SANTA CLARA UNIVERSITY

Department of Civil Engineering

I HEREBY RECOMMEND THAT THE THESIS PREPARED
UNDER MY SUPERVISION BY

Daniel Garrett, Liam Anderson

ENTITLED

Affordable Farmworker Housing

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

BACHELOR OF SCIENCE
IN
CIVIL ENGINEERING

DocuSigned by:
Tonya Nilsson 6/10/2022
8DC63147049A406...
Thesis Advisor(s) (use separate line for each advisor) date

Rong He 6/11/2022
Thesis Advisor(s) (use separate line for each advisor) date

DocuSigned by:
Dr. E. Maurer 6/9/2022
86BDD7E4CB47498...
Department Chair(s) (use separate line for each chair) date

Affordable Farmworker Housing

By

Daniel Garrett, Liam Anderson

SENIOR DESIGN PROJECT REPORT

Submitted to
the Department of Civil Engineering

of

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AFFORDABLE FARMWORKER HOUSING PROJECT
FINAL REPORT

Liam Anderson and Daniel Garrett

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I. INTRODUCTION

The deadly combination of Coronavirus and poor housing has caused devastation to the vulnerable community of California migrant farm workers. The average life expectancy of a farm worker in the United States is 49 years, which is 30 years less than the average American man (Sanchez). The US General Accounting Office reported in 1992 that farmworker housing options in California, Oregon, and Washington had the capacity to house less than 30% of these states' farmworkers, even excluding the dependents who migrate with workers (Jacobs). According to the US General Accounting Office, the situation has hardly changed over the last 30 years (Jacobs). The lack of appropriate housing forces many workers to set up makeshift living conditions. The California Agricultural Worker Health Survey found workers living in bare garages, vehicles, and animal stalls (Jacobs). Due to these poor housing conditions, Coronavirus was able to spread easily among farmworkers, contributing heavily to their rise in mortality. There has been a 59% increase in mortality among Latino food/agriculture workers comparing rates before the pandemic to 2020 (Nicholas).

Housing is intimately related to health. The World Health Organization (WHO) and the American Public Health Organization (APHO) have long identified the connection between human health and housing (Jacobs). If there could be a solution to provide humane housing to farmworkers in California, it could have major positive implications towards migrant farmworker health.

Aside from the obvious moral objective, is it vital that farmers provide farm workers housing? One answer to this question is that farmers have been struggling to find enough workers. The farmworker workforce has declined from 9.93 million in 1950 to 2.4 million today. According to the California Farm Bureau Federation, in 2019, 56% of California farmers reported being unable to obtain a sufficient workforce over the last five years (Moriarty). The labor shortage has only become more pronounced during the pandemic (Moriarty). In order to have a competitive advantage over other companies, some bigger farms have begun to have housing built for their workers, sometimes on land they already owned and sometimes on land that the farm purchased. These housing complexes draw in farm workers, as it gives them a secure, affordable place to live that is convenient for them to get to work.

Other factors for farmers to consider are the decline in seasonal workers and the increase in worker productivity with good housing. In 2016, more than 80% of American hired crop farm workers were not seasonal workers but were considered settled, meaning that they work at a single location within 75 miles of their home. This percentage is nearly double what it was in 1996-98, when only 41% of workers were non-seasonal. More workers staying local means that there is more incentive to provide permanent housing. Lastly, a survey done by the Urban Institute showed that worker productivity and mood improve with better housing. Workers provide improved work when they know they are returning to a stable, decent home.

In this Senior Design project, engineers designed a residential, affordable housing complex that provides adequate living space. These housing complexes will be suitable residences, as well as being beneficial to the farm owners. As there are many different farmworkers and farms in California[1], this housing complex will be a reproducible model that can work on any farm in California with slight adjustments. However, in order to provide the work necessary for a senior design project, it was necessary to choose an actual site where one could design a real project, but there will not be any features that are specific to the location to maintain reproducibility. The design of this project included site considerations and alterations that may arise with a project such as this. The site of this project is a parcel located in Salinas, California, which is a city known for its agricultural production. The APN for this site is 153-091-020-000, and it is located on the corner of East Boronda and Natividad Road. Figure 1 provides a picture of the site.

Figure 1: Project site area on East Boronda and Natividad Road in Salinas, CA. 50.2 acre overall parcel with 2.7 acres being utilized for the project. Site is agriculturally zoned and is near to farms as well as commercial areas.

Schematic design including grading plans, storm water control plans and site development plans were all included in the scope of work. That section of the scope will focus more on the land development side of the project, such as the site attributes and the water connections. Other parts of the scope included a more of a construction based focus, including the architectural design of three example structures which have the capacity to hold approximately 200 residents. There will also be a structural portion, based on the California Residential Code (CRC) 2019. There are three two-story buildings, and each floor will have the capacity to house up to approximately 36 residents, if necessary. This number is approximate because there may be two workers in each room, and there may also be a family staying in each room. Furthermore, the construction scope included a cost analysis of the best options for materials, and a cost estimate of the entire project. To demonstrate that the solution provided by this senior design is superior to that of an alternative, the cost to house the same amount of people using trailers will be estimated. The project will provide a solution to the problem of inhumane farm worker housing while being relatively inexpensive.

II. CONSTRAINTS

The purpose of the housing complex is not to make a profit off of rent, but to provide a space for workers to live to attract a workforce for farms. Since attracting a workforce while limiting cost is what an owner would ideally want, the overall cost of the project was a constraint. The client also wants to maximize the use of the land by housing as many workers as possible in the given parcel. Depending on the size of the farm and the number of employees, these numbers will vary.

Several constraints are seen in the selection of the parcel. This housing complex will be for farmworkers on a farm. Thus, when looking for a parcel of land, there was a limit to residential and agricultural zoning. Agricultural zoning in California allows for housing units to be constructed, as long as the housing is provided for strictly farmworkers. California residential code was the main code that was used for the design of the housing complexes. Monterey County code also provided constraints. Section 20.24 of the Monterey County code provides guidelines and requirements for employee housing, including max building height and setback requirements. Section 20.58 pertains to parking and landscaping requirements. Other requirements in Section 20 are given for things such as regulations of reduced vehicle trips and maximum building coverage. Section 20.66.060 of the Monterey County code provided more standards for agriculture employee housing, including minimum site size and requirements for recreational space. These codes, along with Federal codes and ADA regulations posed constraints that the design had to follow.

For the design project, it was necessary to find a site where existing sewer and water mains were nearby. When speaking to industry professionals, they stressed that although providing a sewer and water system without existing utilities is possible, it is extremely difficult and expensive. The Central Coast also is subject to flooding due to nearby rivers, which led the team to choose a site that will be outside of the floodplain.

III. CRITERIA

For the preliminary design alternative analysis, criteria were created to evaluate the best design that best incorporated what the client wants while also falling under the requirements of Federal and local building codes. From talking to industry professionals, looking at plans of existing affordable farmworker housing, and conducting individual research, eight criteria were established that helped determine the appropriate site and site design, building layout, and construction method that were used in this project.

IV. RANKING OF CRITERIA

The following list indicates the ranking of the criteria.

1. Cost
2. Maximizing Use of Space
3. Living Conditions
4. Lifespan of Building
5. Speed of Construction
6. Proximity to Farms
7. Sustainability
8. Aesthetics

Below is the analysis of each criterion and the weight that was determined based on the importance of the criteria. A score of five is the highest score (cost) for a given criteria while one is the lowest score (aesthetics).

Cost

Cost is obviously a factor when designing an affordable housing complex. Most farmers will not want to spend a great deal of money on non-essential features, and thus cost is a foremost issue. This housing complex will provide an affordable solution that also is a quality finished product. According to a cost analysis with data used from 2022 by HomeAdvisor, The average California home is around 1,625 square feet. This brings the average cost to build a house in the state to about $240 per square foot. Thus prices at more than $240 per square foot will not be accepted (Fisher). As this criterion is so important, the price per square foot should be much less than $240. The cost will be affected by things such as the materials used for construction, the workforce and equipment required, and the overall size of the housing site. This criterion is given a weight of five.

Sustainability

Sustainability, especially in California, is a point of interest in today's construction industry. Although it is crucial to this project to not spend monetary resources unnecessarily, sustainable building materials and appliances which can provide a long-term cost-benefit were examined. Due to the fact that a client would not be interested in spending extra money on something that will not advance him/herself financially, this can not be a principal interest. This criterion is given a weight of two.

Lifespan of Building

For this project, the aim was to provide a finished product that will last and provide housing for many generations of farmers. Residential buildings in the US have an average lifespan of 70-100 years. Thus the intention of this project was to design a housing complex that will at least stand for 85 years. This criterion is given a weight of three.

Living Conditions

Farmworkers are humans and thus deserve humane housing. The objective was to provide quality, humane housing with the funds that are available. Unfortunately, it may be difficult to design an exceptional home that fits the cost of a client. For a housing complex to attract potential workers for farm companies, a facility with ample communal space and open space may be beneficial. It is important to find a balance of living conditions and costs that satisfies both the client and their employees. It is also important to consider that many workers have families, and accommodation for their families is something that should be looked into. This criterion is given a weight of three.

Proximity to Farms

When choosing a site, close proximity to the workplace is something that is beneficial to both the worker and the client, although transportation will be available per Section 20 of the Monterey County code. This criterion is given a weight of two.

Maximizing Space

It is important to maximize the lot by providing the maximum amount of buildings and rooms, while also allowing for comfort and ample communal space. A potential client would want to house enough workers for their fields to yield as many crops as they can. This criterion is given a weight of four.

Speed of Construction

Time is money for the farms, and the sooner the construction is completed, the sooner that workers can have affordable housing. The complexity of the building design and whether the building is made from a traditional building material are also factors. If the builders do not have experience constructing with these building materials, construction time may be slowed. According to the industry-standard Construction Labor Market Analyzer (CLMA), labor cost percentages in construction lie between 20% and 40% of the total project's budget. Costs that fall under the labor umbrella include not just wages but also things like payroll taxes. Thus it is vital to build the structure as quickly as possible while still maintaining the structure's integrity. This will provide considerable savings in labor costs. This criterion is given a weight of four.

Aesthetics

The client wants something that is affordable but also looks nice. This will help appeal to workers and show that the farm cares about the workers. However, it will be difficult to explain extra spending on simply trying to make the residences more aesthetic. This criterion is given a weight of one.

V. ALTERNATIVE ANALYSIS

For this project, the team decided to conduct three different alternative analyses. One analysis was conducted for the preliminary site layout, one for the layout of the housing complex, and one was conducted for traditional and sustainable building material. This section will detail each alternative and will be graded based on the criteria and weights given above.

Site Alternatives

The first site layout strictly focused on the client's needs. This design focused on maximizing the number of living units available in the given amount of buildings and space. This design will only meet the minimum spacing requirements per H2A requirements. The H2A requires 100 square feet of space per person in a living unit per the code. This design has the minimum recreational space required, as well as minimum parking space and landscaping area. This design did not try to find a convenient site where the farm as well as stores for workers to get food and other necessities are close by, but rather found land that fits spatial needs to house the farmworkers. The design emphasizes cost over everything else.

The second site layout took into consideration the comfort of the building habitants. This design exceeds the minimum space requirement per person in a living unit and provides a layout that allows for extra recreational and parking space. Landscaping area will still be at a minimum. This site was chosen with strong consideration to closeness to not only the farms but closeness to stores where workers can buy food and necessities.

The third site layout combines the two previous layouts. The layout provides for more than minimum living space requirements to provide adequate living space for habitants. The site includes minimum recreational and parking space, but the layout was designed to accommodate larger areas of recreational space rather than many small areas to meet the minimum requirements. Parking spaces were optimized in the space allocated on the site. This site takes into consideration closeness to the farms so travel to work is less than two to three miles away, but did not prioritize closeness to stores because many workers have their own vehicles.

For these alternatives, an analysis was conducted for the criteria that applied for each design. The results are seen in Table 1 below, which determined that Alternative 3 was the best option for the site.

Table 1: Rankings of alternatives based on criteria for site layout. 5 is the highest ranking and is multiplied by the weight of the criteria and totaled. Alternative 3 had the highest sum.

Criteria	Alternative 1	Alternative 2	Alternative 3
Cost (5)	5	2	4
Maximizing Space (4)	5	2	4
Living Conditions (3)	1	5	3
Proximity to Farms (2)	1	5	5
Aesthetic (1)	1	4	3
TOTAL	51	47	58

Building Layout

Three separate alternatives were considered for the design of the units. The objective of this project was to create a reproducible design that can be used by any farm, whether that be a large commercial farm with many workers or a small private farm with a few workers. Per the above analysis of site layout, all of these alternatives will exceed the minimum space requirements per person. All buildings will also be two stories, in order to maximize space and house as many residents as needed.

For the first alternative, a dorm-style layout with living units back-to-back, with a separate communal space and restrooms was considered. The units will be designed to house one or two workers. If a family needs space to live, they will have to rent multiple units back to back. This design will have communal spaces that are shared between all residents including bathrooms, kitchens, and laundry facilities. This design is similar to some college dorm designs, but this does not provide a realistic living situation for farmers who have kids and families. Figure 2 shows a generic example of this design, but the number of rooms can be altered to cater to the farm size. This particular design houses one person per 170 square feet.

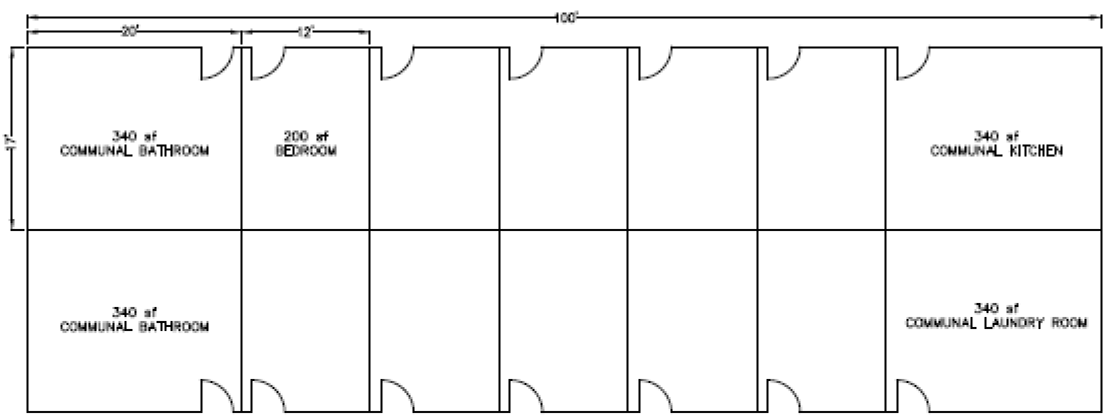

Figure 2: Generic layout for alternative 1. This example can house 20 residents.

The second layout alternative keeps space in mind but also provides a solution to farmers with families. On either side of the communal space, two rooms will be provided as well as a bathroom for each room. The communal space will have at minimum a kitchen, a sink, and tables to eat on. These units will provide more than the required 100 square feet per person. The units will be designed to house two to four workers and will be able to accommodate families. If a worker wants to live with his/her family, then they can rent out the entire unit. The design of one of these units is shown below in Figure 3, and an entire building in Figure 4. Figure 4 is just a general example, and more or fewer units can be added or subtracted depending on the size of the farm. Note that the dimensions shown are preliminary, and can be subject to change. This particular design houses one person per 131 square feet.

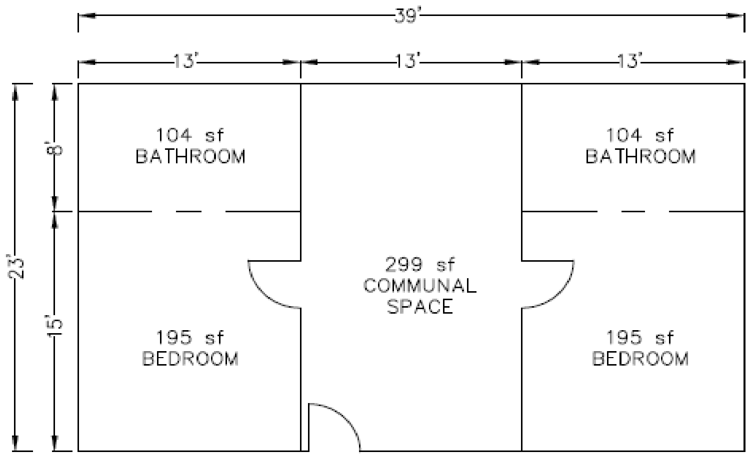

Figure 3: Typical unit layout. Each room is designed to house anywhere from two to four people.

