line which lets water through and onto the ground when water is flowing through the drip lines (IDE). Surface drip is one of the most commonly used micro-irrigation systems used today in tree crops. With this surface drip system, "in-line" emitters are usually used. Holes are punched into the drip lines in a certain spacing pattern in order to get water to the tree. These holes serve as the emitters for the drip system. Micro-sprinkler irrigation emitters are a bit more complicated than that of drip emitters but they serve the same purpose. Instead of holes being punched through a line, these misters possess and sprinkler like

device that pushes water through at 360 degrees. In order to calculate the discharge rater per emission device for any micro-irrigation emitter, a calculate will be used. In order to do the calculation, the number of emission devices per tree and the discharge rate per emission device will be needed. The calculation is carried out in table one.

Application rate (gal/hr)	=	Number of emission devices	Discharge rate per emission device (gal/hr/ emitter)

Table 1: UCDavis, The Orchard Micro-irrigation

Summary

With the information provided above, it is apparent that many components and factors go into implementing a new micro-sprinkler irrigation system. With all of the technology and different equipment that goes into irrigation systems, water conservation will also be a factor. All of these systems and equipment described above go hand in hand with having a properly functioning irrigation system. These are the systems that will be used throughout this proposal.

Chapter Three

Materials and Methods

After exploring the different options and considerations when implementing a micro-irrigation system, the next step is to figure out what parts need to go into this design process. Exploring different options with careful consideration is necessary when choosing equipment in order to make the irrigation system run smoothly and effectively. This chapter will discuss the main components and considerations that will go into completing this design.

Procedures for Design

When reviewing the options for removing a drip irrigation system and installing a micro-sprinkler irrigation system, there are many factors that must be researched before coming to a conclusion of whether or not to go through with this process. A good majority of these factors include cost effectiveness and labor when deciding if switching systems is a worthwhile choice. In a personal interview with Phil Schiber, who owns the 30-acre orchard, the necessary changes that would need to take place if this orchard was to switch irrigation systems were discussed. This included the main topic of having to replace the pump, mainlines, and media filters in order to supply a sufficient amount of horsepower, flow rate, and pressure to run the micro-sprinkler system for this orchard. Before jumping into the research, a field check and overview of the orchard was conducted to get a better understanding the orchard itself and where the pumps and mainlines were. Figure 4 shows an aerial view of this 30-acre orchard.

Figure 4. Visual image of the 30 acre almond

After discussions with the grower, it was determined that research on these components would be necessary in order to determine which ones would be utilized effectively on this orchard. The United States Department of Agriculture: Natural Resources Conservation Service website on micro-irrigation and the procedures and measures that are involved in producing a thriving orchard with a successful irrigation system was reviewed. This site provides the necessary steps that should be taken and considered when installing a micro-sprinkler irrigation system into an almond orchard.

Not only did this website discuss the mechanical variables involved in switching irrigation systems but it also covered what was necessary in terms of labor required to remove the current drip tape lines and laying down new irrigation hoses for the micro-sprinkler system.

After the research was conducted, it was important to keep in contact with the grower to meet again in order to go over options available as well as the steps involved in switching systems. Clarification on what was needed in order to make the switch successful and beneficial in terms of minimizing labor and increasing profit was needed.

Switching Systems: Mechanical

As stated earlier, the main components that would hold the grower back from switching from drip to micro is the mechanical side of switching. The system that operates this orchard currently is a low pressure/low volume system made specifically for drip system irrigation. Before installing the new micro-sprinkler system, a completely new mechanical system would have to be put in place of the current system installed. This requires a new pump, new mainlines, as well as new media filters that would have a higher pressure/higher volume that would be able to successfully irrigate the orchard through the micro-sprinklers.

