AECOM

# FINAL

# TASK 3 - FEASIBILITY STUDY REPORT

# WASTEWATER FEASIBILITY STUDY FOR THE TOWN OF PĀHOA

**County of Hawai‘i**
**Department of Environmental Management**
**345 Kekuanao‘a Street, Suite 41**
**Hilo, Hawai‘i 96720**

**October 2023**

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# FEASIBILITY STUDY REPORT

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**Prepared for:**

**County of Hawaiʻi**
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October 2023

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AACE | American Association of Cost Engineers |
| AECOM | AECOM Technical Services |
| ALISH | Agricultural Lands of Importance to the State of Hawaiʻi |
| ATU | aerobic treatment unit |
| BBBA | Build Back Better Act |
| $BOD_5$ | Five-Day Biochemical Oxygen Demand |
| CAS | conventional activated sludge |
| CCH | City and County of Honolulu |
| CCI | Construction Cost Index |
| CCWG | Cesspool Conversion Working Group |
| CDP | Community Development Plan |
| COH | County of Hawaiʻi |
| CWA | Clean Water Act |
| CWB | Clean Water Branch |
| CWRM | Commission of Water Resource Management |
| CWSRF | Clean Water State Revolving Fund |
| DBEDT | Department of Business, Economic Development and Tourism |
| DEM | Department of Environmental Management |
| ENR | Engineering News Record |
| EPA | Environmental Protection Agency |
| FCA | Financial Capability Assessment |
| ft | foot (feet) |
| ft/s | foot (feet) per second |
| GIS | geographic information system |
| GO | general obligation |
| GP | General Plan |
| gpd | gallon(s) per day |
| HAR | Hawaiʻi Administrative Rules |
| HCPT | Hawaiʻi Cesspool Prioritization Tool |
| HDOH | State of Hawaiʻi Department of Health |
| HRS | Hawaiʻi Revised Statutes |
| ID | Improvement District |
| I/I | inflow and infiltration |
| IWS | individual wastewater system |
| LCC | life cycle cost |
| LPS | low pressure sewer |
| LSB | Land Study Bureau |
| LUPAG | Land Use Pattern Allocation Guide |
| M | million ($) |
| MBBR | moving bed bioreactor |
| MBR | membrane bioreactor |
| mg/L | milligram(s) per liter |
| mgd | million gallon(s) per day |
| MHI | median household income |
| NA | not applicable |

| | |
|---|---|
| NPDES | National Pollutant Discharge Elimination System |
| NPV | net present value |
| O&M | operation and maintenance |
| OSDS | onsite sewage disposal system |
| PDR | Project Definition Report |
| SBR | sequencing batch reactor |
| SRF | state revolving fund |
| STEP | septic tank effluent pump |
| T | thousand ($) |
| TDH | total dynamic head |
| TSS | total suspended solids |
| UIC | Underground Injection Control |
| U.S. | United States |
| USBR | U.S. Bureau of Reclamation |
| USDA | U.S. Department of Agriculture |
| WIFIA | Water Infrastructure Finance and Innovation Act |
| WQS | water quality standard |
| WWTP | wastewater treatment plant |
| ZID | zone of initial dilution |
| ZOM | zone of mixing |

# EXECUTIVE SUMMARY

## INTRODUCTION

The County of Hawaiʻi (COH) contracted with AECOM Technical Services to provide professional engineering services pursuant to Hawaiʻi Revised Status (HRS) 103D-304 for the preparation of a wastewater feasibility study for the Town of Pāhoa and its adjacent community. The Department of Environmental Management (DEM) Wastewater Division is managing the work performed for this wastewater feasibility study contract.

## REGULATORY REQUIREMENTS

The regulatory driver for this feasibility study is related to HRS 342D-72. During the 2017 regular session, the Hawaiʻi State Legislature passed House Bill 1244, Act 125, to amend HRS 342D-72, requiring the replacement of all cesspools in Hawaiʻi by Year 2050. Act 125 directed State of Hawaiʻi Department of Health (HDOH) to investigate the State's number, scope, location, and priority of cesspool replacements based on impact on public health. Act 87, approved in 2022, further amended HRS 342D-72 to generalize the OSDS options to which a cesspool could be upgraded or converted.

This Pāhoa Wastewater Feasibility Study investigates various alternatives for treating wastewater. The wastewater treatment alternatives located in Pāhoa will be regulated by the HDOH Clean Water Branch (CWB) and Hawaiʻi Administrative Rules (HAR). There are several options for effluent discharge considered for this Pāhoa Wastewater Feasibility Study:

- Water reuse regulated by HDOH
- Land application regulated by HDOH
- Surface water discharge regulated by the United States (U.S.) Environmental Protection Agency (EPA) and administered by HDOH
- Injection wells/groundwater discharge regulated by HDOH

## CURRENT SITUATION

There are no COH wastewater facilities that presently serve or are being planned for the Project Area. Currently, individual wastewater systems (IWS) are used by the surrounding developed properties. These are classified as on-site sewage disposal systems (OSDS). Most of the wastewater in the Project Area is handled by Class IV OSDS (i.e., cesspools). Wastewater from Class IV OSDSs is discharged directly into a seepage pit with no treatment.