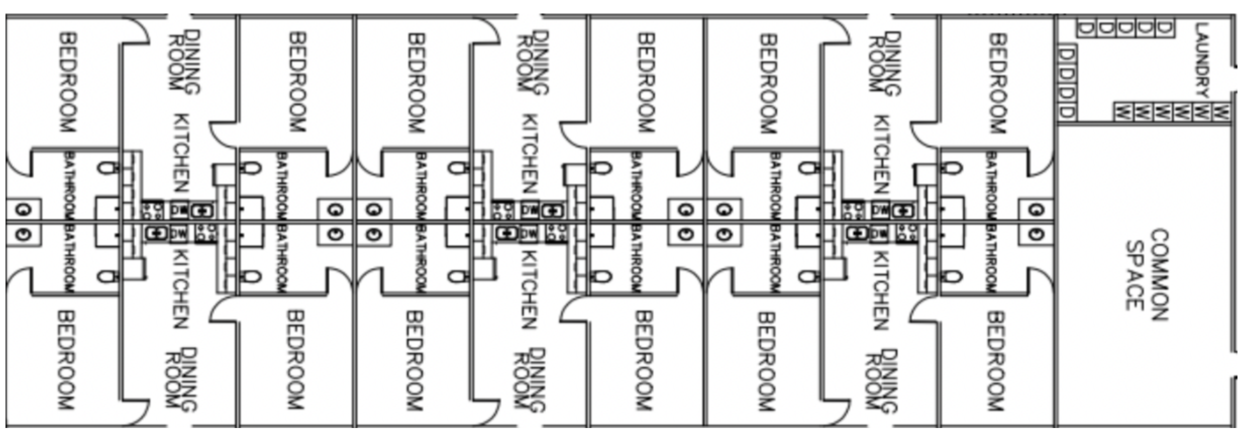

Figure 4: Example of a layout of an entire facility. This facility can house up to 48 residents and provides a laundry facility as well as extra communal space.

The third alternative also provides an option for families but caters towards smaller farms that may not be able to afford the costs of possibly having empty rooms. Smaller farms will not need separate communal spaces for every four residents, and would rather have spaces that are designed for the exact amount of people they have on staff. For this design, the rooms will be catered to two to three people living in one room, or one family living in each whole unit. There can be many units as the farm sees necessary. A communal space for every two to three rooms, adjacent to the units would be provided. The example shown in Figure 5 is capable of housing 21 residents, and a single floor unit layout is shown in Figure 6. This particular design houses one person per 150 square feet.

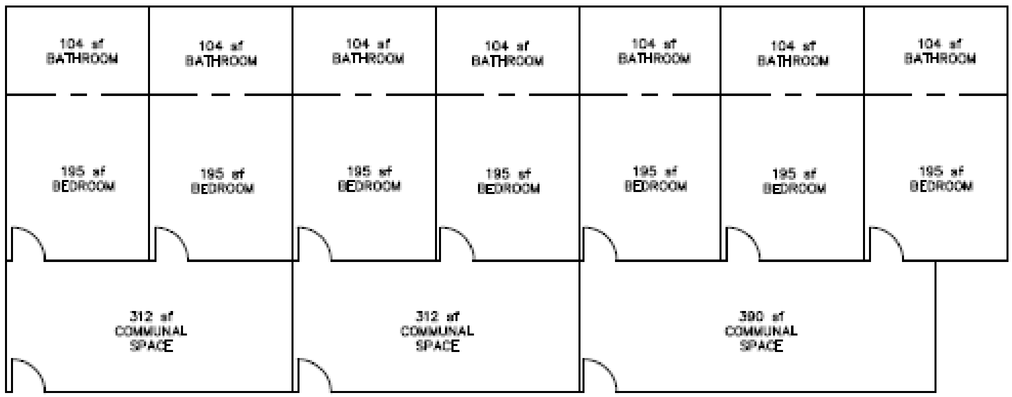

Figure 5: Typical building design for smaller farms. This design allows for flexibility in communal space and the number of people living in the entire building.

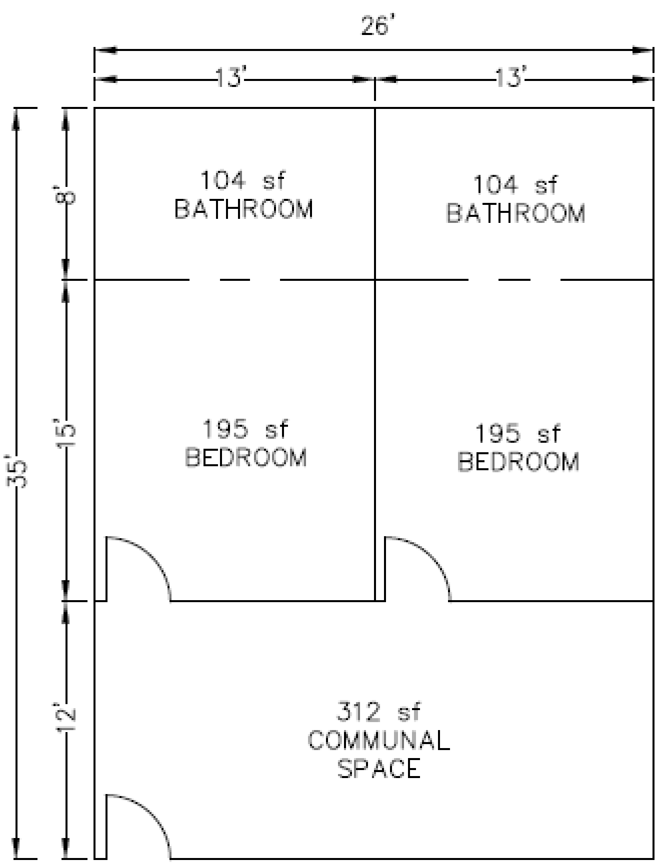

Figure 6: Typical unit for design. Communal space can be expanded to accommodate three rooms as seen in Figure 3. Each room houses two to three people depending on needs.

The third alternative design shown in Figures 5 and 6 are useful in the event of numbers not being perfectly divisible by two. For example, if there were seven workers and all of them had families of three to four people, each family would have a room. However, if there are not many families and more workers, then there is an option to put two to three workers together in one room. The results of the team's analysis is shown in Table 2.

Table 2: Rankings of alternatives based on criteria.

Criteria	Alternative 1	Alternative 2	Alternative 3
Cost (5)	5	5	4
Maximizing Space (4)	4	5	3
Living Conditions (3)	3	4	5
Aesthetic (1)	1	4	3
TOTAL	51	61	50

From the rankings in Table 2, the team decided that the design would be best if alternative 2 is implemented. Alternative 2 scored 10 points higher than Alternatives 1 and 3, and received at least a 4 in all criteria. It is simple, makes the best use of space, and the communal space and bathroom do not need to be shared between everyone. In alternative design 1, a dorm-style layout would not provide the best living conditions for its inhabitants. The only privacy that a worker has is their own room, which is relatively small and has little space for personal belongings. The communal space would be very large and crowded on some farms, and no one would be accountable for keeping it clean. In layout 2, there is a communal space for every four to eight residents, and it is directly connected to their bedrooms. Thus, it would be in their best interest to keep their communal spaces and bathrooms clean and functional. This option also provides workers living in the unit some type of privacy and gives them a kitchen and bathroom that is not shared by everyone. Layout 3 is similar to layout 1, but it does not have the most effective use of space. Since there was no design for a communal laundry room, washers and dryers would need to be provided for each shared communal space or a different facility would need to be constructed.

The chosen design provides livable conditions and privacy for workers, an accommodation for potential families, and efficiently uses space that appeals to the client. It also provides a repeatable and possibly modular solution for relatively fast construction and appeals to farms of varying sizes.

Building Material Alternatives

Selecting the proper building materials accounts for up to 50% of the construction costs of a residential project (Porter). The primary objective for the project is having a low-cost design, thus it was important to investigate alternatives that allowed the team to reduce the cost of the overall project. Materials impact most elements of cost in the design, because materials impact all but one of the ten criteria, including cost, maximizing space, living conditions, the proximity of materials, an easy to build design, the lifespan of the building, speed of construction, sustainability, and aesthetics. There was not a design for a different system with each building material; instead each material will be examined with the criteria and the material that best meets the interests of the clients (farmers) will be used in the design. The results of this materials analysis is shown in Table 3.

Straw Bale with Wood Frame

Straw bale is an agricultural byproduct which may already be on the farm, and if not, it will certainly be available at a nearby farm. Thus, straw bale is likely to be easily accessible. Straw bale buildings are more expensive per square foot in part due to high labor costs associated with moving the bales (Johnson). The wood frame will be a secondary material, and will not account for much of the structure (Johnson). Straw bale is an excellent insulator, with an R value between 40 and 60 Fahrenheit*square feet*hours/British thermal units ($F°\cdot ft^2\cdot hr/Btu$). The R value, or the insulation value in Monterey County ranges between 19 and 25 $F°\cdot ft^2\cdot hr/Btu$ (Owens). It requires maintenance of the plaster on the outsides, however, which keeps moisture out. Straw bale, if built correctly, needs no protection against seismic forces or fires. It does not maximize space well at all, as it ranges from approximately 14 to 22 inches thick. If built correctly, straw bale houses last approximately 100 years. Straw bales are soft and safe, and it is family friendly material. It generally takes seven to eight months to build a house, and a straw bale house can take anywhere from four to ten months. It is extremely sustainable, as when the building has finished its cycle, the straw can be decomposed right back into the earth (Johnson).

SIPS (Structurally Insulated Panels)

The panels consist of an insulating foam core sandwiched between two structural facings, typically oriented strand board (OSB). SIPS cost more to purchase than stick frame buildings, but have superior insulation and construction times (Raetz). SIPS have a range of R values from 15-67 $F^{\circ}\cdot ft^2\cdot hr/Btu$, with higher R values relating to thicker walls and higher material costs. SIPS are great insulators, and generally do not need extra insulation (Rodriguez). SIP construction can be designed to meet Class O surface spread of flame and up to 60 minutes fire resistance. In the IRC, SIPS are limited to low seismic design categories (A through C) and for wind speed up to 130 miles per hour due to construction type classification (Mosalem). Thus, extra precautions may be needed to make it seismically safe. The big disadvantage of SIPS is moisture resistance. They can be damaged by moisture, and require special and careful protection. One needs to install additional panels or waterproof surfaces. Pest resistance is another problem. Space is virtually maximized with SIPS, as they range from four to seven inches thick. SIPS can last 60 years or more, meaning they do not last as long as other materials. SIPS can be used to build homes extremely quickly, cutting construction times by about 55 percent from traditional wood framing. The foam in the middle is only composed of two percent plastic and 98 percent air, so they can be disposed of easily. OSB boards are extremely sustainable. SIPS can be found almost anywhere (Ditka).

Concrete

Concrete is an extremely inexpensive material, which every builder will have experience with (Raetz). Unfortunately when using concrete it is necessary to ensure that it is seismic resistant, such as providing steel reinforcement. This can drive up the prices when using concrete (Gritzmacher). There is generally no need for maintenance, and concrete is safe against fires (Gritzmacher). A downside to concrete is that it is a terrible insulator, with an R of around 1.11 $F^{\circ}\cdot ft^2\cdot hr/Btu$ for an eight inch concrete wall (Valle). An option could be to utilize ICF, or Insulated Concrete Foam, which has excellent insulation. Unfortunately, ICF is not a cost effective solution (Valle). Concrete makes good use of space, as it can be formed to any shape the designer desired. Depending on the curing and other factors, concrete homes can last anywhere from 30 to 100 years (Gritzmacher). Concrete is a little rough for a home, as it is hard, and does not provide a homely look or feel. It takes a reasonable amount of time to build with concrete, as one has to wait for the concrete to cure and set. Concrete can be altered to be greener, but this usually drives up the price. Traditional concrete is not eco-friendly (Valle).

Stick Framing

The fourth material being considered is wood. The price of wood is currently on the rise, as the line item costs for wood doubled between 2014 and 2018. Despite this rise in cost, wood remains less expensive to build with than other traditional building materials such as metals and concrete (Raetz). There have been large fluctuations in the price of wood, including a tripling in cost in wood prices from August of 2021 to January of 2022. (Lambert). These fluctuations have been due in large part to the pandemic, and prices are beginning to relax at the time of this report (Rosa). For a farmer considering building with stick framing, it would be most cost effective to wait until prices are not extremely high. It was decided to consider only stick framing, because timber framing houses cost more to construct and take much longer to build, despite its other benefits. With stick framing, construction with two by four studs will be considered due to costs.

Stick framing is reasonably inexpensive, and if these homes were to be stick framed with two by fours, then the exterior walls would be approximately five inches thick. This would certainly be a good thing in terms of maximizing space, but a wooden wall with such thickness would only provide an insufficient R value This means more money would have to be dedicated to cladding and possibly an effective HVAC system to keep the building at a reasonable temperature. Correctly built wood buildings with metal fasteners are seismically resistant, meaning no extra money will be needed to make the building safe from earthquakes. Proper finishing materials such as interior drywall and fire-rated exterior siding will be used to ensure that the building maintains the code required minimum one-hour fire rating. According to the National Association of Home Builders (NAHB) Research Center, stick-built homes account for more than 90 percent of all new homes built in the nation each year. Thus, it can be assumed that builders in the area will be experienced in building stick frame houses, which means there will be less errors and less delays. Stick frame houses are also completed in less time than the average house, given the same number of workers with each project .Two by fours are easily accessible and can be obtained almost anywhere in the United States. Stick frame houses can last for hundreds of years, depending on the quality of construction. Wood is a natural, renewable, and sustainable material, but stick framing uses much more wood than timber framing and produces a lot of waste. The results of the materials analysis for building materials is shown in Table 3.

Table 3: Rankings of Building Materials.

Criteria	Straw Bale with Wood Frame	SIPS	Raw Concrete	Stick Frame
Cost (5)	2	4	3	4
Maximizing Space (4)	1	4	5	5
Speed of Construction (4)	4	5	3	4
Living Conditions (3)	5	4	4	4
Lifespan of Building (3)	4	3	3	5
Proximity to Farms (2)	5	4	4	4
Sustainability (2)	5	5	2	4
Aesthetic (1)	5	3	2	3
TOTAL	82	98	82	102

Following the materials analysis, the two best options according to the team's research and grading are stick framing and SIPS. Stick framing is less expensive per square foot to construct with than SIPS, but it is an inferior insulator. Thus, more money would have to be spent on HVAC or insulation to ensure that the residents can rely on suitable indoor conditions. A more extensive cost analysis was conducted to decide which was the most suitable for this project. This involved calculating the amount of wood which wood would be necessary and the amount of insulation necessary, and comparing these with the prices of the amount of SIPS. The combined price of wood and insulation for one unit of this project came out to be approximately

$79,000, excluding plywood. This was just considering the exterior walls, and the walls separating units because there is no insulation in the other interior walls. The price for SIPS came out to be approximately $82,000 per unit. These prices were found using the help of a professional estimator. SIPS are more difficult to assemble on site, and fewer builders have experience with them. With this, it was determined that the money spent on insulation for stick framing was not enough to warrant using SIPS. Thus, the project was designed using stick framing.

Prefabricated Units

On some farms, the workers stay year-round, and on others, the workers are only there seasonally. Farms that only house workers seasonally may not want to deal with the difficulties of construction, and simply desire a fast solution that can be available right away. Instead of building a structure, it may be simpler to buy many prefabricated units, and have them available for use. This will be a useful alternative for farmers who want an immediate solution to housing.

It may be useful to have mobile homes which can be moved to different locations. In the search for cost-effective prefabricated units, wheels that come with the unit or wheels that can be attached to the unit were considered. In section X of the report, there is a cost analysis comparing the cost of our stick frame building and the cost of trailers. When the team was finding a trailer to compare, the team ensured that the trailer had wheels.

VI. NON-TECHNICAL CONSIDERATIONS

Along with the technical analysis, an overview of non-technical considerations was necessary. Non-technical considerations included items such as risk, sustainability, and ethics.

Sustainable Actions

Due to the imminent threat of climate change, sustainability is a moral obligation which can not be ignored. Despite a limited budget, there are available measures which will allow one to save money and still be sustainable. Cost effective sustainability measurements include the orientation of the building to take advantage of natural light, water saving techniques, and limiting construction waste. Throughout this project, there was an attempt to be as sustainable as possible while still being fiscally responsible. This in large part depends on the materials that were chosen to be used.

VII. TASKS FOR SCOPE OF WORK

As stated previously, there will be two separate scopes of work, one involving land development and the other the architectural design and cost estimate of the building. Below are Table 4 and Table 5 which outline the tasks and completion dates for each scope.

Table 4: Overall tasks and milestones for the scope of work pertaining to land development.

Tasks	Approximate Completion Dates
Obtain parcel as well as alternative locations	October
Get topographic and surface data to evaluate constraints	November
Review site background data: topo, drainage, geotechnical, flood, etc	December
Preliminary grading and drainage plan	December-January
Estimate earthwork volumes	January-February
Utility plan	February
Street Improvement plan	March
Conceptual stormwater control plan	March-April

Home Design

The design aimed to serve an impoverished and vulnerable community. As discussed in this report, many farmworkers are currently living in inhumane conditions. The team wanted to provide a decent home which is up to code and can allow families and workers to live humanely. Among the elements needed to have a decent standard of living in a home are a roof that does not leak, functioning insulation that keeps the house at a reasonable temperature, access to water and sewer. The house must meet standards allowed by Monterey County municipal codes for agricultural zoned land. The proposed housing complexes will provide a kitchen, a bathroom, a bedroom, and a shared common space for each resident.

Table 5: Overall tasks and milestones for the scope of work pertaining to Architectural and Structural Design.

