HALAWA-LULUKU DEVELOPMENT FEASIBILITY REPORT

Luluku

Honolulu
Oahu, Hawaii
September 2019

Prepared for:
Halawa-Luluku Interpretive Development Project
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Disclaimer: This report is only for conceptual purposes for the Halawa-Luluku Interpretive Development project. The content presented in this report will not determine actual designs or use of the project sites. This report is only meant to provide insight for community working groups for future growth.

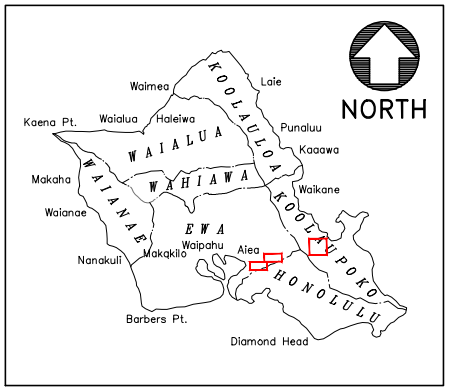
Section 1 Introduction

The Halawa-Luluku Development Feasibility Report is based on the Interpretive Development Plan (IDP) set forth by the Halawa-Luluku Interpretive Development (HLID) team, acting on behalf of the Office of Hawaiian Affairs (OHA). The IDP was created by the HLID team to initiate the mitigation process of the impacts to cultural and archaeological resources caused by the construction of Interstate H-3. Reference can be made to the "PROJECT DESCRIPTIONS: North Halawa Valley and Luluku Project Areas," dated October 24, 2014; for the background and development of the HLID project and the IDP.

The purpose of the Halawa-Luluku Development Feasibility Report is to investigate the feasibility of incorporating various elements within the project area to assist the working community group (Stewards) with their visions for the North Halawa Valley and Luluku project areas. The objective of this report is to provide site layout alternatives based on discussions with the Stewards and coordination with representatives from the Federal Highway Administration (FHWA) / State of Hawaii Department of Transportation (HDOT) and OHA. The project elements presented in this report are based off the IDP for their respective project site, with input from FHWA/HDOT and the Stewards. Each project element will be explored and options for implementing the element within the project site will be discussed. These various project elements are incorporated into different feasible site layouts, put together through consultations with the stakeholders on what elements are most desirable, the feasibility of implementing the project element, and the budgetary expenses for installation, operation, and maintenance of each element. The cost estimates presented in this report are based on rough budgetary estimates and are subject to change.

As part of the HLID project, the Stewards will develop a work plan to sustain their respective project areas. To assist the community group, this feasibility report is intended to provide a basis to move forward towards goals and visions for the project area. At this time, the feasible project alternatives presented in this report will be based on the current capacity of the community group. Looking towards future growth projections, provisions to support expansion of the project areas will also be discussed in this report. Site layouts presented in the feasibility report are conceptual and subject to alterations moving forward.

Refer to Figure 1 for overall project location map.



NORTH
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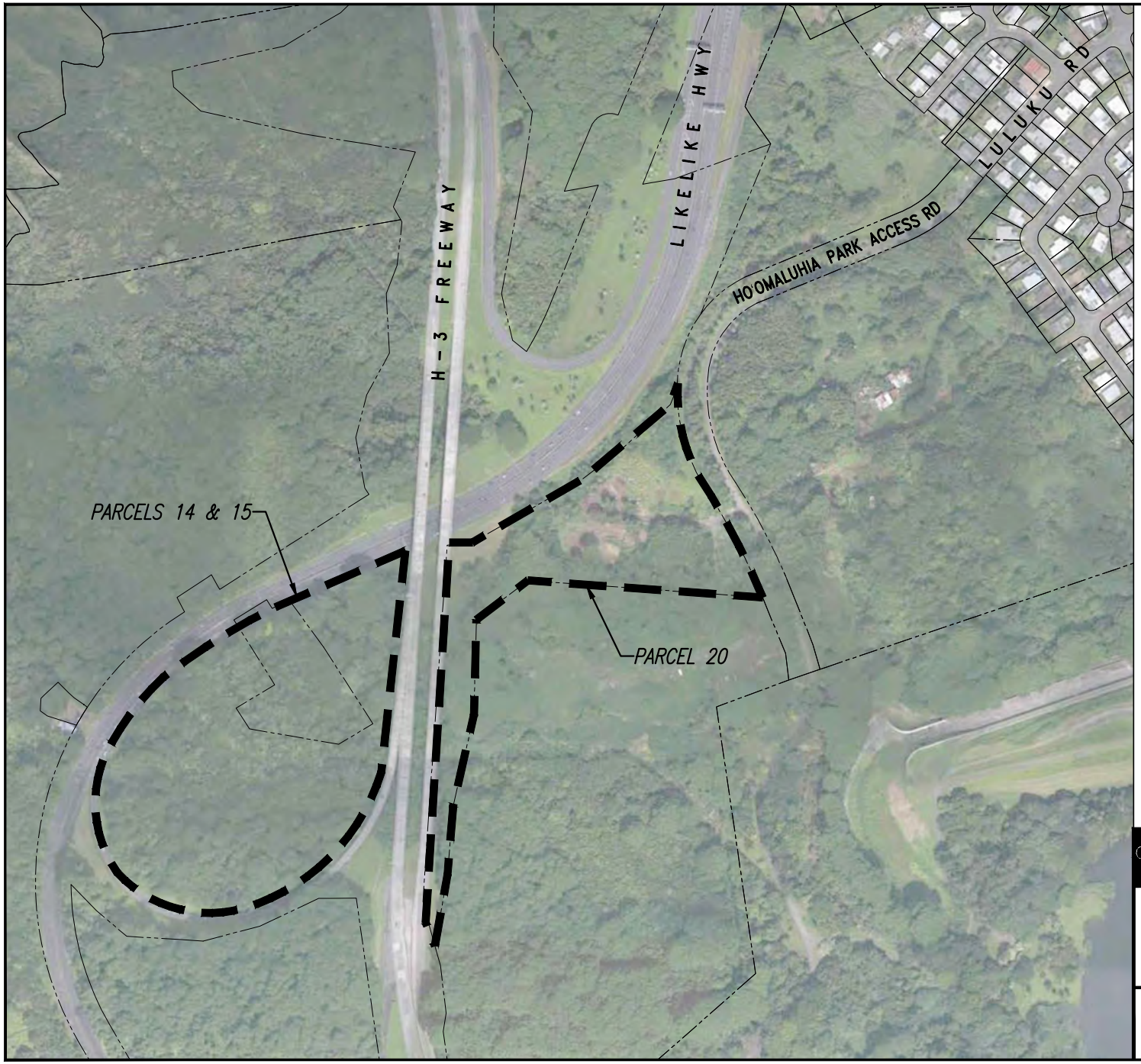
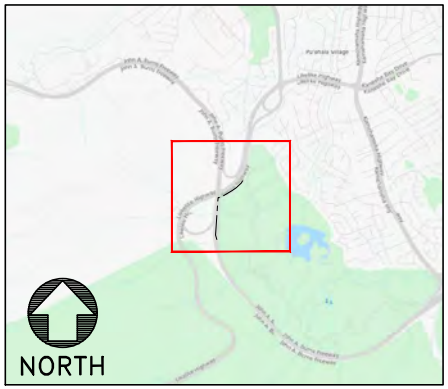
FIGURE 1
OVERALL PROJECT LOCATION MAP

2.2 Site Description – Luluku

The Luluku project area is located on the mauka side of the Ho`omaluhia Park Access Road near the Kaneohe H-3 Interchange. The area referred to as "Parcel 20" was originally a subdivision (Lot B) of TMK: (1)4-5-041: 017, but was later included as part of the Interstate H-3 right-of-way and no longer has a TMK number designation. The project site is accessed through Ho`omaluhia Park Access Road, which is the entrance road to the Ho`omaluhia Botanical Garden. The current zoning designation of this parcel is restricted preservation district (P-1). According to the State of Hawaii DLNR, the project site is within the general subzone of the conservation district. This subzone is the least restrictive category within the conservation use district.

Refer to Figure 3 for location and vicinity map for the Luluku project area.





LEGEND

PROPERTY LINE

PROJECT AREA

NORTH

Scale : 1"=500'

500 250 0 500

Graphic Scale in Feet

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FIGURE 3
LOCATION AND VICINITY MAP
FOR LULUKU

Section 4 Luluku Project Area

Project elements were defined based on scope items and discussion with the stakeholders. In the following sections, there will be a description of each project element that explains the intended use for the particular project site. The options explored to meet the criteria of the project element will also be presented, along with a cost estimate and the permitting needed to construct the project element on-site.

4.1 Project Elements

4.1.1 Administrative Center

The administrative center would be a multipurpose pavilion that would provide office space and a common meeting area for the community group and visitors. This type of space will allow the Stewards to provide an area to welcome and educate visitors about the site, as well as have an area to work out off. The options presented for the administrative center will also have provisions for a food production area. The location of the administrative center would be within parcel 20 near the Ho`omaluhia Access Road. Constructing an administrative center on-site would require a building permit.

4.1.1.1 Option 1

The base option for the administrative center would include a small-size pavilion, approximately 1,118 sf, with a small food production area, approximately 518 sf. This base option would also include two (2) accessible single user restrooms. This building will be able to provide the Stewards a common meeting area and an open space to for multi-functional uses. The administrative center would be an enclosed structure and have provisions to be secured and locked. Refer to Figure 15 for a concept drawing of the base option of the administrative center.

Expansion of the base option was also explored to allow for a larger working space. This expansion would increase the pavilion area to approximately 1,785 sf with a substantially larger food production area, approximately 1,484 sf. This expansion would also include restroom facilities and have the option to include a security office, approximately 2,395 sf for visitors entering the site. Refer to Figure 16 for a concept drawing of the expanded option of the administrative center.

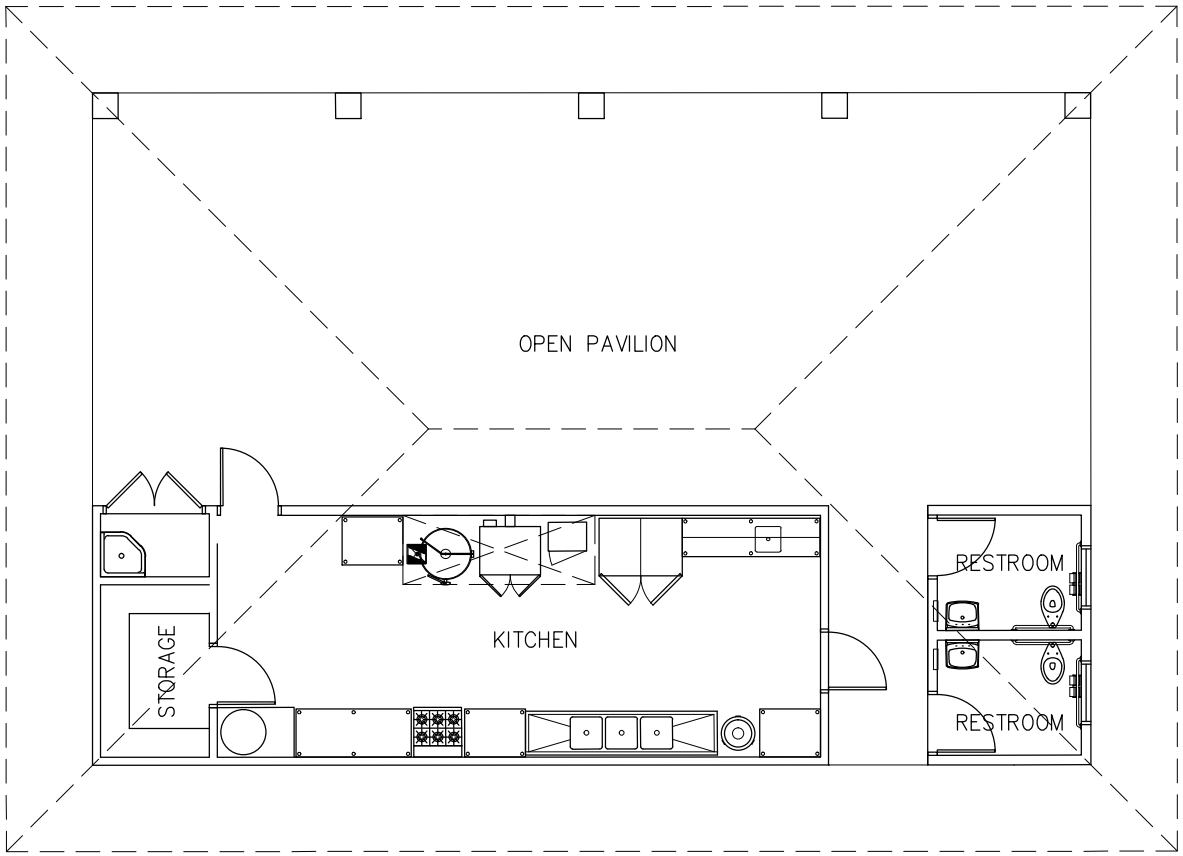
4.1.1.2 Option 2

A second option for the administrative center would be to utilize a modular, trailer-type of structure. From consultation with the stakeholders, this type of structure for the administrative center would be adequate to meet their needs at this time. This modular trailer would be 12-feet by 44-feet (528 square feet) and provide a gathering space approximately 264 square feet to serve about 17 people and one administrative office with 2-3 occupants. Refer to Figure 17 for a concept drawing of the modular trailer.

4.1.1.3 Cost Estimate

Below is a rough magnitude cost estimate for the administrative center options mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Alternative	Cost Estimate
Luluku	Base Option	$940,000
	Expanded Option	$2,000,000
	Modular Trailer	$360,000



FLOOR PLAN
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FIGURE 15
LULUKU PROJECT AREA
ADMINISTRATIVE CENTER - BASE OPTION

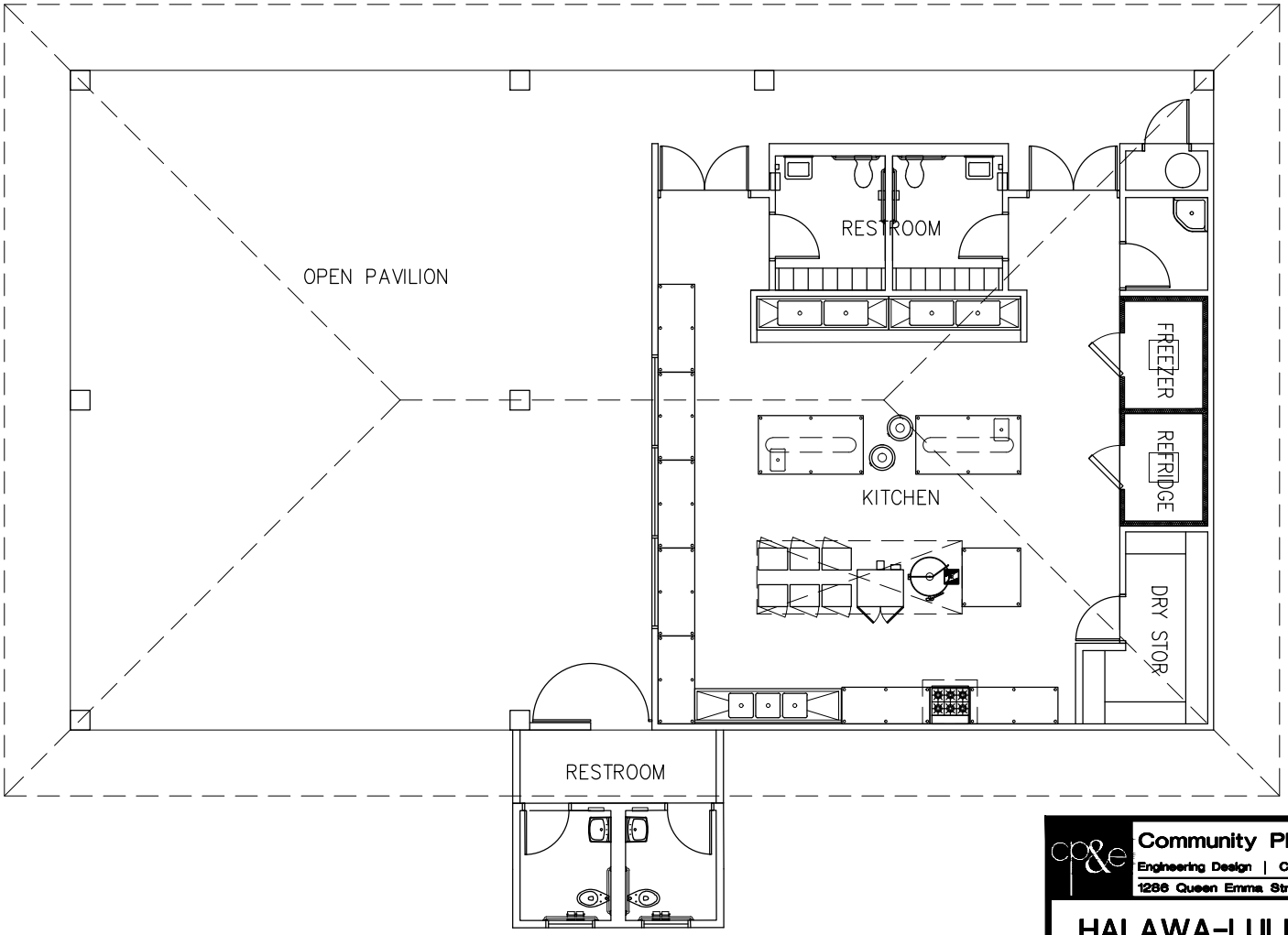

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FIGURE 16
LULUKU PROJECT AREA
ADMINISTRATIVE CENTER - EXPANDED OPTION

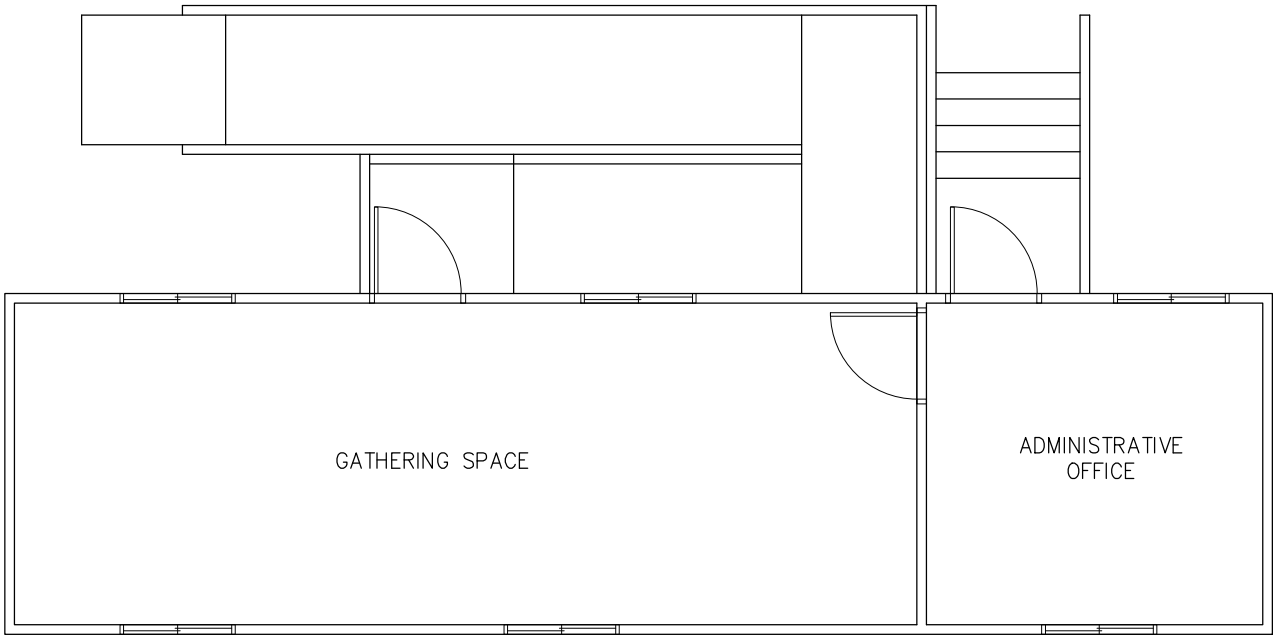

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FIGURE 17
LULUKU PROJECT AREA
ADMINISTRATIVE CENTER - MODULAR TRAILER

4.1.2 Halau

The halau would provide a gathering and learning space for the community and visitors for the Luluku project site. This structure would provide shelter for people from weather elements, such as rain and sun, while engaging in culture practices. Construction of the halau would be subject to building code regulations and will require a building permit. Also depending on the site work that will be needed for the structure, a grading permit may be required for the project site.

4.1.2.1 Option 1

An open structure halau option will be explored for the Luluku project area. The structure would be open on all sides with a roof covering and would provide a large covered meeting space. This pavilion-like structure would be approximately 20-feet by 40-feet to accommodate a group up to fifty people. The roof of the halau could also be used to collect rain water in a water catchment system, for non-potable water use on-site. Being that this type of halau would be open on all sides, there would be no provisions to secure or lock the structure when not in-use. Refer to Figure 18 for a concept drawing of the open halau structure.