Pump Installation

The pump's job within this system will be to supply pressurized water to the control head and will be driven by a centrifugal motor. The most efficiently designed irrigation systems have pumping capacity closely matched to system demand. In this case, it would be at a higher demand than the drip system currently in place. The 30-acre orchard currently runs off of a 15 horsepower pump used to irrigate through a drip irrigation system. This pump would not supply enough horsepower to pump enough water through the micro-sprinkler system to successfully irrigate the orchard. Because the micro-sprinkler system is a higher pressure/volume system, this will require a larger pump to push the water through the system and out of the sprinklers. After research, the conclusion was to use a 40 horsepower push pump to raise the flow rate of water as well as increase the pressure. This level of horsepower will be able to effectively pump water through the micro-sprinkler system and irrigate the orchard. For all of Phil's irrigation

needs, he goes to Atwater Irrigation Supply in Atwater, California. Atwater Irrigation Supply recommends he put in a high flow/high efficiency centrifugal pump by Pentair-Berkeley Company. The centrifugal pump puts out a broad flow range to 7,500 gallons per minute (GPM). This pump will be able to irrigate the orchard effectively and efficiently at a price of $4,000 for the parts. There are many other types of pumps but Atwater Irrigation delivers the parts directly to the farm, which makes it easier on the farmer. Figure 5 is the exact pump that will be installed in the orchard (Pentair 2015).

Figure 5. Centrifugal pump by Pentair-Berkeley

Mainlines

This orchard currently contains smaller mainlines because of the drip irrigation system that is currently in place. These mainlines are smaller because less water pressure and a lower volume of water is needed for the drip system. Installing this micro-sprinkler irrigation system would require the farmer to increase the mainline sizes. The current size

of the mainline is 12 inches (lengthwise) with 4-inch laterals (width). The current layout of the mainline and laterals are displayed in Figure 6. The mainline is depicted in blue while the laterals are shown in yellow. The new mainlines would have to double in size in order to effectively transport enough water through the lines and out of the sprinkler. The mainline receives irrigation water from the control head and delivers it to the lateral and sprinkler emitters. The proper design of mainlines ensures the pressure loss through these conduits does not negatively affect operation of the system. Pipe size should be selected based primarily on the economic trade-off between power costs and pipe installation costs. The flow velocity, check valves, air and vacuum relief valves, and pressure relief valves must be considered and incorporated as part of the system. These mainlines will also be purchased through Atwater Irrigation Supply, consisting of PVC pipe. PVC pipe is the most functional yet cost efficient option for this farm. Putting in this new mainline system will cost a total of about 10,000-12,000 dollars after labor and installation.

Figure 6. Mainline (blue) and lateral (yellow) overview

Emitters

Emitters are a very important component of the micro-sprinkler irrigation system. These are the devices that will actually propel water onto the soil and trees in order to irrigate. The emitters that will be used for this new irrigation system are also Bowsmith brand. Again, through careful research and consideration, the emitters that were chosen are the 8521 72" PE #40 Fan-Jet pattern F standard barb J stake Bowsmith emitter shown in Figure 7 (Bowsmith 2015). For this 30-acre orchard, 3,400 units will be purchased to irrigate. Each of these emitters will be placed in between each tree and connected to the Bowsmith tubing described above.

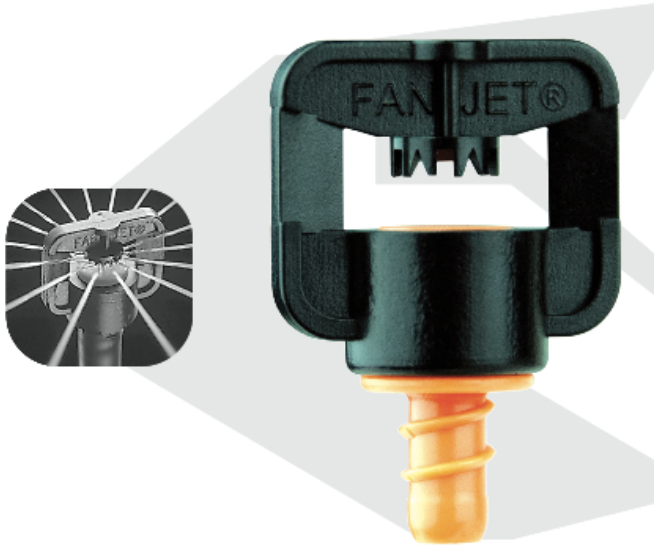

Figure 7. Fan-Jet micro-sprinkler head by Bowsmith

Tubing

In the 30-acre almond orchard, the trees are being irrigated through drip tapelines, which contain small holes for water to exit onto the soil. These will not be able to be used for the new micro-irrigation system. When those are taken out, they will nee to be replaced by drip hose tubing and emitters. The drip hose tubing as well as the emitters will be purchased through Bowsmith. The best tubing for this orchard and this scale of orchard will be the 1195P72 Bowsmith Premium Plus+ tubing with a pressure rating of 53 (Bowsmith 2015). This tubing is manufactured from the highest grades of polyethylene resins. After careful research of many types of drip tape, this one will work the best for this orchard as well as it is extremely durable. The amount that will need to be purchased is about 63,360 feet to cover all rows and all trees.