Task	Completion Dates
Meet with local farmers	Early November
Brainstorm best design	November-December
Complete design of living quarters	January-February
Complete Drawings of living quarters	February-April
Cost estimates of design for Stick Framing	March-April
Construction Scheduling	March
Analysis of Modular Construction	April
Analysis of Trailers	April

The goal was to create a design that is family friendly and allows children to study and learn. Where a person grows up is a big factor in how they will turn out as a person, and thus the hope was to provide a safe environment in which children can grow up to be successful. Some of these homes would accommodate families, and some will have infants and young children. The fact that these people have been treated poorly and have survived inhumane housing does not affect their humanity in the slightest.

It is imperative that materials are chosen which are not harmful to humans. Certain materials have dangerous effects which would be devastating not to the residents and possibly to construction workers as well. Thus the team considered whether these materials would be suitable for being around humans for long periods of time. For example, the team considered using Expanded Polystyrene Insulation (EPS), as it is extremely inexpensive. The California Building Standards Commission unanimously approved the use of expanded polystyrene foam without flame retardant chemicals in slab on grade assemblies (Fredricks). However, according to the United States Public Interest Group, when people are exposed for an extended period, EPS is a carcinogen (Schultz). Thus, the team decided against using EPS.

Competency

In order to be a good engineer, one must therefore be technically competent. Without competency, it does not matter how honest, responsible, and loving an engineer is. By completing the design, the team acknowledged that they have the technical knowledge necessary to complete it. The team has performed the research and learned the things necessary to affirm absolutely that the team has the capability to design this building.

Risk

There are many risks in designing a housing complex, namely that if it collapses, there almost certainly may be fatalities. Thus Engineers must check their work multiple times, and ensure it is done with the best quality and accuracy. The team did not cut corners, or assume things simply based on judgment. In this project, the team designed structures which contain over 200 humans. It is thus of the utmost importance that the team makes sure that the structure is sound, and that in the event of a disaster, the residents will have time to evacuate. In the event of a worst case earthquake for the site's location, enough support must be provided so that there are minimal deaths and injuries. Several reassessments were made for the grading of the overall site to ensure that sewer and storm drain piping would have the required slope to connect to existing infrastructure. Calculations for pipe sizing were double checked to reassure that the site would have functional and safe utilities. For the structural piece, the codes were checked many times in order to ensure that the building would comply with the CRC.

VIII. PRELIMINARY DESIGN

Pipe Design

The first component considered for the preliminary design of this project was the pipe sizing for both the sanitary sewer and storm drain. For this particular site, there is an existing 30” storm drain and 16” sewer main that will be connected to.

The storm drain size was determined using standards and criteria found in the *Stormwater Development Standards* for the City of Salinas. The development standards provided values for minimum and maximum pipe flows for storm drains, minimum slope, and minimum pipe sizing seen in the calculations found in the Appendix. An Intensity-Duration-Frequency (IDF) curve is also provided, shown in Figure 7 below. The City of Salinas also provided a storm drain network map, which allowed the team to determine where the storm drain will connect to existing storm drain mains. From the calculations in Appendix A, a 24-inch pipe will be used to allow for drainage of the entire 50.52-acre parcel and will connect to the existing 30-inch storm drain on Boronda Road. This existing storm drain can be seen in Figure.

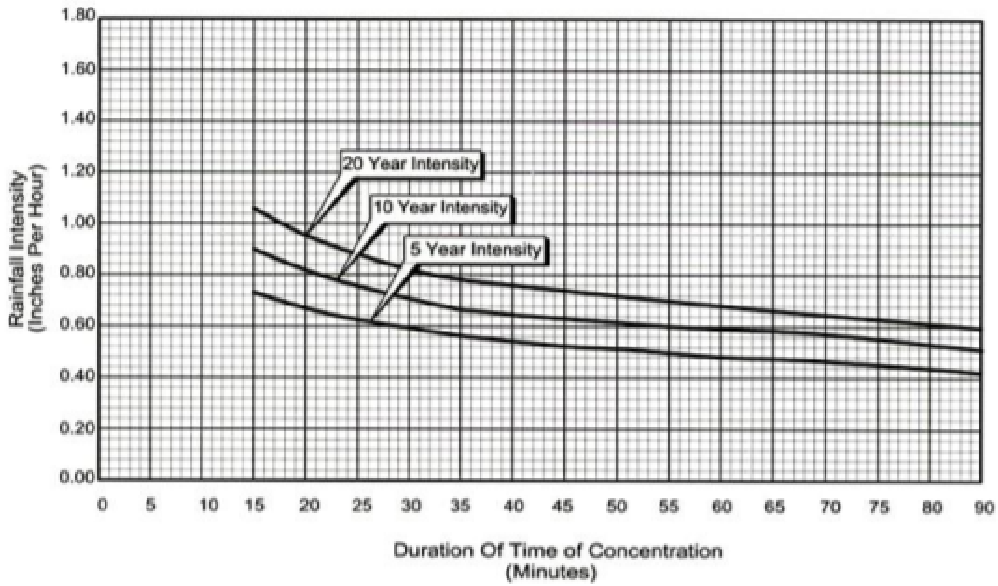

Figure 7: IDF curve for the City of Salinas.

Figure 8: Existing storm drain near the site location, which is on the right corner of Natividad and Boronda Road.

The sanitary sewer pipe size was determined using requirements and criteria found in the *Sanitary Sewer System Master Plan* from the City of Salinas and the *Standard Specifications Design Standards And Standard Plans* from the City of Salinas. These standards gave requirements for pipe sizing, minimum flow, and minimum slope. From the calculations found in the Appendix, a six-inch (6") sewer pipe was chosen to connect to the existing sixteen-inch (16") sewer main found on Natividad Road. A map of the existing sanitary sewer mains can be found in Figure 9 below, which provided possible connection points for the proposed sewer.

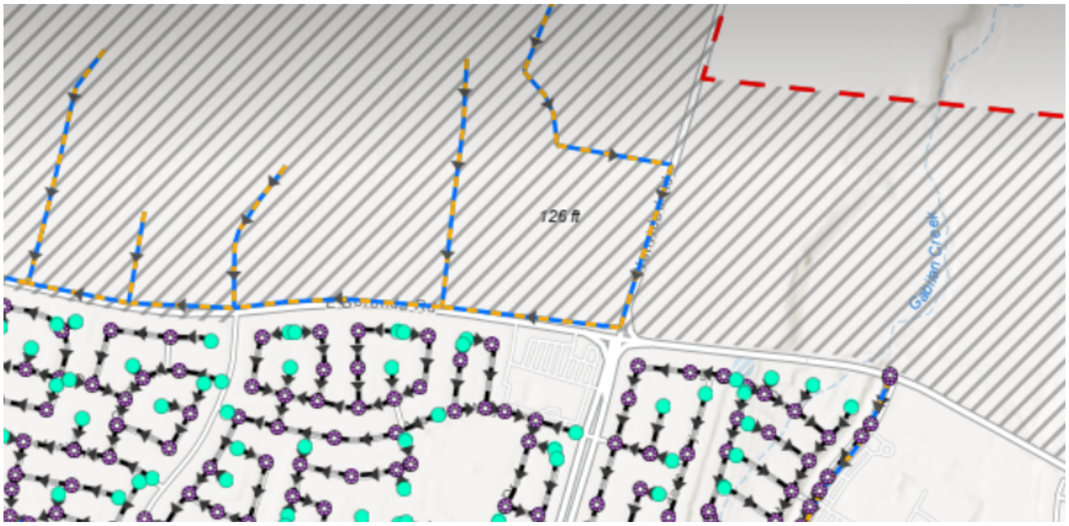

Figure 9: Existing sanitary sewer seen near the site, located on the corner of Boronda Road and Natividad Road.

Wind Loads

To determine the wind loads, the team first had to decide what type of roof would be used. As cost is foremost in the objectives for this project, the team decided to use a shed roof or a mono slope roof as it is simple and is the most cost-effective option for a roof. An example of a mono slope roof is shown in Figure 10. The structure must be able to withstand wind loads, which will be the governing load. Due to the light weight of the structure, seismic forces will not exceed wind forces. Although the team is designing this building prescriptively, it was decided that it would be useful to perform this calculation. To achieve maximum thermal efficiency, it was decided to orient the building so that the longer ends of the building are facing north/south. Most wind in California is westward from the Pacific Ocean, meaning that wind coming parallel to the ridge will be the most common situation for this structure. Calculations are shown in Appendix B for both wind coming in parallel to the ridge of the roof and perpendicular to the ridge. Calculations were performed using ASCE 7-16 and IBC guidelines. Although there is only one building shown in the calculations, there will be two identical structures. An overhead view of one of the units is shown below in Figure 10.

Figure 10: Example of a Shed Roof.
(https://www.youtube.com/watch?v=dQdC0mpST3E)

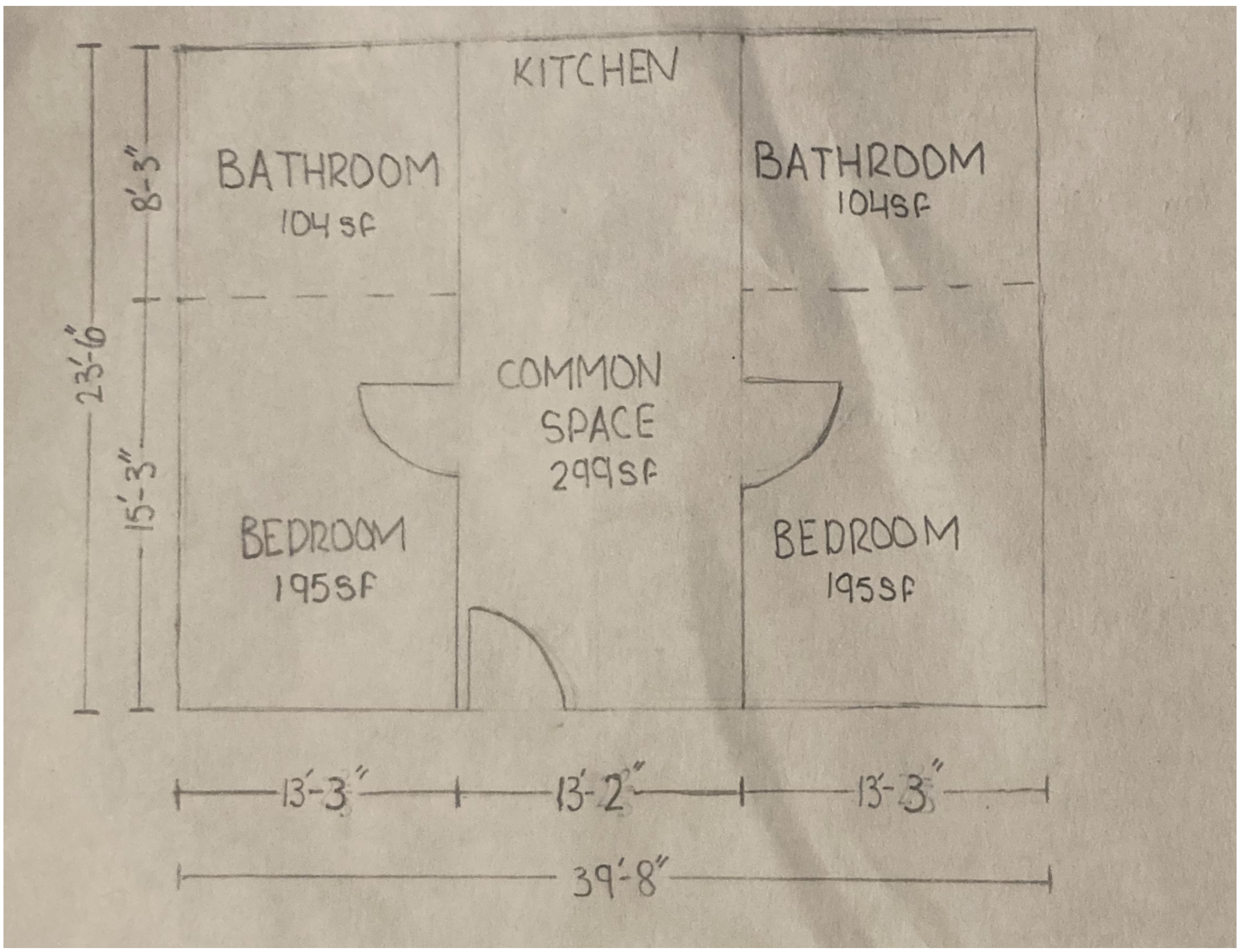

Figure 11: Overhead View of a Unit.

IX. DESCRIPTION OF DESIGNED FACILITY

Structure:

The purpose of this project was to create a structure which could house many laborers in a humane but cost-effective way, but the team was not sure on the most effective way to accomplish this. Early on in the project, it was considered that the project could revolve around the actual design of the project. Unfortunately, the engineer in question did not have the necessary knowledge to design such a project without outside help. The engineer in question is not currently licensed, and thus they can not sign off on plans and put them into action. This is a current issue which is facing many laborers in the current time. Thus, it was decided that a prescriptive type design would be best for the design. In this way, farmers would be able to construct the entire structure with their own labor force, which would be extremely cost effective. A farmer would be able to construct the facility in the traditional manner as well; meaning with contractors, and specialized workers.

The layout of the structure is an attempt to be as inexpensive as possible. Everything is to the California Residential Code (CRC) minimum standards. The buildings are built on top of five (5) inch slabs-on-grade with typical footings and typical makeups. The foundation plan can be found in Figure D-7. The structures have standard, cost effective materials such as pvc roofing, T1-11 sheathing, and #2 Douglas-Fir (#2 D-F). On the interior of the structure, there are either two half-inch drywalls or for shear wall sections there is a half-inch drywall and half-inch plywood. An example of a first floor section is shown in Figure D-6. There are no second floor ceiling joists, so that one can look straight up to the ceiling drywall if one is standing on the second floor. The joists and rafters were sized per CRC standards, and are 2x12 #2 D-F at 16 inches on center, and 2x10 D-F at 16 inches on center respectively. The framing plan is shown in Figure D-8. Shear wall lengths were based on the CRC. The wall nailing schedule can be found in table D-1, and the shear wall locations can be found in Figure D-9.

Land Development:

For the proposed reproducible structure, a site was chosen to provide an example of what a finished product would look like, thus leading to the land development of an example site and design of three two-story buildings to house 200 or more people.

The parcel selected is located on the corner of East Boronda and Natividad Road, having an overall size of 50.2 acres, 2.7 of which will be used for development. Several features of the site led to it being more desirable than other sites that were considered. The most important of these features are the existing utilities nearby. The utilities include sewer, storm drain, water, electric, and cable television lines. The site is agriculturally zoned, and is near to agricultural fields as well as commercial areas. Being in proximity to work and commercial areas is both beneficial to the worker and the owner. Other beneficial features include it being relatively flat, which will help with grading costs.

A constraint of the site that limited the grading was that the two roads sit higher than the actual site. The site grading took this into consideration and made sure that the required slope for the utilities was possible to meet. Utility design was also constrained by existing infrastructure on East Boronda Road that the team did not want to interfere with. This infrastructure includes sidewalks, power lines and traffic signals. For the sanitary sewer, even though the existing sewer runs down Natividad Road, the nearest existing manhole is located on the intersection of East Boronda and Natividad Road, which guided this design.

Site Layout

The sites for the project are AI zoning, which will require Monterey County codes. Section 20.24 of Monterey County code provides guidelines and requirements for employee housing, including maximum building height and setback requirements. Section 20.58 pertains to parking and landscaping requirements. Other requirements in Section 20 are given for guidelines such as regulations of reduced vehicle trips and maximum building coverage. Section 20.66.060 of the Monterey County code provided more standards for agriculture employee housing, including minimum site size and requirements for recreational space. Below, Figure 12 shows the proposed site layout.

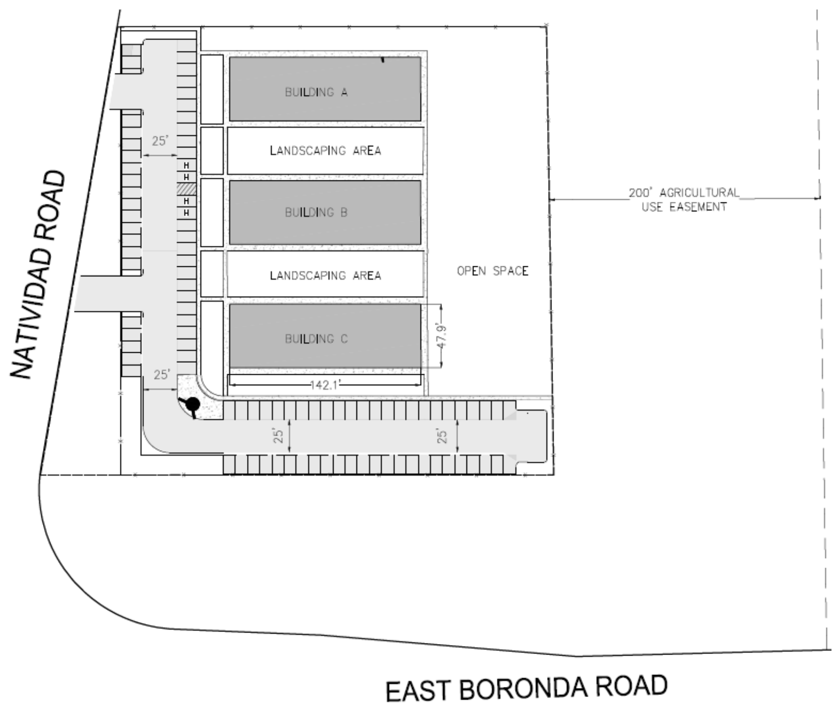

Figure 12: Proposed Site Layout.