4.1.2.2 Cost Estimate

Below is a rough magnitude cost estimate for the halau option mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Open Structure Halau	$360,000

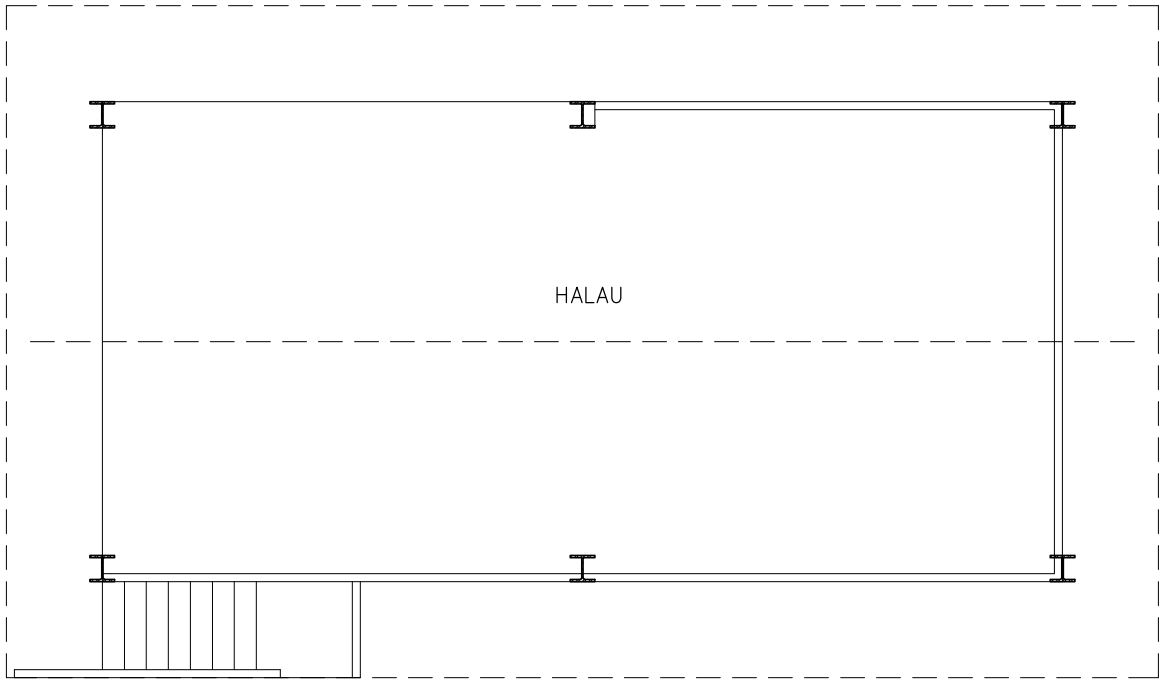

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FIGURE 18
LULUKU PROJECT AREA
OPEN STRUCTURE HALAU

4.1.3 Food Production Area (Certified Kitchen)

During consultations with the stakeholders, there was interest for including a food production area on-site. Having a food production area, such as a certified kitchen, will allow the Stewards to prepare and package their own spices and plant-based products that are harvested on-site. HAR §11-50 outlines minimum requirements for food establishments. The minimum requirements include water from an approved source, a plumbing system including at least one toilet, and a storage area for refuse, recyclables, and returnable.

Building a food production area would require a building permit and food preparation activities would be subject to DOH Sanitary Branch inspections and approvals.

4.1.3.1 Option 1

A food production area could be incorporated into the administrative center building mentioned in the previous section. Requirements for the area to become a certified kitchen would include the installation of a wastewater system and a water source. The cost of the kitchen will vary depending on the quality and quantity of the equipment needed and required. For example, a standard reach-in refrigerator would be much less costly than a walk-in refrigerator.

4.1.3.2 Option 2

If a certified kitchen is not immediately needed by the Stewards, provisions for such an area could be put in-place. Due to budgetary constraints, an option would be to provide an open pavilion type of structure on-site. When the Stewards are ready to implement the certified kitchen on-site, they will already have a concrete pad space on-site to construct additional features to meet the requirements of a certified kitchen. In the meantime, the open pavilion structure can be used as a halau, as mentioned in the previous section.

4.1.3.3 Cost Estimate

Below is a rough magnitude cost estimate for the food production area options mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Commercial Kitchen in Administrative Center	$100,000 to $300,000
	Open Pavilion Structure (building for future kitchen)	$360,000

4.1.4 Storage

A storage structure that could store farm equipment and maintenance vehicles could be provided on-site. During consultations with the stakeholders, a storage area of this capacity was highly desired. The structure would provide a secure space with parking bays as well as storage closets for smaller equipment items.

4.1.4.1 Option 1

The storage space that was explored offered a basic storage structure with two different capacities. The base option for the storage structure would provide a building with two parking bays for storage of farm equipment, as well as a secured storage closet for a total area of 580 sf.

Expansion of this base option is possible with an option to up-size the capacity of the structure to allow three parking bays for storage of farm equipment. Also, the expanded option would include a larger secured storage and hazmat storage room for a total area of 960 sf.

Refer to Figure 19 for a concept drawing of the base option, as well as the expanded option, for the storage structure.

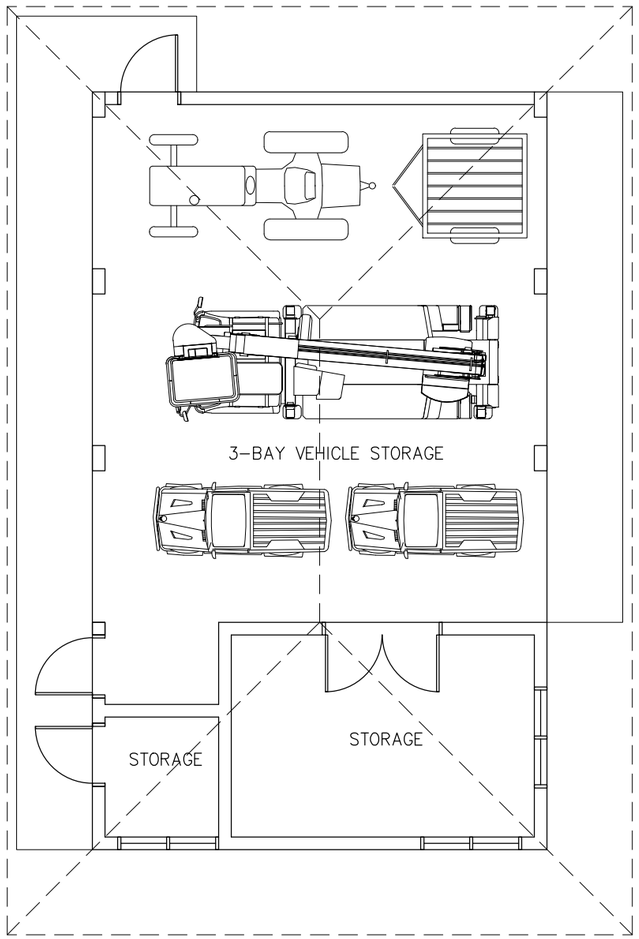
4.1.4.2 Option 2

A second storage option for the Luluku project site would be to provide a storage container on-site. This option would be equivalent to a Matson shipping cargo container and would have provisions to be secure. Providing a storage container on-site would provide a smaller storage capacity, but it will be a cheaper option for the Stewards.

4.1.4.3 Cost Estimate

Below is a rough magnitude cost estimate for the storage structure options mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Base Option (2-Bay Storage)	$310,000
	Expanded Option (3-Bay Storage)	$360,000
	Storage Container (ex. Matson Shipping Container)	$20,000



3-BAY STORAGE FLOOR PLAN
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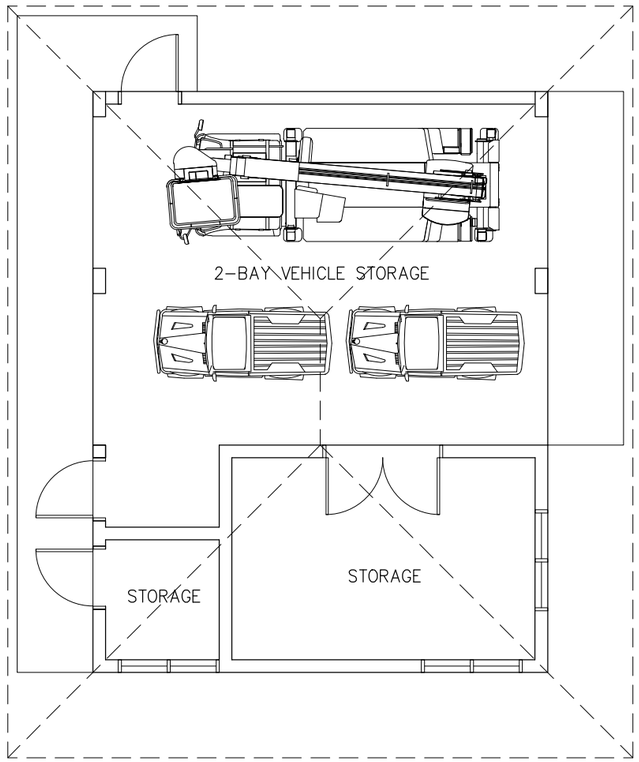

2-BAY STORAGE FLOOR PLAN
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FIGURE 19
LULUKU PROJECT AREA
STORAGE STRUCTURES -
BASE OPTION AND EXPANDED OPTION

4.1.5 Roads/Trails

Currently, a dirt road to the west of Ho`omaluhia Park Access Road is used to access Parcel 20. The dirt road extends approximately 540 feet into the parcel and ends at the bottom of an embankment with a steep incline. At the top of the embankment, there is an old bypass maintenance road. For ease of access between the two areas, a paved roadway or access trail could be created.

4.1.5.1 Option 1

The area between the end of the dirt road and the bypass road is heavily vegetated and would need to be cleared and grubbed. The existing terrain is sloped, with the incline of terrain increasing from the Ho`omaluhia Park Access Road up the dirt road to the top of the embankment, with the steepest slope being 40%. If any type of access will be provided, the area would need to be graded with possible erosion and slope hazard provisions. Preparation of the access way would require a grubbing permit, grading permit, and possibly a stockpiling permit for excess material.

An option to provide access would be to construct a paved roadway from the Ho`omaluhia Park Access Road to the top of the embankment. A paved roadway would provide easier mobility for maintenance equipment and personnel, but the construction of a paved roadway may be costly.

4.1.5.2 Option 2

The second option for access would be to provide a gravel trail from the end of the dirt road to the top of the embankment. The trail would be approximately 220 feet in length. The ground is usually muddy due to frequent rain in the area. It is recommended that the gravel trail be constructed with a wooden header on both sides and erosion control matting under the gravel surface to prevent overgrowth of vegetation and wash-out of the gravel.

4.1.5.3 Cost Estimate

Below is a rough magnitude cost estimate for the access way options mentioned above. The cost presented below is for the installation and site work cost of the access way, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Paved Access Roadway	$800,000
	Gravel Access Trail	$250,000

4.1.6 Parking

For the community and visitors, paved parking can be provided at the site. The existing access way into parcel 20, off Ho`omaluhia Park Access Road could be paved over and used as a parking lot.

If the total amount of cut/fill exceeds 50 cubic yards, a grading permit will be required. Also, if the total impervious area of the site exceeds 5,000 square feet, more substantial stormwater management will be needed.

4.1.6.1 Option 1

The number of parking stalls provided will be dependent on the site layout and needs of the Stewards. It is recommended, that the parking lot be sized appropriately for the Stewards' current needs, as expansion of the parking lot can easily done in the future.

A small parking lot with 5 to 10 stalls can be provided on the Luluku project site for the community and visitors. The parking lot would include one (1) loading space and one (1) accessible parking space. The parking lot can be provided with provisions to allow overflow parking on open dirt areas. Creating additional impervious area on-site would require the design to abide by water quality standards, so minimizing impervious area could aid in cost savings for material and grading on-site. Storm water quality requirements are discussed in detail in Appendix A of this report.

In order to support larger visitor groups in the future, the parking lot can be expanded to include 10 to 20 stalls. A parking lot of this size would provide ample space for large groups and buses. However, because of its size and impervious area, the parking area would be required to abide by more stringent water quality standards. Storm water quality requirements are discussed in detail in Appendix A of this report.

4.1.6.2 Cost Estimate

Below is a rough magnitude cost estimate for the parking area options mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Parking Lot (5-10 stalls)	$250,000
	Parking Lot (10-20 stalls)	$500,000

4.1.7 Bomb Shelter Mitigation

According to the IDP, a historic Japanese bomb shelter is located on-site. Currently, there is an opening leading to an underground structure, however, the condition and size of the structure below the surface is not known. The opening poses a fall risk for visitors and should be mitigated. Any mitigation measures done to the bomb shelter will require consultation with State Historic Preservation Division (SHPD).

4.1.7.1 Option 1

Aluminum, plastic, or wood fencing with signage can be installed around the boundary of the bomb shelter. This would keep visitors a reasonable distance away

from the vicinity of the bomb shelter and the opening; creating a buffer around the entire shelter.

4.1.7.2 Option 2

Another alternative would be to place warning signs and gate the opening of the bomb shelter by means of metal, aluminum, plastic, or wooden bars. The gate would only safeguard the entrance of the opening to prevent visitors from falling inside. This alternative would be the most affordable but least durable of all the options.

4.1.7.3 Cost Estimate

Below is a rough magnitude cost estimate for the bomb shelter mitigation options mentioned above. The cost presented below is for material cost and installation cost of the mitigation measures, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Fencing with Signage	$2,000
	Gate with Signage	$1,500

4.1.8 Trash Receptacles

Trash receptacles will be provided for the project site. The City and County's Refuse Division only collects trash for households, so the refuse will have to be disposed of by other means. However, refuse at City and County parks are picked up by the Department of Parks and Recreation. Since the site shares the same access road as Ho`omaluhia Botanical Garden, an agreement with the Department of Parks and Recreation may be possible, but further coordination will need to be conducted between the responsible parties.

4.1.8.1 Option 1

A trash receptacle can be provided at the under the viaduct area, near the administrative center. Depending on the needs and estimated trash accumulation of the Stewards, the trash receptacle can range in sizes from 2 to 8 cubic yards. If more trash volume is projected, then a roll-off container with a capacity of 10 to 40 cubic yards could alternatively be provided. If the Stewards decide to utilize a trash receptable, they would need to coordinate with a private trash disposal company to pick-up their trash weekly or monthly for a fee.

4.1.8.2 Cost Estimate

Below is a rough magnitude cost estimate for the range in costs for a trash receptacle of varying capacities. The cost presented on the following page is for the structure only, maintenance fees for coordination for trash pick-up will be the responsibility of the Stewards, if they choose to utilize a trash receptable on their project site. The cost is subject to change at the time of construction.

Site Location	Alternative	Cost Estimate
Luluku	Trash Receptacle (2 to 8 cubic yards)	$200 to $600
	Trash Receptacle (10 to 40 cubic yards)	$500 to $800

4.1.9 Sewer Service Connection

For restroom and kitchen operations, alternatives for wastewater services were investigated. A sewer connection or IWS will be required to handle wastewater and greywater if a certified kitchen will be implemented on-site.

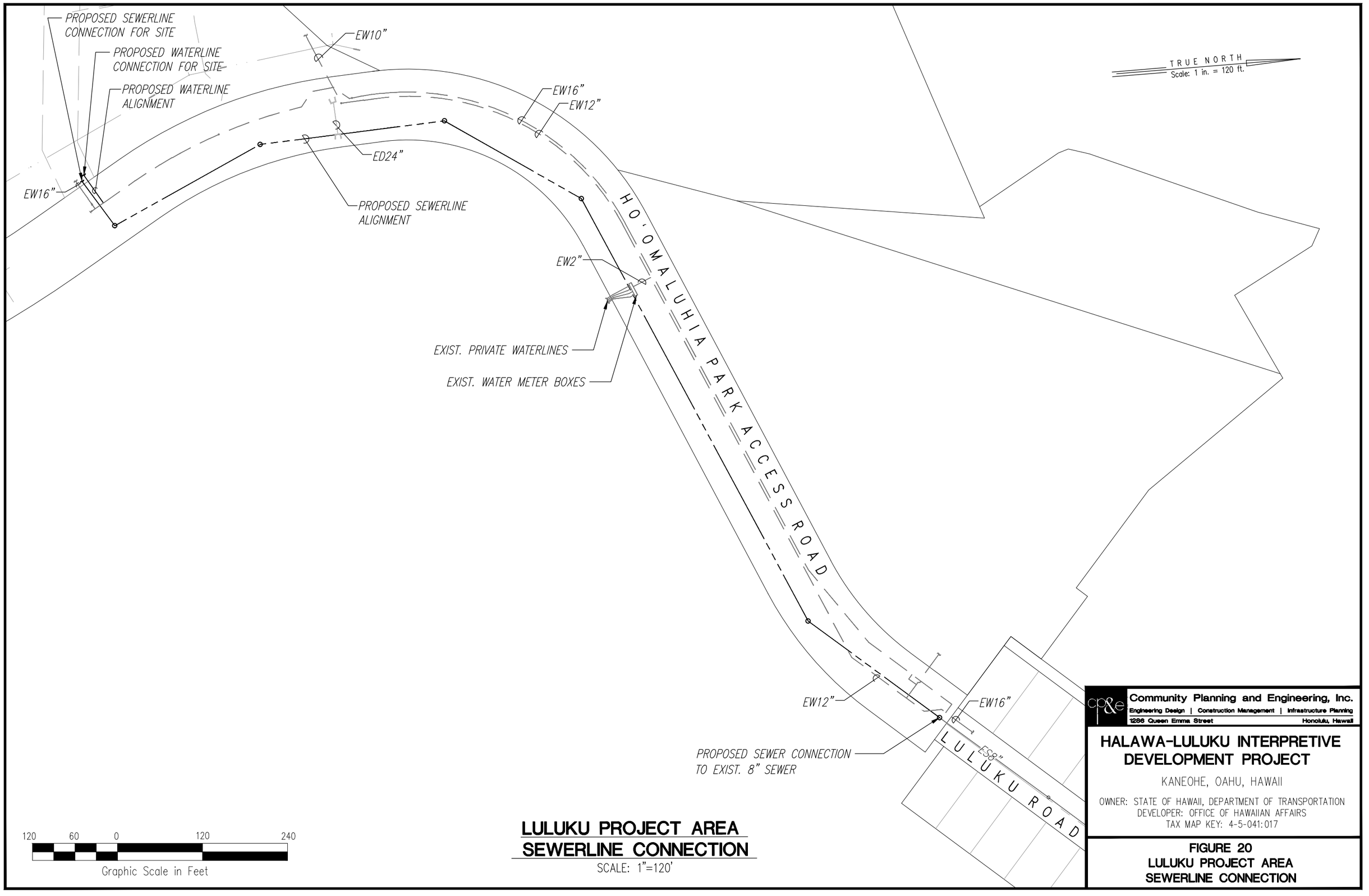
4.1.9.1 Option 1

Connection to the existing sewer system will be an option for the Luluku project site. The nearest connection to a City-owned sewer system is at the end of Luluku Road and the beginning of Ho`omaluhia Park Access Road. Connecting to the existing sewer system on Luluku Road would require approximately 1,900 linear feet of sewer line. Due to the curvy alignment of Ho`omaluhia Park Access Road, approximately 6 manholes would have to be installed for the proposed connection.

Construction of the proposed sewer line would require approval from City and County of Honolulu for a sewer connection permit and trenching permit from DPP, for utility installation within the City right-of-way.

Refer to Figure 20 for the proposed sewer line connection.

Remote wastewater accommodations will also be investigated in the event a connection to the existing sewer system is deemed infeasible.



LULUKU PROJECT AREA SEWERLINE CONNECTION

SCALE: 1"=120'

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FIGURE 20
LULUKU PROJECT AREA
SEWERLINE CONNECTION

4.1.9.2 Option 2

An option for remote wastewater treatment is to provide a septic system. Per HAR §11-62, for an IWS, a septic tank and the effluent from the septic tank needs to be discharged into a soil absorption system, sand filter, irrigation system, or another treatment unit approved by the Director of DOH.

A septic tank is an underground, water-tight container usually made of concrete, fiberglass, or plastic. The tank allows the solids in the wastewater to settle to the bottom of the tank forming sludge, while the oil and grease float to the top forming scum. The remaining liquid effluent flows out the tank and into another treatment method. It is uncertain what DOH will dictate as acceptable because the soil is relatively impermeable, and the site is in the vicinity of Luluku Stream, but the most likely economical option for the second treatment will be a seepage pit. A seepage pit is a tank with perforated sides, or bricks stacked on top of each other, forming a cylinder. The wastewater would then percolate out of the sides and into the soil, similar to a cesspool. The septic tank would need to be periodically pumped to clean out the sludge and scum by a licensed septic pumper. It is generally recommended the tanks be cleaned once a year.

To obtain approval for an IWS, a permit application is required to be sent to DOH Wastewater Branch. Further field investigations and discussions with DOH would be required to determine appropriate treatment methods. The IWS permit is discussed in more detail in Appendix A of this report.

4.1.9.3 Cost Estimate

Below is a rough magnitude cost estimate for the sewer service connection options mentioned above. The cost presented below is for material cost and installation cost for the infrastructure, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Connection to Exist. Sewer	$500,000
	Septic Tank System	$20,000 to $60,000 $200 to $700 per septic pumping

4.1.10 Off-Grid Toilets

Because the potential high cost of connecting to the existing sewer system or installing and maintaining a septic system, off-grid toilet options were investigated. However, if there will be a sewer connection or septic system, and water service connection, then it would be more economical to install standard toilets.

Off-grid toilets would be subject to the same permitting requirements as a septic system, described in Section 4.1.9.2 of this report.

4.1.10.1 Option 1

A composting toilet is a type of toilet that treats human waste by using a natural biological process to convert human waste into a reusable end-product. This type of toilet does not require connection to septic tanks or sewer systems and is therefore ideal for off-grid areas such as national parks, camp grounds, and rural areas.

Waterless composting toilets are the most widely-used type of composting toilets since they do not require a water source. Waste is collected in a container beneath the toilet. The container contains a bulking material which mixes with the waste and oxygen, allowing bacteria to convert the material into a safe and usable liquid fertilizer. Solar panels and ventilation fans can be installed to control the odors of the compost toilets.

Manufacturers provide large capacity units with compost bins of 80 cubic feet, capable of handling 60 visits a day or 22,000 visits a year. One or two toilet units are available with prefabricated structures, which would save on construction costs. The composting bin would require approximately four feet of vertical space below the toilet.

Regular maintenance would include adding bulking material to the compost chamber and raking the compost pile. Periodic maintenance would include the cleaning of the fan and cleaning of the compost chamber approximately once a year.

4.1.10.2 Option 2

Portable toilets (Porta Potties) can be brought on-site and used as a short-term solution to accommodate larger groups and events. Portable toilets typically use a chemical to minimize odors and need to be pumped frequently. However, the cost for renting the portable toilets would likely outweigh the compost toilet options in the long run.