Media Filters

The last mechanical component that would need to be changed are the media filters. The media filters this farmer currently owns run at about 400-500 gallons per minute. This works well with the drip system right now but the grower would need to install larger filters in order to increase the operation's gallons per minute. The ideal media filter for this farm's micro-sprinkler irrigation would have to be about 850 gallons per minute.

Labor

When removing the drip system, most of the labor will be done by hand. For this orchard's drip system, there are two drip lines on each row of trees with 36 rows of trees

and this is shown in Figure 8. As stated before, the lines will be removed by hand and removed from the orchard. After these drip lines are removed and the larger mechanical equipment is put into place, the new micro-sprinkler hoses will be put down manually as well. For this system, only one hose is required per row with one sprinkler head between each tree. The removal of the drip-lines and installation of the micro-sprinklers and hoses will all be done manually by hand. Once the hoses are laid down and the sprinklers are connected to the hose, the system will be connected and will be able to operate.

Figure 8. Displays the two drip lines on a regular almond orchard

Summary

It is essential that thorough communication between the farmer and author is clear while the author proposes options and the farmer chooses the final product. Setting up meetings and doing careful research is necessary to make effective decisions. Making

sure that all the parts work together smoothly and correctly is extremely vital to this operation. In this case the pump, mainlines, emitters, tubing, and media filters will work together efficiently and correctly in order to provide the farmer with a new functioning micro-sprinkler irrigation system. All of these parts integrated together so it is imperative that all decisions are made and executed with careful thought and consideration by the farmer himself.

Chapter Four

Results and Discussion

Introduction

The microspary irrigation system for the 30-acre field owned by Phil Schiber was designed. The field is to be irrigated in one set at the control of the owner. This system will run off of the functioning pump system installed and will irrigated the full 30-acre block. The system will utilize #40 nozzle size microsprayers with a full spray pattern in order to maximize irrigation performance. A summary of the components for the complete this design is shown in Table 2.

The total cost of the system was estimated at approximately $33,435.68, or approximately $1,114.52 per acre. A summary of the major design components is shown in Table 2, below.

Table 2. Summary of Major Design Component Costs

Centrifugal pump by Pentair-Berkeley	1	Unit	$2,500	$/unit	$2,500
Mod. No. 330 media filter Fresno Valves and Casting	1	Unit	$11360	$/unit	$11,360
1195P72 Drip Hose	63360	ft.	$44	$/500ft	$5,575.68
8521 72" PE #40 Fan Jet pattern F standard barb J stake Bowsmith	3400	Unit	$1.50	$/assembly	$5,100
Lateral piping from Atwater Irrigation Supply	1600	yd.	$5	$/yard	$8,000
Trench Rental Cost	1	Unit	$150	$/day x 6	$900
Total					$33,435.68

Discussion

Because this orchard already contains most of the basic functioning irrigation equipment, some things were able to stay and not be replaced. By doing so, this cut down the cost tremendously. The decision was made to leave in the mainline and laterals that are already established in the ground. The plan is to rent a trencher and trench new lateral lines a few feet away from the laterals already in the ground. This would eliminate cost of removal and extraction of that tubing. The old

laterals would be capped off and the new laterals would be connected to the existing mainline and irrigation system. This was also the same for the strainer component of an irrigation system. The irrigation system on Phil's property already contains a strainer that would be suitable for this new irrigation system. A flow meter and transmitter is also already on the property. Keeping all of these components instead of replacing them, cut out approximately $8,000 total.