The site was designed to conform to the natural topography, and buildings were oriented to take advantage of natural light . To meet the requirements of a maximum 50% building coverage, three two story buildings were chosen instead of designing a one story approach. The site takes up a total area of 2.7 acres to meet the minimum requirements of 2.5 acres. The parking lot consists of 92 total spaces, four (4) of which are handicap accessible, which exceeds the requirements of one space per every four (4) beds. The 92 spaces will often not be fully utilized due to limited car ownership among residents.

Per the Monterey County code, the two entrances to the site were placed on Natividad Road to help mitigate traffic impact. The two entrances were chosen to incorporate bus transport of the farmworkers to the fields and back to the facility. Bus transport is commonplace for large farms due to the fact that many farmworkers do not own cars. Bussing limits the traffic impact of the housing so that the only vehicle trips generated will be personal trips, which occur outside of peak hours. The site also incorporates bus transportation with 25' lanes, which provide ample space for buses to make turns. The 25' lanes also provide space for fire vehicles or other large vehicles. Not only does this mitigate traffic impact, it also is beneficial to the environment. The reduced trips from the site reduces the amount of pollution from vehicles.

Grading

The site overall is relatively flat, but there were several constraints of the site design. The most important of these constraints was the site sitting at a lower elevation than East Boronda and Natividad Road. In order to keep acceptable slopes for the sewer and storm drain design, the amount and location of cut on site was a constraint, and they dictated where utilities would connect to existing infrastructure. The final grading design followed the natural topography, and resulted in a net 520 cubic yards of cut, which is allocated to landscaping once construction is completed. Figure 13 shows the rough grading and a summary of total cut and fill of the site.

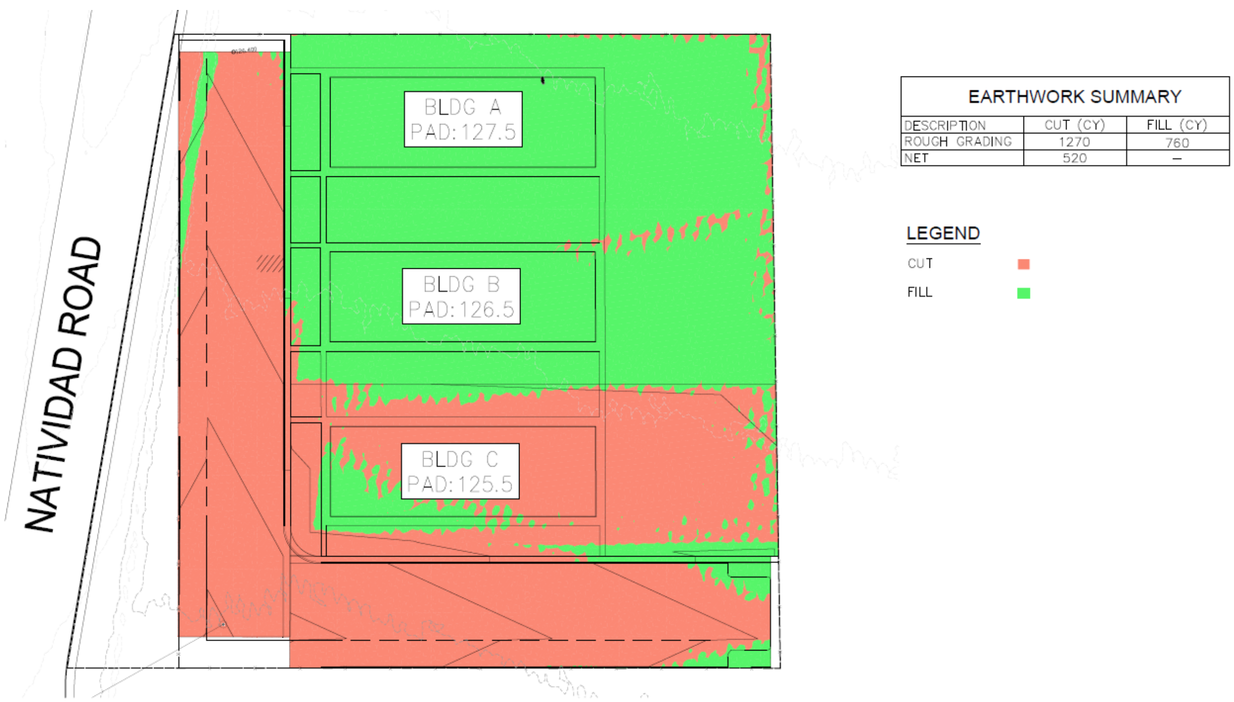

Figure 13: Overall Cut and Fill Exhibit.

Utilities

Design of sewer and storm drain and their connections to existing utilities were part of the scope of this project. Water design was considered, but access to the location of existing water lines was not given to the team by Cal American Water, the supplier in the area. In the grading and drainage sheet set found in Appendix B, locations, sizing, and slope can be seen for sewer and storm drain design. Sheets 2.1 and 2.2 also display proposed manhole locations and proposed connection to existing utilities. In Table 5 below, a summary of the total proposed sewer and storm drain piping is shown in linear feet.

Table 5: Summary of sewer and storm drain quantities

	SEWER	STORM
PROPOSED MANHOLES	2	1
PIPE (LF)	470	300

Codes/Regulations:

Site/Zoning Codes

Monterey County Code 2022

Section 20.24-Zoning

https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/land-use-regulations/coastal/zoning-ordinance-title-20/20-24-agricultural-industrial-or-ai-cz-districts

Section 20.66.060-Agriculture Employee Housing

http://www2.co.monterey.ca.us/planning/docs/ordinances/Title20/20.66.060%20FARM%20WKR%20HOUS.htm#:~:text=060%20STANDARDS%20FOR%20FARM%20EMPLOYEE,and%20farm%20worker%20housing%20facilities.

Section 20.58-Parking

https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/land-use-regulations/coastal/zoning-ordinance-title-20/20-58-regulations-for-parking

Utility Design

Stormwater Development Standards for the City of Salinas

https://www.cityofsalinas.org/our-city-services/public-works/water-waste-energy/document-lists/stormwater-development-standards-downloadable-documents

Sanitary Sewer System Master Plan from the City of Salinas

https://www.cityofsalinas.org/sites/default/files/departments_files/public_works_files/water_solid_waste_energy/swds/public_review_sanitary_sewer_management_plan_update_2014_1.pdf

Standard Specifications Design Standards And Standard Plans from the City of Salinas https://www.cityofsalinas.org/sites/default/files/departments_files/public_works_files/2008citystandards.pdf

Building/Construction Codes

The 2019 California Residential Code (CRC) Section 18.09 provides information on fire code, while section 18.02 has requirements for building code.

City of Salinas Building Code 2019:

https://www.cityofsalinas.org/sites/default/files/departments_files/permit_center_files/city_of_salinas_2019_code_adoption.pdf

H2A Regulations

Some of these farmers are migrant workers on H2A work visas. There are standards and regulations that need to be met via H2A requirements.
https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/land-use-regulations/coastal/zoning-ordinance-title-20/20-58-regulations-for-parking

X. COST ESTIMATE

In the cost estimate, the team wanted to provide a realistic cost estimate of the project, so that the farmer in question could know how much such a project would cost. Thus a detailed quantity takeoff was created. The cost of the materials were all found by using prices from manufacturers, or sellers of construction goods such as Home Depot. The team worked side by side with a professional estimator working for Truebeck Construction who could give the team accurate information on industry averages. This included adding 10% to the total wood necessary, and 30% to the total sheathing necessary. This is due to the fact that wood will be wasted from cuts. An extra 10% was added to the materials cost for miscellaneous materials, and an additional 12% was added for taxes and delivery. We then subtracted 10% from the total materials cost, due to this project being constructed through modular construction. This cost for the materials necessary to construct three structures to hold approximately 200 people was $1,161,000.

The labor costs were then calculated. The number of laborers and the cost of those laborers were calculated using industry averages, and with the help of a professional estimator. Once these were calculated, there was a 20% reduction in labor for modular construction. The total labor cost came out to $1,986,000.

The cost of the preparation of the site also needed to be calculated. For this, a professional estimator assisted the team in finding a range of values that could be the possible cost of the preparation of the site. The reason that there is a range for cost is that there are many different ways one could prepare a site and there are many different sites. For example, there could be a much larger cut and fill in a particular site. As well, one could also choose to use better materials in the creation of the site, such as simple gravel or smooth paving.

Finally, the total cost of the project was calculated. The cost of labor and the cost of materials were added together, and 15% of this value was added to the total cost. This 15% was a fee for project management, overseeing, and additional fees, such as trucks and gas. The total cost of this project is approximately $4,504,000 - $4,954,000.

The team also had to estimate the cost of trailers, which is a quick solution which has been used by some farmers as a means to house workers. In order to determine an accurate comparison, the team needed to calculate the number of trailers which would be needed. Thus, the amount of square footage per resident in our structures which hold 200 people was calculated. This square footage came out to be approximately 161 square feet. Thus, the number of 400 square foot trailers was calculated to be 81. In order to calculate the cost per square foot, the team multiplied 161 by 200 to get the total personal space. We then added the three common spaces, as those will also be used for personal space. The total came out to be 34660 square feet. The total square footage for the trailers was the total amount (81) by an individual trailer's square footage (400). The total square footage for the trailers came out to be 32400 square feet. The same labor and site work procedures used to calculate the costs of the stick frame model were used to calculate the cost of trailers. Table 6 outlines the findings of the team's cost estimate.

Table 6: Comparison of the Cost of Stick Frame v Trailers

HOUSING METHOD	STICK FRAME	TRAILERS (81)
MATERIALS	$1,161,000	$3,240,000
LABOR	$1,986,000	$100,000
SITE WORK	$750,000 - $1,200,000	$2,250,000 - $3,600,000
PROJECT MANAGEMENT	$157,218	$0
TOTAL	$4,504,000 - $4,954,000	$5,590,000 - $6,940,000
COST PER SQUARE FOOT	$129.94 - $142.93	$163.27 - $214.20
COST PER PERSON	$22,520 - $24,770	$27,950 - $34,700

XI. CONCLUSION

During the design process there were a lot of ups and downs. We learned the importance of communication and reaching out to professionals to learn from them. We learned the process of designing a building and site, and the work that it takes to get that done. Sometimes the team hit roadblocks, which took time to overcome. One thing the team would do differently would be to reach out to industry professionals and advisors. They have more experience, and often can help push us in the right direction because they have been there before.

With the rise of Covid and an already existing problem of farmworker living conditions, fielding a sufficient labor force has been a problem for farms.. That was the goal of our project: a housing option that benefits both the farm owner and farmworker. The team chose this project because we wanted to design something that can help out the community and increase the overall quality of life for our farmworkers. Our design accomplishes this, and is something that can be applied to more than just Salinas. Every farmworker deserves a quality place to live, and the team hopes that this project will help farmers see the benefit of investing in their workforce.

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APPENDIX A: PIPE PRELIMINARY CALCS

DANIEL GARRETT
PRELIMINARY DESIGN

STORM DRAIN DESIGN

$$Q = CIA$$

DESIGN GIVENS:

$C_1 := 0.7$ HIGH DENSITY RESIDENTIAL $A_1 := 2.5\ \textbf{acre}$ OF TOTAL SPACE

$C_2 := 0.3$ OPEN SPACE $A_2 := 48.02\ \textbf{acre}$ OF TOTAL SPACE

$C := 0.7 \left(\frac{2.5}{50.52}\right) + 0.3 \left(\frac{48.02}{50.52}\right) = 0.32$ $V := 4\ \frac{ft}{s}$ MIN

FOR 5 YEAR INTENSITY DURATION CURVE...

$t_c := 15\ min$ MINIMUM PER CITY OF SALINAS GUIDELINES

$I := 0.72\ \frac{in}{hr}$

TOTAL PARCEL AREA

$A := 50.52\ \textbf{acre}$

$Q := C \cdot I \cdot A = 11.729\ \frac{ft^3}{s}$

PIPE SIZE

$Q = A \cdot V$

$A := \frac{Q}{V} = 2.932\ ft^2$ $r := \sqrt{\left(\frac{A}{\pi}\right)} = 0.966\ ft$ $D := 2 \cdot r = 1.932\ ft$

A 24" PIPE WILL BE USED AND WILL BE CONNECTED TO THE
EXISTING 30" PIPE ON BORONDA ROAD

SANITARY SEWER DESIGN

GIVEN:

90 GALLON PER PERSON PER DAY — WHITSON ENGINEERS DESIGN VALUE

$f_{MIN} := 2.0 \, \frac{ft}{s}$ $\quad f_{MAX} := 8.0 \, \frac{ft}{s}$ — PER SALINAS GUIDELINES

PEAK FACTOR=2 — PER SALINAS GUIDELINES

FOR 300 PEOPLE

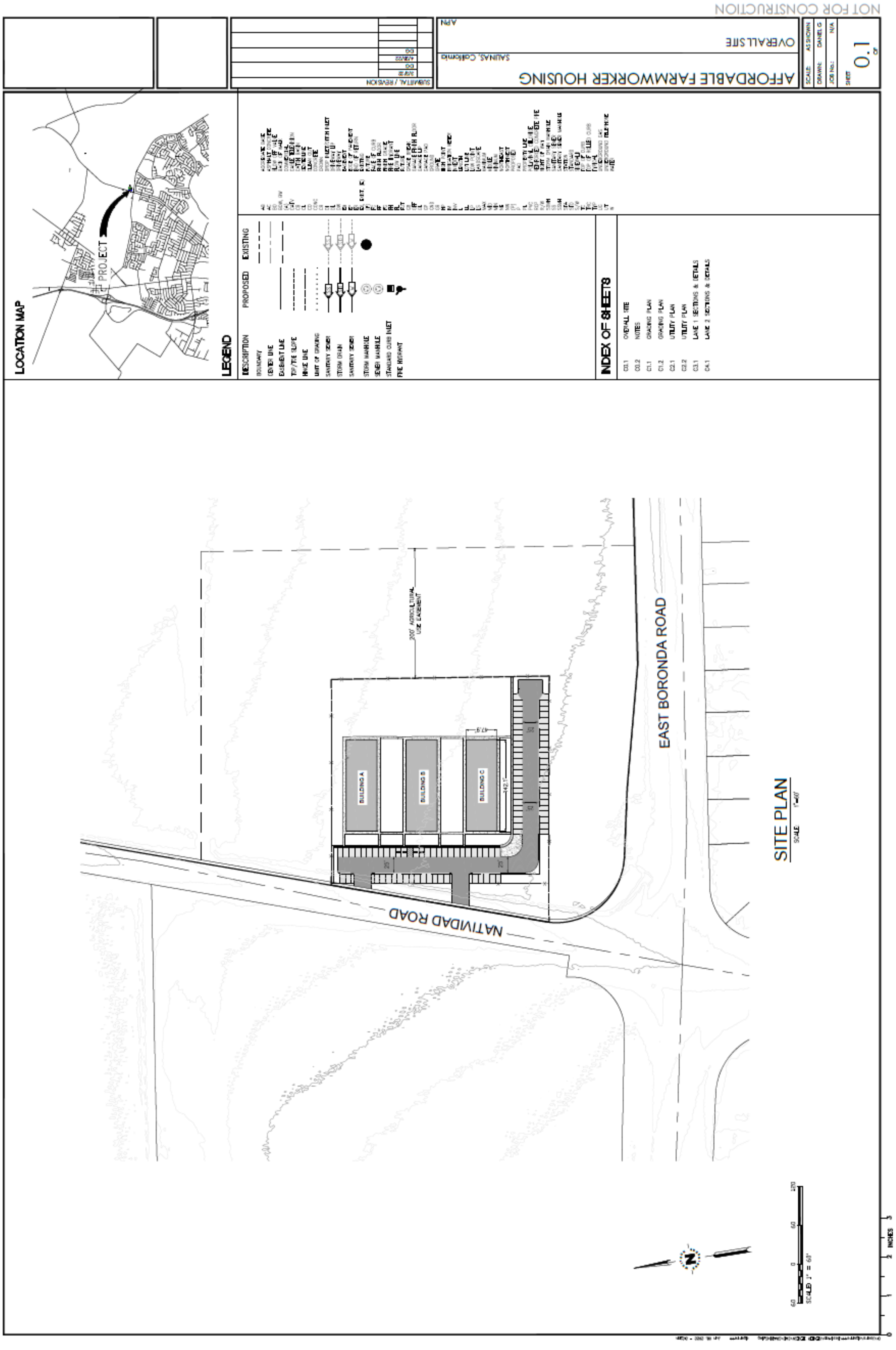
$$Q := 90 \, \frac{gal}{day} \cdot 300 \cdot 2 = 0.084 \, \frac{ft^3}{s}$$

$$Q = V \cdot A \qquad V := 2.0 \, \frac{ft}{s}$$

$$A := \frac{Q}{V} = 0.042 \, ft^2 \qquad r := \sqrt{\frac{A}{\pi}} = 1.384 \, in \qquad D := 2 \cdot r = 2.768 \, in$$

A PIPE SIZE OF 6 IN WILL BE USED TO CONNECT TO THE EXISTING 16"
SEWER MAIN LOCATED ON NATIVIDAD ROAD

APPENDIX B: GRADING AND DRAINAGE PLANS


NOT FOR CONSTRUCTION
AFFORDABLE FARMWORKER HOUSING
SALINAS, California
OVERALL SITE
LOCATION MAP
PROJECT
LEGEND
INDEX OF SHEETS
C0.1 OVERALL SITE
C0.2 NOTES
C1.1 GRADING PLAN
C1.2 GRADING PLAN
C2.1 UTILITY PLAN
C2.2 UTILITY PLAN
C3.1 LANE 1 SECTIONS & DETAILS
C4.1 LANE 2 SECTIONS & DETAILS
BUILDING A
BUILDING B
BUILDING C
NATIVIDAD ROAD
EAST BORONDA ROAD
SITE PLAN

GENERAL NOTES

1. ALL GRADING SHALL CONFORM TO THE SALINAS MUNICIPAL CODE,TITLE 17 CITY-ADOPTED EDITION OF THE CALIFORNIA BUILDING CODE.
2. ALL PROVISIONS OF THE PRELIMINARY SOILS REPORT PREPARED BY THE GEOTECHNICAL ENGINEER SHALL BE COMPLIED WITH DURING GRADING OPERATIONS.
3. CERTIFICATION FROM THE REGISTERED (CIVIL ENGINEER/ARCHITECT/LANDSCAPE ARCHITECT) STATING THAT THE GRADING HAS BEEN COMPLETED PER THE APPROVED PLAN, AND A COMPACTION REPORT FROM THE SOIL ENGINEER FOR FILL AREAS ARE REQUIRED PRIOR TO BUILDING PERMITS BEING ISSUED.
4. CONTRACTOR IS RESPONSIBLE FOR EROSION, DUST AND TEMPORARY DRAINAGE CONTROL DURING GRADING OPERATIONS.