4.1.10.3 Cost Estimate

Below is a rough magnitude cost estimate for the off-grid toilet options mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Waterless Composting Toilet (Large Capacity)	$200,000 (Prefabricated two toilet unit including the structure) $100,000 (Prefabricated single toilet unit including the structure)
	Portable Toilets (Porta Potties)	$200 to $500 per day

4.1.11 Water Service Connection

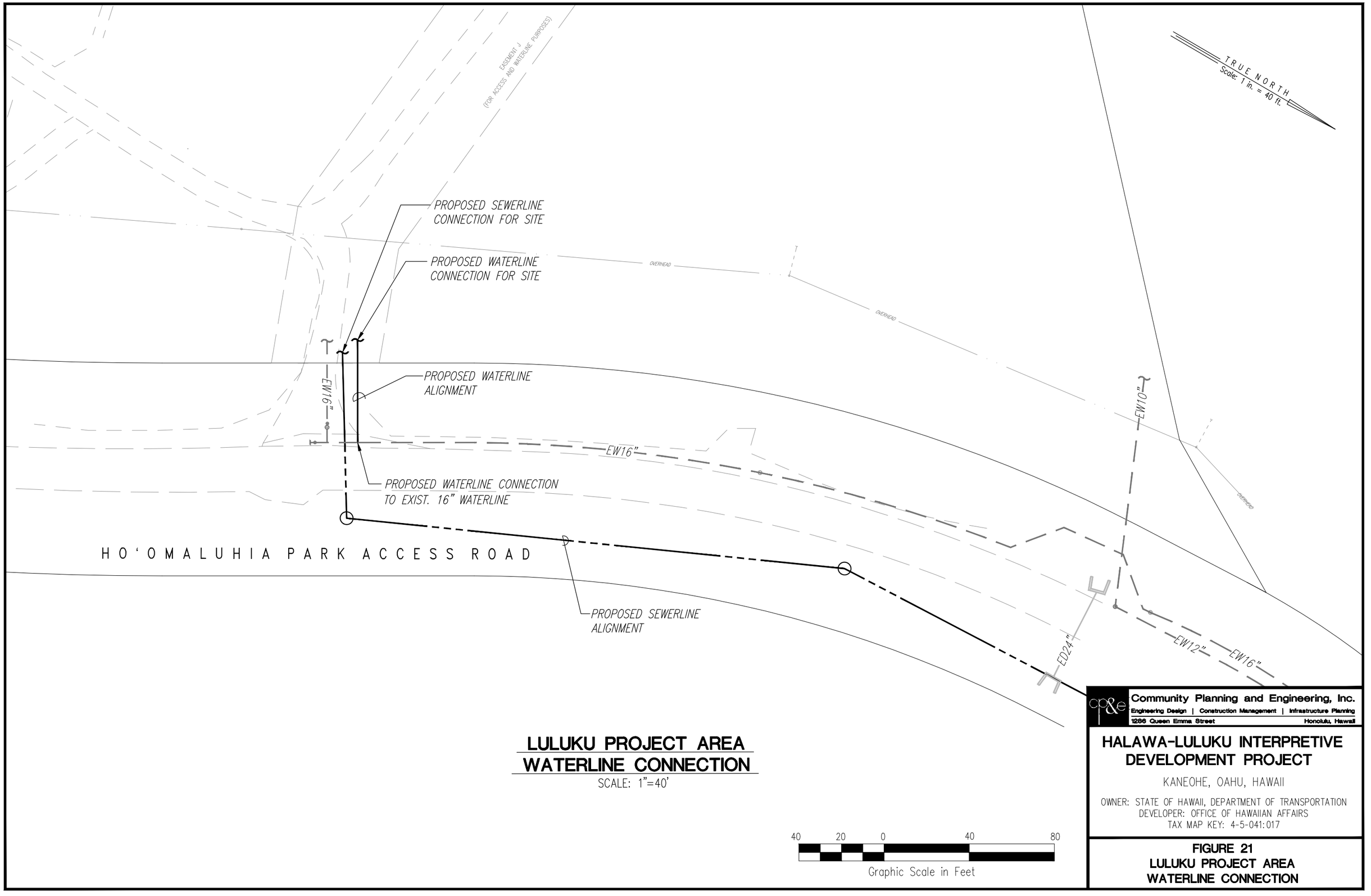
For restroom and kitchen operations on-site, alternatives for water services were investigated.

4.1.11.1 Option 1

Connection to an existing waterline would be an option for the project site. The nearest connection would be to an existing 16-inch waterline via Ho`omaluhia Park Access Road. This connection would require approximately 50 linear feet of new waterline. Based on the maximum capacity of 100 visitors and personnel on-site daily, the estimated water demand would require the installation of a 1-inch water meter. A request to connect to the existing water line and for service will need to be sent to the Honolulu Board of Water Supply. A trenching permit would also be required from DPP for utility installation within the City right-of-way.

Refer to Figure 21 for the proposed waterline connection.

Remote water service accommodations will also be investigated in the event a connection to the existing water system is deemed infeasible.



LULUKU PROJECT AREA
WATERLINE CONNECTION

SCALE: 1"=40'

40 20 0 40 80

Graphic Scale in Feet

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FIGURE 21
LULUKU PROJECT AREA
WATERLINE CONNECTION

4.1.11.2 Option 2

Remote water service via an on-site water storage tank will be also be investigated as an option for the Luluku project site.

It is recommended that green or black polyethylene tanks be used to reduce the exposure of sunlight and algae growth. Locally, polyethylene tanks have capacities of up to 5,000 gallons, however a tank that size likely wouldn't be able to be moved once installed, so potable water would have to be delivered to the site. Logistically, portable smaller capacity tanks would be simpler to maintain on-site. Multiple tanks could be connected if more capacity is required.

A booster pump can be integrated into the water system to pressurize the distribution lines. The pump could be powered by batteries and solar panels or the pump can be tied into the electrical system, if available on-site. The inlet end of the pump would connect to the water tank and the outlet would connect to the distribution line. The pump would detect the pressure in the water line and turn on/off to keep the required pressure in the system. However, if large groups are anticipated, the pump would have to turn on and off more often, which may cause excessive wear and tear over time. Also, the water pressure will be lower if multiple water fixtures are in use at the same time.

4.1.11.3 Cost Estimate

Below is a rough magnitude cost estimate for the water service connection options mentioned above. The cost presented below is for material cost and installation cost of the infrastructure only; mobilization costs, and other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Connection to Exist. Water	$400,000
	Water Storage Tank w/ Booster Pump	$20,000 + $5,000 for Well Tank

4.1.12 Rain Catchment

The Luluku project site will have an option to utilize rain catchment from the buildings that will be located on the site. The rain water collected will be for non-potable usages such as irrigation.

Rain water collected from the structures' roofs, can be drained and collected into a water tank. The most economical type of roofing material used for water catchment is non-toxic painted or enameled galvanized steel. Elastomeric coatings can also be used over other materials, but this type of coating will need to be repainted every seven years. The gutter would be made of aluminum, PVC, or plastic. Screens would be used to keep large debris out of the catchment system. A simple first flush system, consisting of a downspout chamber collecting sediment before reaching the tanks, would be installed

to reduce contamination. The tanks will be placed on concrete pads or compacted gravel.

4.1.12.1 Option 1

One option for the rain catchment tank material is polyethylene. The maximum size of a polyethylene tank is 4,000 to 5,000 gallons. If more storage is needed, additional tanks can be brought to the site and the tanks can be connected with piping. Polyethylene tanks are more expensive than corrugated steel tanks, but the polyethylene tanks are likely more durable and offer more mobility and flexibility.

4.1.12.2 Option 2

An alternative tank material is corrugated steel. Tank sizes ranging from 1,000 gallons to 10,000 gallons would be reasonable for this project. In terms of initial cost, a corrugated steel tank would be more economical than a polyethylene tank. However, over time, the corrugated steel tank may require more maintenance since it is more likely to corrode and leak, which would also affect the quality of the water.

4.1.12.3 Cost Estimate

Below is a rough magnitude cost estimate for the rain catchment storage tank options mentioned above. The cost presented below is for material cost and installation cost of a 5,000-gallon tank structure, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Alternative	Cost Estimate (for a 5,000 gallon tank)
Luluku	Polyethylene Water Storage Tank	$30,000
	Corrugated Steel Water Storage Tank	$20,000

4.1.13 Greywater Treatment System

DOH defines greywater as untreated household wastewater that has not come into contact with toilet waste. This includes the water from bath tubs, showers, bathroom sinks, and wash tubs. Kitchen sink and toilet water would be considered black water. Effluent from the greywater system can be used for irrigation purposes.

The following alternatives assume that a system for treating black water will be installed and the overflow from greywater could be drained into the septic/sewer system. If a black water treatment system is not installed, a seepage pit could be constructed to handle the greywater.

4.1.13.1 Option 1

If a greywater system is desired for the Luluku project site, a separate holding tank for the greywater will need to be installed. The tank can be placed above or below ground, however it is recommended to install the tank above ground since it would be less costly to install and easier to maintain. DOH guidelines basically limit the use of the greywater effluent to be distributed via subsurface irrigation.

The holding tank will also need an overflow pipe that connects to the sewer/septic system. Maintenance on the tanks involve pumping out the built-up solids and sediment every three to five years.

4.1.13.2 Cost Estimate

Below is a rough magnitude cost estimate for the greywater tank system option mentioned above. The cost presented below is for material cost and installation cost, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Aboveground Greywater Tank	$30,000

4.1.14 Electrical Service

Depending on the site layout chosen for the Luluku project area, the site will most likely require power for lights, receptacle loads, and a possibly a commercial kitchen. If a commercial kitchen is constructed, the building will include at minimum a refrigerator, freezer, double oven, and dehydrator systems. The site is planned to not have air conditioning. Therefore, the total connected load is anticipated to be between 100 and 115 amps. Knowing the estimated load requirements, options for electrical services were investigated.

4.1.14.1 Option 1

Connecting to HECO's existing grid system will be an option. There is an existing HECO line along the Ho`omaluhia Park Access Rd fronting the project site, although for new service to be provided electrical connection may need to come from Luluku Road. The exact point connection will be pending further coordination with HECO.

4.1.14.2 Option 2

The Luluku project site does not have excessive tree cover, allowing for the possibility of utilizing solar or wind power to offset grid power costs or forego connecting to the grid entirely.

Building rooves at the site could be used for mounting a solar photovoltaic (PV) system of up to approximately 10 kW, with an installation cost of roughly $4 per

Watt. Installation of a 10 kW system would cost roughly $40,000, providing approximately 12,000 kWh per year.

In addition, exterior pole-mounted lights are recommended to provide a measure of safety and security along the driveway and parking lot. To reduce site power usage and trenching costs, it is recommended to use solar PV powered light poles, approximately 9 poles are estimated to be required on-site.

If renewable power is utilized at the site, it is recommended to add a battery storage system. The battery storage system is necessary if the site does not receive grid power. Cost for a 40 kWh battery system, including installation, is approximately $30,000.

4.1.14.3 Option 3

Wind power is also an option in this area for off-grid electrical power. One or more wind turbines could be installed on towers to reach above the tree line. A 5 kW wind turbine system would cost roughly $35,000, and be expected to generate approximately 9,000 kWh per year. These figures are subject to change, pending further coordination with a local wind turbine installer. A battery storage system is also recommended for this option if there will no connection to grid power.

4.1.14.4 Cost Estimate

Below is a rough magnitude cost estimate for providing electrical power services on-site. The cost presented below is for material cost and installation cost to provide electrical services, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change, at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Grid Power	$200,000[1]
	Solar PV System	$40,000[2]
	w/ Site Lighting	$54,000 (Additional)
	Wind Power	$35,000[2]

[1]Subject to change pending HECO coordination

[2] Battery storage is recommended in addition to the options if site not connected to HECO's grid ($30,000)

4.1.15 Telephone, Internet and Cable Television Service

Options for telephone, internet, and cable television services were looked in to for usage at the Luluku project site.

4.1.15.1 Option 1

Spectrum (formerly Oceanic Time Warner Cable, providing telephone, internet, and cable TV) service is available from Luluku Road, and will require an underground duct line to be installed, approximately 2000 feet in length. Rough cost for Spectrum service is $97,000; rough cost to install underground duct is $55,000.

4.1.15.2 Option 2

Hawaiian Telcom (providing telephone and internet) service is available from either Ho`omaluhia Park Access Road or Luluku Road (nearest point of connection is pending further Hawaiian Telcom coordination) and will require underground or overhead infrastructure to be installed. Rough cost for Hawaiian Telcom service is $13,000, rough cost to install underground duct is $55,000, or $33,000 if in addition to Spectrum service.

4.1.15.3 Option 3

Viasat is an available option for satellite internet service, with an installation cost of $100, and $175 per month for service. Business service package includes unlimited data (though it slows after 75GB in a month), 35MB/second download speed, and 4MB/second upload speed. Satellite TV from Viasat is also an available option if desired, with an install cost of $100 to $300, and service cost of roughly $80/month.

Based on installation costs, Viasat is recommended for providing satellite internet service. Internet speeds are slower than a cable connection, but still acceptably fast for video streaming.

4.1.15.4 Cost Estimate

Below is a rough magnitude cost estimate for providing telephone, internet, and cable television services. The cost presented below is for the installation of the respective service, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change, pending further coordination with the service companies at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Spectrum	$152,000
	Hawaiian Telcom	$68,000
	Viasat	$300 + $80 per month

4.1.16 Gas Service

For operations requiring gas, alternatives for gas services were investigated.

Based on preliminary site investigations, there are no known gas lines in the area near the project site. Therefore, to provide gas services for the Stewards, a gas tank would need to be present on-site. The gas tank would need to be refilled and maintained when required.

4.1.16.1 Option 1

A permanent large capacity gas tank can be installed within parcel 20. Because of its size and potential danger, more restrictions and requirements are needed for large capacity tanks than the smaller tanks. A separate entity, such as Hawaii Gas, would

also have to refill the tanks on-site since the tanks would not be portable. This option would likely cost more but would be the easiest for user maintenance.

A Honolulu Fire Department (HFD) Permit for Tank Installation would have to be obtained for tanks with capacities of more than 60 gallons.

4.1.16.2 Option 2

If the demand of the gas tank usage is low, an alternate option for a permanent propane gas tank on-site would be portable propane gas tanks. These portable tanks could also be used to provide gas to the site. The maximum portable size would be a 100-pound (23.6 gallon) tank, which is approximately 4-feet tall and 1.5-feet in diameter, however multiple tanks can be placed on-site if more capacity is needed. The placement and regulations of the portable tanks are much less restrictive than the large gas tanks. The portability of the tanks would allow the Stewards to refill the tanks at local hardware stores.

4.1.16.3 Cost Estimate

Below is a rough magnitude cost estimate for providing gas services via propane gas tank options. The cost presented below is for material cost and installation cost to provide a propane gas tank on-site, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change, at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Large Capacity Propane Tank	$7,000
	Small Portable Propane Tanks	$4,000

4.1.17 Nursery

A nursery facility within the Luluku project site would provide a propagation area and a transition area for Native Hawaiian plants to be utilized for food, medicinal and utilitarian uses.

4.1.17.1 Option 1

A horticultural nursery will be an option for the site. Ideally, a partnership could be made with a buyer so the Stewards can plan what is planted and when it's planted. This would be the most efficient use of space and time. Otherwise, a larger amount of space and time would be required to sell the plants. Some plants may also grow too large and caring for the plants for a longer amount of time would cost time and resources. With this notion in mind, it may be difficult for the Stewards to provide the resources for determining what kind plant material will be needed and the manpower and time to take care of these plants to have a successful nursery business. Therefore, a nursery on-site does not seem like a viable option for the Luluku community group.

4.1.18 Landscaping

Landscaping would provide privacy and improve the aesthetics for the Luluku project site. Landscaping is planned to be provided on-site near the structures to be located on-site.

4.1.18.1 Option 1

The Luluku community group's intent for this land is for it to be become a protected "Agriculture District". As the City's Land Use Ordinance defines it a "AG-1 restricted agriculture district will conserve and protect important agricultural lands for the performance of agricultural functions by permitting only those uses which perpetuate the retention of these lands in the production of food, feed, forage, fiber crops and horticultural plants." The community group hopes to reinstate the Lo`i farming that once flourished here.

The "Landscape" design/scope is to support this effort by being functional and low maintenance. First the City's Land Use Ordinance should be followed. The off-street parking lot will need to be planted with one shade tree per 6 parking stalls, per the City's Land Use Ordinance for off street parking areas.

There is a large 40 ft. setback along Luluku Road/Hoomaluhia Botanical Garden entry road. Since the setback area is not landscaped as is the rest of the entry road, there may be or should be a "Memorandum of Understanding" with the City regarding planting along that setback area. Any planting within the setback area will need to be coordinated with the City's Parks and Recreation Department's, Hoomaluhia Botanical Garden entry road design plan. The stakeholders would need to meet with the City and negotiate an agreement with the City regarding the design and maintenance of that land area. The City may be inclined to include that area in their overall maintenance of the Hoomalahia Botanical Garden entry road. The City may also want to design and install it because it would be worthwhile for Hoomaluhia Botanical Garden entry road to have a continuous landscape all the way into the Botanical Garden.

4.1.18.2 Cost Estimate

Below is a rough magnitude cost estimate for landscaping for the project site. The cost presented below is for the material and planting of the vegetation only, any other additional costs will be taken into consideration when developing a feasible site layout for the project area. The cost is subject to change at the time of construction.

Site Location	Option	Cost Estimate
Luluku	Landscaping	$75,000

4.2 Feasible Project Alternatives

Two (2) different feasible site layout alternatives for Luluku were developed to include select project elements based on input from the stakeholders. The feasibility of each alternative presented below is based off of budgetary constraints, construction/mobility factors, and the capacity of management for the Stewards. The alternative site layouts are suggestive and can be altered to include or not include certain project elements.

The Luluku project area is located on the mauka side of the Ho`omaluhia Park Access Road near the Kaneohe H-3 Interchange. The project site is accessed through Ho`omaluhia Park Access Road, which is the entrance road for the Ho`omaluhia Botanical Garden. Some areas within Parcel 20 are currently used for farming and some areas have become overgrown with invasive flora.

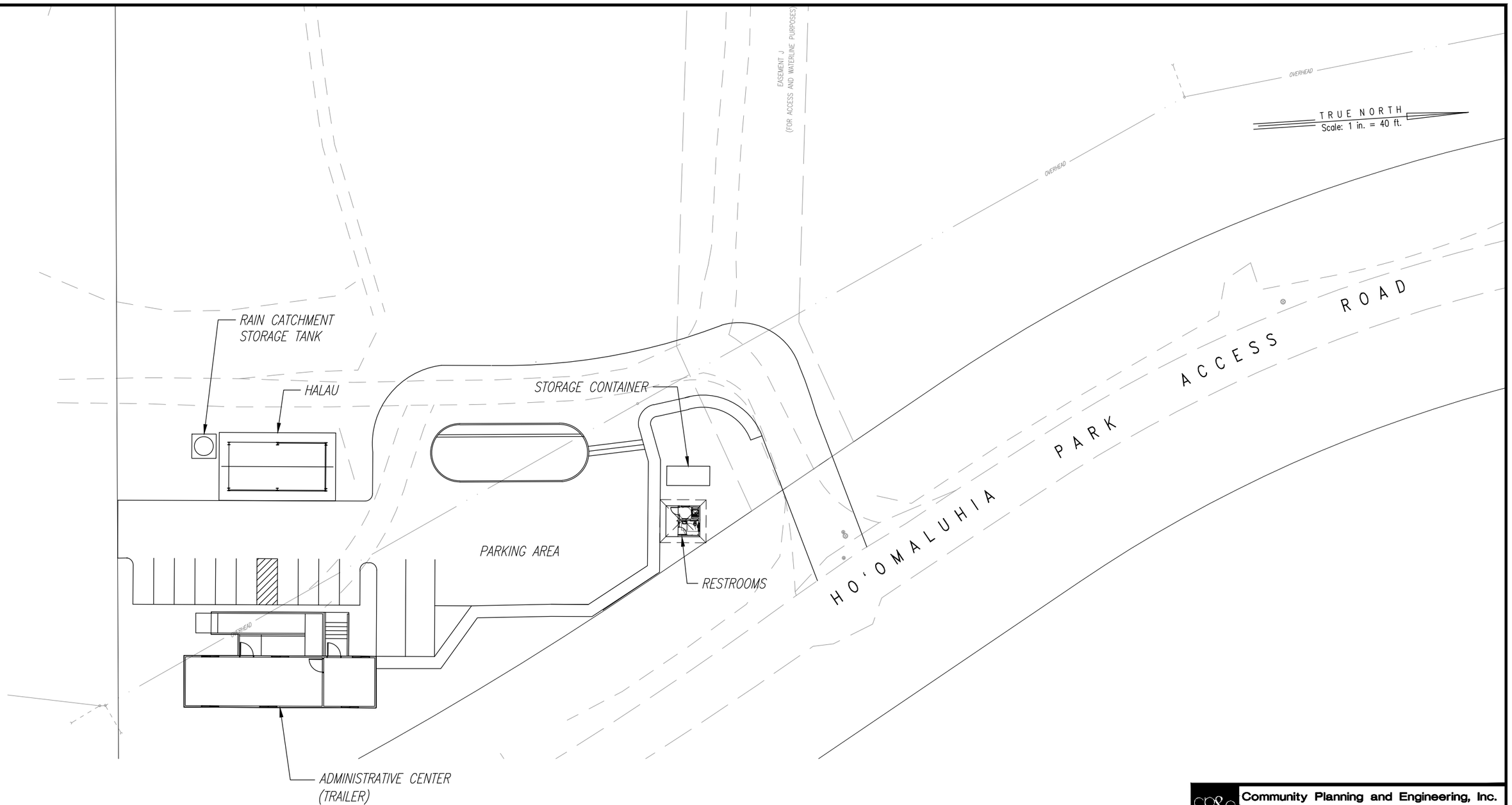
4.2.1 Alternative 1

This alternative site layout will provide a common meeting area for the community and visitors. Alternative 1 will include the following project elements: administrative center, open structure halau, storage container, composting toilet, parking lot, solar PV system, and rain catchment storage tank. The administrative center would provide an enclosed office area and would include a solar PV system on the roof to provide electricity for the site. The open structure halau would be utilized as a meeting area for work groups and visitors. In the future, this structure could possibly be used for a commercial kitchen with improvements made in accordance with the current Department of Health regulations. Also, a rain catchment storage tank will be placed next to the halau to collect roof runoff for non-potable water use. A storage container, similar to a shipping cargo container, would provide a substantial amount of storage space and also have provisions to be secure. In addition, a parking area and a composting toilet will also be provided on-site for the community and visitors use. For the parking area to be provided on-site, the driveway will extend from Ho`omaluhia Park Access Road up into a small parking lot. The driveway will incorporate erosion control measures to address the current erosion occurring at the existing access way. Constructing these elements would require a clearing and grubbing permit, grading permit, and a building permit. See the table below for a breakdown of the estimated cost for Alternative 1. Incidental construction cost will include factors, such as, but not limited to, construction management, archaeological monitoring, geotechnical monitoring, construction surveying, and mobilization.

Project Element	**Cost**
Administrative Center (Trailer)	$360,000
Open Structure Halau	$360,000
Storage Container (ex. Matson Shipping Container)	$20,000
Composting Toilet (Double)	$200,000
Parking Lot (5-10 stalls)	$250,000
Solar PV System w/ Site Lighting	$94,000
Rain Catchment Storage Tank (5,000 gallons)	$30,000

Incidental Construction Cost	$560,000
Estimated Total Cost	**$1,874,000**

Refer to Figure 22 for site plan alternative 1 for the Luluku project area.