There is one multi-unit aerobic onsite treatment system serving the Puna Kai Shopping Center in Pāhoa. The shopping center consists of retail, restaurants, and a new grocery store. The treatment facility is comprised of primary treatment, followed by aerobic trickling filters. The trickling filter effluent is then treated with a constructed wetlands system. Effluent is discharged to a leach field beneath the parking lot. The existing facility is designed to treat 16,000 gallons per day. The facility serves as a sustainable feature for the shopping center.

## FUTURE SITUATION

Pāhoa is located within the Puna area, which is experiencing the fastest growth of all COH districts. Pāhoa is one of Puna's largest existing urban settlements with region-serving facilities. A community planning effort for Pāhoa started in 2007. COH is currently working on several projects to plan future growth, including this report's project for wastewater services. To effectively plan wastewater services for Pāhoa, it is important to project the town's future direction and growth. This would help with design of the capacity and location of wastewater lines and facilities.

As a potential future regional village center, Pāhoa would provide new local employment opportunities and new market venues for local farmers. Village centers are the model for Puna's future land use pattern, redirecting sprawl development to formation of village and town centers.

A key document containing the development goals of Pāhoa is COH's 2008 Puna Community Development Plan (CDP). The CDP initiative stems from COH's 2005 General Plan (2005 GP), which serves as a blueprint for long-term development on Hawaiʻi. The 2005 GP is the policy document for long range development on Hawaiʻi. Land use courses of action that pertain to Pāhoa include the following:

- Centralization of commercial activities in Pāhoa Town, rather than along the Pāhoa By-Pass, to serve residents of Lower Puna shall be encouraged

- Service-oriented limited industrial and/or industrial-commercial uses may be permitted in Pāhoa although the area is not currently identified in the Land Use Pattern Allocation Guide (LUPAG) map

Building upon the 2005 and 2008 planning, COH released a General Plan 2045 (GP 2045) in September 2023 for comments [1].

The future GP 2045 will update the 2005 and 2008 planning documents. Currently in progress, the draft GP 2045 includes a section on land use planning. The goals are similar to those of the CDP, such as directing growth towards urban and village centers. Policies and actions to achieve these objectives are outlined in the document and are under review by COH.

The draft 2045 GP depicts future land use designations. Low-density urban has been designated for most of Pāhoa, with some areas of medium-density urban, urban expansion reserve, and recreation.

The Pāhoa Wastewater Feasibility Study uses a 30-year planning period, through year 2052. The Hawaiʻi Department of Business, Economic Development and Tourism (DBEDT) provides forecast estimates through 2040. The Pāhoa Wastewater Feasibility Study extends another 12 years beyond this planning period in order to cover the January 1, 2050 deadline required by the 2017 Act 125 relating to Hawaiʻi cesspool conversions. Act 125 mandates every cesspool in the State to be "upgraded or converted to a director-approved wastewater system; or connected to a sewerage system."

The projected future populations described herein are multiplied by per capita wastewater flows to estimate overall wastewater flows for Year 2052. Pāhoa is estimated to have 0.154 million gallons per day (mgd). This feasibility study also assumes that the Pāhoa project area will receive flows from Mauka Makuʻu, which would add about 0.126 mgd in 2052. Summing these two flows, the total is about 0.28 mgd, rounded to 0.3 mgd.

**CONCEPTUAL DESIGN**

For this Study, COH is using the City and County of Honolulu Wastewater Design Standards and Low Pressure Sewer (LPS) Design Guidelines for the conceptual-level hydraulic analysis of the sewers.

**ALTERNATIVES**

Wastewater collection, treatment, and disposal system alternatives are discussed in this Study. Alternatives reviewed include:

- Alternative 1A: All IWS or Decentralized Systems
- Alternative 1B: Both Decentralized On-Site Treatment and LPS
- Alternative 2A: Pāhoa Wastewater Treatment Plant (WWTP) with All Conventional Gravity Sewers
- Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS

**EVALUATION OF ALTERNATIVES**

The alternatives were evaluated using various criteria, including estimated cost, environmental impacts, and technical considerations. The estimated conceptual level project capital cost prepared for this study are shown in August 2023 dollars. (ENR20 Cities Index = 13,473). The following is an estimate of the Pāhoa project capital costs for each alternative. LPS options are used to account for rolling terrain and to allow for shallower placement of sewers.

- Alternative 1A: All IWS or Decentralized Systems: **$81 M (million)**
- Alternative 1B: Both Decentralized On-Site Treatment and LPS: **$90M**
- Alternative 2A: Pāhoa Wastewater Treatment Plant (WWTP) with All Conventional Gravity Sewers: **$174M**
- Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS: **$140M**

The alternatives were also assessed based on the following criteria.

- Estimated Construction Cost
- Estimated Annual O&M Cost
- Operational Ease and Maintainability
- Flexibility to meet Potential Future Requirements
- Utilization and Acquisition of Land
- Environmental Concerns/Regulatory Permitting

Feedback from DEM and HDOH indicate Alternative 1A as the most favorable alternative, especially in estimated construction cost, operational ease and maintenance, utilization and acquisition of land, and environmental concerns/regulatory permitting. The selection of an alternative also needs to include Countywide assessments of the improvements required for cesspool conversions and other required improvements. COH is currently in the process of planning for multiple areas and beginning a Countywide plan for implementation. Selection of the best alternative for Pāhoa should include input from this countywide process.