A. ALL MANUFACTURED SLOPES IN EXCESS OF 5 FEET IN VERTICAL HEIGHT ARE TO BE PROTECTED FROM EROSION DURING ROUGH GRADING OPERATIONS AND, THEREAFTER, UNTIL INSTALLATION OF FINAL GROUNDCOVER.

B. ALL SLOPE PROTECTION SWALES TO BE CONSTRUCTED AT THE SAME TIME AS BANKS ARE GRADED.

C. THE DEVELOPER AND HIS CONTRACTOR ARE RESPONSIBLE FOR IMPLEMENTATION AND MAINTENANCE OF THE EROSION CONTROL MEASURES SHOWN ON THIS PLAN AND SWPPP AND ALSO TO PROVIDE ANY ADDITIONAL EROSION CONTROL MEASURES (E.G., HYDRO SEEDING, MULCHING OF STRAW, SAND-BAGGING, DIVERSION DITCHES, RETENTION BASINS, ETC.) DICTATED BY FIELD CONDITIONS TO PREVENT EROSION AND/OR THE INTRODUCTION OF DIRT, MUD OR DEBRIS INTO EXISTING PUBLIC STREETS AND/OR ONTO ADJACENT PROPERTIES DURING ANY PHASE OF CONSTRUCTION OPERATIONS. SPECIAL ATTENTION SHALL BE GIVEN TO ADDITIONAL EROSION CONTROL MEASURES NOTED ABOVE DURING THE PERIOD OCTOBER 1 TO MAY 31.

D. AFTER A RAINSTORM, ALL SILT AND DEBRIS SHALL BE REMOVED FROM CHECK BERMS AND CHECK DAMS. SILT AND DEBRIS SHALL BE REMOVED FROM CITY OF RIVERSIDE STREETS. THIS REQUIREMENT SHALL REMAIN IN EFFECT UNTIL CITY ACCEPTANCE OF THIS PROJECT.

5. ANY IMPROVEMENTS CONSTRUCTED IN THE PUBLIC RIGHT-OF-WAY WILL REQUIRE A SEPARATE CONSTRUCTION PERMIT AND INSPECTION FROM THE PUBLIC WORKS DEPARTMENT.

6. IT IS THE GRADING CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT ADEQUATE COMPACTION HAS BEEN ATTAINED ON THE ENTIRE GRADING SITE, INCLUDING FILL AREAS OUTSIDE THE BUILDING PADS AND ON ALL FILL SLOPES.

7. IT IS THE SOIL ENGINEER'S RESPONSIBILITY TO OBSERVE AND PERFORM COMPACTION TESTS DURING THE GRADING TO EVALUATE THE PREPARATION OF THE NATURAL GROUND SURFACE TO RECEIVE THE FILL AND THE COMPACTION ATTAINED IN THE FILL, INCLUDING FILL AREAS OUTSIDE THE BUILDING PADS AND ON ALL FILL SLOPES.

8. EARTHWORK QUANTITIES ARE SHOWN FOR GRADING PERMIT PURPOSES ONLY, AND THE CITY OF SALINAS IS NOT RESPONSIBLE FOR THEIR ACCURACY.

9. GRADING OPERATIONS SHALL BE LIMITED TO BETWEEN THE HOURS OF 7 A.M. AND 7 P.M. ON WEEKDAYS AND BETWEEN 8 A.M. AND 5 P.M. ON SATURDAYS. NO GRADING WILL BE PERMITTED ON SUNDAY OR FEDERAL HOLIDAYS.

SUBMITTAL / REVISION
3/3/22 DG

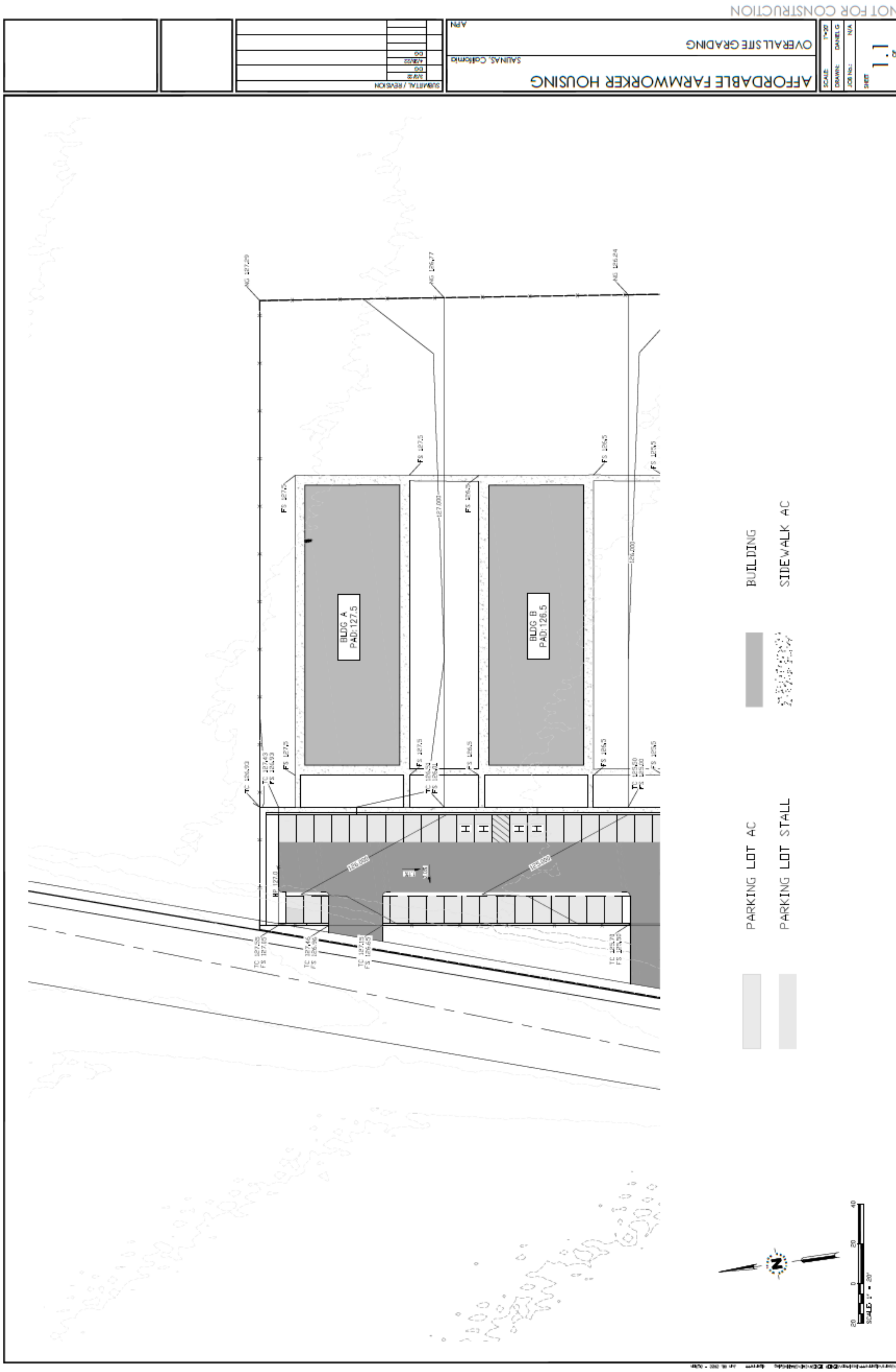
AFFORDABLE FARMWORKER HOUSING
SALINAS, California
APN
GENERAL NOTES

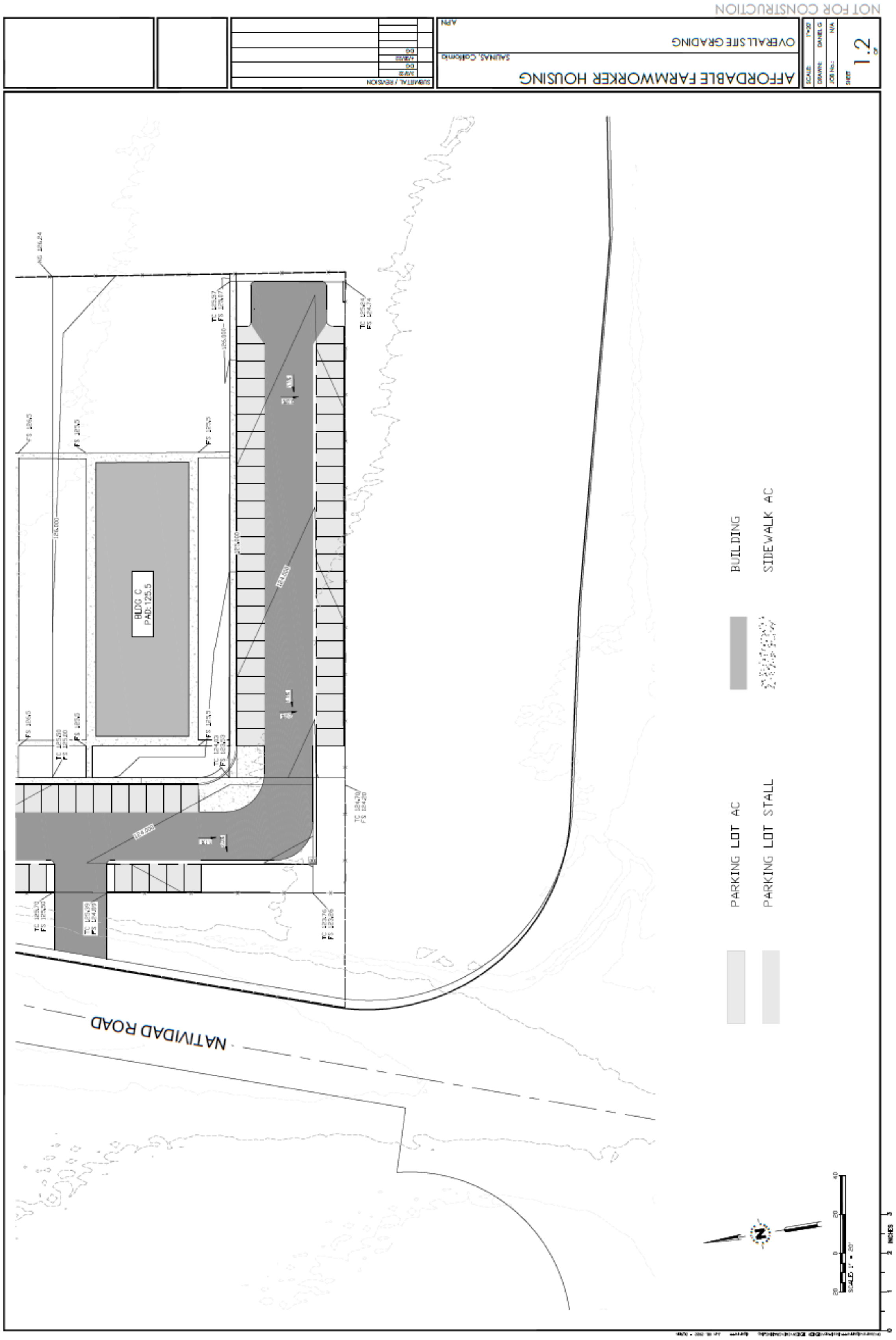
SCALE:	AS SHOWN
DRAWN:	DANIEL G
JOB No.:	N/A