LULUKU PROJECT AREA
SITE PLAN ALTERNATIVE 1

SCALE: 1"=40'

40 20 0 40 80

Graphic Scale in Feet

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HALAWA-LULUKU INTERPRETIVE DEVELOPMENT PROJECT

KANEOHE, OAHU, HAWAII

OWNER: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION
DEVELOPER: OFFICE OF HAWAIIAN AFFAIRS
TAX MAP KEY: 4-5-041:017

FIGURE 22
LULUKU PROJECT AREA
SITE PLAN ALTERNATIVE 1

4.2.2 Alternative 2

This alternative site layout will be aimed towards providing the Stewards with the basic essentials. Alternative 2 will include the following project elements: administrative center, storage container, composting toilet, and parking lot. The administrative center would provide an enclosed space with a small meeting area and office space. A storage container, similar to a shipping cargo container, would provide a substantial amount of storage space and have provisions to be secure. In addition, a parking area and a composting toilet will also be provided on-site for the community and visitors use. For the parking area to be provided on-site, the driveway will extend from Ho`omaluhia Park Access Road up into a small parking lot. The driveway will incorporate erosion control measures to address the current erosion occurring at the existing access way. Constructing these elements would require a clearing and grubbing permit and possibly a grading permit, depending on the locations of the project elements. See the table below for a breakdown of the estimated cost for Alternative 2. Incidental construction cost will include factors, such as, but not limited to, construction management, archaeological monitoring, geotechnical monitoring, construction surveying, and mobilization.

Project Element	**Cost**
Administrative Center (Trailer)	$360,000
Storage Container (ex. Matson Shipping Container)	$20,000
Composting Toilet (Single)	$100,000
Parking Lot (5-10 Stalls)	$250,000
Incidental Construction Cost	$316,000
Estimated Total Cost	**$1,046,000**

Refer to Figure 23 for site plan alternative 2 for the Luluku project area.

EASEMENT J
(FOR ACCESS AND WATERLINE PURPOSES)

OVERHEAD

OVERHEAD

TRUE NORTH
Scale: 1 in. = 40 ft.

STORAGE CONTAINER

PARKING AREA

RESTROOMS

OVERHEAD

ADMINISTRATIVE CENTER
(TRAILER)

HO'OMALUHIA PARK ACCESS ROAD

LULUKU PROJECT AREA
SITE PLAN ALTERNATIVE 2

SCALE: 1"=40'

40 20 0 40 80

Graphic Scale in Feet

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FIGURE 23
LULUKU PROJECT AREA
SITE PLAN ALTERNATIVE 2

4.3 Recommendation

Through consultation with the stakeholders a recommendation has been provided for the Luluku project area. The recommendation will be based on budgetary constraints, construction/mobility factors, and the capacity of management for the Stewards. At this time, alternative 2 will be the most suitable alternative for the Steward's needs. This alternative will be inclusive of the following project elements: administrative center, storage container, composting toilet and parking lot. The estimate cost for this alternative is $1,046,000.

For the purposes of this planning report, alternative 2 will be the recommended alternative moving forward into the design phase of this HLID project. During the design phase, collaboration and coordination will be required between the design team and Luluku Steward to develop a viable final design. Due to budgetary cost restraints and possible unforeseen conditions during design and construction, certain elements of the recommended site layout may be changed or altered.

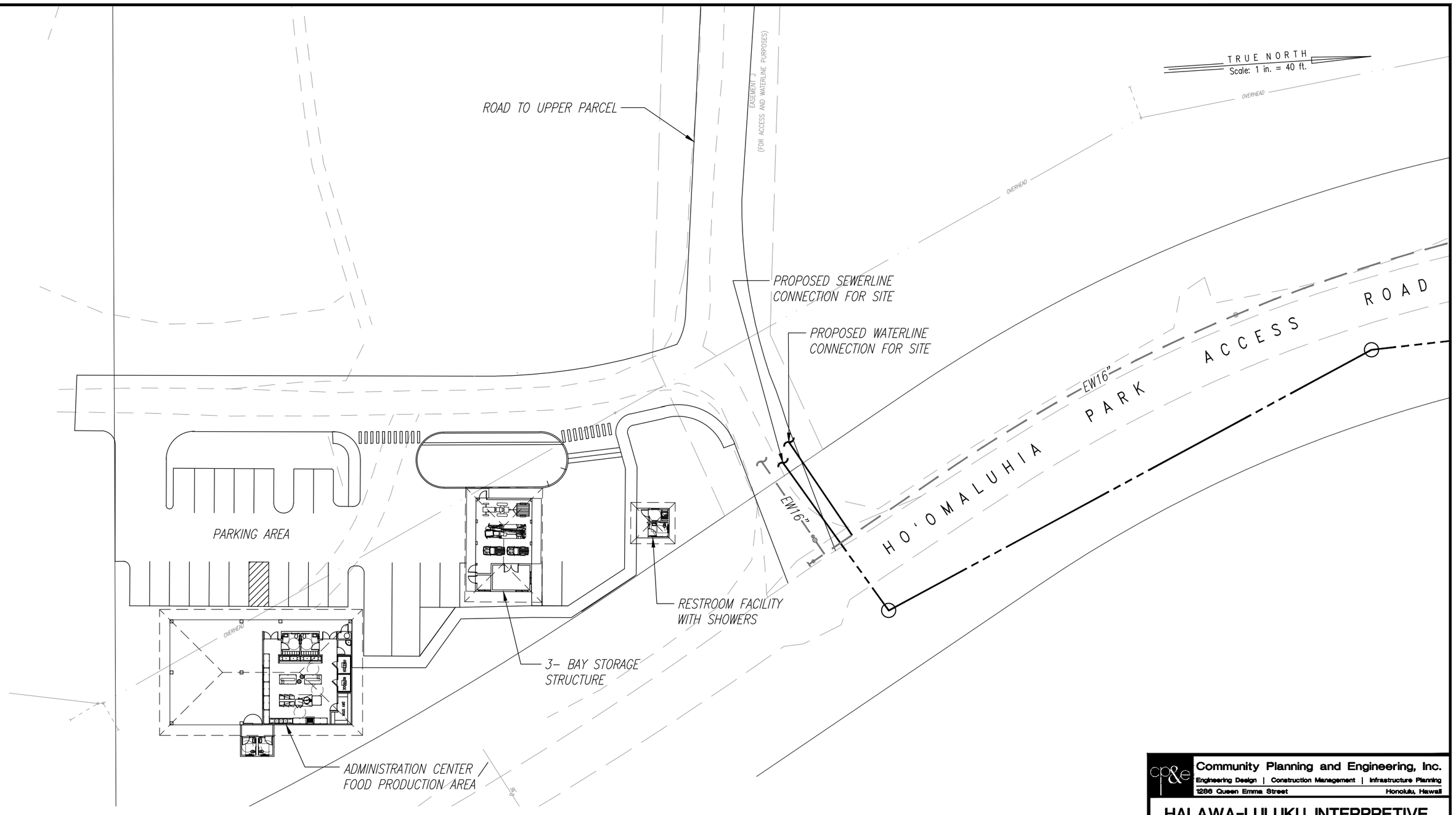
4.4 Future Growth Projections

As the community work towards their goals and visions for the Luluku project area, they will concurrently need to look at future expansion of their working area. Looking towards the future growth projections of the working group, an overall site layout was developed for Parcel 20 of the Luluku project site. This site layout would be inclusive of all the project elements discussed in the previous section. The site layout presented are only conceptual and will be subject to further coordination and consultation.

The overall site layout would include the following project elements: large administrative center, access road to the top of the berm, 3-bay storage structure, restroom facility with showers, parking lot area, bomb shelter mitigation, a greywater treatment system, a propane gas tank, and utility connection. Although this alternative would encompass such project elements, the site plan option may be costly. See the table below for a breakdown of the estimated cost for the overall site layout. Incidental construction cost will include factors, such as, but not limited to, construction management, archaeological monitoring, geotechnical monitoring, construction surveying, and mobilization.

Project Element	**Cost**
Large Administrative Center	$940,000
Access Road to Top of Berm	$800,000
3-Bay Storage Structure	$360,000
Restroom Facility w/showers	$300,000
Parking Lot (10-20 stalls)	$500,000
Bomb Shelter Mitigation	$2,000
Greywater Treatment System	$20,000
Sewer Service Connection	$500,000
Water Service Connection	$400,000
Electrical Service Connection	$200,000
Gas Service Tank	$7,000
Incidental Construction Cost	$1,693,000
Estimated Total Cost	**$5,722,000**

Refer to Figure 24 for the overall site layout for the Luluku project area.



LULUKU PROJECT AREA ULTIMATE SITE LAYOUT

SCALE: 1"=40'

40 20 0 40 80

Graphic Scale in Feet

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FIGURE 24
LULUKU PROJECT AREA
ULTIMATE SITE LAYOUT

Section 5 Summary

The Halawa-Luluku Interpretive Development Project was set out to initiate the mitigation process of the impacts to cultural and archaeological resources cause by the construction of the Interstate H-3. Through this feasibility report, various project elements were explored to determine the feasibility of incorporating such elements within the North Halawa Valley and Luluku project areas. The project elements and site layout alternatives presented in this report were aimed to assist the working community group (Stewards) with their vision for their respective project site. Through the exploration of the project elements and site layout alternatives for each project area, in addition to consultation with the stakeholders, a recommended site layout alternative was chosen. The recommended alternative was based on budgetary constraints, construction/mobility factors, and the capacity of management for the Stewards.

For the Luluku project area, the recommended alternative is summarized in the following table along with cost estimates:

Luluku	
Project Element	**Cost**
Administrative Center (Trailer)	$360,000
Storage Container (ex. Matson Shipping Container)	$20,000
Composting Toilet (Single)	$100,000
Parking Lot (5-10 stalls)	$250,000
Incidental Construction Cost	$316,000
Estimated Total Cost	**$1,046,000**

For the purposes of this planning report, the alternatives presented above will be the recommended alternative moving forward into the design phase of this HLID project. The estimated cost for these alternatives are rough budgetary estimates and is subject to change. During the design phase, collaboration and coordination will be required between the design team and Stewards to develop a viable final design. Due to budgetary cost restraints and possible unforeseen conditions during

design and construction, certain elements of the recommended site layout may be changed or altered.

Section 6 References

1. Halawa-Luluku Interpretive Development Team, Office of Hawaiian Affairs, 2014. *PROJECT DESCRIPTIONS: North Halawa Valley and Luluku Project Areas.*

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8. Water Resources Research Center and Engineering Solutions, Inc., 2008. *Onsite Wastewater Treatment Survey and Assessment*.

Appendix A – Permitting

There will be several Federal, State, and City and County of Honolulu permits and approvals that will need to be obtained to complete the project. The permits and approvals listed below may be required for the proposed project. Further consultation with the permitting agencies will be done in the design phase to determine if the permit/approval is required based on the chosen site layout and project elements. It is assumed that the nearby streams would not be altered. However, if the streams are altered, additional federal and local permits would be required.

State of Hawaii Permitting

Department of Health, Compliance Branch

The DOH Compliance Assistance Branch does not have permitting requirements but provides guidance to which agency within DOH should be consulted based on the scope of the proposed work.

Department of Health, Clean Water Branch

National Pollutant Discharge Elimination System (NPDES)

The DOH CWB has a responsibility to protect Hawaii's coastal and inland water resources. An NPDES permit from the CWB is required before any discharge of flow is released into State waters. Either a general or individual NPDES permit may be required for the discharge of dewatering effluent, stormwater, or wastewater. A Notice of Intent (NOI) must be submitted to the CWB a response shall be received within thirty days.

Section 401 Water Quality Certification (WQC)

The DOH CWB is authorized under Section 401 of the Federal Clean Water Act to administer the Section 401 WQC program in Hawaii. A WQC is required to apply for a Federal license or permit to conduct any activity including but not limited to the construction or operation of facilities which may result in any discharge into nearshore or inland waters.

Some activities including maintenance, utility line activities, temporary construction, and dewatering may be granted coverage under the Blanket Section 401 WQC developed by the 2012 Department of the Army NWP file number WQC0804.

Department of Health, Wastewater Branch

Plans Approval

DOH Wastewater Branch is responsible for the review and approval of planning/environmental documents, wastewater project plans and specifications, final construction inspections of wastewater projects, and assisting in enforcement activities in the joint Federal-County-State Wastewater Construction Grants

Program, the State Revolving Fund Program, and for regulating wastewater systems in accordance with Administrative Rule, Chapter 11-62, entitled, "Wastewater Systems."

Individual Wastewater System (IWS) Permit

A State Department of Health Individual Wastewater System permit is required to construct a new individual wastewater system. This permit involves owner, engineer, and contractor certifications/inspections, a site evaluation, percolation tests, approval of construction, site, and floor plans, approval of an operations manual, and approval of a sludge disposal plan.

Department of Land and Natural Resources (DLNR)

Stream Alteration Permit

A Stream Alteration Permit is required for any temporary or permanent activity within the stream bed or banks that may obstruct, diminish, destroy, modify, or relocate a stream channel; change the direction of flow of water in a stream channel; place any materials or structures in a stream channel; or remove any material or structure from a stream channel.

Stream Diversion Works Permit

A Stream Diversion Works Permit is required for the removal of water from a stream into a channel, ditch, tunnel, pipeline, or other conduit for off-stream purposes including agricultural uses.

Department of Health, Sanitation Branch

Application for Food Establishment

A Food Establishment Permit is required to operate a food establishment. This permit is valid for one year and the establishment is subject to DOH inspections. Items in the application may include plans and specifications of the food establishment, a list of food items to be offered, a Hazard Analysis and Critical Control Point (HACCP) plan, and an operational agreement between a food establishment and a support kitchen, if applicable.

Alternatively, a Special Events Permit may be obtained if food is produced specifically for a special event. The operations cannot exceed 31 days over a 365-day period.

If hand-pounded poi is exclusively produced, the activity would be exempt from needing a Food Establishment Permit. However, the site would need a sink on-site, need food labels, and the poi would need to be directly sold to the consumer.

Commercial imus are also subject to specific DOH requirements if constructed.

State Historic Preservation Division (SHPD)

Section 106

Any federally funded projects are subject to Section 106 Protection of Historic Properties of the National Historic Preservation Act (NHPA). The NHPA requires Federal Agencies to take into account the effects of the project on historic properties and to allow the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the project. The Federal Agency may also seek public comments.

Chapter 6E-8

Under Hawai Revised Statues (HRS) Chapter 6E-8 "Review of Effect of Proposed State Projects", SHPD shall be consulted to determine its potential to effect historic property, aviation artifact, or a burial site. A written concurrence from SHPD is required prior to commencement of construction.

Disability and Communication Access Board (DCAB)

Plan Review

DCAB reviews and provides recommendations on all State and County plans and specifications for buildings, facilities, and sites, as required under Hawaii Law HRS Chapter 103-50, in order to ensure that they are designed and constructed to be accessible to persons with disabilities.

Office of Conservation and Coastal Lands (OCCL)

Conservation District Use Application (CDUA)

A Conservation District Use Permit is required for any work activities within an area designated as the conservation district. The Conservation District is established by the State Land Use Commission and includes large areas of mountain and shoreline lands, virtually all traditional Hawaiian fishponds, and most submerged offshore lands. Maps displaying the boundaries of the Conservation District are available at DLNR.

Office of Environmental Quality Control (OEQC)

Environmental Assessment (EA) or Environmental Impact Statement (EIS)

Under the State's environmental review law, activities that trigger Chapter 343, HRS are required to prepare an EA or an EIS.

Department of Transportation, Highways

Lane Use / Occupancy Permit

A HDOT Lane Use / Occupancy Permit is required if there is a need to occupy a lane for construction activities adjacent to or within the HDOT Highways right-of-way.

Permit to Construct Within a State Highway

HDOT requires permits for the routine construction projects within the state highway right-of-way. This permit includes utility service connections, minor repairs, or minor adjustment of utilities. Permit applications are reviewed by the O'ahu District Office and require two sets of construction plans (including a traffic control plan), insurance, a minimum permit fee of $10, minimum bond of $1,000, and two sets of plans.

City and County of Honolulu Permitting

Department of Planning and Permitting

Building Permit

According to Revised Ordinances of Honolulu (ROH) Chapter 18, Section 18-3.1, a building permit is required for the following:

(1) Erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish any building or structure;

(2) Any electrical work;

(3) Install, remove, alter, repair or replace any plumbing, fire sprinkler, gas or drainage piping work or any fixture, gas appliance, or water heating or treating equipment; or

(4) Construct, reconstruct or improve any sidewalk, curb or driveway in any public street right-of-way

Flood Determination in General Floodplain District

Prior to processing any development plans for approval, a request for flood determination within the project area shall be submitted to DPP. This will determine the flood hazard district requirements and may initiate a flood study to be conducted for the project site.

Grading Permit

Projects with grading in excess of 50 cubic yards of cut or fill, or cut or fill of more than 3 feet would require a grading permit. Construction plans would have to be submitted to DPP for review and approval.

Grubbing Permit

Projects requiring clearing and grubbing of the site prior to any grading work being conducted will require a grubbing permit. Construction plans would have to be submitted to DPP for review and approval.

Sewer Connection Permit

A Sewer Connection Application is required for projects that will increase sewage flow to the municipal sewer system. This includes new sewer connections from unsewered lots and new commercial buildings.

DOH also requires a rejected City and County of Honolulu sewer connection application before their review of IWS permits.

Storm Water Quality

DPP requires different levels of storm water quality measures depending on the project's area of disturbance. Prior to starting work, an Erosion and Sediment Control Plan (ESCP) will have to be developed. The ESCP is a plan to prevent and control erosion and sediment discharge from the construction site. The project sites would likely be classified under a category 3 or 4. For project in those categories, construction drawings with a Best Management Practices (BMP) site plan, BMP design details, and other drawings must be included.

The projects sites would also be considered a priority B1 or B2 under the City's Water Quality Rules. Priority B1 projects are any new development that results in 5,000 square feet or more impervious area and/or parking lots with 20 stalls or more. Priority B2 projects are new developments that results in 500 to 5,000 square feet of impervious area. The design requirements for Priority B1 projects are stricter than Priority B2 projects. The runoff for Priority B1 projects must be kept on-site as much as possible and the runoff not retained on-site must be treated. This can be done by installing infiltration basins, permeable pavement, vegetative swales, bioretention, etc. A Storm Water Quality Report (SWQR) must also be prepared by a Certified Water Pollution Plan Preparer (CWPPP) and be approved by the DPP Director. Priority B2 projects, on the other hand, are not required to retain the runoff on-site. Also, the project would only need to a Storm Water Quality Checklist (SWQC) prepared by a CWPPP to be approved by the DPP Director. An Operations Manual (O&M) Plan would have to be prepared detailing how the BMP measures will be maintained.

Trenching Permit

If there is trenching of any public street, sidewalk, or thoroughfare, a trenching permit will be required. Trenching may be required for sewer or water connections. An ESCP would be needed with the trenching permit. Clearances from other City departments and utility companies having underground installations would have to be obtained. Bond and insurance are also required.

Department of Transportation Services

Street Usage Permit

A street usage permit is required for all work performed within the City and County of Honolulu right-of-way, parking on City and County of Honolulu roadways for

construction related activities, and roadway closure for construction related activities. Some construction activities may be subject to a required traffic control plan. Permit fees are required only when construction obstructs or uses metered parking spaces including on-street parking and municipal parking lots.

Honolulu Fire Department (HFD)

Permit for Tank Installation

A permit or license shall be obtained from the HFD's Fire Prevention Bureau to install or operate equipment in connection with the storage, handling, use, or sale of flammable or combustible liquids regulated, such as propane, for tanks with capacities of over 60 gallons.

Appendix B – Agency Responses

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET * HONOLULU, HAWAII 96813
Phone: (808) 768-8209 * Fax: (808) 768-4210

SEWER CONNECTION APPLICATION

APPLICATION NO.: **2019/SCA-0110** STATUS: **Approved**

DATE RECEIVED: **01/16/2019** IWDP APP. NO.:

PROJECT NAME: **2019/SCA-0110 Halawa-Luluku Interpretive Development Project**

$15,878.40
Estimated Wastewater System Facility Charge*

LOCATION:

SPECIFIC LOCATION: **Parcel 20 of H-3 Right of Way Near TMK: 4-5-041:009**

APPLICANT: **Camacho, Frank**
1286 Queen Emma Street
Honolulu, Hawaii 96813

DEVELOPMENT TYPE: **Schools (other)**

SEWER CONNECTION WORK DESIRED:

OTHER USES: **Administrative Building**
Tours with 100 Students
2 Employees

NON-RESIDENTIAL AREA: s.f.

APPROXIMATE DATE OF CONNECTION: **03/31/2019**

PROPOSED UNITS	EXISTING UNITS	UNITS TO BE DEMOLISHED
No. of New Units: **0**	No. of Existing Units: **0**	No. of Units to be Demolished: **0**
Studios:	Studios:	Studios:
1-Bedroom:	1-Bedroom:	1-Bedroom:
2-Bedroom:	2-Bedroom:	2-Bedroom:
3-Bedroom:	3-Bedroom:	3-Bedroom:
4-Bedroom:	4-Bedroom:	4-Bedroom:
5-Bedroom:	5-Bedroom:	5-Bedroom:
6-Bedroom:	6-Bedroom:	6-Bedroom:

REMARKS

APPROVAL DATE: **01/28/2019**

EXPIRATION DATE: **01/27/2021**

Valid 2-years after approval date. Construction plans shall be completed and approved within this 2-year period. Construction shall commence within 1-year after approval of plans.
** Applicable WSFC shall be collected at the prevailing rate in accordance with ROH 1990, Chapter 14, Sections 14-10.3, 14-10.4, 14-10.5 and Appendix 14-D.*

REVIEWED BY: ***Jon Coloma***

Site Development Division, Wastewater Branch

ExternalID: **064575845-001** JobId: **64575845**

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com

July 25, 2019

Mr. Laine Okimoto
Community Planning and Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

Dear Mr. Okimoto:

Subject: Your Email Dated May 21, 2019 Requesting Comments on the Availability of Water for the Proposed Office Buildings at Halawa Under the Viaduct, and at Luluku at Parcel 20 of the H-3 Right of Way, Tax Map Key: 9-9-010: 010; Near 4-5-041: 017

Thank you for your email regarding the proposed office buildings.

The existing water system is adequate to accommodate the proposed office building at the Halawa project site, under the viaduct (Tax Map Key [TMK]: 9-9-010: 010). However, please be advised that this information is based upon current data, and therefore, the Board of Water Supply (BWS) reserves the right to change any position or information stated herein up until the final approval of the building permit application. The final decision on the availability of water will be confirmed when the building permit application is submitted for approval.

The developer will be allowed to connect to the existing 16-inch waterline for the Luluku Site.