**FUNDING AND FINANCING CONSIDERATIONS**

To allow development of operating plans for this feasibility plan, the existing COH institutional arrangement should be reviewed, and a financial program should be developed after selection of a plan and design. The operating plans should include preliminary allocation of the costs among various users of the wastewater system. Feasibility of the plan requires agreement among participating entities (COH), regulatory agencies (HDOH), and stakeholders (ratepayers) on the implementation requirements.

Affordability is an essential metric for developing a wastewater management plan. A homeowner is typically financially burdened if the average monthly cost exceeds 2% of their annual income.

## SUMMARY AND CONCLUSIONS

Based on the overall evaluation criteria, Alternative 1A is seen as the most favorable. As discussed earlier, COH is working on a Countywide master plan, which will allow cross-prioritization of capital projects across the various districts. Thus, rankings are preliminary and will be updated pending review by COH, DEM and other project stakeholders.

# 1.0 INTRODUCTION

The County of Hawaiʻi (COH) contracted with AECOM Technical Services (AECOM) to provide professional engineering services pursuant to Hawaiʻi Revised Status (HRS) 103D-304 for the preparation of a wastewater feasibility study for the Town of Pāhoa and its adjacent community. The Department of Environmental Management (DEM) Wastewater Division is managing the work performed for this wastewater feasibility study contract.

## 1.1 STUDY PURPOSE AND SCOPE

AECOM prepared a Project Definition Report (PDR) as a basis for establishing parameters for a wastewater feasibility study for Town of Pāhoa [2]. The Pāhoa wastewater feasibility study will evaluate various options for wastewater infrastructure improvements. The assessment will be based on the requirements of the Hawaiʻi Department of Health (HDOH) Clean Water Branch (CWB) regulations and COH wastewater design basis on City and County of Honolulu (CCH) guidelines. The following topics are addressed in this Feasibility Study Report:

- Introduction
- Regulatory Requirements
- Current and Future Situations
- Conceptual Design
- Alternatives
- Evaluation of Alternatives
- Funding and Financing Considerations
- Summary and Conclusions

## 1.2 PLANNING AREA

The Project Area boundary for the Pāhoa Wastewater Feasibility Study was established in the Project Definition Report [2]. The boundary is based on Pāhoa as a Census Designated Place. It is also based on the urban zones in the Pāhoa area of the Land Use Pattern Allocation Guide (LUPAG) from the COH General Plan. These include low and medium density urban and urban expansion zones. The resulting Project Area, approximately 2,000 acres, is a combination of the Census Designated Place and LUPAG boundaries comprising the largest area (Figure 1-1).

From the 2020 census, Pāhoa Census Designated Place's population was 924. From the American Community Survey, the 2016 to 2020 population was 1,234.

As mentioned above, the Project Area includes areas beyond the Census Designated Place boundary. It also overlaps the intersection of three Census Tracts:

- 211.01 Kalapana-Kapoho
- 211.07 Kīlauea-Pāhoa (includes DHHL Mauka Makuʻu)

- 211.08 Pāhoa-Makai (includes DHHL Mauka Makuʻu)

See Figure 1-1 for a map showing the boundaries of the study area used for this Pāhoa Wastewater Feasibility Study.