After finding the components that are going to be used, things became pretty simple in terms of installation and executing this design. The most challenging part of this project was the actual selection of specific manufacturers and parts for the major design components. Many different companies and part types were explored, with the decisions made on the basis of the quality of the products that the companies were able to provide. Atwater Irrigation Supply was the biggest resource in terms of determining which components to choose. The main employees at Atwater Irrigation Supply were extremely helpful in terms of addressing any difficulties a user may encounter. Although some parts were more expensive than other places, the extra cost was made up by their ease of use, location, and availability. Atwater Irrigation Supply was able to identify different options for this design as well as have those parts directly shipped to their location and then deliver it straight to Phil Schiber's 30-acre almond orchard. The system could have been designed just as easily using less expensive and reliable parts, but more money would have been spent later in replacing parts and maintenance.

Another challenge that is facing this design and implementing it into this farm is the drought situation currently facing California. David Kohen from Atwater

Irrigation Supply advised that to switch from drip to micro sprinklers may not be the best move at a time like this with the challenging irrigation season California farmers are experiencing. In the years to come, this situation will hopefully improve and this system will be able to be implemented into this orchard. It would take a while for the switch to occur so this problem would just be a minor setback.

This system was designed specifically for this orchard with this field shape, size, and specific area. Because some parts would be recycled to this new system, it would not be wise to take this procedure and implement it on another farm. When it comes to irrigation systems, all the parts can be viewed as a puzzle. If one piece is missing or not working correctly, the system as a whole fails. It is imperative that all the components are put together properly as well as making sure the right equipment is being used.

Summary

The cost to put in this new system calculated out to approximately $33,435.68 or $1,114.52 per acre. A lot of money was saved because the farm already had some major components that can also be used for the new microsprinkler irrigation system. This cut down on the cost significantly, which the farmer was very pleased with. The main challenges were choosing which equipment would suit this orchard best as well as contain good quality and a reasonable price. Atwater Irrigation Supply was really able to help solve this problem for this design. Overall, the equipment chosen and the design produced will work very well for this orchard and for Phil Schiber himself.

Chapter Five

Summary, Recommendations, and Conclusions

Summary

This irrigation proposal and development plan was designed in order to create an accurate outline for the implementation of a quality micro-irrigation sprinkler system, with adequate water conservation and decreased labor requirements in a 30-acre almond orchard. Putting in a new irrigation system is always a difficult process and one that should be carefully thought out. Thorough research must be completed in order to address as many of the variables as possible. The specific plan that is being proposed is based on the conclusions reached during the discovery process. This plan covers the start to finish process of correctly and effectively implementing a micro-irrigation system.

Recommendations

The following should be considered prior to completing a proposal plan for putting in an irrigation system.

1. Reach out to individuals familiar with irrigation systems and in the industry.
    a. This is highly recommended because the individual will be able to provide knowledgeable information and suggestions on what decisions should be made especially in today's agriculture world. With drought being a major negative factor in agriculture, it is

important to be aware of the conditions and how those conditions may affect decisions made. Research will provide useful information but speaking to someone directly who is facing challenges and difficulties as well as success will be the most beneficial.

2. Doing careful research in determining equipment to use and where to use it is also extremely recommended.
    a. Throughout this paper the reader will discover that there are many different factors that must be taken into consideration when planting an almost orchard. All of these variables can be solved through research online and contacting companies. Making sure the right equipment is being used is one of the most important parts of this project. Making sure that all the equipment flows correctly with each other will make or break the irrigation system. Research should be conducted for all aspects of implementing an irrigation system. There are many online tools that will assist in creating the proposal plan.
3. The third recommendation would be to find lower cost equipment.
    a. This proposal plan contains equipment that is on the more expensive end but was still approved by the farmer himself. Finding lower cost equipment that is still good quality and gets the job done is something to consider when creating the proposal plan. In the end, it is up to the farmer how much should be spent

and how much shouldn't. There is equipment out there that is cost efficient as well as good quality but it all depends on the type of system being used. Careful research in considering these products is very important and should be conducted.

Conclusion

Creating, developing, and implementing this micro-irrigation system proposal plan was a success. The proposal plan not only met the objectives outlined in Chapter One, but also met the desired goals for Phil Schiber himself. Each aspect that needed to be adequately addressed and developed was reached in a way that made the irrigation system proposal realistic and feasible. This irrigation system, once put into the orchard, will be able to irrigate efficiently as well as meet the needs of Phil Schiber.

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