The existing water system cannot provide adequate fire protection to accommodate the proposed office/meeting building at the Luluku project site (near TMK 4-5-041: 017). The BWS Water System Standards (WSS) require a fire hydrant to be located fronting the property and provide a fire flow of 2,000 gallons per minute for commercial developments. The nearest fire hydrant, fire hydrant W-01331, is located approximately 2,034 feet from the property. Therefore, the developer will be required to install the necessary water system improvements to provide adequate fire protection in accordance with our WSS. The construction drawings should be submitted to BWS for approval.

When water is made available, the applicant will be required to pay our Water System Facilities Charges for resource development, transmission and daily storage.

The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

If you have any questions, please contact Robert Chun, Project Review Branch of our Water Resources Division at 748-5443.

Very truly yours,

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Appendix C – Reports

GEOTECHNICAL EXPLORATION REPORT

FOR HALAWA - LULUKU INTERPRETIVE DEVELOPMENT PROJECT
LULUKU PROJECT AREA
KANEOHE, OAHU, HAWAII

For:

Community Planning & Engineering, Inc.
1286 Queen Emma Street
Honolulu, HI 96813

By:

Geotechnical • Environmental • Construction Management
Testing • Inspection • Drilling & Sampling

CORPORATE HEADQUARTERS
94-547 Ukee Street, Suite No. 210
Waipahu, Hawaii 96797

Tel: (808) 676-6677 - Fax: (808) 676-7733 - Email: Secretary@pscconsultants.com
www.psc-hawaii.com

July 16, 2019 PSC Job No. 216301.10

GEOTECHNICAL EXPLORATION REPORT
FOR HALAWA - LULUKU INTERPRETIVE DEVELOPMENT PROJECT
LULUKU PROJECT AREA
KANEOHE, OAHU HAWAII

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PSC CONSULTANTS, LLC

GEOTECHNICAL EXPLORATION REPORT
FOR HALAWA - LULUKU INTERPRETIVE DEVELOPMENT PROJECT
LULUKU PROJECT AREA
KANEOHE, OAHU HAWAII

July 16, 2019 PSC Job No. 216301.10 - Luluku Project Area

INTRODUCTION

This report presents the results of our Geotechnical Study for the Luluku Project Area portion of the proposed Halawa-Luluku Interpretive Development (HLID) Project at the Luluku project area in Kaneohe, Oahu, Hawaii. The project site is shown on the Project Location Map, Plate 1. Our work was performed in accordance with the scope of work outlined in our proposal dated January 25, 2016.

The purpose of the HLID project is to mitigate some of the impacts to cultural and archaeological resources caused by the construction of Interstate H-3 based off the 1987 Memorandum of Agreement (MOA) between the Federal Highways Administration (FHWA), State Historic Preservation Division (SHPD), and Advisory Council on Historic Preservation (ACHP) which mandates prescribed mitigation actions for Interstate H-3 construction.

The scope of the project area has been defined to include certain portions of Luluku and North Halawa Valley. Through years of community outreach and the accumulation of archaeological data, an Interpretive Development was created to clearly identify impacts to cultural and archaeological resources caused by Interstate H-3 and to express the vision of the Working Group for healing the land as well as the community. The project is divided into the two project areas (North Halawa Valley and Luluku). This report reflects the Luluku Project Area site.

On the basis of the information provided to us, the Luluku project area will generally include construction of storage space, composting toilets, cultural resource complex/steward residence, security structure, grid power, potable/non-potable water, water catchments, grey water treatment system, farming, parking, roads/trails, fencing, native out planting, nursery facilities, aquaponics facilities, renewable power generation, meeting house, dining facility, outdoor learning areas and access roads.

This report summarizes the findings from our field exploration and laboratory testing, and presents our geotechnical engineering recommendations for feasibility planning derived from our analysis for the proposed Luluku Project Area. These recommendations are intended for planning and design input only.

Community Planning and Engineering, Inc. is the planner for this project and the clients include the Federal Highway Administration (FHWA), Historic Preservations Division (SHOPO) and the Advisory Council of Historic Preservation (ACHP).

PURPOSE AND SCOPE

Our Geotechnical Report for the proposed project provides a general overview of the subsurface conditions at the Luluku Project Area site. The subsurface information obtained will be used for the development of geoengineering recommendations for the site improvements including building foundations, and road and parking areas.

Our work was done in general accordance with our proposal dated January 25, 2016. The scope of work included the following:

1. Coordinate and schedule the soil investigation;

2. Secure clearances from various agencies and companies to obtain drilling access permits;

3. Drill two borings to depths of up to 16.5 feet below the existing ground surface;

4. Provide a field engineer to monitor the drilling operation, obtain soil samples at selected depth intervals, and maintain a log of the soils encountered within each boring;

5. Perform laboratory tests on selected samples to determine the relevant engineering properties of the near surface soils;

6. Analyze the field and laboratory data; and

7. Provide a written report summarizing our findings and recommendations.

FIELD EXPLORATION

Our field exploration program consisted of drilling and sampling two borings at the proposed Luluku project area. Borings were drilled to about 16.5 feet below the existing ground surface. The locations of the borings drilled are shown on Plate 2. Boring locations considered vehicular traffic, overhead obstructions, existing parking and roadways, existing walkways, buried lines, and accessibility of drilling rigs and trucks.

The borings were advanced using a truck-mounted drill rig equipped with 4-inch solid-stem augers. Samples of the surface soils were obtained at selected levels using a 3.0-inch O.D. by 2.4-inch I.D. split barrel Modified California (MC) sampler and a 2.0-inch O.D. by 1.5-inch I.D. Standard Penetration Test (SPT) sampler. The samplers were driven 18 inches using 140-lb hammer falling

30 inches. The number of blows required to drive the sampler for the last 12 inches are presented on the Log of Borings on Plates 4, 5, and 6. It should be noted that the blow counts using the MC Sampler were not converted to SPT blow counts on the Boring Logs.

Our field engineer classified the soils in the field by visual/manual methods. Soils are classified in accordance with the Unified Soil Classifications System shown on Plate 3. Graphic presentations of the materials encountered are presented on the Log of Borings.

SITE DESCRIPTION

The project site for the proposed cultural resource complex, access road and parking areas are generally located on the eastern portion of the Luluku Project Area in Kaneohe, Oahu, Hawaii. The project site is generally bordered by vacant land to the north and south, an existing access road to Ho`omaluhia Botanical Gardens to the east, and Likelike Highway to the west.

A topographic survey plan was not provided at the time this report was prepared; however, based on our field observations the general topography of the project site gradually slopes down from northwest to southeast. At the time of our field exploration, the project site was generally covered by moderate to heavy vegetation, including several large trees. In addition, unpaved and asphaltic concrete paved access roads were observed at the project site.

SUBSURFACE CONDITIONS

Our borings at the Luluku Project Area generally encountered alluvial soils consisting of medium stiff to stiff clayey silt extending down to the maximum depth explored of about 16.5 feet below the existing ground surface. Boring No. 2 was drilled in a pavement area and encountered a pavement structure overlying the alluvial soils consisting of about 2 inches of asphaltic concrete and about 10 inches of medium dense sandy gravel fill material.

We did not encounter groundwater in the borings at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

LABORATORY TESTING

Moisture Content

Moisture Content (ASTM D2216) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Atterberg Limits

Two Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits. The results are used to help classify the soil and to obtain an indication of the expansion and shrinkage potential of the spoil with changes in moisture content. The test results are summarized on the Logs of Borings at the appropriate sample depth. Graphic presentation of the Atterberg Limits test result is provided on Plate 6.

Ring Swell Test

A one-inch ring swell test was performed on a remolded sample to evaluate the swelling potential of the on-site soils. Results from the swell test can help indicate is the on-site soils have swell potential when subjected to moisture fluctuations. The ring swell test results are summarized on Plate 7.

California Bearing Ratio

One California Bearing Ratio (CBR) test (ASTM D1883) was performed on a selected bulk sample of the near-surface soils to evaluate the pavement support characteristics of the on-site soils. Results of our laboratory CBR tests are used pavement and foundation recommendations. The CBR test results for are presented on Plate 8.

DISCUSSION AND RECOMMENDATIONS

Site Preparation

At the onset of earthwork, the area within the contract grading limits should be cleared of trees, vegetation, debris, rubbish, boulders and other deleterious materials. These materials should be removed and properly disposed of offsite.

Areas to receive fill should be scarified to a depth of about 8 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place, dry density of soil expressed as percentage of the maximum dry density of the same soil established in accordance with ASTM Test designation D 1557. The optimum moisture content is the moisture content corresponding to the maximum compacted dry density.

Soft or yielding areas encountered during site preparation should be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick, loose lifts and compacted to a minimum of 90 percent relative compaction. It is important that the scarification and recompaction operations be performed in the presence of a representative of PSC Consultants, LLC (PSC).

Fills and Backfills

In general, the excavated on-site soils should be suitable for use as general fill materials, provided that they are free of vegetation, deleterious materials, and rock fragments greater than 3 inches in largest dimension. It should be noted that the project site is located in a high rainfall environment throughout the year; therefore, the in-situ soils will constantly be in a very moist to wet condition and drying or aerating the excavated materials may be necessary prior to their use as general fill.

Imported fill materials should consist of select granular fill material, such as crushed basalt or coral. The select granular fill should be well-graded from coarse to fine with particles no larger than 3 inches in largest dimension and should contain between 10 and 30 percent particles passing the No. 200 sieve. The material should have a laboratory CBR value of 20 or more and should have a maximum swell of less than 1 percent when tested in accordance with ASTM D1883.

Aggregate base materials should consist of crushed basaltic aggregates and should conform to Section 31 of the City and County of Honolulu, Department of Public Works, "Standard Specifications for Public Works Construction," dated September 1986. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Fill Placement and Compaction Requirements

As mentioned above, the project site is located in a high rainfall environment throughout the year; therefore, the in-situ soils will constantly be in a very moist to wet condition and drying or aerating the excavated materials may be necessary prior to their use as general fill.

General fill materials should be placed in level lifts not exceeding 8 inches in loose thickness, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to at least 90 percent relative compaction. Select granular fill materials should be placed in level lifts of about 8 inches in loose thickness, moisture-conditioned to above the optimum moisture, and compacted to at least 90 percent relative compaction.

Aggregate base and subbase course materials should be moisture conditioned to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 95 percent relative compaction.

Relative compaction refers to the in-place, dry density of soil expressed as percentage of the maximum dry density of the same soil established in accordance with ASTM Test designation D 1557. The optimum moisture content is the moisture content corresponding to the maximum compacted dry density.

Compaction should be accomplished by sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment. Water tamping, jetting, or ponding should not be allowed to compact the fills. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction. It should be noted that excessive vibrations from compaction equipment may soften the on-site soils with high in-situ moisture contents; therefore, vibrations should be carefully controlled during compaction efforts.

Excavations

Based on the anticipated grading and our field exploration, excavation for this project will generally consist of excavations for pavement structure, foundations, and infrastructure installation. Some of the excavations may encounter boulders and clusters of cobbles within the alluvial soils. It is anticipated that most of the materials may be excavated with normal heavy excavation equipment. However, deep excavations and boulder excavations may require the use of hoerams.

The above discussions regarding the rippability of the subsurface materials are based on field data from the borings drilled at the site. Contractors should be encouraged to examine the site conditions and the subsurface data to make their own reasonable and prudent interpretation.

Building Foundations

Based on the information provided and the subsurface conditions encountered at the project site, a shallow foundation system consisting of spread and/or continuous footings may be used to support the proposed building structure. We anticipate that 1 to 2 story buildings with relatively light loadings will be constructed. Due to the varying consistency and high in-situ moisture contents of the on-site soils, for 1 story buildings we recommend placing a minimum 18-inch thick layer of select granular fill material below the foundations to provide a firm and unyielding bearing layer. The select granular fill should also extend a minimum of 18-inches beyond the perimeter of the foundations. For 2 story buildings we recommend placing a minimum 24-inch thick layer of select granular fill material below the foundations to provide a firm and unyielding bearing layer. The select granular fill should also extend a minimum of 24-inches beyond the perimeter of the foundations. A non-woven geotextile fabric, such as Mirafi 180N or equivalent, should be provided below and along the sides of the non-expansive, select granular fill layer to reduce the penetration of the granular fill material into the soft and/or moist on-site soils.

An allowable bearing pressure of up to 2,500 pounds per square foot (psf) may be utilized for the design of building foundations bearing on minimum 18-inch thick layer of select granular fill material. This bearing value is for supporting dead-plus-live loads and may be increased by one-third (1/3) for transient loads, such as those caused by wind or seismic forces.

Footing subgrades should be recompacted to a firm surface prior to the placement of the geotextile fabric and select granular fill material. Soft and/or loose materials encountered at the bottom of footing excavations should be over-excavated to expose the underlying firm materials. The over-excavation should be backfilled with select granular fill material compacted to a minimum of 90 percent relative compaction. It should be noted that excessive vibrations from compaction equipment may soften the on-site soils with high in-situ moisture contents; therefore, vibrations should be carefully controlled during compaction efforts.

In general, the bottom of footings should be embedded a minimum of 24 inches below the lowest adjacent finished grades. Footings located adjacent to planned (or existing) retaining walls should be embedded deep enough to avoid surcharging the retaining wall foundations. Foundations next to utility trenches should be embedded below a one horizontal to one vertical (1H:1V) imaginary plane extending upward from the bottom edge of the utility trench, or the foundation should be extended to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

If foundations are designed and constructed in strict accordance with our recommendations, we estimate total settlements of the foundations to be less than 1 inch. Differential settlements between

adjacent footings supported on similar materials may be on the order of 0.5 inches or less.

Lateral loads acting on the structures may be resisted by friction between the base of the foundation and the bearing materials and by passive earth pressure developed against the near-vertical faces of the embedded portion of foundations. A coefficient of friction of 0.4 may be used for footings bearing directly on the minimum 18-inch thick layer of select granular fill material. Resistance due to passive earth pressure may be estimated using an equivalent fluid pressure of 300 pounds per square foot per foot of depth (pcf) assuming the soils around the footings are well compacted. Unless covered by pavements or slabs, the passive pressure resistance in the upper 12 inches below the finished grade should be neglected.

Concrete Slabs-On-Grade

Based on the results of our field exploration and laboratory testing, the near-surface soils exhibit a moderate expansion potential when subjected to moisture fluctuations. Therefore, we recommend placing a minimum 12-inch thick layer of non-expansive select granular fill material below the slab to reduce moisture changes in the slab subgrade soils. Placement of the non-expansive select granular fill layer would reduce the potential for future distress to the lightly loaded slabs-on-grade resulting from shrinking and swelling of the on-site soils due to changes in the moisture content. The layer of select granular fill would also serve as a protective layer or working platform since the site is located in a high rainfall environment. The non-expansive select granular fill should be compacted to a minimum of 90 percent relative compaction.

Prior to placing the non-expansive select granular fill, we recommend scarifying the subgrade soils to a depth of about 8 inches, moisture-conditioning the soils to at least 2 percent above the optimum moisture content, and compacting to a minimum of 90 percent relative compaction. The underlying subgrade soils and select granular fill should be wetted and kept moist until the final placement of slab concrete. Where shrinkage cracks are observed after compaction of the subgrade, we recommend preparing the soils again as recommended. Saturation and subsequent yielding of the exposed subgrade due to inclement weather and poor drainage may require over-excavation of the soft areas and replacement with engineered fill.

For interior building slabs (not subjected to vehicular traffic or machinery vibration), we recommend placing a minimum 4-inch thick layer of cushion fill consisting of open-graded gravel (ASTM C33, No. 67 gradation) below the slabs and above the non-expansive select granular fill layer. The open-graded gravel cushion fill would provide uniform support of the slabs and would serve as a capillary moisture break. To reduce the potential for future moisture infiltration through the slab and subsequent damage to floor coverings, an impervious moisture barrier is recommended on top of the gravel cushion fill layer. Flexible floor coverings, such as carpet or sheet vinyl, should be considered because they can better mask minor slab cracking.

Where the slabs will be subjected to equipment vibration and/or vehicular traffic, we recommend placing the floor slab over 6 inches of aggregate subbase in lieu of the 4-inch thick layer of cushion fill mentioned above. The aggregate subbase should consist of crushed basaltic aggregates compacted to a minimum of 95 percent relative compaction. Where slabs are intended to function as rigid pavements, a minimum slab thickness of 6 inches may be used for preliminary design purposes. Provisions should be made for proper load transfer across the slab joints that will be subject to vehicular traffic.

We anticipate exterior concrete walkways may be required for the proposed project. We recommend supporting concrete walkways on a minimum 12-inch thick layer of non-expansive select granular fill. The select granular fill should be compacted to at least 90 percent relative compaction. Control joints should be provided at intervals equal to the width of the walkways with expansion joints at right-angle intersections. The thickened edges of slabs adjacent to unpaved areas should be embedded at least 12 inches below the lowest adjacent grade.

It should be emphasized that the areas adjacent to the slab edges should be backfilled tightly against the edges of the slabs with relatively impervious soils. These areas should also be graded to divert water away from the slabs and to reduce the potential for water ponding around the slabs.

Pavements

We anticipate that asphaltic concrete (flexible) pavements are planned for the access roadway and parking areas. While traffic loading has not been specified, we anticipate that the vehicle loading for the access road and parking areas will consist primarily of passenger vehicles with some light trucks.

We have assumed that the pavement subgrade will consist of the on-site soils with high in-situ moisture contents. As discussed above, the project site is located in a high rainfall environment throughout the year and the in-situ soils will constantly be in a very moist to wet condition. Therefore, we recommend incorporating a layer of triaxial geogrid, such as Tensar TriAx Grid TX7 or equivalent, and non-woven geotextile fabric, such as Mirafi 180N or equivalent, between the aggregate base course and the underlying clayey silt subgrade soils.

To maximize the benefits of the triaxial geogrid, we understand that aggregate base course with nominal maximum size of 1.5 inches should be used. In general, the triaxial geogrid will interlock with the aggregate base course, resulting in two benefits during initial construction and for the life of the project: 1) lateral confinement – increasing the modulus of the aggregate base course, and 2) subgrade bearing capacity enhancement.

Based on the site conditions encountered and the above assumptions, we recommend using the following pavement sections for preliminary design purposes:

Flexible Pavement Section

2.0-Inch	Asphaltic Concrete
10.0-Inch	Aggregate Base Course
12.0-Inch	Total Pavement thickness on a layer of Reinforcing Geogrid (such as Tensar TriAx Grid TX7 or equivalent) and non-woven geotextile fabric (such as Mirafi 180N or equivalent) on Moist Compacted Subgrade

The above pavement section is based on the assumption that the actual pavement subgrade soils will be similar to the soils generally encountered during our field exploration and that adequate drainage will be provided for the paved areas. The pavement subgrade soils should be scarified to a minimum depth of about 8 inches, moisture-conditioned to about 2 percent above the optimum moisture content, and compacted to no less than 90 percent relative compaction.

Prior to placing the aggregate base course materials, the triaxial geogrid should be placed over the finished subgrade soils and rolled out flat and tight with no folds in accordance to the manufacturer's recommendations. Adjacent rolls of triaxial geogrid should be overlapped a minimum of 12 inches. Aggregate base course materials should consist crushed basaltic aggregates with a 1.5-inch maximum nominal size and should conform to Section 31 of the City and County of Honolulu, Department of Public Works, "Standard Specifications for Public Works Construction," dated September 1986.

CBR and density tests and/or field observations should be performed on the actual subgrade used for the road construction to confirm the adequacy of the above pavement section.

Road and Walkway Drainage

Subdrains should be provided where there is a possibility that runoff from rainfall or irrigation could saturate the subsurface soils. Exposed surface soils should be protected from erosive runoff by providing surface drains, diversion berms, sloping surface, concrete curbs, dry wells and other flood control devices.

Utility Trenches

Granular bedding consisting of 6 inches of No. 3B Fine gravel is recommended under the pipes. Free draining granular materials, such as No. 3B fine gravel (ASTM C 33, No. 67 gradation) should also be used for the trench backfill above and at sides of the pipes to provide support around the pipes and to reducing the potential for damaging the pipes.

CONCLUSIONS

Clayey silts with relatively high in-situ moisture contents will be a likely soil profile for this portion of the Luluku Project Area and the HLID project. The on-site soils exhibit moderate shrink/swell potential and relatively poor pavement support characteristics. Conventional earthwork and construction methods may be used for the proposed project grading.

In general, the excavated on-site soils should be suitable for use as general fill materials, provided that they are free of vegetation, deleterious materials, and rock fragments greater than 3 inches in largest dimension. It should be noted that the project site is located in a high rainfall environment throughout the year; therefore, the in-situ soils will constantly be in a very moist to wet condition and drying or aerating the excavated materials may be necessary prior to their use as general fill.

The information and recommendations presented in this report have been based upon the existing materials encountered at the site, and during construction PSC Consultants, LLC (PSC) should be notified in the event that soil conditions change so we can modify or amend our recommendations as necessary.

LIMITATIONS

The analysis and recommendations submitted in this report are based, in part, upon information obtained from two test borings and laboratory tests. Variations of subsoil conditions may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendation provided in this report.

PSC Consultants LLC selected the boring locations in this report. The boring locations were located by taping from existing features and structures shown on the plans. The physical locations and elevations of the test boring should be considered accurate only to the degree implied by the methods used.

This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., and their consultants for specific application to this project in accordance with generally accepted geotechnical engineering principles and practices. It may not contain sufficient data or proper information to serve the structural/civil engineer for their design work or a contractor wishing to bid on this project. No warranty is expressed or implied.

The owner/client should be aware that unanticipated soil/rock and cavity/soft spot conditions are commonly encountered. Unforeseen soil/rock conditions, hard layers, soft deposits, and cavities may

occur in localized areas and may require probing or corrections in the field (which may result in construction delays) to attain a properly constructed project.

The findings in this report are valid as of the present date. However, changes in the soil conditions, either natural or manmade, can occur with the passage of time. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period of two years.