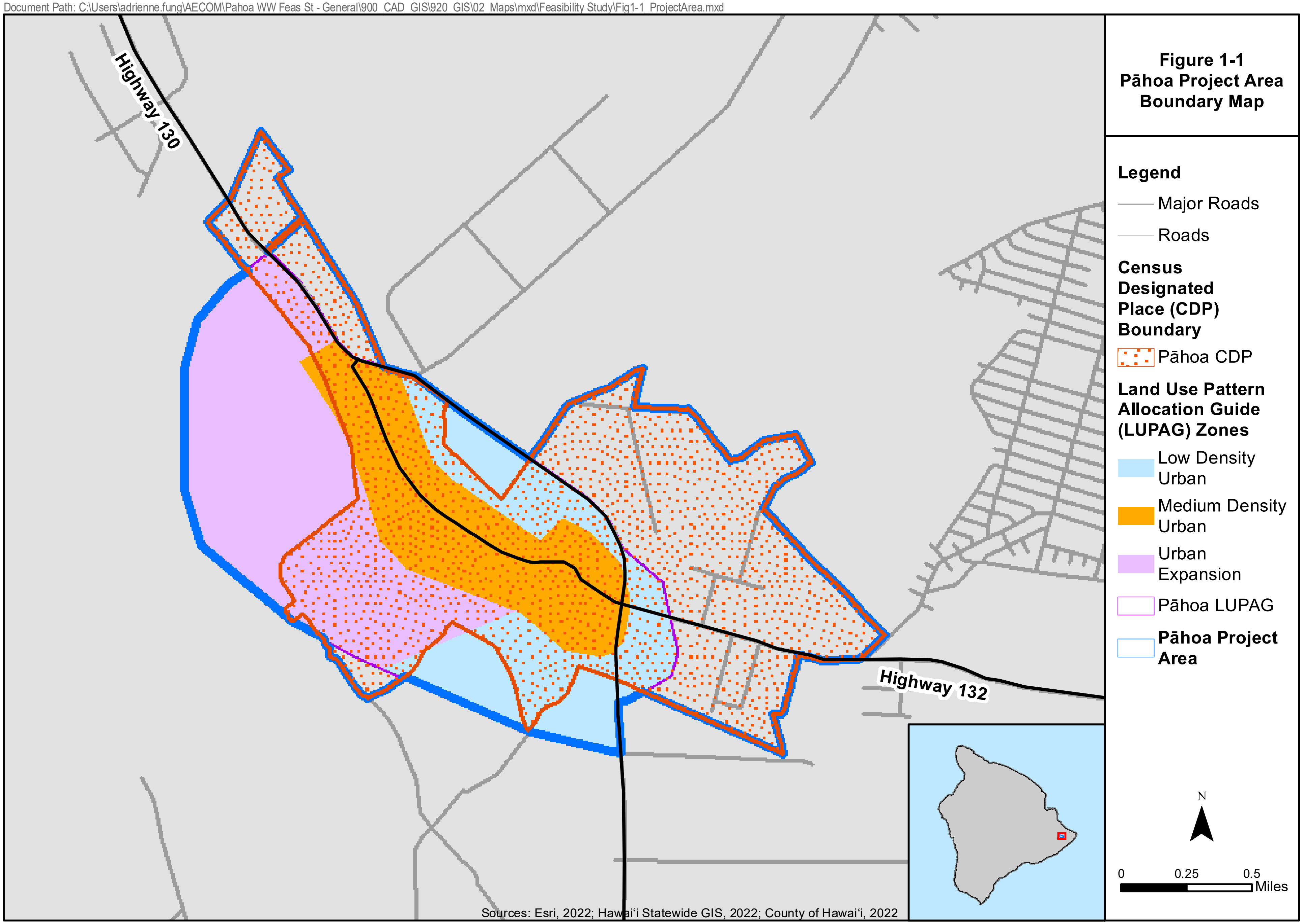


Figure 1-1
Pāhoa Project Area
Boundary Map
Legend
Major Roads
Roads
Census Designated Place (CDP) Boundary
Pāhoa CDP
Land Use Pattern Allocation Guide (LUPAG) Zones
Low Density Urban
Medium Density Urban
Urban Expansion
Pāhoa LUPAG
Pāhoa Project Area
N
0
0.25
0.5
Miles
Highway 130
Highway 132
Sources: Esri, 2022; Hawaiʻi Statewide GIS, 2022; County of Hawaiʻi, 2022

# 2.0 REGULATORY REQUIREMENTS

A regulatory review was performed for the Pāhoa Wastewater Feasibility Study. Relevant regulatory requirements are described in this Chapter.

## 2.1 WASTEWATER TREATMENT AND DISPOSAL REQUIREMENTS

During 2017 the Hawaiʻi State Legislature passed House Bill 1244, Act 125, to amend Hawai'i Revised Statutes (HRS) 342D-72. This legislation included requirements for the replacement of all cesspools in Hawaiʻi by Year 2050. Act 125 directed HDOH to investigate the State's number, scope, location, and priority of cesspool replacements based on impact on public health. In 2022, Act 87 was approved further amending HRS 342D-72 to generalize the options for cesspool replacements to allow upgrades or conversions.

According to the latest HRS 342D-72, before January 1, 2050, every cesspool in the State of Hawaiʻi is required to be

- "Upgraded or converted to a director-approved wastewater system" or
- "Connected to a sewerage system."

A "director-approved wastewater system" refers to the options described in the following articles:

- Hawai'i Administrative Rules (HAR) 11-62-33 for treatment systems
- HAR 11-62-34 for disposal systems
- HAR 11-62-35 for other individual wastewater systems like composting toilets or innovative systems.

## 2.2 EFFLUENT LIMITATIONS

There are several options for effluent discharge:

- Water reuse regulated by HDOH
- Land application regulated by HDOH
- Surface water discharge regulated by the United States (U.S.) Environmental Protection Agency (EPA) and administered by HDOH
- Injection wells/groundwater discharge regulated by HDOH

The following paragraphs describe regulatory requirements for each potential treated wastewater effluent discharge alternative.

### 2.2.1 HDOH Water Reuse

HDOH regulates the treatment and use of recycled water. These regulations provide the public with protections so that human health and water resources are not compromised. Use of recycled water has become more significant due to Hawaiʻi's growing population, limited potable water resources, and other wastewater disposal issues.

Since increasing the safe use of recycled water will help meet the State's growing water needs, the Guidelines for the Treatment and Use of Recycled Water (hereafter referred to as the “Reuse Guidelines”) outline the planning, design, and permit application processes for use of recycled water. The Reuse Guidelines consist of two volumes:

- Volume I: Recycled Water Facilities addresses technical requirements.
- Volume II: Recycled Water Projects covers the application process for a recycled water system.

There are different grades of recycled water depending on the level of treatment that the wastewater receives. Typical uses for each grade are listed in Section 6.3.1.2.

- R-1 is the highest grade of recycled water. The wastewater undergoes oxidation, filtration, and disinfection.
- R-2 is the next highest grade of recycled water. The wastewater undergoes oxidation and disinfection.
- R-3 is the lowest level of treatment that is permissible. The wastewater only undergoes oxidation.