SHEET C0.1 OF

NOT FOR CONSTRUCTION

0 1 2 INCHES 3


NOT FOR CONSTRUCTION
AFFORDABLE FARMWORKER HOUSING
SALINAS, California
OVERALL SITE GRADING
BLDG A
PAD:127.5
BLDG B
PAD:126.5
BUILDING
SIDEWALK AC
PARKING LOT AC
PARKING LOT STALL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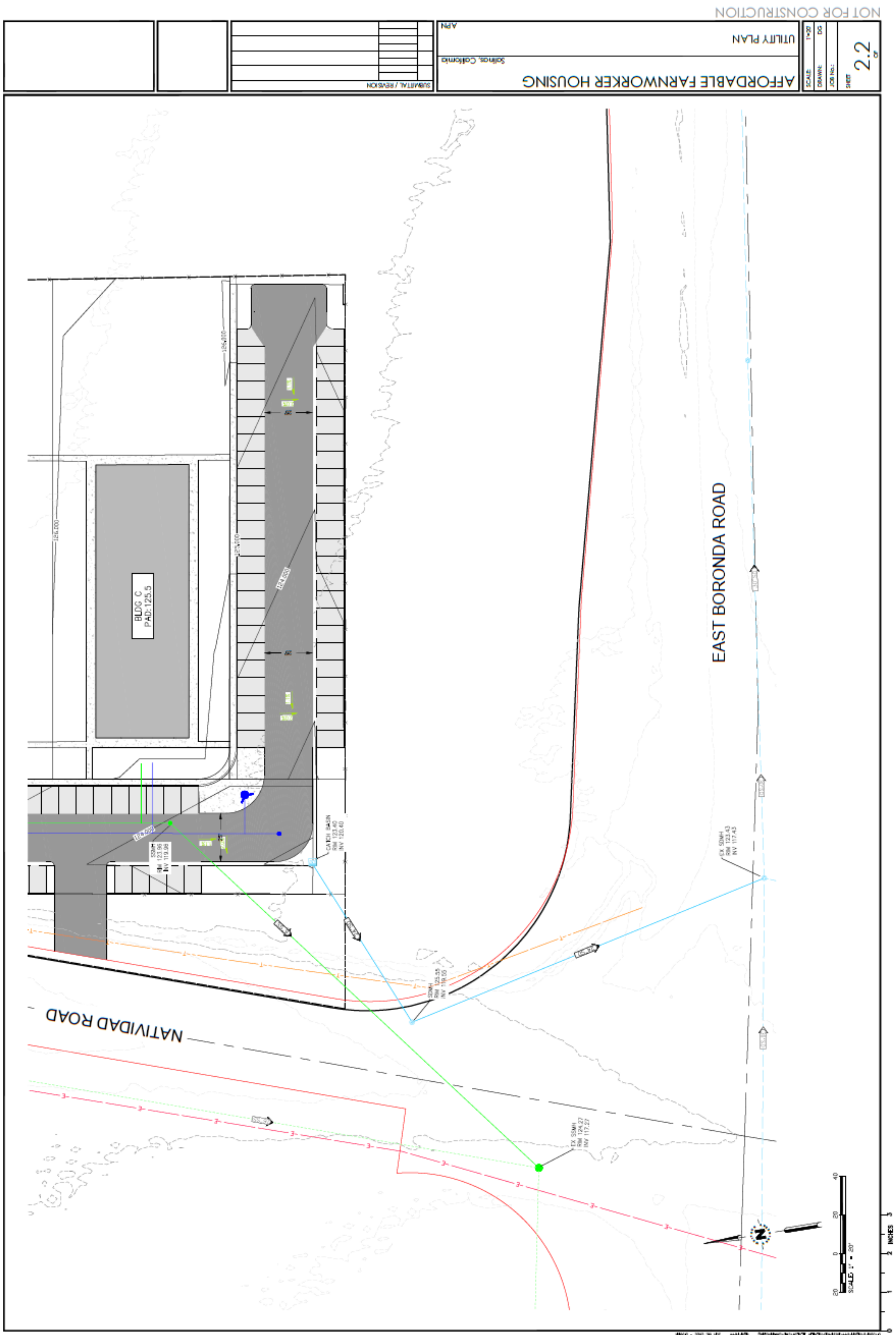
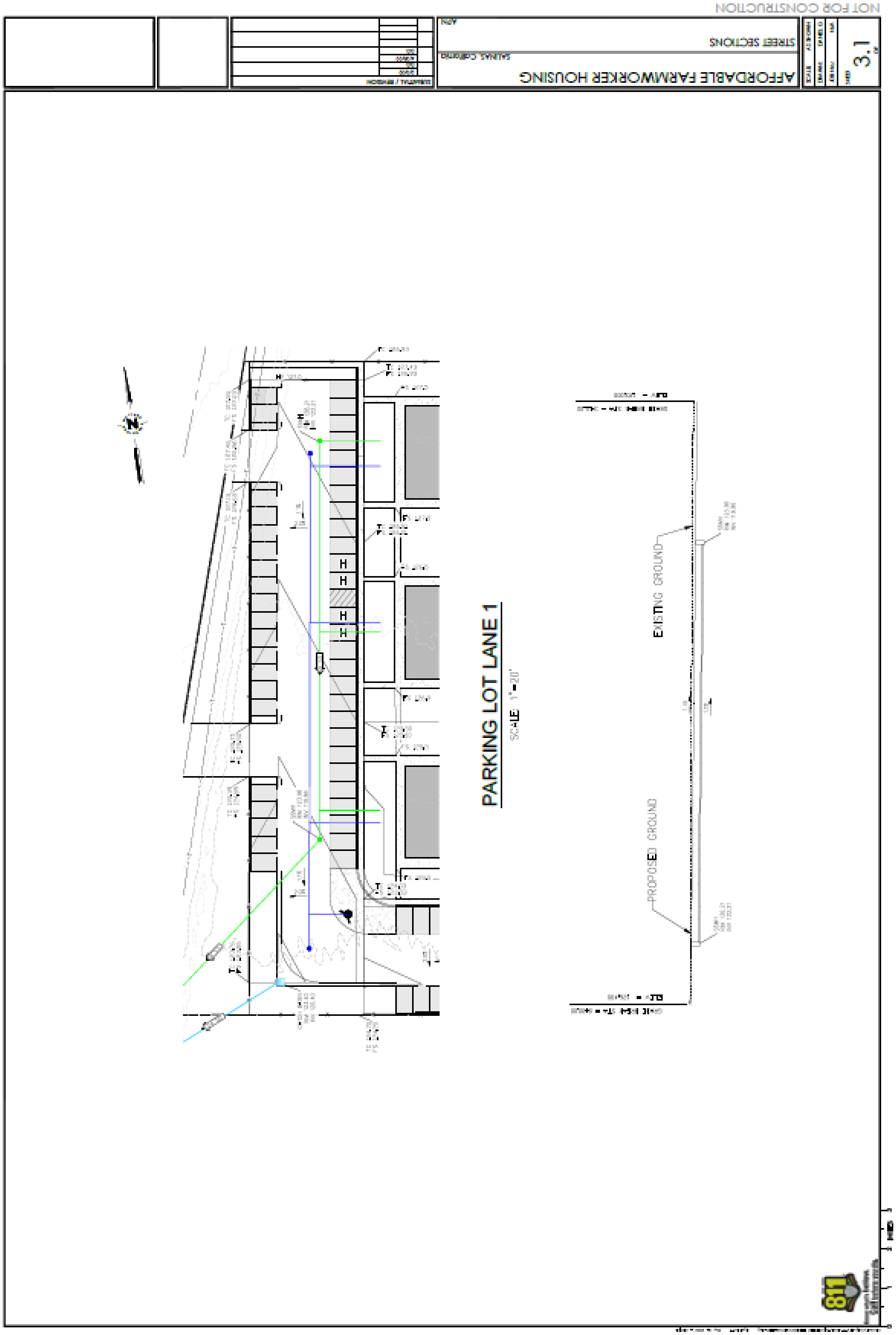
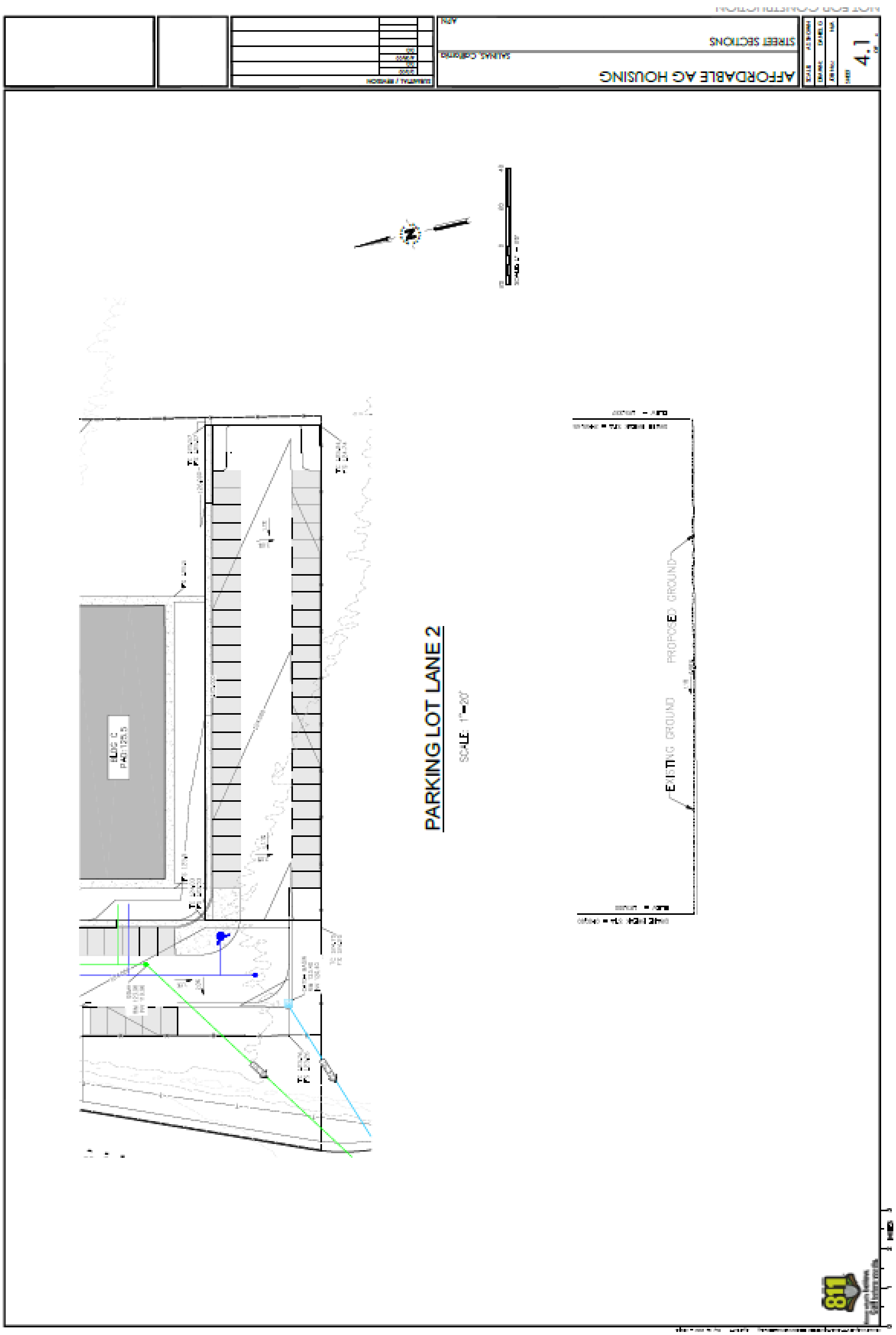
AFFORDABLE FARMWORKER HOUSING
SALINAS, California
OVERALL SITE GRADING
1.2
BLDG C
PAD:125.5
NATIVIDAD ROAD
BUILDING
SIDEWALK AC
PARKING LOT AC
PARKING LOT STALL


NOT FOR CONSTRUCTION
AFFORDABLE FARMWORKER HOUSING
Salinas, California
UTILITY PLAN
APN
SUBMITTAL / REVISION
SCALE
DRAWN
JOB No.
SHEET
2.1
BLDG A
PAD: 127.5
BLDG B
PAD: 126.5
BLDG C
PAD: 125.5
NATIVIDAD ROAD


NOT FOR CONSTRUCTION
AFFORDABLE FARMWORKER HOUSING
Salinas, California
UTILITY PLAN
SUBMITTAL / REVISION
2.2
BLDG C
PAD:125.5
EAST BORONDA ROAD
NATIVIDAD ROAD


NOT FOR CONSTRUCTION
AFFORDABLE FARMWORKER HOUSING
STREET SECTIONS
PARKING LOT LANE 1
SCALE: 1"=20'
EXISTING GROUND
PROPOSED GROUND
3.1


NOT FOR CONSTRUCTION
AFFORDABLE AG HOUSING
STREET SECTIONS
4.1
PARKING LOT LANE 2
SCALE: 1"=20'
EXISTING GROUND
PROPOSED GROUND

APPENDIX C: WIND LOADS

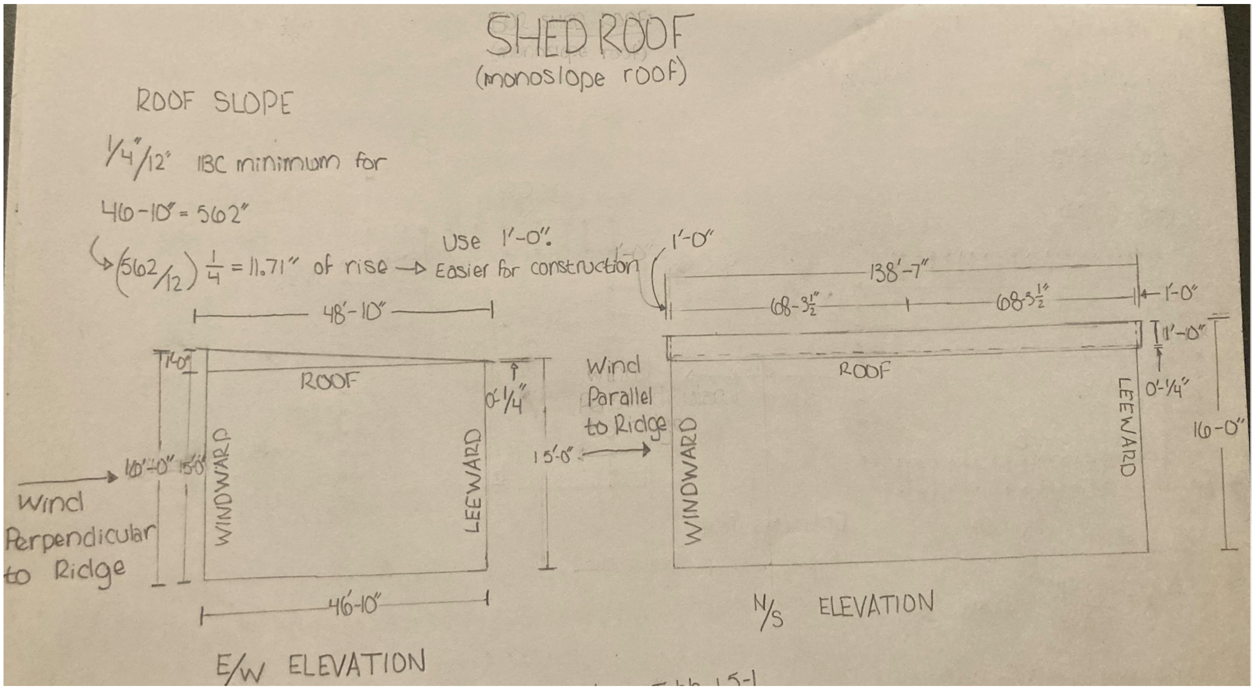


Figure C-1: Elevations.

Risk Category: II → residential building, Table 1.5-1

$q_z = 0.00256 K_z K_{zt} K_d K_e V^2$ $q_h = 0.00256 K_z K_{zt} K_d K_e V^2$

$V = 91$ mph

→ ATC Hazards by location for Salinas, CA

$K_d = 0.85$

→ This building will be the Main Wind Force Resisting System, Table 26.6-1

$K_{zt} = 1$

→ Assumed to not be on hill/crest. Figure 26.8-1

$K_e = 1$

→ assumed to be less than 305' above sea level. If it is, check ASCE/SEI chapter 26, table 26.9-1

$G = 0.85$

→ Gust-effect for a rigid building, section 26.11.1, see definition of rigid buildings in section 26.2