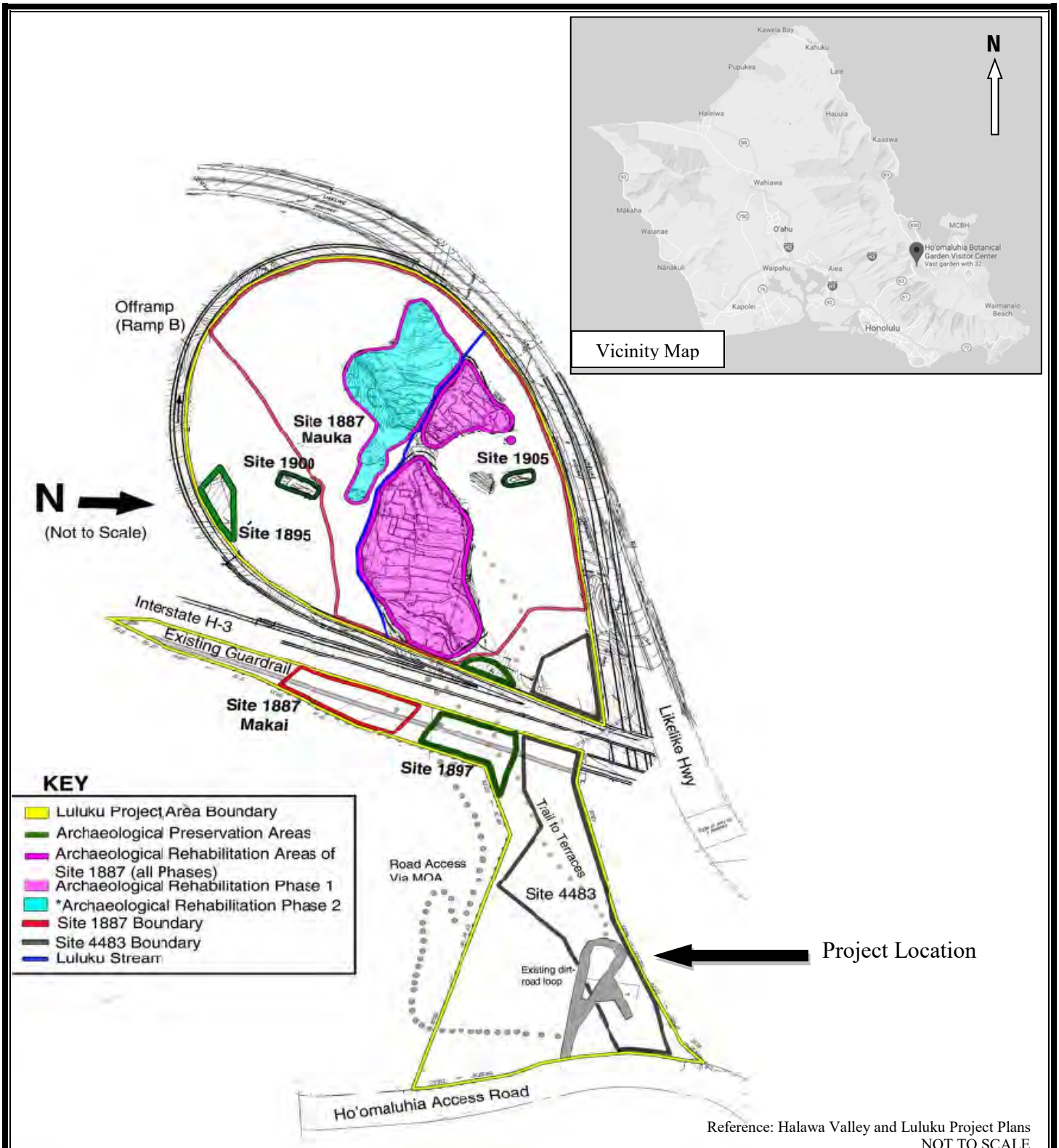
Respectfully submitted:
PSC CONSULTANTS, LLC

Derrick S. Chan, P.E.
President

This work was prepared by
me or under my supervision
(License Expires April 30, 2020)

Encl.:

Plate 1	Project Location and Vicinity Map
Plate 2	Boring Location Map
Plate 3	Unified Soil Classification System
Plate 4	Key to Log of Boring
Plate 5	Log of Boring B-1
Plate 6	Log of Boring B-2
Plate 7	Atterberg Limits Test Results
Plate 8	Ring Swell Test Results
Plate 9	California Bearing Ratio Test Results



Reference: Halawa Valley and Luluku Project Plans
NOT TO SCALE

Project Location and Vicinity Map

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019

PROJECT NO. 216301.10

PLATE NO. 1

LEGEND

Boring Location

NOT TO SCALE

Boring Location Map

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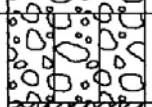
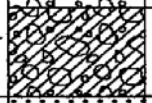
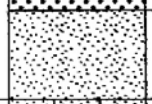
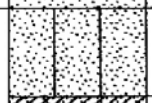
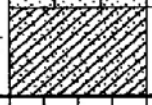
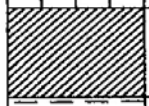
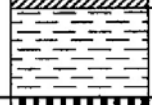
Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019

PROJECT NO. 216301.10

PLATE NO. 2

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
50 % OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN OR EQUAL TO 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

Unified Soils Classification System

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019

PROJECT NO. 216301.10

PLATE NO. 3

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	U.S.C.S	Graphic Log	MATERIAL DESCRIPTION	Pocket Pen./Torvane, tsf	Water Content, %	Relative Consistency	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. U.S.C.S: Type of material encountered.
7. Graphic Log: Graphic depiction of the subsurface material encountered.
8. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
9. Pocket Pen./Torvane, tsf: the reading from Poecket Penetrometer or Torvane.
10. Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
11. Relative Consistency: Relative consistency of the subsurface material.
12. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Asphaltic Concrete (AC)
Poorly graded GRAVEL with Silt (GP-GM)
SILT, SILT w/SAND, SANDY SILT (MH)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Key to Log of Boring

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Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019 | PROJECT NO. 216301.10

PLATE NO. 4

Date(s) Drilled **8/14/18**	Logged By **TL/JJP**	Checked By **AJF**
Drilling Method **CF Auger**	Drill Bit Size/Type **4-inch Solid-Stem Auger**	Total Depth of Borehole **16.5 feet**
Drill Rig Type **Mobile B59**	Drilling Contractor **GeoTek Hawaii, Inc.**	Approximate Surface Elevation **Unknown**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **SPT**	Hammer Data **140 lbs. at 30-inch drop**
Borehole Backfill **Soil Cuttings & Gravel**	Location **See Site Plan (Plate 2)**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	U.S.C.S	Graphic Log	MATERIAL DESCRIPTION	Pocket Pen./Torvane, tsf	Water Content, %	Relative Consistency	REMARKS AND OTHER TESTS
	0				MH		Brown CLAYEY SILT, medium stiff, moist (alluvium)				
			1	8				>4.5	56	LL=77, PI=39	
	5						grades to stiff				
			2	9				4.0	55		
	10						grades medium stiff to stiff				
			3	10				2.0	58		
	15						grades to medium stiff with multi-color mottling				
			4	7				2.0	55		
							Boring terminated at approximately 16.5 feet below the existing ground surface				
	20										

LOG OF BORING B-1

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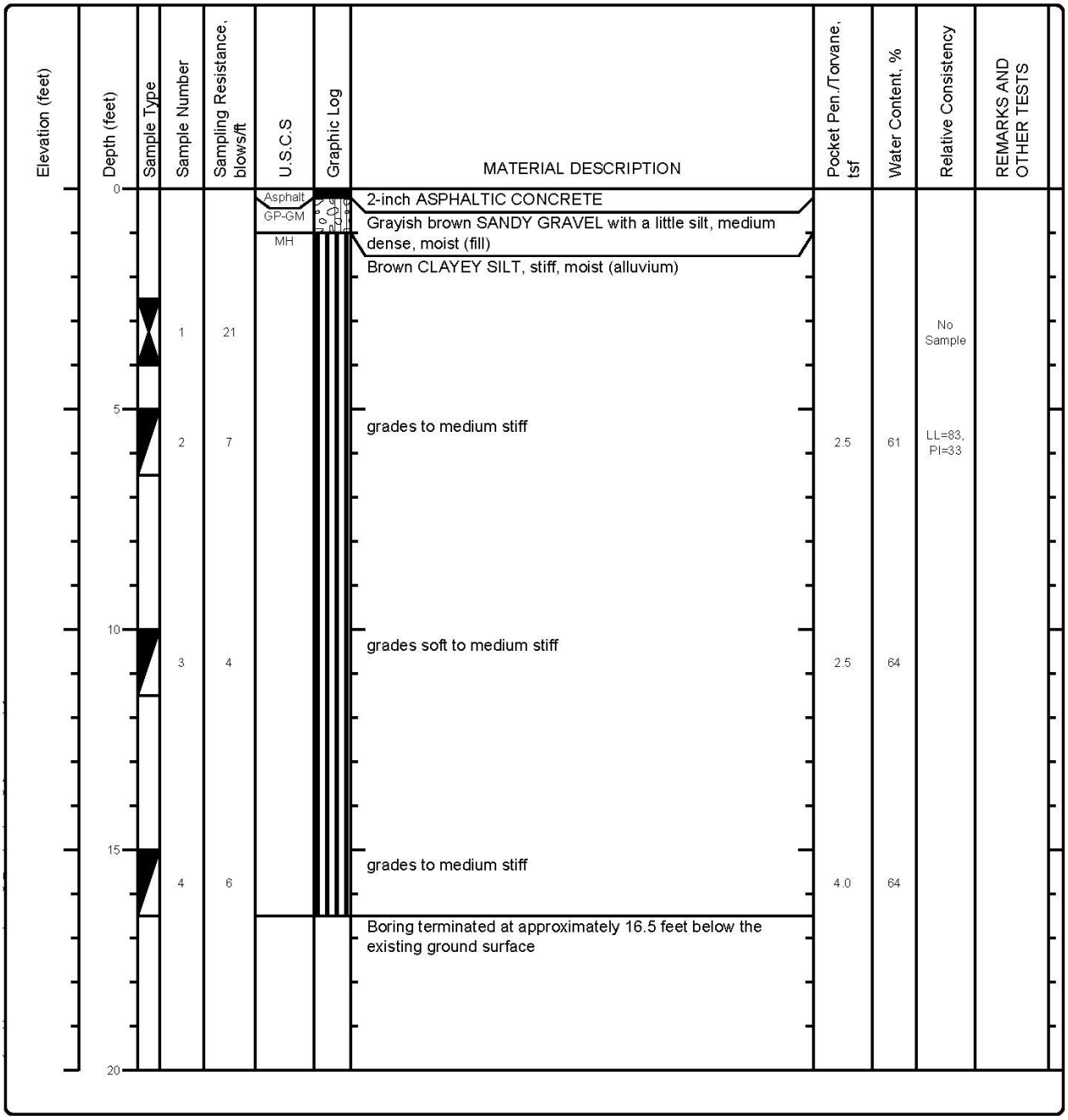
Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019 | PROJECT NO. 216301.10

PLATE NO. 5

Date(s) Drilled **8/14/18**	Logged By **TL/JJP**	Checked By **AJF**
Drilling Method **CF Auger**	Drill Bit Size/Type **4-inch Solid-Stem Auger**	Total Depth of Borehole **16.5 feet**
Drill Rig Type **Mobile B59**	Drilling Contractor **GeoTek Hawaii, Inc.**	Approximate Surface Elevation **Unknown**
Groundwater Level and Date Measured **Not Encountered**	Sampling Method(s) **RS/SPT**	Hammer Data **140 lbs. at 30-inch drop**
Borehole Backfill **Soil Cuttings, Gravel, AC Patch**	Location **See Site Plan (Plate 2)**	



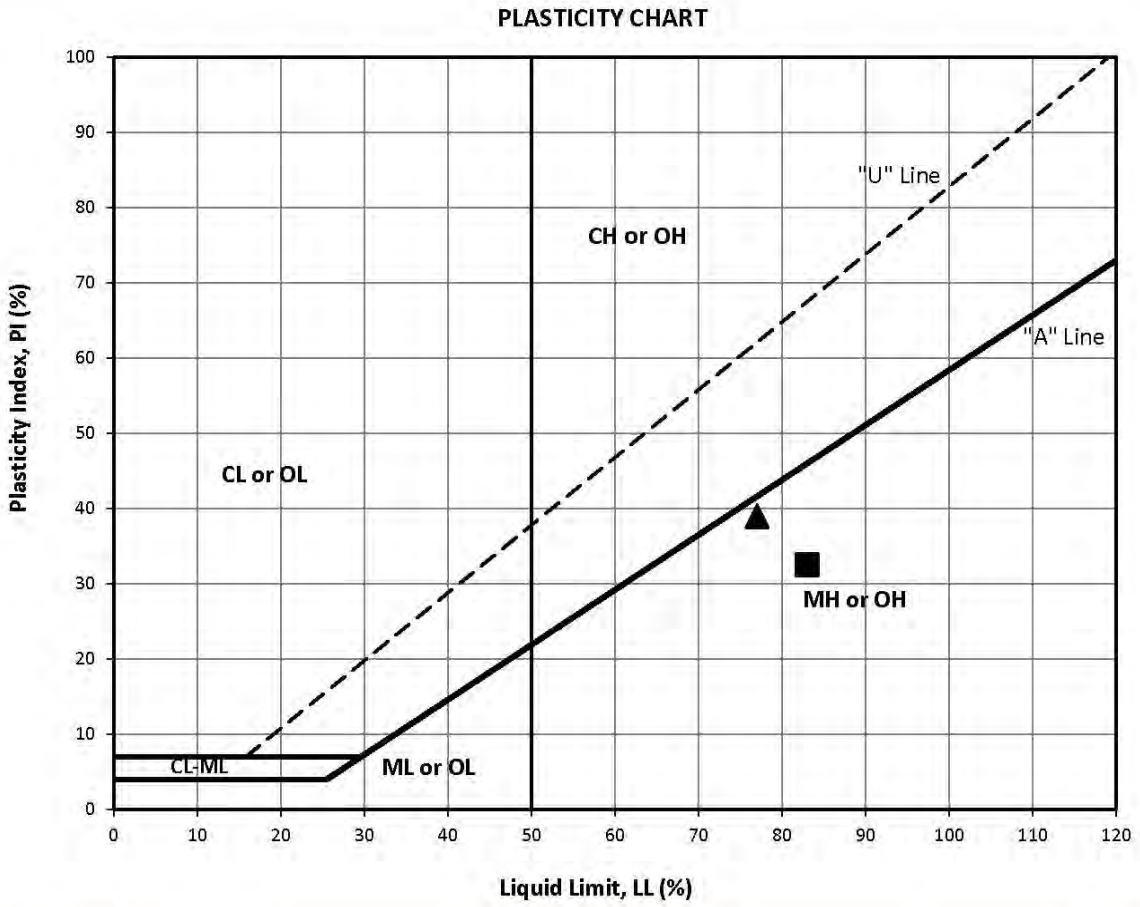
LOG OF BORING B-2

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019 | PROJECT NO. 216301.10

PLATE NO. 6



Symbol	Sample	Depth (feet)	Material Description	USCS	LL	PL	PI
▲	B-1	2.5 to 4.0	Brown CLAYEY SILT	MH	77	38	39
■	B-2	5.0 to 6.5	Brown CLAYEY SILT	MH	83	50	33

ATTERBERG LIMITS TEST RESULTS

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019

PROJECT NO. 216301.10

PLATE NO. 7

Location	Depth (feet)	Test Type	Soil Description	Dry Density (pcf)	Moisture Contents			Ring Swell (%)
					Initial (%)	Air-Dried (%)	Final (%)	
BULK-1	0 to 1	Remolded	Dark brown CLAYEY SILT w/ some sand and gravel	82.0	38	27	39	7.0

Note: Sample tested was remolded in a 2.4-inch diameter by 1-inch high ring. Sample was then air-dried overnight followed by saturating for a minimum of 24 hours under a surcharge pressure of 60 psf.

RING SWELL TEST RESULTS

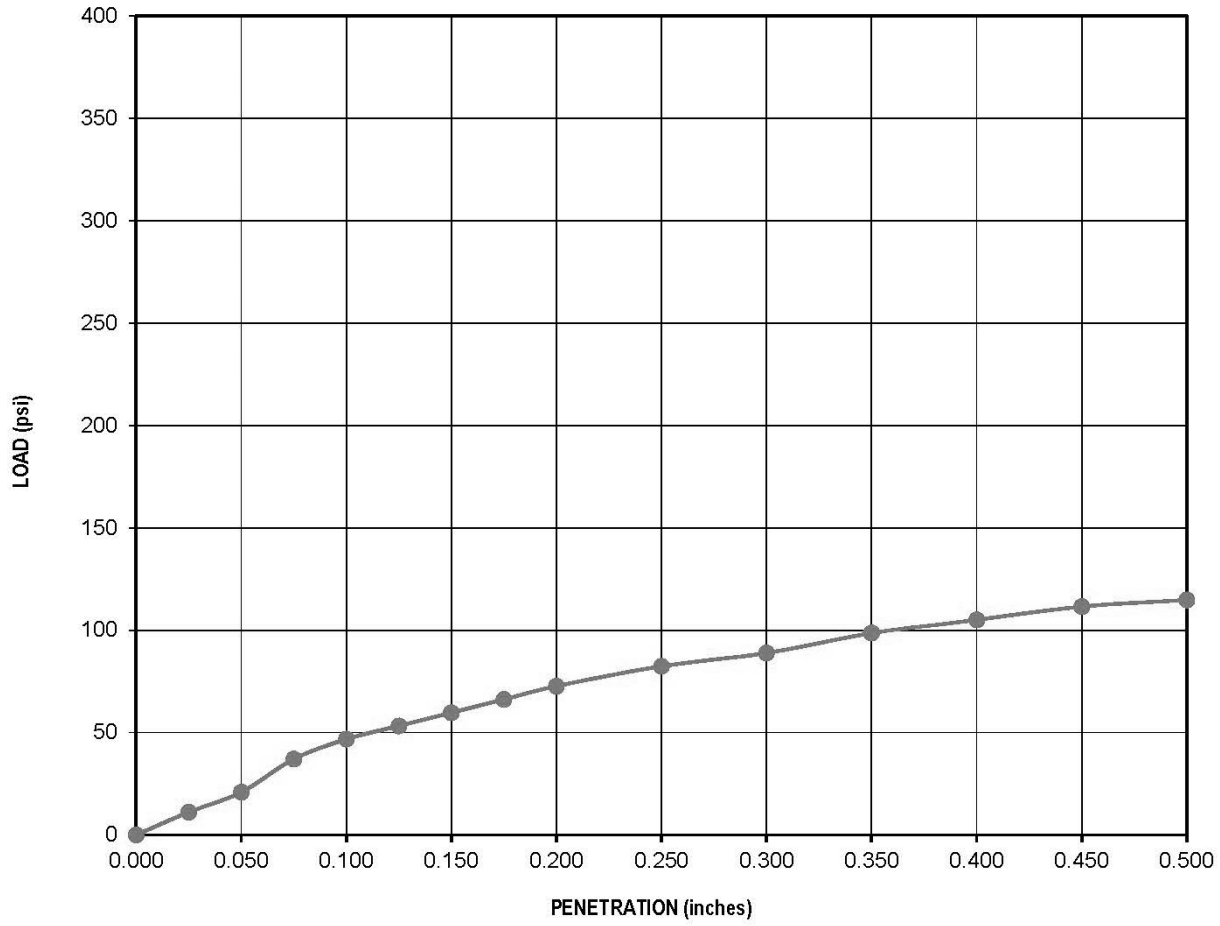
PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019

PROJECT NO. 216301.10

PLATE NO. 8



Location:	BULK-1
Depth:	0 to 1
Description:	Dark brown CLAYEY SILT w/ some sand and gravel
Molding Dry Density:	71.8 pcf
Molding Moisture:	50.1%
Days Soaked:	5
Aggregate:	¾-inch minus

Corrected CBR @ 0.1":	4.6
Corrected CBR @ 0.2":	4.6
Swell (%):	0.02

CALIFORNIA BEARING RATIO TEST RESULTS

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Luluku Project Area
Community Planning & Engineering, Inc.
Halawa - Luluku Interpretive Development Project
Kaneohe, Oahu, Hawaii

DATE: July 16, 2019 | PROJECT NO. 216301.10

PLATE NO. 9

Appendix D – Data Cut Sheets

West Oahu Aggregate Co., Inc.

Prices Effective 7/1/18

855 Umi Street
Honolulu, HI 96819
Ph. 808-847-7780/Fax 808-847-7782
www.woahawaii.com

PRICE LIST

YARDS DIMENSIONS	BIN COST	DUMP FEE	SUBTOTAL	TAX	TOTAL
10 (18'L X 8'W X 3'H)	350.95	287.95	638.90	30.10	$669.00
10 (11'L X 8'W X 5H)	350.95	287.95	638.90	30.10	$669.00
15 (13'L X 8'W X 5.5'H)	360.50	287.95	648.45	30.55	$679.00
20 (16'L X 8'W X 5'H)	376.73	287.95	664.68	31.32	$696.00
30 (22'L X 8'W X 6'H)	401.56	287.95	689.51	32.49	$722.00
40 (24'L X 8'W X 6'H)	436.90	287.95	724.85	34.15	$759.00

The above pricing includes up to:

- 5 tons of construction debris & $57.59 per ton thereafter
- 4 tons of green waste & $48.17 per ton thereafter
- 2 tons of household debris & $95.36 per ton thereafter

A second invoice will be generated if a bin exceeds the 5-ton weight limit.

Additional charges for the following:

- $150.00 relocation fee
- $32.25 standby fee, per 15 minutes (after the first 15 min.)
- $55.00 per each mattress
- $98.00 per ton, for loads containing carpets (2-ton minimum charge).
- $125.00 fee to reload unacceptable materials
- $75.00 per car tire
- $125.00 per truck tire
- $100.00 fee for graffiti cleaning/removal.
- **$20.00 per day, per bin, for bins kept beyond 10 calendar days**

Additional Handling Fees for Unacceptable Materials:

- $100.00 Minimum cleaning fee for Hazardous Materials, i.e. gas, paint, oxygen, chemicals, etc.
- $75.00 Auto parts (each item)
- $100.00 Each appliance, i.e. refrigerators, freezers, AC units, washing machines, dryers, water heaters, etc.
- $50.00 Each battery
- $50.00 Each Computer, copy machine, printer or each miscellaneous electronic equipment, etc.

NOTE:

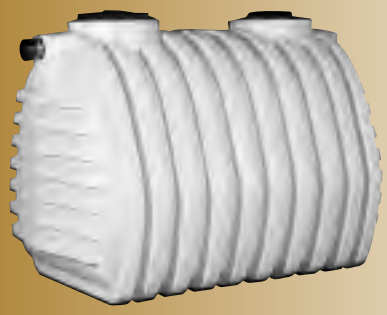
- Please call our office if you need to keep a bin longer than 10 calendar days.
- It is the customer's responsibility to contact our office to schedule a pick-up.
- Do not mix Green Waste with any other debris. Green Waste is defined by West Oahu Aggregate as anything that grows above the ground (trimmings, grass, etc.). All soil must be removed from green waste before placing in bin.
- All tree stumps can be no larger than 2' x 2' in size and should not be mixed with any other waste material.