The following is a summary of the approval process for construction or major modification of a wastewater recycling facility that intends to produce recycled water:

- Application Submittal: The application submittal consists of an engineering report and construction plans. The engineering report includes the design basis, treatment processes, and other information to demonstrate compliance with applicable requirements.

- Approval to Construct: Once the application submittal is reviewed and found to be acceptable, HDOH will issue an approval to construct. When construction of the facility is substantially complete, the applicant should provide at least two weeks' notice to HDOH so that HDOH can schedule and conduct a final inspection.

- Approval to Use: HDOH will inspect the project for consistency with the application submittal and compliance with requirements. Conditional approval may be given until pilot testing or test results demonstrate compliance with requirements. If the facility is found to be acceptable and all required documents have been received, HDOH will issue an approval to use.

Once HDOH has determined that the application submittal conforms to Hawaiʻi Administrative Rules (HAR) 11-62 and the Reuse Guidelines, HDOH will issue an Approval to Construct to the owner, with a copy to the engineer who prepared the application submittal.

An irrigation assessment was prepared to assess the viability of water recycling as the preferred effluent management system, assuming the recycled water would be used to irrigate agricultural potable water customers in the area. In Hawaiʻi, irrigation is not normally required on a year-round basis due to high rainfall from November through March. There also are no other potential users (e.g., industrial) in the area. In addition, HDOH requires that all water recycling programs have a 100 percent (%) backup disposal system in place to handle flow that does not meet recycled water quality standards or when recycled water supply exceeds demand. Therefore, water recycling may not be an economical alternative as the preferred effluent management strategy for Pāhoa.

### 2.2.2 HDOH Land Application

Discussions with HDOH have indicated that the land application systems would be regulated as land disposal via requirements in HAR 11-62. Each site would need to obtain an "Authority to Construct" from HDOH. This application generally requires submission of plans, specifications, design data, and other information describing the project. If HDOH finds the project satisfactory, a letter approving construction will be issued. Upon completion of the project, HDOH will inspect the site for compliance.

The HAR 11-62 regulations require secondary treatment (Five-Day Biochemical Oxygen Demand ($BOD_5$) and total suspended solids (TSS) less than 30 milligram(s) per liter (mg/L)) and disinfection prior to surface land application of wastewater effluent and establishes minimum monitoring, record-keeping, and reporting requirements. The HDOH director can establish more stringent requirements for systems, if needed, on a case-by-case basis. Groundwater monitoring is commonly required at land application systems to allow assessment of the groundwater impacts and system efficacy. Typical groundwater monitoring systems consist of three wells:

- One well located upgradient of the land treatment system
- Two wells located downgradient of the land treatment system.

Groundwater monitoring would typically consist of quarterly or semi-annual testing for nutrients (nitrogen and phosphorus), salts, and other parameters. The wells should be installed several months prior to starting wastewater effluent land application operations. This allows background data to be collected before operations commence. It is possible that HDOH and/or the community may request some form of monitoring in advance of approvals to assess the assimilative capacity of the land application system. Monitoring requirements would generally be established at the time that the draft permit requirements are first issued.

Table 2-1 highlights typical effluent characteristics for land application systems. See HAR 11-62 for additional requirements.

**Table 2-1 Typical Effluent Characteristics for Land Application**

| Parameter | Value | Regulatory Reference |
|---|---|---|
| $BOD_5$ | 30 mg/L monthly average<br>60 mg/L peak | 11-62-26 |
| TSS | 30 mg/L monthly average<br>60 mg/L peak | 11-62-26 |
| Disinfection | Continuous disinfection except with subsurface disposal | 11-62-24 |
| Setback Requirement | 25 feet from property line<br>10 feet from on-site buildings | 11-62-23.1 |
| Access Control | 6-foot height fence around entire site | 11-62-08 |

### 2.2.3 EPA Surface Water Criteria

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the Waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, and was amended in 1972 to what is now the CWA. The CWA is codified in Title 33 (Navigation and Navigable Waters) of the United States Code from Sections 1251 - 1388 (33 U.S.C §1251 - §1388). The objective is to restore and maintain the chemical, physical, and biological integrity of Waters of the United States. One of the primary goals is to achieve "fishable and swimmable" waters wherever it is feasible.

Under the CWA, the EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters. The CWA outlaws discharge of any pollutant from a point source into navigable waters, unless a permit has been obtained.

The National Pollutant Discharge Elimination System (NPDES) is one of the pollution control programs established by CWA. This program provides a regulatory framework for managing pollution in the nation's waterways. It was established in 33 U.S.C. §1342 (also referred to as Section 402 of the CWA) and prohibits the discharge of pollutants from certain sources to waters of the United States without an NPDES permit.

The CWA allows EPA to authorize states, territories, and tribes to administer the NPDES program in that entity's jurisdictional area, under oversight from the EPA. This process is called the "state authorization program". The HDOH was first authorized to administer the NPDES permitting program within the State in 1974.