$(GC_{pi}) = \pm 0.18$

→ Enclosed building, Table 26.13-1

Exposure C

→ roof height < 30', open field, Table 26.11-1

$\alpha = 9.5$ $z_g = 900'$

Figure C-2: Calculations for Wind Perpendicular to Ridge

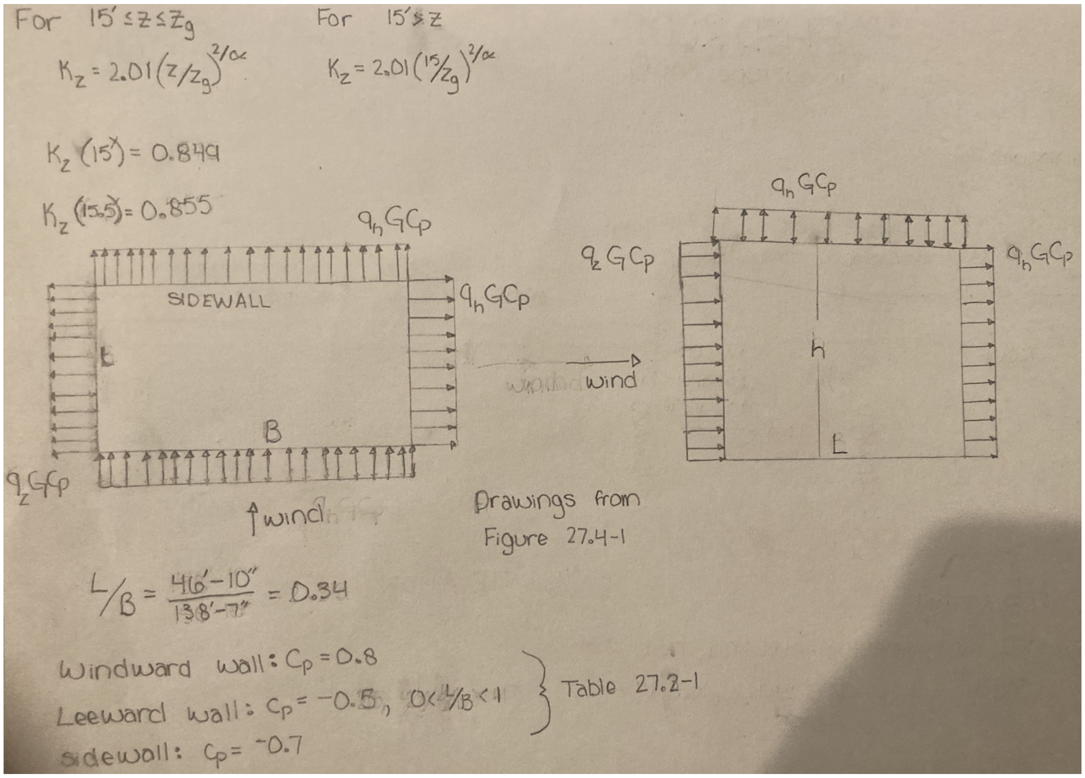


Figure C-3: Calculations for Wind Perpendicular to Ridge

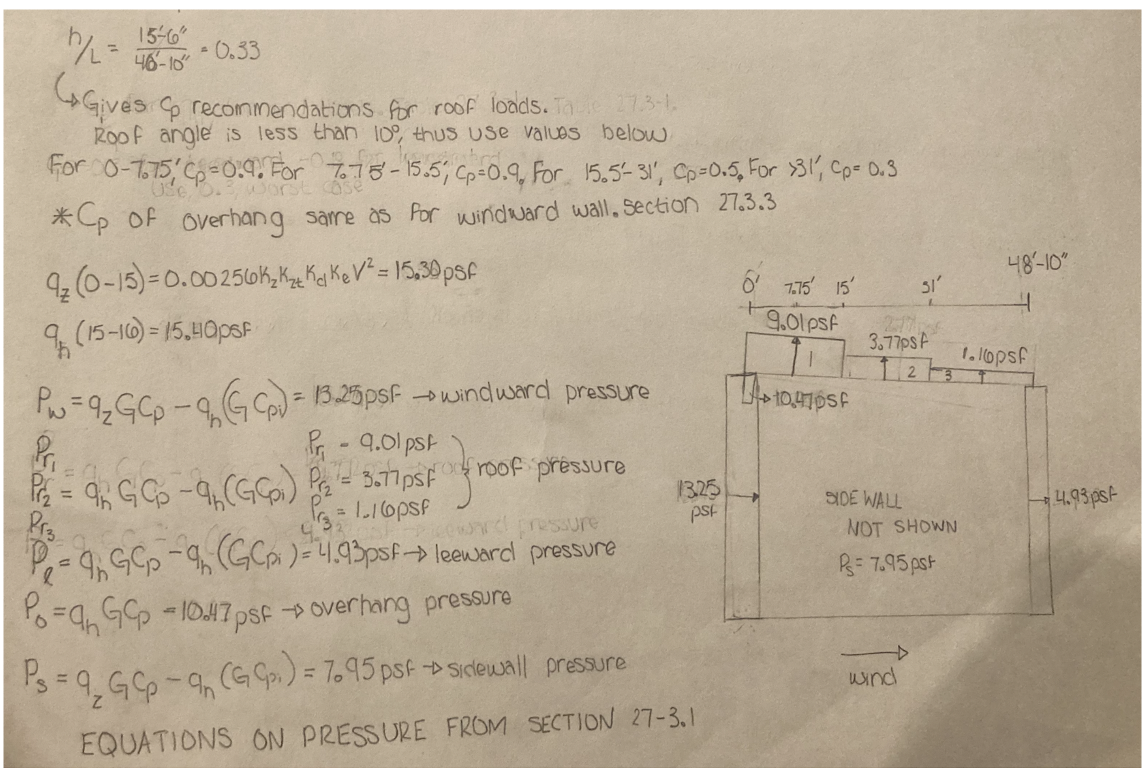


Figure C-4: Calculations for Wind Perpendicular to Ridge

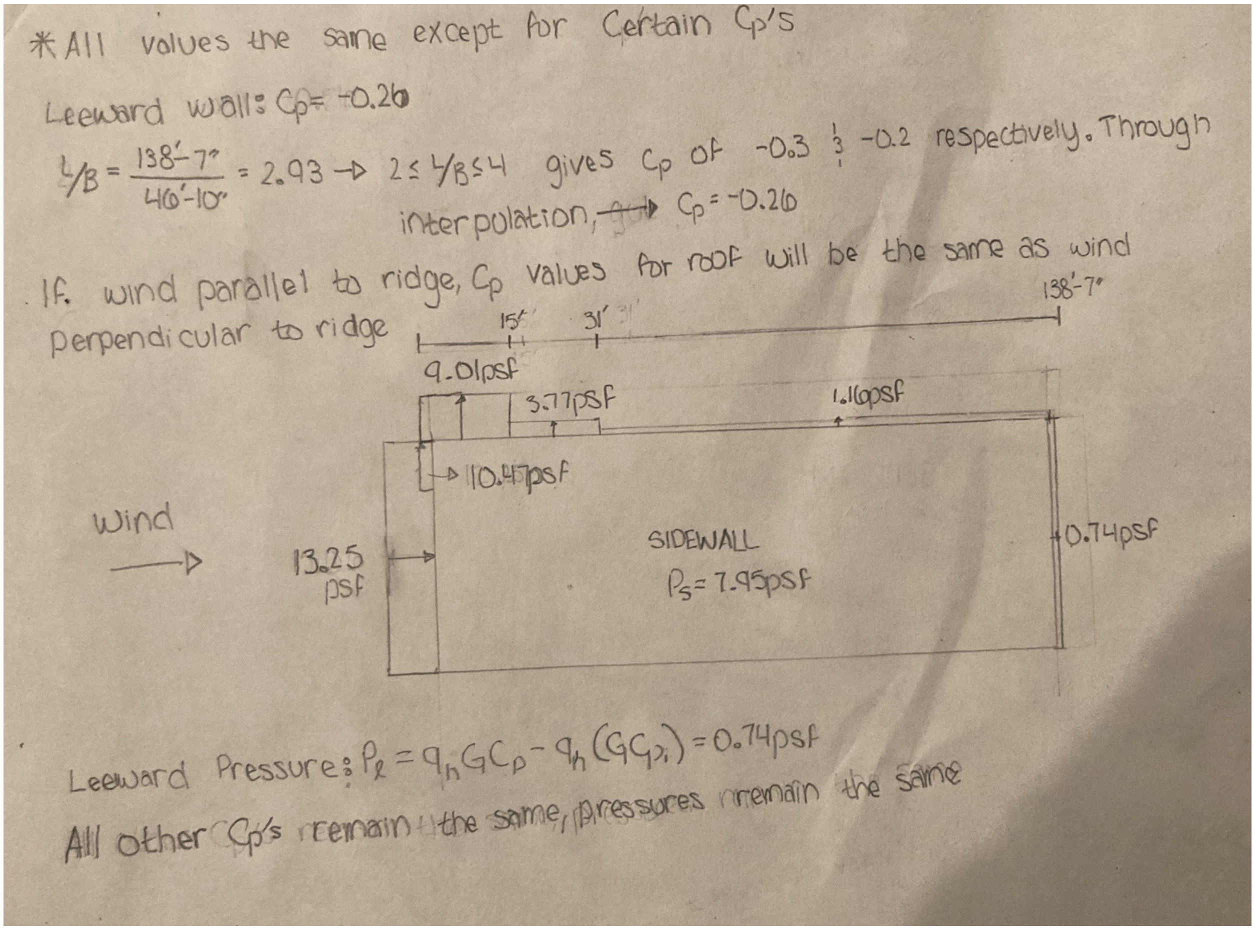
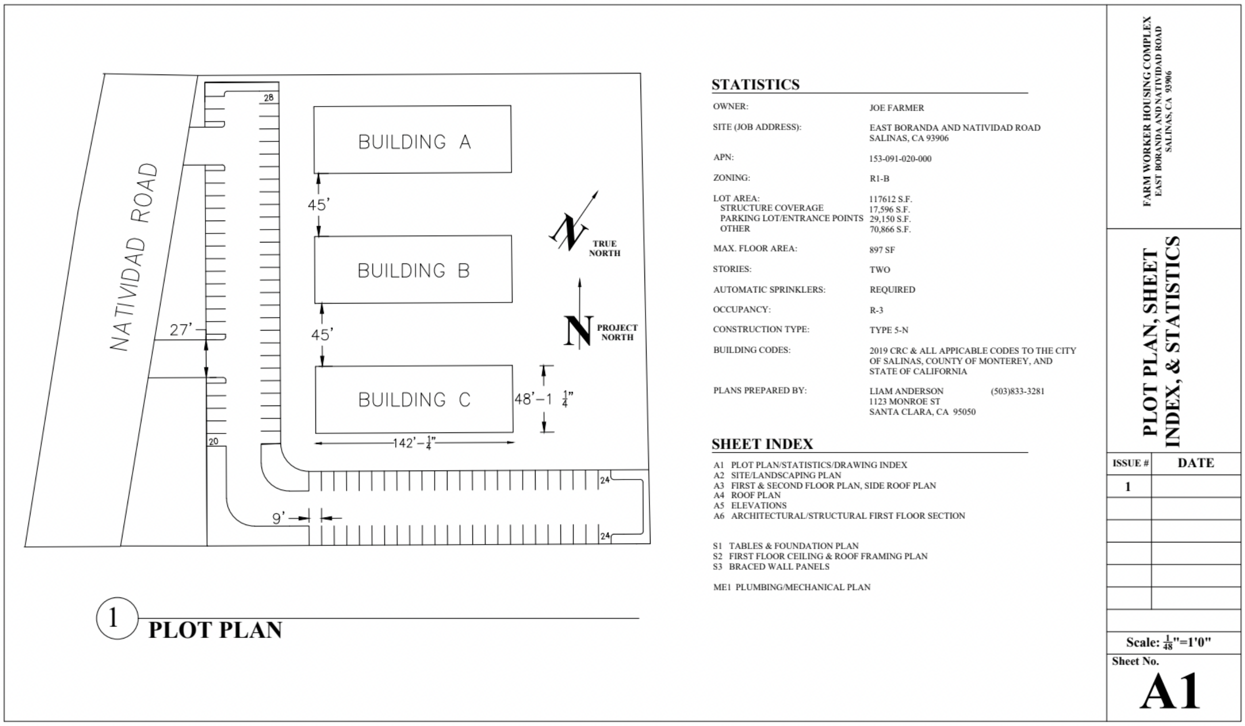


Figure C-5: Calculations for Wind Parallel to Ridge

APPENDIX D: CONSTRUCTION DRAWINGS



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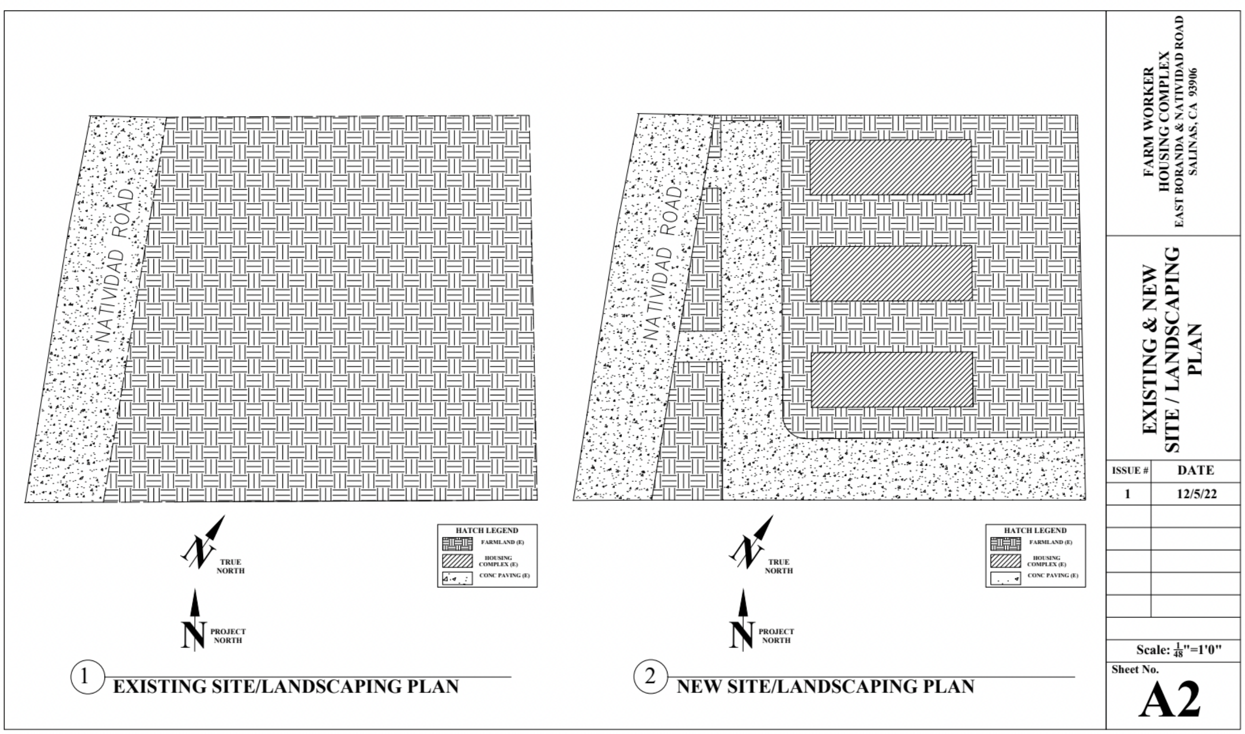


Figure D-2: Sheet A2

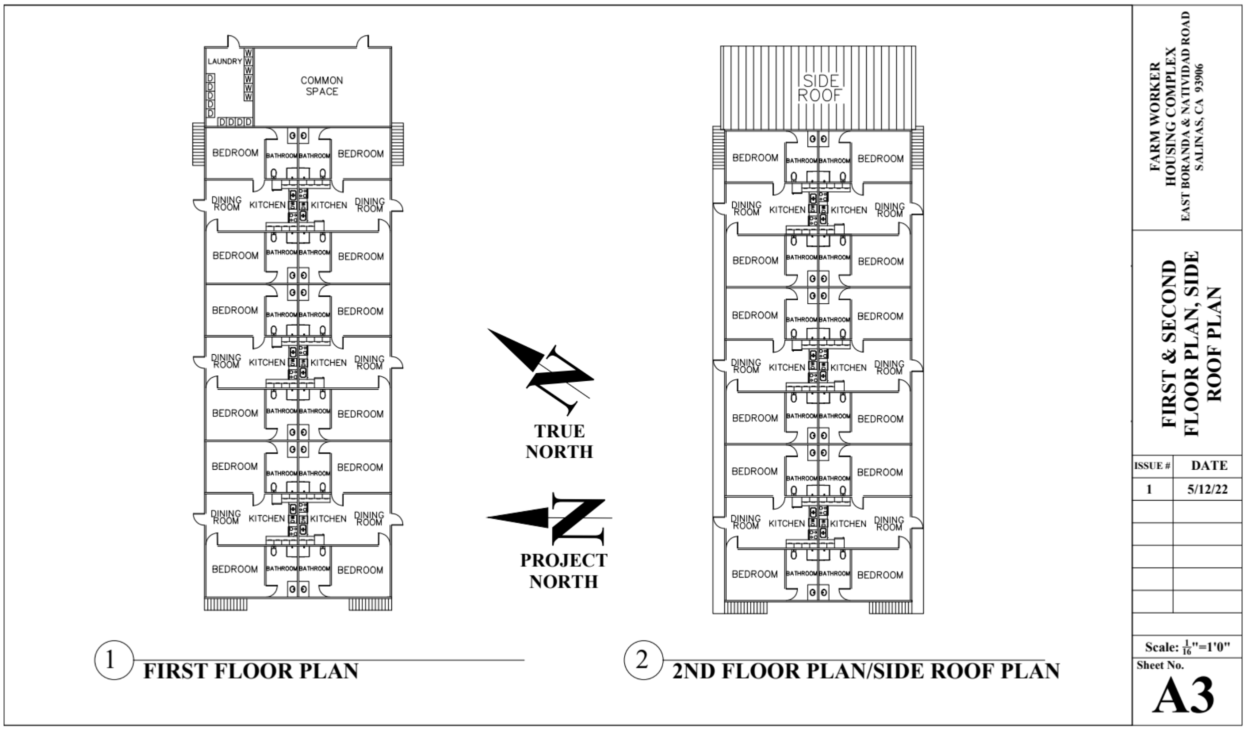
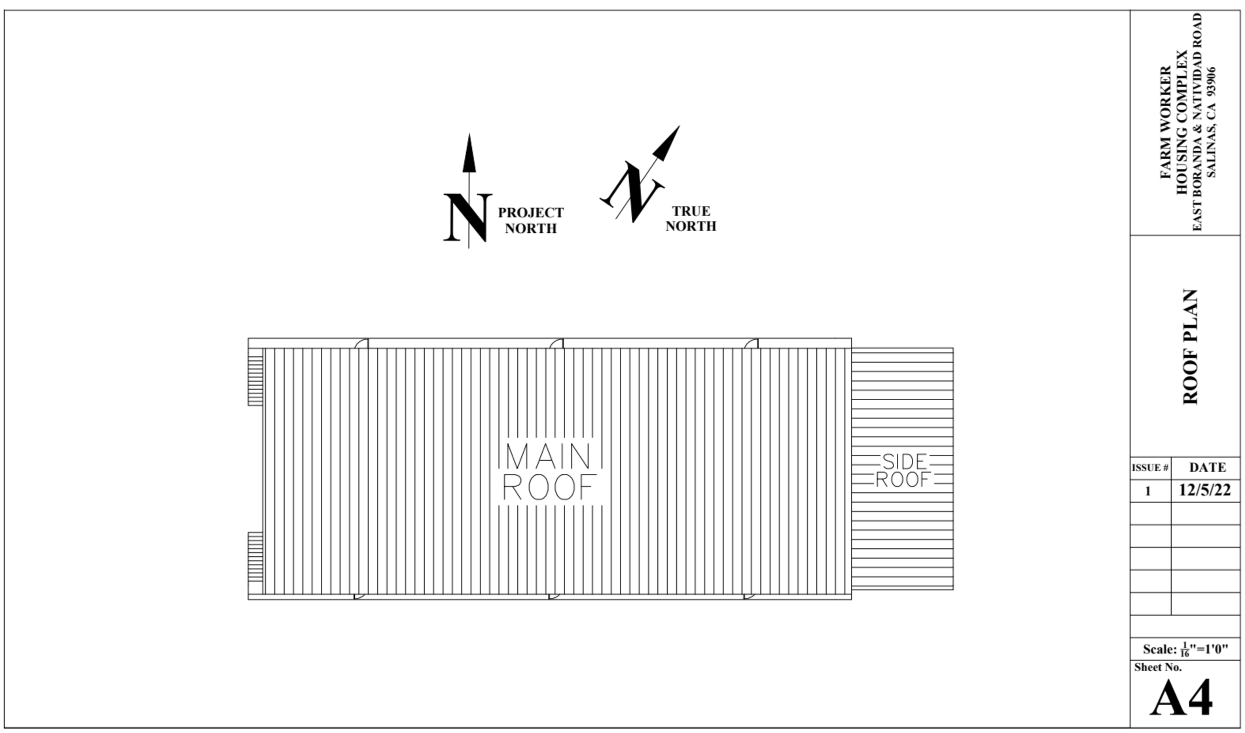