NO SOIL IS ALLOWED IN BIN – UNLESS TESTED FOR CONTAMINANTS & FALLS BELOW HAWAII EAL LEVELS

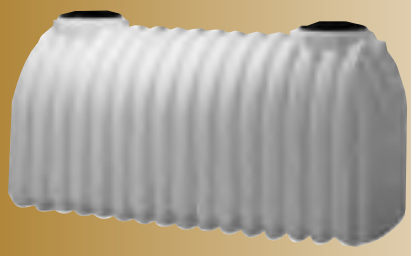
By accepting the delivery of the rental bin, you acknowledge and agree to the terms stated above.

We at West Oahu Aggregate thank you and appreciate your business!

Septic Tank



Underground Water Tank



IMPORTANT- Review tank handling, installation & use guidelines, pg. 20.

- The degree of translucency varies with wall thickness and tank color.
- Tank sizes are nominal. Capacities indicate approximate volume.
- Calibrations on molded tanks indicate approx. vol.
- Tanks UV stabilized for outdoor use.
- Go to chemtainer.com for updated product information.

Below Ground Septic Tanks - Two Compartment

CAPACITY (GAL)	SIZE (IN.)	FOB POINTS (1)
1000	102 x 60 x 58	CIFP,Tn
1250	116 x 55 x 66	CIFP,Tn
1500	143 x 55 x 66	CIFP,Tn

Below Ground Septic Tanks - Single Compartment

CAPACITY (GAL)	SIZE (IN.)	FOB POINTS (1)
300	54(DIA) x 51H	CIFP,Tn
500	60(DIA) x 64H	CI,Tn
500	101 x 51 x 42	IPF,Tn
750	96 x 52 x 58	PIC
1000	86 x 65 x 68	H
1000	102 x 60 x 58	IPF,Tn
1250	116 x 55 x 66	IPF,Tn
1250	86 x 76 x 68	H
1500	143 x 55 x 66	IPF,Tn

Bruiser Septic Tanks
- Single Compartment

CAPACITY (GAL)	SIZE (IN.)	FOB POINTS (1)
1000	60 x 102 x 58	NIPC,Tn
1250	55 x 116 x 66	NIPC
1500	55 x 133 x 66	NIPC,Tn

Bruiser Septic Tanks
- Two Compartment

CAPACITY (GAL)	SIZE (IN.)	FOB POINTS (1)
1000	60 x 102 x 58	NIPC,Tn
1250	55 x 116 x 66	NIPC
1500	55 x 133 x 66	NIPC,Tn

Below Ground Water Storage Tanks

CAPACITY (GAL)	SIZE (IN.)	FOB POINTS (1)
325	54 Dia x 51H	CIPF,Tn
550	64 Dia x 64H	CI,Tn
600	101 x 51 x 58	IPF,Tn
1000	86 x 65 x 68	H
1200	102 x 60 x 58	CIPF,Tn
1250	86 x 76 x 68	H
1700	143 x 55 x 66	CIPF,Tn

Septic & Water Tank Accessories

Item	
Manhole Extension	15 H x 20
Manhole Extension	24 H x 20
20" Lid & 12" Riser	
Septic & Water Tank Lid	20
Septic & Water Tank Lid	24

Septic Tank Plumbing Kits

Item	
Service Weight Sanitary	Schedule 40 Sanitary (2 ea)
Service Weight or Schedule 40	Service Weight Tee & Gasket (1 ea)

Material Selection

A brief description of our materials:

(Always refer to our Chemical Resistance Chart at **chemtainer.com** before selecting tank materials.)

1) Polyethylene

A high quality thermoplastic that has outstanding resistance to both physical and chemical degradation. The overall general toughness and excellent chemical resistance to a wide array of wet and dry industrial chemicals and food products make polyethylene ideally suited for storage tanks and containers. Polyethylene is translucent and its natural color ranges from slightly off white to creamy yellow, depending on wall thickness and type. Ultraviolet light stabilizers are added for use in outdoor applications. Colors are available on request for a nominal up charge.

A) Linear Polyethylene

Linear Polyethylene has superior mechanical properties, high stiffness, excellent low temperature impact strength and excellent environmental stress crack resistance. The linear polyethylene used by Chem-Tainer Industries meets specifications contained in FDA regulation 21CFR177.1520 (c) 3.1 and 3.2 and so may be used as an article or a component of articles intended for use in contact with food, subject to any limitations in the regulations. Maximum operating temperature for linear polyethylene is 140° F. weldable.

B) Crosslinkable Polyethylene

Crosslinkable polyethylene is a high density polyethylene that contains a crosslinking agent which reacts with the polyethylene during molding, forming a crosslinked molecule similar to a thermoset plastic. This reaction improves toughness and environmental stress crack resistance. Crosslinked Polyethylene (XLPE) is not weldable and does not meet FDA requirement 21CFR177.1520. Maximum operating temperature of crosslinked polyethylene is 150° F. Available only in limited sizes and styles. Please contact sales office.

2) Polypropylene

Polypropylene is a rigid plastic that has a higher operating temperature limit than polyethylene: 212° F. It offers good chemical resistance, has a high resistance to stress crack, and is autoclavable. Polypropylene (PP) is not recommended for applications in sub-freezing temperature or where high impact strength is needed. A rough, irregular interior surface is common characteristic of molded polypropylene. Available only in limited sizes and styles. Please contact sales office.

Model M54 Double
Specification Sheet

NSF Certification

The Clivus Model M54 is certified by the National Sanitation Foundation under Standard 41 (day-use, park).

Capacity

The M54 Double is comprised of two M54 Composters set side by side.

Volume For Each M54:

Solids storage capacity: 81 cubic feet; 604 US gallons

Liquid storage capacity: 40 cubic feet; 300 US gallons

Daily capacity at average temp. >65°F: 60 visits

Annual capacity at average temp. >65°F: 22,000 visits. Total annual capacity for M54 Double: 44,000 visits

Specifications and Materials

Dimensions

Kit Shipping Dimensions: Length: 122"; Width: 85.5"; Height: 114"

Pre-fabricated Shipping Dimensions (2 pcs):

Base: Length: 118"; Width: 65"; Height: 48"

Building: Length: 122"; Width: 85.5"; Height: 114"

Shipping Weight: 4,800 lbs (ships in several pieces; maximum weight of any piece is 2,400 pounds)

Assembled Building Dimensions:

Outside Length: 118"; Width: 132"; Height: 110"

Building Enclosure (inside)

Inside Length: 84"; Inside Width: 61.5"

Composter Base

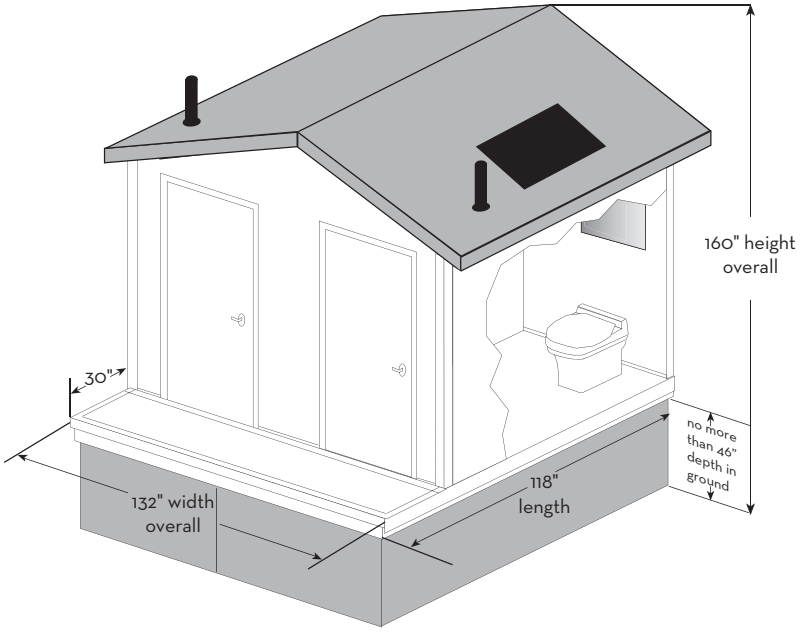
Length: 118"; Width: 65"; Height: 48"

Materials

Composter Base

Composter Base is rotationally molded high-density linear polyethylene resin that conforms with the following specifications:

- Density (ASTM TEST 4883): 0.942 g/cm3
- Tensile Strength at Yield (ASTM D638): 2.950 psi
- Dart Impact (-40°C, 250 mils thickness): 108 ft-lbs
- Envt. Stress Crack Resistance, 100% Igepal (D1693): 550 hrs



Building

Building walls are eight structural insulated panels (SIP) with expanded polystyrene core with fiberglass reinforced plastic over OSB interior finish and OSB exterior surface finished with 1" rough-sawn pine board-and-batten (other exterior finishes optional). Doors are 24 gauge cold rolled steel with zinc coating, factory painted medium gloss white, foamed-in-place polyurethane core; steel hinges; adjustable strike; frame milled from 5/4 kiln-dried pine; door opening: 36" x 80". Fixed window is 36" x 24" frosted lexan. Standard exterior is board and batten and custom painted.

Roof is two structural insulated panels (SIP) of 4" virgin expanded polystyrene faced with white fiberglass reinforced panels inside and OSB plywood outside for application of asphalt shingles or other finish.

Floor is expanded polystyrene core with 7/16" plywood underside with painted .016 aluminum skin and 7/16" plywood top surface with .08" non-skid rubber coating surface.

Standard package ships as a kit. Pre-fabrication is an option.

Ventilation

DC: 12V fan. Maximum free air is 100 cfm. Power input is 5 watts. CSA & UL approved. DC fan is powered by an optional photo-voltaic system customized for location and site requirements. Call for quotation. AC fan also available.

Toilets

Waterless toilets constructed of impact resistant fiberglass with sanitary white finish. Seat and lid are made of plastic; the liner is rotationally molded polyethylene. Grab bars and toilet paper holder included.

Toilet Height: 18"; Width: 18.5"; Length: 24.25"

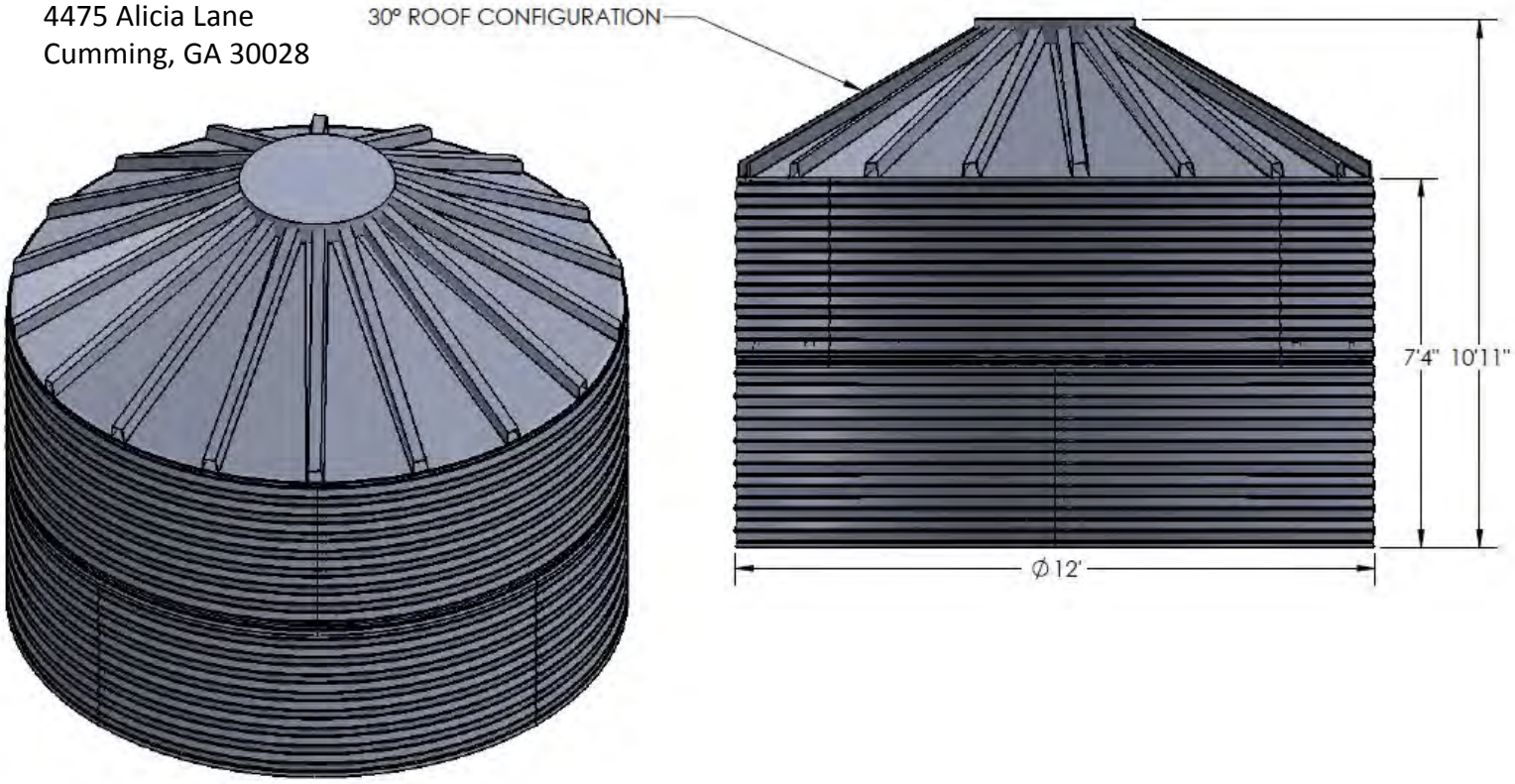
ADA Compliant

The M54 Trailhead conforms to the requirements for universal access of the Americans with Disabilities Act .

Provided by:

Dan Peters
Tel: 678-771-0098
E-Mail: Dan@RainHarvest.com

RainHarvest Systems
4475 Alicia Lane
Cumming, GA 30028



WATER STORAGE TANK PROJECT DATA SHEET

PART I – GENERAL SUMMARY:

A) Section includes: Requirements, including, but not limited to:

- Contain Water Systems Inc. Water Storage Tank.
- Interior Components.
- Accessories necessary for a complete installation.

B) Related work:

- Refer to water tank manufacturer drawings.
- Refer to civil documents.
- Refer to mechanical documents.

PART II – SUBMITAL DOCUMENTS:

- Accessory Specifications – Tank Manufacturer approved.
- Warranty Documents – Tank warranty must be 20 years minimum.
- Shop Drawings.

- Submittal Drawings.
- Coordination Drawings.
- Operations & Maintenance Data.

PART III – QUALITY ASSURANCE:

- Water Tank specifications & Warranties – To be a manufactured water storage tank meeting the above & below design requirements. Must have a minimum 20 year warranty, must have a minimum 40 mil liner for structural integrity, must have an NSF 61 approved potable liner for potential client application switchover in the future, must have minimal G115 Galvanizing on the tank walls & **tank roofs**, Estimations must be compliant with all AWWA Codes & Standards, OSHA Codes & Standards, Seismic Zones 4 Standards (Highest Seismic). All Tanks must come with a minimum 165 MPH Wind Rating. All other project code requirements must be listed here. Tanks must meet AWWA Standards & 2012 IBC Minimum.

PART IV - DELIVERY, STORAGE & HANDLING:

- Deliver Water Storage Tank, Systems & Accessories in original manufacturers packaging. Take necessary precautions to prevent damage to the system. Protect from damage during delivery, storage & handling.

PART V – PRODUCTS & MATERIALS:

A) Water Tank Engineering

WATER SYSTEMS ENGINEERING

WATER TANK COMPLETE WITH ROOF SCOPE AND SPECIFICATIONS PROJECT SPEC MUST INCLUDE: 20 YEAR WARRANTY, G115 GALVANIZING, MINIMUM 40 MIL NSF 61 APPROVED POTABLE WATER LINER WITH REINFORCMENTS & MINIMUM 165 MPH WIND LOADS.

- Estimation exceeds AWWA D103-09 Codes & Standards (American Water Works Association - Standards for bolted steel tanks) CWSI estimations are in compliance with all OSHA Codes & Standards, Seismic Zones 4D (most stringent) ASCE Structural design considerations, 165 MPH Wind Rating. 30 PSF Live Roof Loads. Designed to IBC 2015. NBC 2015, NSF 61 / ANSI Standards are also included.
- This water storage tank is a water storage product that uses a G115 corrugated galvanized steel cylindrical tank in conjunction with a liquid-tight 40 MIL NSF 61 Approved PVC liner. The tanks are built with a conical galvanized G115 steel roof. Tanks are designed to be constructed and anchored to a concrete foundation.
- The tank is designed to store water with a density of 62.4 lbs / cubic foot.
- Wall sheets are continuous 4” pitch x 1/2” depth corrugated galvanized steel with a minimum yield strength of 40,000 psi and a minimum tensile strength of 55,000 psi for 20 and 18 gauge

sheets. All heavier gauges have a minimum yield strength of 50,000 psi and a minimum tensile strength of 65,000 psi. The wall sheets are manufactured from G115 galvanized steel conforming to ASTM A653. Wall sheets have a 44" nominal coverage. Wall sheets have a coverage length of 9' 4-1/2" long. The wall sheets are connected with GR8.2 bolts along both the vertical and horizontal seams.

a. Vertical seams are punched for a staggered, double, triple or quad row connection at 2" on center.

b. Horizontal seams are a single lap connection with spacing of 9-3/8".

- Tanks are supplied with anchor brackets which bolt at the vertical seams and the center of the wall sheets.
- Water tank roofs have either a 30 degree slope, flat roof, dome roof, inverted roof or open top roof design and are made up of self-supporting roof sheets, and are designed for 30 PSF roof snow loads minimum.
- 12' through 48' diameter 30 degree roof panels are triangular in shape and have formed structural ribs along the radial edges to provide stiffness and strength. The 12' through 48' 30 degree roof panels extend past the eave to allow for drainage and are attached to the wall sheets with top ring angle sections that bolt around the entire circumference of the tank opening.
- The 27' through 48' diameter 30 degree roof panels are manufactured from G115 galvanized steel conforming to ASTM A653 GR40.
- The 15' to 48' diameter tanks come with formed steel roof ladder rungs that bolt between the roof ribs of a single panel, extending from eave to peak.
- The center opening for the 33' through 48' diameter tanks the opening is 53" in diameter.
- Each 15' through 48' diameter water tank comes complete with one roof panel complete with an inspection hatch, to be located at the eave next to the roof ladder. 24'' minimum.
- The 21' through 48' diameter roofs inspection hatch is circular with a 24" diameter.
- Water tanks are designed for 165 MPH wind speed, UBC Exposure C. With engineering packages to exceed higher seismic zones.
- Water tanks are designed for Seismic Zone 3 as standard. (Most stringent).
- All bolts and nuts are galvanized with JS-500 coating. Roof bolts are hex-head and have factory installed PVC washers under a wide-flange shoulder. Wall sheet bolts have slotted round heads with PVC washers for ease of installation and minimal interaction with the liner.
- All bolts meet SAE Grade 8.2 or stronger.
- The liner shall be made from a flexible NSF 61 Approved Potable PVC material capable of containing water. Minimum liner thickness shall be 0.040 inches & reinforced to comply with a 65 year life expectancy. All seams in tank liners are factory welded.
- The liner shall be suspended around the inside perimeter of the tank structure at the eaves with liner clips.
- Erection and installation manuals are supplied with each tank.

B) Valve & Drain Fittings

C) Overflow Piping

D) Clean Out

E) Pump

PART VI – EXECUTION & PREPERATION:

A) Install Water Storage System In accordance with manufacturer's specifications & instructions.

- Tanks to be field erected on customer supplied foundation. Engineering & design by others.
- Foundation recommendations are available from CWS.
- Water must be provided for the leak test at the expense of the customer. Water for the leak test should be considered as a part of the installation cost. If water is not made available to fill the tank immediately upon completion of the construction than the client will be responsible for re-mob costs for the repair. Water testing is a part of the completion of the tank.
- CWSI is installing a NSF 61 Approved Potable Water Liner, however, all potable systems must be disinfected prior to use. Without proper disinfecting within a 72 hour period the liner is no longer considered NSF 61 / ANSI Potable compliant. Additionally, all potable water storage tank customers must consult with a professional conveyance contractor to include U.V sterilization, chlorine rinse upon initial use, water circulation system, aerator and ozone generator. Without a proper system in place as mentioned above - this water storage tank is not considered compliant with NSF 61 / ANSI Potable Water Storage Standards and should not be used for human, animal or food irrigation consumption. Quality Control Steel provides a NSF 61 Potable Water Storage Tank but cannot guarantee the quality of water added nor the usability of the water without the proper conveyances listed above.

B) Foundation should be designed to support the weight of the water storage tank (full) & should be designed to meet local building codes.

C) Plumbing code

D) Piping

E) Refer to mechanical drawings

F) Refer to civil drawings

G) Refer to site drawing

PART VII – FINAL NOTES AND WARNINGS:

- Twenty Year Manufacturer's Structural Warranty on materials and workmanship when assembled by CWSI or certified experts.
- One year Manufacturer's Workmanship Warranty when assembled by CWSI or certified experts.
- One year structural warranties are available for tanks sold as supply only and installed by others.
- All Water Tanks are installed as per manufactures installation instructions and therefore a Water Test and a Sign Off by the customer are required at the completion of the installation with the understanding the water tank has been installed to the best of CWS's ability and within the guidelines set out by the manufacture.
- Further mobilizations to site for potential Warranty work will be as per standard warranty description guidelines.
- Permits, soils testing, foundation engineering, or inspections if required, are not included in this proposal, unless otherwise stated.

Vertical Water Storage Tanks

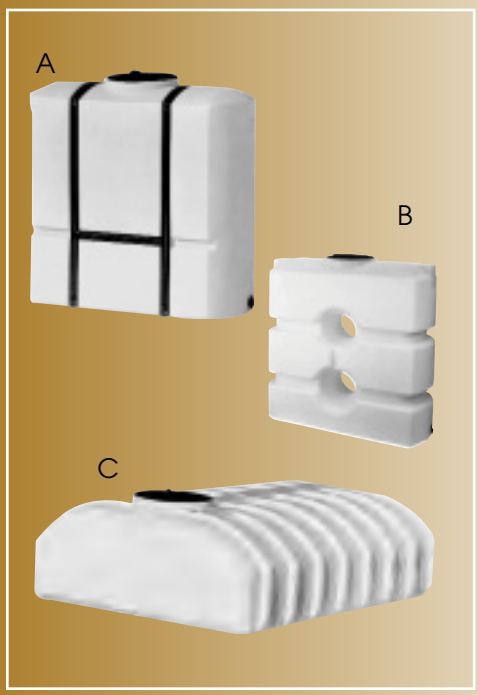
IW Series

- Economical way to store potable (drinking) water for Residential and Commercial applications.
- Resin complies with U.S. Food and Drug Administration regulation 21CFR 177.1520(1) 3.1 and 3.2 for storage of potable water. These tanks are designed for water use only.
- Green color reduces algae growth and blends with the environment.
- Comes complete with threaded inlet /outlets and a vented twist entry.