The Hawaiʻi NPDES permitting program is a regulatory mechanism to control water pollution through the issuance of permits. The purpose of issuing an NPDES permit is to implement federal and State water pollution control requirements to help protect human health and the environment. A permit does this by imposing restrictions and requirements on discharges of pollutants from permitted sites/facilities. Permittees are legally obligated to comply with the requirements specified in the issued permit. Violation of permit requirements may be punishable by requiring specific changes to the facility or operations, fines, or other enforcement actions based on the nature of the violation.

The NPDES permit is a document that outlines requirements to control water pollution. NPDES permits contain limits on what can be discharged, monitoring and reporting requirements, and other provisions to allow discharges to achieve published water quality standards.

There are two types of NPDES permits:

- Individual Permits
- General Permits

Individual permits are facility-specific permits that are issued to a specific permittee, after submittal of an NPDES permit application. The maximum period of permit coverage is five years, with the opportunity to renew coverage to continue discharge, provided that there is a public notice and public comment period to comment on the proposed permit. Due to the need to draft a facility-specific permit and the public comment period, processing and issuance of an individual permit is typically a time-consuming process. Once issued, the permit may be modified either by HDOH or by the permittee upon request, following a public notice and public comment period for the proposed modifications. The following are key considerations related to individual NPDES permits:

- One Permit- One Permittee
- For Any Type of Discharge
- Facility-Specific Permit Conditions
- Submit NPDES Permit Application
- Public Notice of Proposed Permit
- 5-Year Maximum Coverage Term
- Issued NPDES Permit
- Can be Modified After Issuance Following Another Public Notice of Proposed Permit Changes

General permits are not issued to a specific permittee, and are instead written to address a specific type of activity or discharge. Any number of facilities or projects can request to be covered under a general permit, provided they can meet the requirements outlined in the specific general permit. If a facility or project has multiple types of discharges, they may separately request coverage under multiple general permits for their facility or project (e.g., a construction project may request coverage for construction storm water and dewatering discharges).

NPDES permits apply to discharges from regulated point sources to surface waters, including discharges through drainage systems such as storm drains that outlet to a surface water. A point source is any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft. This term does not include return flows from irrigated agriculture or agricultural storm water runoff, except return flows from agriculture irrigated with reclaimed water.

All other activities and actions, including, but not limited to, land use decisions, whether or not construction or industrial activities should be allowed, business operation, zoning, and non-point source pollution are not authorized or approved by NPDES permits. Determining the validity or merits of an activity are outside the scope of any NPDES permit. Issuance of an NPDES permit does not convey any other rights, authorizations, approvals, or any other ability not specified in the permit.

Discharges of treated domestic wastewater, cooling water, and other wastewaters to surface waters need to have an individual NPDES permit to discharge.

A consideration impacting surface water discharges is the need to meet published water quality standards at the point of discharge. Hawaiʻi water quality standards are described in HAR 11-54. Per HAR 11-54, the nearshore coastal waters surrounding Pāhoa are Class AA.

The objective for Class AA waters is to remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions. Note that "zones of mixing (ZOM)" are not permitted for discharges into Class AA waters:

- Within a defined reef area, in waters of a depth less than 10 fathoms (18 meters)
- In waters up to a distance of 300 hundred meters (1,000 feet) offshore (if there is no defined reef)

Moving further offshore, the water quality classification is Class A out to the three-mile boundary line for Hawaiʻi State Waters. The objective for Class A waters is to protect their use for recreational purposes and aesthetic enjoyment. Other uses are permitted as long as they are compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters.

Table 2-2 presents water quality standards for Class A and AA discharges to the coastal waters in the vicinity of Pāhoa (HAR 11-54, Appendix D).

**Table 2-2 Water Quality Standards for Discharges to Coastal Waters**

| Water Quality Parameter | Geometric Mean Value | Not greater than listed value 10% of the time | Not greater than listed value 2% of the time |
|---|---|---|---|
| Total Nitrogen | 110 to 150 ug/L | 180 to 250 ug/L | 250 to 350 ug/L |
| Nitrate + Nitrite Nitrogen | 3.5 to 5 ug/L | 10 to 14 ug/L | 20 to 25 ug/L |
| Ammonia Nitrogen | 2 to 3.5 ug/L | 5 to 8.5 ug/L | 9 to 15 ug/L |
| Total Phosphorus | 16 to 20 ug/L | 30 to 40 ug/L | 45 to 60 ug/L |
| Chlorophyll A | 0.15 to 0.3 ug/L | 0.5 to 0.9 ug/L | 1 to 1.75 ug/L |
| Turbidity | 0.2 to 0.5 NTU | 0.5 to 1.25 NTU | 1 to 2 NTU |
| Light Extinction Coefficient | 0.1 to 0.2 k units | 0.3 to 0.5 k units | 0.55 to 0.85 k units |
| Note: Lower values represents "dry" criteria that receive less than three million gallons per day of fresh-water discharge per shoreline mile. Upper values represent "wet" criteria that receive more than three million gallons per day of fresh-water discharge per shoreline mile.<br>µg/L: microgram(s) per liter<br>NTU: Nephelometric Turbidity unit<br>k unit: Kelvin unit | | | |

For discharges into Class A waters, a zone of initial dilution (ZID) and/or zone of mixing (ZOM) area is allowed where the treated effluent and receiving waters undergo a mixing process. A ZOM/ZID is defined as the limited areas around an outfall that allow for the initial dilution of wastewater effluent discharges. The ZOM can provide assimilation of domestic, agricultural, and industrial discharges that have received the best possible degree of treatment or control. ZID/ZOM allow for dilution of wastes before compliance with the applicable water quality criteria must be met. ZID are a subset of ZOM that are applied to toxic pollutants.