Figure D-3: Sheet A3



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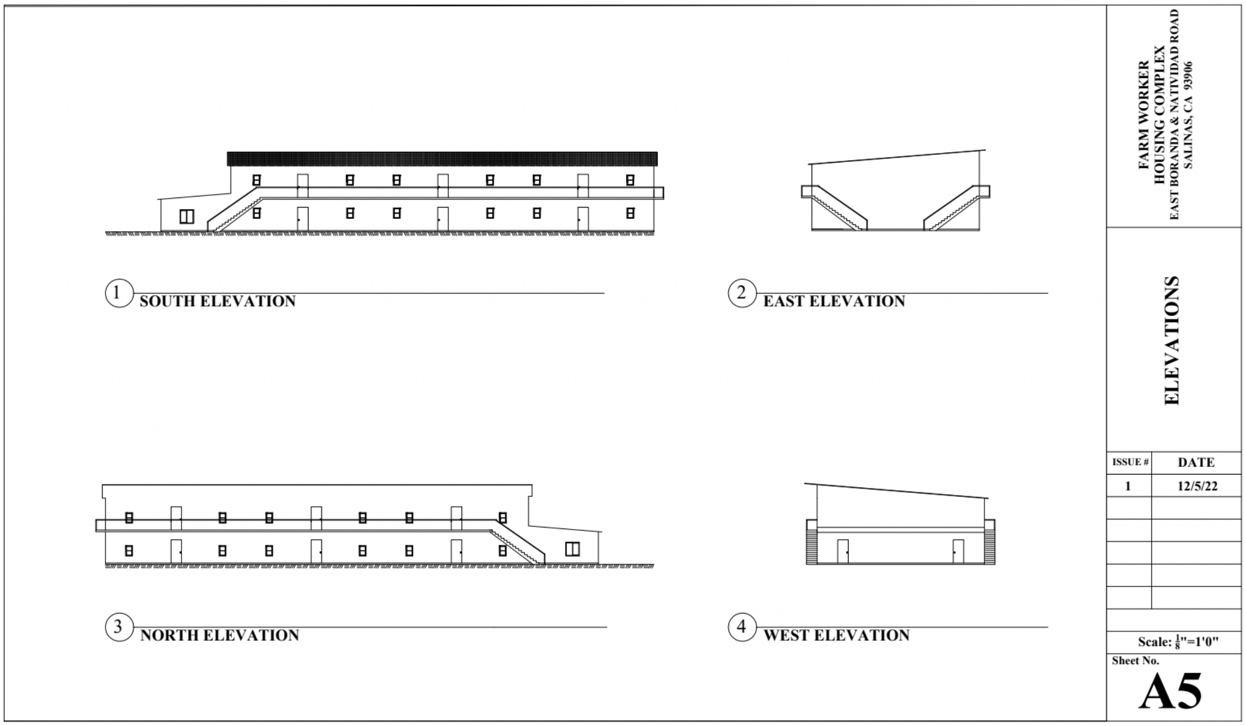

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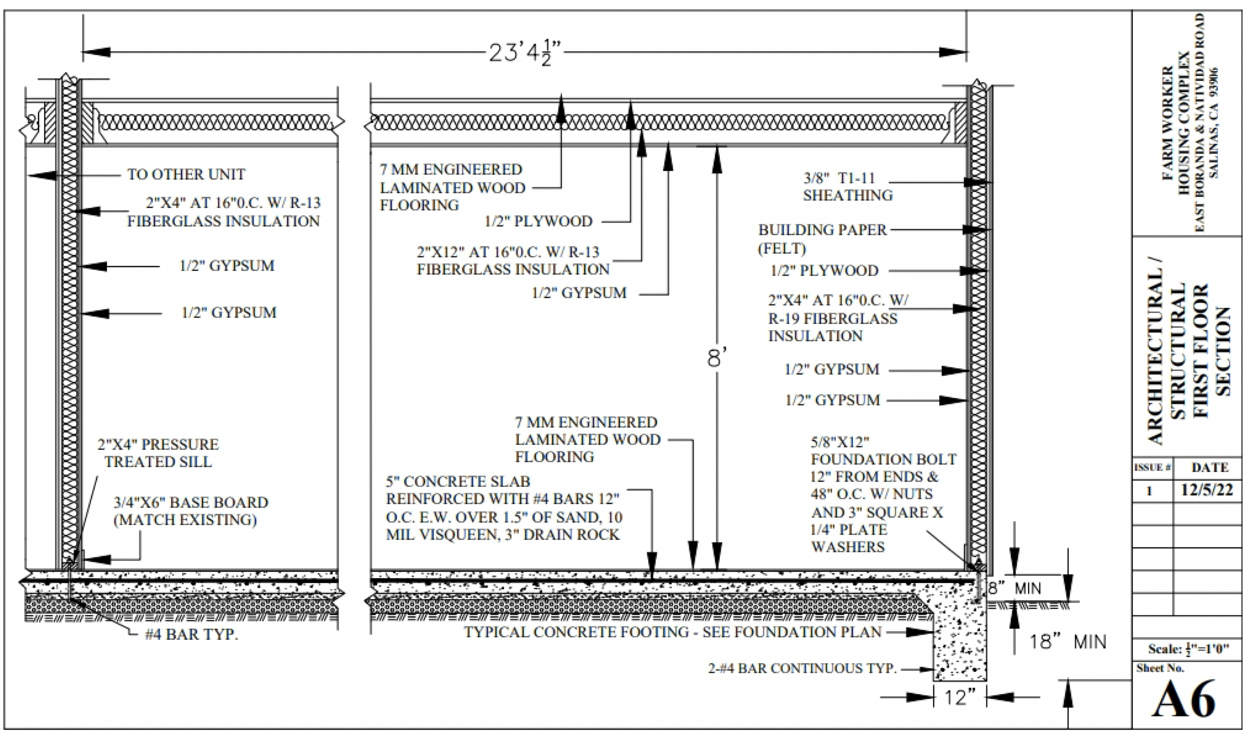

Figure D-6: Sheet A6

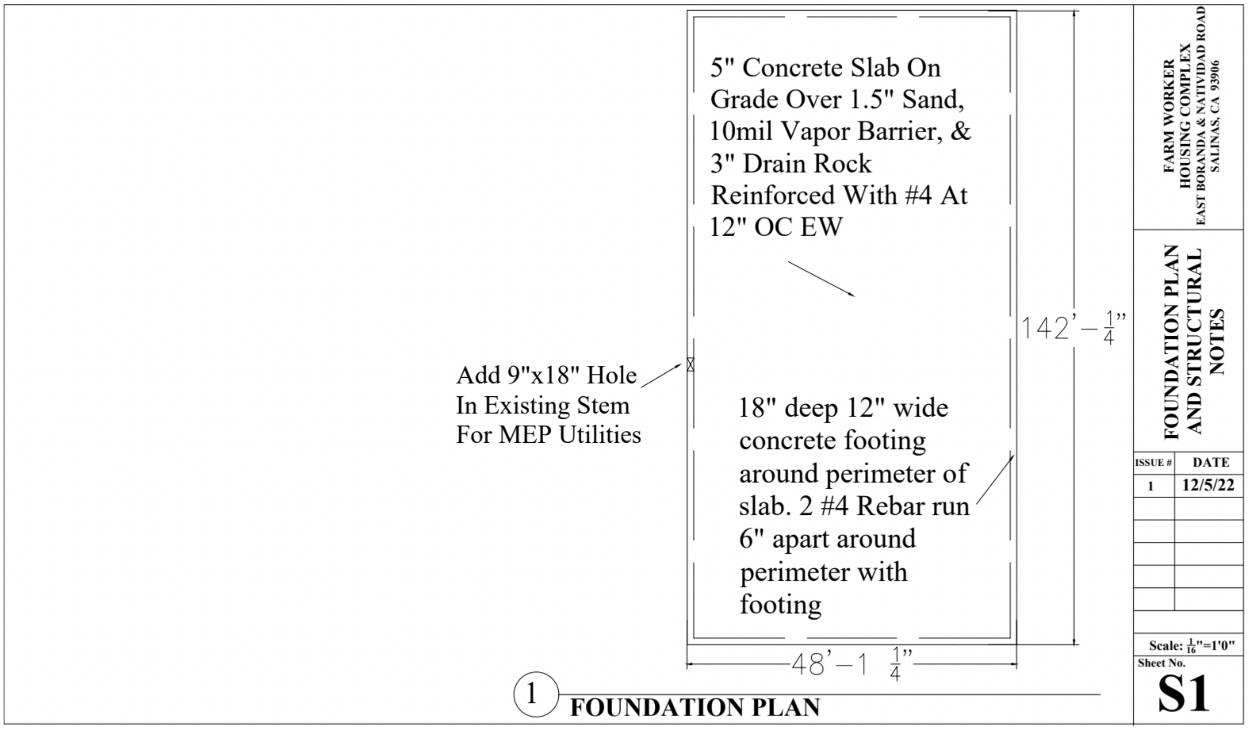

Figure D-7: Sheet S1

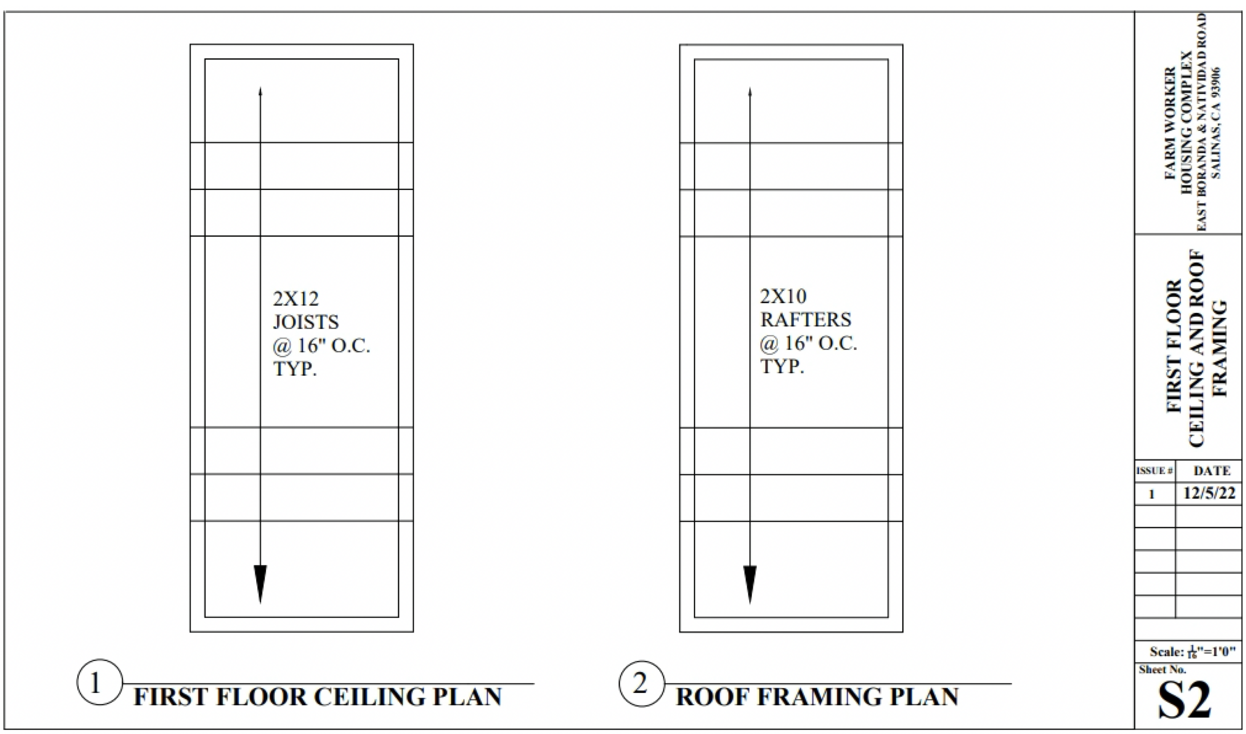

Figure D-8: Sheet S2

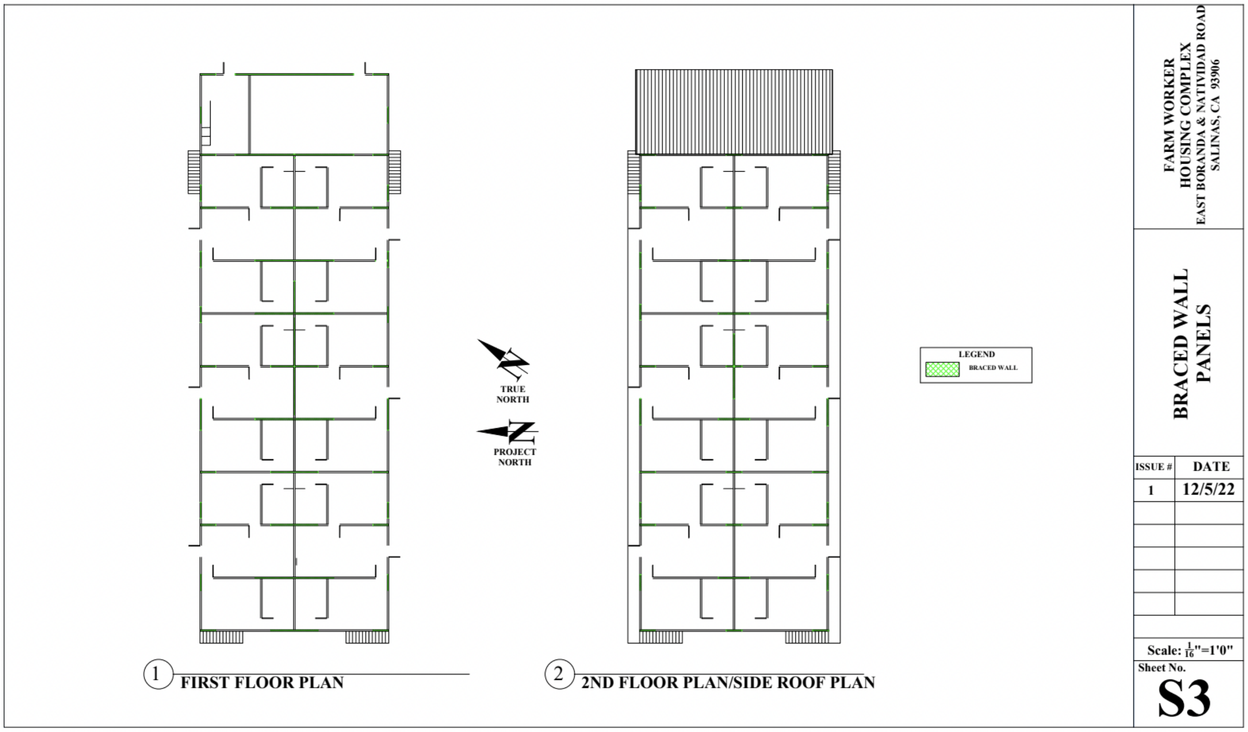

Figure D-9: Sheet S3

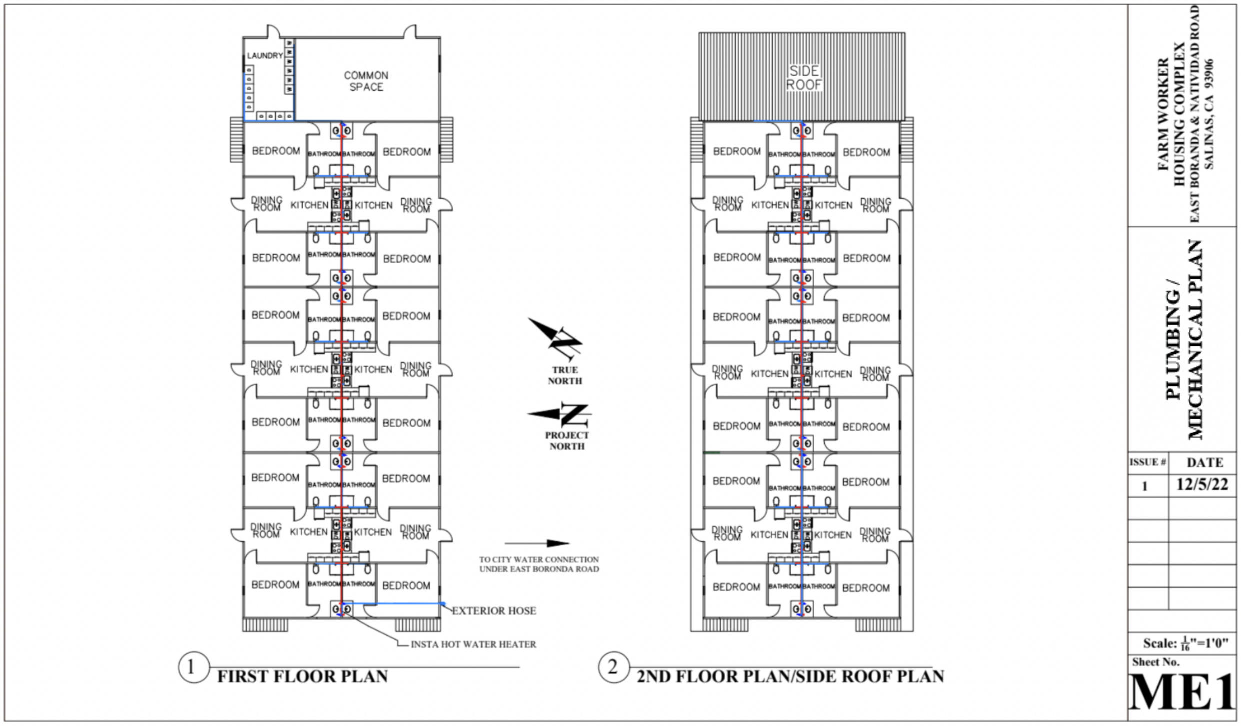

Figure D-10: Sheet ME1