CAPACITY (GAL)	SIZE DIA. X HT (IN.)	VENTED MANWAY (IN)	FOB POINTS (1)
45	18 x 51 (3)	4	CIP,Tn
65	23 x 42	8	CIPF,Tn
100	23 x 64	8	CIPF,Tn
110	35 x 36 (5)	8	CIPF,Tn
130	23 x 76	8	C
165	31 x 58	8	CIPF,Tn
200	31 x 72	16	CIP,Tn
300	35 x 81	16	CIP,Tn
500	64 x 42	16	CIPF,Tn
500	46 x 76	16	CFP,Tn
550	45 x 94	16	CF
650	56 x 70	16	C
750	46 x 119	16	CIP,Tn
850	48 x 124	16	CIP,Tn
1000	64 x 81	16	CIPF,Tn
1000	69 x 74	16	C
1500	64 x 121	16	CIPF,Tn
1550	87 x 65	16	CIP,Tn
1700	86 x 74	16	Tn
2000	64 x 144	16	CIPF,Tn
2500	95 x 89	16	CI,Tn
3000	95 x 107	16	CI,Tn
4000	95 x140	16	CI,Tn
4000	102 x 125	16	C
5000	102 x 152	16	CIP,Tn
10000	141 x 160	16	C

(1) Subject to stocking inventory
(3) 45 Gal. has inverted calibrations
(5) 110 Gal. has side indents for fork lift handling

45 - 165 Gals: have 1" inlet and 1.5" outlet standard 300 Gals and up: have 1.5" inlet and 2" outlet standard. Outlets are located close to top and bottom, in line.



Specialty Water Tanks

- 375 and 400 gallon tanks allow fit through conventional doorway. The 400 gallon tank is designed to be free standing and self-supporting.

CAPACITY (GAL)	SIZE W X H X L (IN.)	OUTLET SPECS.	VENTED MANWAY (IN.)	FOB POINTS (1)
375 (A)	30 x 60 x 62	1.25"	16	CIP,Tn
400 (B)	29 x 65 x 60	1.25"	16	CIP,Tn
1250 (C)	80 x 35 x 132	2"	16	CIP,Tn
1500 (C)	81 x 41 x 130	2"	16	CIP,Tn
2400 (C)	90 x 51 x 149	2"	16	CIP,Tn

(1) Subject to stocking inventory

IMPORTANT- Review tank handling, installation & use guidelines, pg. 20.
- The degree of translucency varies with wall thickness and tank color.
- Tank sizes are nominal. Capacities indicate approximate volume.
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A) Linear Polyethylene

Linear Polyethylene has superior mechanical properties, high stiffness, excellent low temperature impact strength and excellent environmental stress crack resistance. The linear polyethylene used by Chem-Tainer Industries meets specifications contained in FDA regulation 21CFR177.1520 (c) 3.1 and 3.2 and so may be used as an article or a component of articles intended for use in contact with food, subject to any limitations in the regulations. Maximum operating temperature for linear polyethylene is 140° F. weldable.

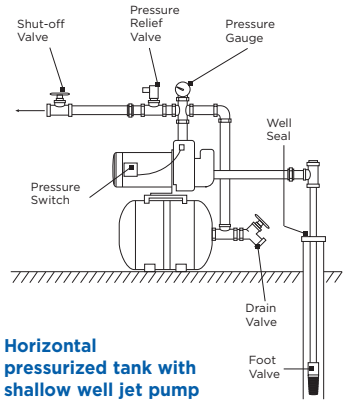
B) Crosslinkable Polyethylene

Crosslinkable polyethylene is a high density polyethylene that contains a crosslinking agent which reacts with the polyethylene during molding, forming a crosslinked molecule similar to a thermoset plastic. This reaction improves toughness and environmental stress crack resistance. Crosslinked Polyethylene (XLPE) is not weldable and does not meet FDA requirement 21CFR177.1520. Maximum operating temperature of crosslinked polyethylene is 150° F. Available only in limited sizes and styles. Please contact sales office.

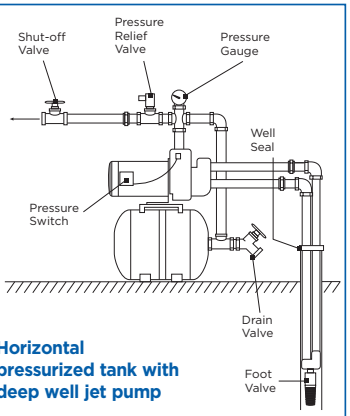
2) Polypropylene

Polypropylene is a rigid plastic that has a higher operating temperature limit than polyethylene: 212° F. It offers good chemical resistance, has a high resistance to stress crack, and is autoclavable. Polypropylene (PP) is not recommended for applications in sub-freezing temperature or where high impact strength is needed. A rough, irregular interior surface is common characteristic of molded polypropylene. Available only in limited sizes and styles. Please contact sales office.

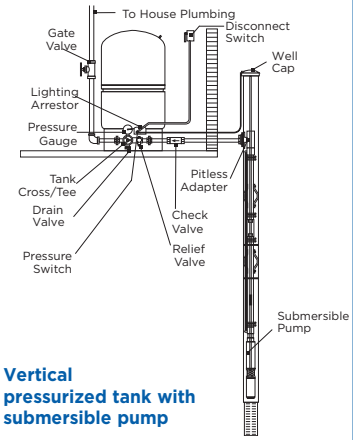
Typical Tank Installations



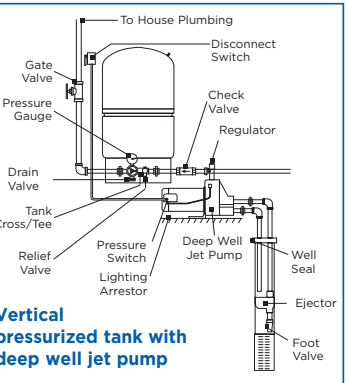
Horizontal pressurized tank with shallow well jet pump



Horizontal pressurized tank with deep well jet pump



Vertical pressurized tank with submersible pump



Vertical pressurized tank with deep well jet pump

Tank Selection Guide

Tank Volume	2	4-4 1/2	6-9	14-16	20-24	25-29	30-36	37-46	47-65	85-96	109-120
Water Worker	**HT-2B**	**HT-4B**	**HT-8B**	**HT-14B**	**HT-20B**	**HT-30B**	**HT-32B**	**HT-44B**	**HT-62B**	**HT-86B**	**HT119B**
Champion	-	-	-	CH3001	CH4202	CH6000	CH8003	CH10050	CH12051	CH17002	CM22050
Challenger	PJR6	PJR15	PJR25	PC44	PC66	PC88	PC122	PC144	PC211	PC266	PC366
Con-Aire	-	-	-	CA15	-	CA42	-	CA82T	CA120	CA220	-
Flo-Tec	FP7105	FP7100	-	-	FP7110	-	FP7120	FP7125	-	FP7130	FP7135
Goulds Hydro-Pro	VP6	V15P	V25P	V45	V60	V80	V100	V140	V200	V250/ V260	V350
H2 Pro	PJR6	PJR15	PJR25	WWT-14	WWT-20	WWT-25	WWT-35	WWT-45	WWT-65	WWT-85	WWT-120
Mark Series	CM1001	CM1002	CM1003	CM3001	CM4202	-	CM8003	CM10050	CM12051	CM17002	CM22050
Pro-Source/Plus	-	-	-	PS30	PS42/ PSP19	-	PS82/ PSP32/ PSP35	PS120	PS200/ PSP50-PSP62	PS220/ PSP85	PSP119
Red Lion	RL2	RL4	RL8	RL14	RL20	-	RL33	RL44	RL62	RL81	RL119
Standard Galvanized	5	12	18	30	42	82	82	120	220	220	315
State Perma-Air	PIL-2	PIL-5	PIL-7	PAD-14	PAD-20	-	PAD-31 PAD-36	-	PAD-52	PAD-86	PAD-119
Wel Flo	-	WF15	WF25	WF45	WF60	WF80	WF100	WF140	WF200	WF240	WF360
WellMate	WM-8L	WM-18L	WM-25L	WM-4	WM-6	-	WM-9	WM-14	WM-20	WM-25	WM-35
Well-Rite	PJR6	PJR15	PJR25	WR45	WR60	WR80	WR120	WR140	WR200	WR260	WR360
Well-X-Trol	WX-101	WX-102	WX-103	WX-201	WX-202	WX-202XL	WX-203	WX-250	WX-251	WX-302	WX-119

Additional Parts Required For Installation

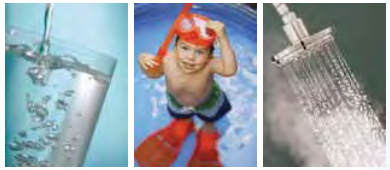
Recommended Tools

Drawdown

Model No	Water Worker Capacity (gal.)	Drawdown (gallons)		
		20/40	30/50	40/60
HT-2B	2.0	0.73	0.62	0.54
HT-4B	4.4	1.61	1.36	1.18
HT-8B	7.4	2.78	2.35	2.03
HT-6HB	5.3	1.94	1.64	1.42
HT-14HB	14.0	5.12	4.33	3.75
HT-14B	14.0	5.12	4.33	3.75
HT-20B	20.0	7.31	6.18	5.35
HT-30B	26.0	8.78	7.42	6.43
HT-32B	32.0	–	9.89	8.57
HT-44B	44.0	16.09	13.60	11.78
HT-62B	62.0	22.67	19.17	16.60
HT-86B	86.0	31.44	26.58	23.03
HT-119B	119.0	43.51	36.79	31.86

WATER WORKER

Well Tank Selection Guide

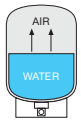


www.waterworkerdiy.com

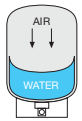
Tank Operation

All well systems require a pre-pressurized well tank to provide a buffer of stored water. Without supplemental storage, small water uses like running a faucet or flushing a toilet would cause rapid pump cycling. This can lead to potential pump failure - an expensive repair or replacement often costing thousands of dollars.

1. As the pump fills the tank with water, the air above the diaphragm is compressed. This increases the pressure in the tank and causes the pressure switch to turn off the pump.



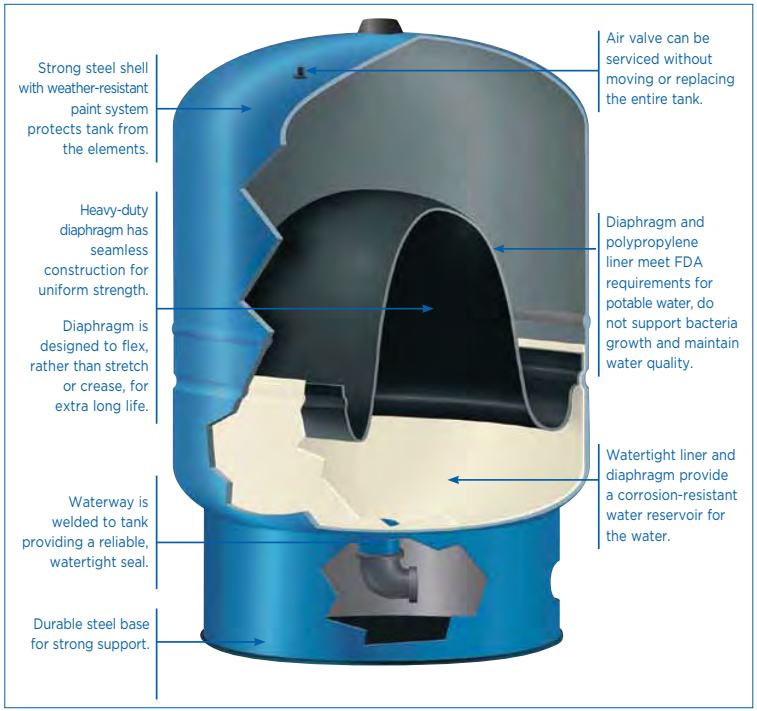
2. When water is drawn from the tank, pressure inside the tank decreases until the pressure switch starts the pump. The amount of water delivered between pump cycles is called drawdown. The greater the drawdown capacity, the less the pump needs to run, saving energy and money, and extending pump life.



3. As water is drawn from the tank, the reduced pressure starts the pump and refills the tank.

Tank Features

Water Worker® Well Tanks are made in the USA, easy to install and specifically designed for years of dependable, trouble-free, energy-saving operation.



Tank Selection

Count the number of water fixtures and select the closest tank size according to the chart.

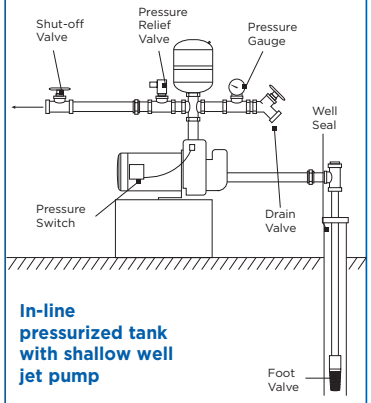
Example: For a home with 3 sinks, 3 toilets, a dishwasher, shower, bathtub, washing machine and an outside faucet, (11 water fixtures) the correct tank size would be: HT-44B.

There are no disadvantages to having a larger well tank. The larger the tank, the fewer pump cycles – extending pump life and saving electricity. Larger tank sizes will also increase the water storage volume to provide more consistent pressure.

Number of Water Fixtures	WaterWorker Capacity (gal)	Model No.	Epoxy Tank Equivalent (gal)
2	2.0	HT-2B	—
2	4.4	HT-4B	12
2	5.3	HT-6HB	12
3	7.4	HT-8B	20
4	14	HT-14B	30
4	14	HT-14HB	30
6	20	HT-20B	42
6	20	HT-20HB	42
8	26	HT-30B	—
10	32	HT-32B	82
14	44	HT-44B	120
20	62	HT-62B	—
28	86	HT-86B	220
40	119	HT-119B	315

The design of a Water Worker tank is much more efficient than an epoxy tank. This allows a smaller Water Worker tank to deliver the equivalent performance as compared to a much larger galvanized or epoxy tank.

Typical Tank Installation



In-line pressurized tank with shallow well jet pump

WATER WORKER®

www.waterworkerdiy.com

MC#7230 (05/12)

SCALA2
PERFECT WATER PRESSURE
FULLY INTEGRATED - COMPACT DESIGN - EASY TO INSTALL

GRUNDFOS SCALA2 is a fully integrated water booster pump delivering perfect water pressure to all taps. It features pump, motor, tank, sensor, drive and non-return valve in one compact unit that installs quickly and easily.

With its intelligent pump control, SCALA2 adjusts performance to any demand – and with its water-cooled motor, it offers one of the lowest noise levels in its class. The result is maximum comfort with minimum effort.

Key features
- Intelligent pump control
- Water-cooled, permanent magnet motor
- Dry running protection
- Self-priming
- User friendly control panel
- Outdoor-ready
- Easy sizing and selection

be
think
innovate

GRUNDFOS

APPLICATIONS

SCALA2 is designed for pressure boosting in single family houses and apartments.

Boosting from mains: Increases the water pressure delivered by city mains.

Boosting from tanks: Increases water pressure from roof tanks, break tanks and ground tanks, including rainwater tanks.

Boosting from wells: Pumps water from a depth of up to 26 feet (8 meters).

Indoor and outdoor installation: NEMA 3

BENEFITS

Perfect water pressure: Intelligent pump control adjusts operation to ensure perfect water pressure at all times.

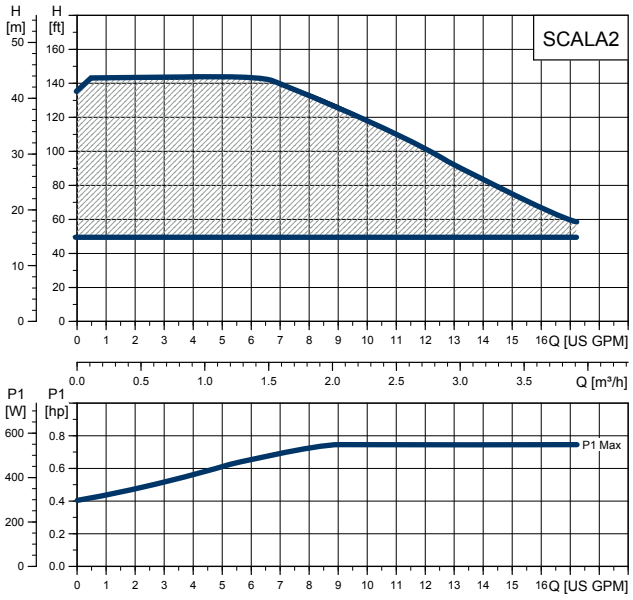
Low noise: With a noise level of 47 dB(A) in typical use, SCALA2 is one of the quietest boosters in its class.

Easy selection: One variant for all domestic applications.

Easy installation: Compact, all-in-one solution for perfect installation in no time.

Easy to operate: User-friendly control panel for easy set-up.

PERFORMANCE CURVE



TECHNICAL DATA

Max. ambient temperature	131°F / 55°C
Max. liquid temperature	113°F / 45°C
Max. system pressure	145 psi / 10 bar
Enclosure rating	NEMA 3
Floors	Max. 3
Taps	Max. 8
Dimensions	H: 11.9 in / 302 mm L: 15.9 in / 403 mm W: 7.6 in / 193 mm
Weight	22 lbs / 10 kg

I-SC-SL-003 02-16 (US)

Grundfos North America
2001 Butterfield Rd, Ste 1700
Downers Grove, IL 60515

www.grundfos.us
www.grundfos.ca
www.grundfos.mx

GRUNDFOS

LPG

STEEL PORTABLE

SPECIFICATIONS

STANDARD

MODEL/SIZE (LBS)	4.25	11	20	30	40	43.5	60*	100*
HEIGHT (IN)	11.8	16.6	17.2	23.7	29.3	32.5	44.1	48
LPG CAPACITY (GAL)	1	2.6	4.7	7.1	9.4	10.3	14.2	23.6
WATER CAPACITY (LBS)	12	26.2	47.6	71.5	95.2	103.6	143	239
NOMINAL TARE WEIGHT (LBS)	11	13.3	17.0	23.3	28.7	33.9	48.1	68
CYLINDER DIAMETER (IN)	9.1	9.1	12.3	12.3	12.3	12.3	12	14.7
CYLINDER VOLUME (CU. IN)	332	725	1,318	1,980	2,635	2,868	3,955	6,616
COLLAR DIAMETER (IN)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
COLLAR HEIGHT (IN)	4	4	4	4	4	5.1	5.1	5.1
FOOTRING DIAMETER (IN)	9.1	7.8	7.8	7.8	7.8	12	12	14.5
HORIZONTAL DESIGN	-	-	Available	Available	Available	-	-	-
VALVE	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-510 NO OPD	CGA-510 NO OPD	CGA-510 NO OPD
STANDARD SPECIFICATION	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BW260	DOT-4BW240

METRIC

MODEL/SIZE (LBS)	4.25	11	20	30	40	43.5	60*	100*
HEIGHT (MM)	300	427	450	602	744	825.5	1,120	1,219
LPG CAPACITY (L)	3.8	9.8	17.3	26.9	35.6	39	53.8	86.7
WATER CAPACITY (KG)	5.4	11.9	21.6	32.4	42.2	47	65	108.4
NOMINAL TARE WEIGHT (KG)	5	6.0	7.7	10.5	13.0	15.4	21.8	30.8
CYLINDER DIAMETER (MM)	231	231	312	312	312	312	305	373
CYLINDER VOLUME (L)	5.4	11.9	21.6	32.4	42.2	47	65	108.4
COLLAR DIAMETER (MM)	165	165	165	165	165	165	165	165
COLLAR HEIGHT (MM)	102	102	102	102	102	130	130	130
FOOTRING DIAMETER (MM)	231	198	198	198	198	305	305	368
HORIZONTAL DESIGN	-	-	Available	Available	Available	-	-	-
VALVE	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-510 NO OPD	CGA-510 NO OPD	CGA-510 NO OPD
STANDARD SPECIFICATION	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BA240	DOT-4BW260	DOT-4BW240

All dimensions are approximate.
***Available with cap and flange**

200 OLD WILSON BRIDGE ROAD
COLUMBUS, OHIO 43085
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F: 614.438.3083

TOLL-FREE: 866.928.2657
CUSTOMERSERVICE@WORTHINGTONINDUSTRIES.COM
WORTHINGTONINDUSTRIES.COM

WORTHINGTON INDUSTRIES

LPG

ALUMINUM PORTABLE

SPECIFICATIONS

STANDARD

MODEL/SIZE (LBS)	6	10	20	30	40
HEIGHT (IN)	22.5	15.9	20.2	25.9	32.1
LPG CAPACITY (GAL)	1.4	2.4	4.7	7.1	9.4
WATER CAPACITY (LBS)	15	23.8	47.6	71.5	95.2
NOMINAL TARE WEIGHT (LBS)	8.1	9.7	13.0	16.5	19.5
CYLINDER DIAMETER (IN)	6.3	10.3	12.3	12.3	12.3
CYLINDER VOLUME (CU. IN)	415	664	1,318	1,999	2,635
COLLAR DIAMETER (IN)	5.7	7.9	7.9	7.9	7.9
COLLAR HEIGHT (IN)	6.5	5.5	5.5	5.5	5.5
FOOTRING DIAMETER (IN)	6.2	8	8	8	8
HORIZONTAL DESIGN	-	Available	Available	Available	Available
VALVE	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD
STANDARD SPECIFICATION	DOT-4E260	DOT-4E240	DOT-4E240	DOT-4E240	DOT-4E240

METRIC

MODEL/SIZE (LBS)	6	10	20	30	40
HEIGHT (MM)	571	404	513	658	814
LPG CAPACITY (L)	5.4	9.1	17.3	26.9	35.6
WATER CAPACITY (KG)	6.8	10.8	21.6	32.4	43.2
NOMINAL TARE WEIGHT (KG)	3.7	4.4	5.9	7.5	8.8
CYLINDER DIAMETER (MM)	160	261	312	312	312
CYLINDER VOLUME (L)	6.8	10.8	21.6	32.7	43.5
COLLAR DIAMETER (MM)	144.8	200	200	200	200
COLLAR HEIGHT (MM)	165	140	140	140	140
FOOTRING DIAMETER (MM)	158	203	203	203	203
HORIZONTAL DESIGN	-	Available	Available	Available	Available
VALVE	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD	CGA-791 w/OPD
STANDARD SPECIFICATION	DOT-4E260	DOT-4E240	DOT-4E240	DOT-4E240	DOT-4E240

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