A regulatory ZID/ZOM allows for certain numeric water quality criteria to be exceeded. However, the blended effluent and receiving waters must meet the published water quality standards at the boundary of the ZID/ZOM. The regulatory ZID/ZOM is defined based on regulations and implementation policies and must be established first in order to calculate numerical effluent discharge concentration limits for surface water discharges.

According to HAR 11-55-41, a ZID/ZOM should be determined concurrently with the corresponding NPDES Permit. This would be done though a ZID/ZOM dilution study, assimilative capacity assessment and antidegradation analysis with the following objectives:

- Develop appropriate dilution ratios for implementation within NPDES permit.
- Develop appropriate ZID/ZOM boundary for implementation within permit.
- Determine whether dilution study is adequately protective.

After regulatory review and approval, the conditions of a ZID/ZOM may be incorporated as a condition of the NPDES permit. The studies, and application for a ZID/ZOM need to be submitted to HDOH with the required forms. HDOH will establish the ZID/ZOM, taking into account the environmental impacts such as:

- The protected uses of the body of water
- Existing natural conditions of the receiving water
- Character of the effluent
- Design adequacy of the outfall and diffuser system to achieve maximum dispersion and assimilation of the treated or controlled waste with a minimum of undesirable or noticeable effect on the receiving waters

The ZID/ZOM requires HDOH to document the following:

- The granting of the ZID/ZOM is in the public interest.
- The proposed discharge does not substantially endanger human health or safety.
- Compliance with the existing water quality standards .
- The proposed discharge does not violate the basic standards applicable to all waters, will not unreasonably interfere with any actual or probable use of the water areas for which it is classified, and has received best available treatment.
- The discharge will receive the best degree of treatment or control.
- The receiving water has assimilative capacity to handle potential pollutants at the location that the ZID/ZOM is requested.

### 2.2.4 HDOH Injection Wells/Groundwater Disposal

The Underground Injection Control (UIC) program was established to protect the quality of Hawaiʻi's underground sources of drinking water from chemical, physical, radioactive, and biological contamination that could originate from discharges to injection wells.

Underground injection wells are used for injecting water or other fluids into a groundwater aquifer. HAR 11-23 provides conditions governing the location, construction, and operation of injection wells so that injected fluids do not migrate and pollute underground sources of drinking water. The rules also establish criteria for classifying aquifers as follows:

- Underground water that is a source of drinking water
- Underground water that is not a source of drinking water (exempted)

The boundary between exempted aquifers and underground sources of drinking water is generally referred to as the “UIC Line”. Restrictions on injection wells differ, depending on whether the area is inland (mauka) or seaward (makai) of the UIC line. UIC Maps depict the UIC lines on all major islands. These maps are meant for general informational purposes only. HDOH maintains the official UIC maps containing information about the UIC Line.

The UIC maps are coded as follows:

- Code 1 (below or makai of the UIC line)
    - Underlying aquifer not considered drinking water source
    - Wider variety of wells allowed
    - Injection wells need UIC Permit or Permit Exemption
    - Permit limitations are imposed
- Code 100 (above or mauka of the UIC line)
    - Underlying aquifer considered drinking water source
    - Limited types of injection wells allowed
    - Injection wells need UIC Permit or Permit Exemption
    - Permit limitations are imposed, and requirements are more stringent

For regulatory purposes, Pāhoa is located above (or mauka) of the UIC line.

# 3.0 CURRENT SITUATION

This section summarizes the current circumstances of Pāhoa, including demographics, land use, and wastewater management.

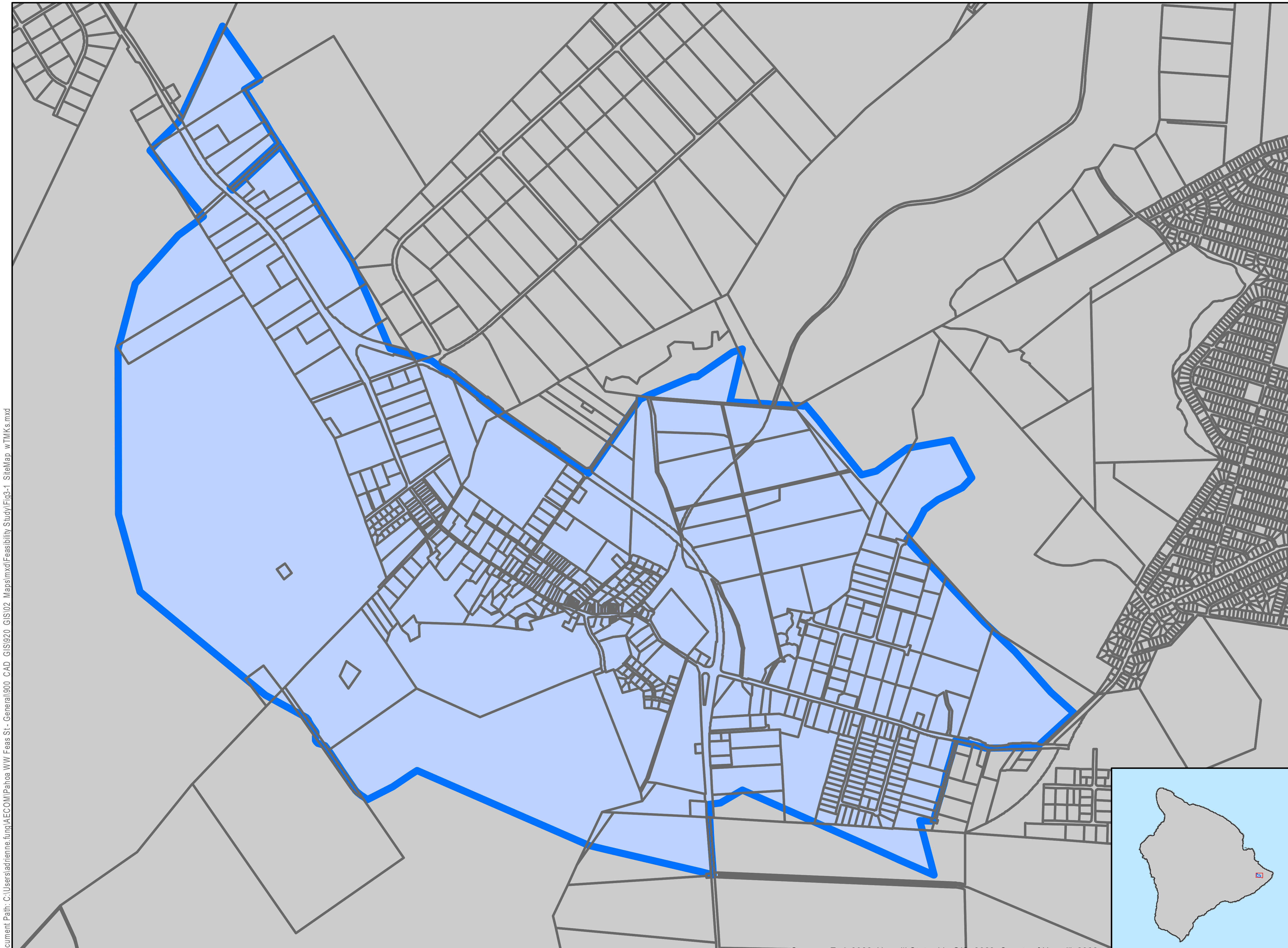
## 3.1 PLANNING AREA DESCRIPTION

Pāhoa town (Figure 3-1) has been identified as a location with a unique “sense of place,” which is reflected in the COH’s 2014 adoption of the Pāhoa Village Design Guidelines (Resolution No. 454 14). These guidelines provide details on the development of village centers exhibiting historic development patterns.

As described in the Puna CDP [3], Pāhoa Town has a main street – a former highway route before the construction of the by-pass road – that still retains much of the original streetwall of plantation-era structures as well as some significant stand-alone buildings. Uses of the area are mostly commercial or civic. There is no historic structure inventory at the scale or level of detail as other Puna villages, such as the Volcano area. Some of the older buildings in Pāhoa appear to be in deteriorated physical condition. [3]

Pāhoa’s village center is divided into two parts. The northern portion straddling Highway 130 at the intersection with the Bypass Road is intended for regional uses and services. The area straddling Pāhoa Village Road from Apaʻa Street to the intersection of Kapoho Road and Pāhoa-Kalapana Road is primarily residential-oriented to serve residents of Pāhoa community. Together, the two areas make up the Pāhoa regional town center. Nearly all the designated regional town center is within the State Urban District. [3]

**Figure 3-1**
**Project Location Map**




**Legend**

- Project Area
- Tax Map Keys (TMKs)

N

0 0.125 0.25 Miles

Document Path: C:\Users\adrienne.fung\AECOM\Pahoa WW Feas St - General\900_CAD_GIS\920_GIS\02_Maps\mxd\Feasibility Study\Fig3-1_SiteMap_wTMKs.mxd

## 3.2 Organizational Context

COH has established an agency to oversee sewer systems. The DEM has the responsibility for matters relating to sewer operation and maintenance (O&M) of nine sewer systems (Kealakehe, Honokaʻa, Kaloko, Kapehu, Kulaʻimano, Pāpaʻikou, Hilo, Pāhala, and Nāʻālehu); solid waste disposal and landfill programs; vehicle disposal; and all other environmental projects, including recycling programs of COH. The Wastewater Division within DEM is responsible for the O&M of COH's wastewater collection and treatment facilities. Presently, COH does not provide any wastewater collection and treatment facilities in the Project Area.

There are existing sewer rates established by COH. The purpose of COH's Sewer Service Charges ordinance is to increase wastewater service charge rates to cover the costs of providing those services. These increases will reduce the Wastewater Division's dependence on the General Fund and provide for improved maintenance and repair of the facilities. Ordinance No. 19 21, which became effective April 1, 2019, set monthly charges for residential, multi-residential, nonresidential, private haulers, and gang cesspools for five years. The monthly charge for residential was increased from $48 to $52, as of April 1, 2023.

## 3.3 Land Use Data

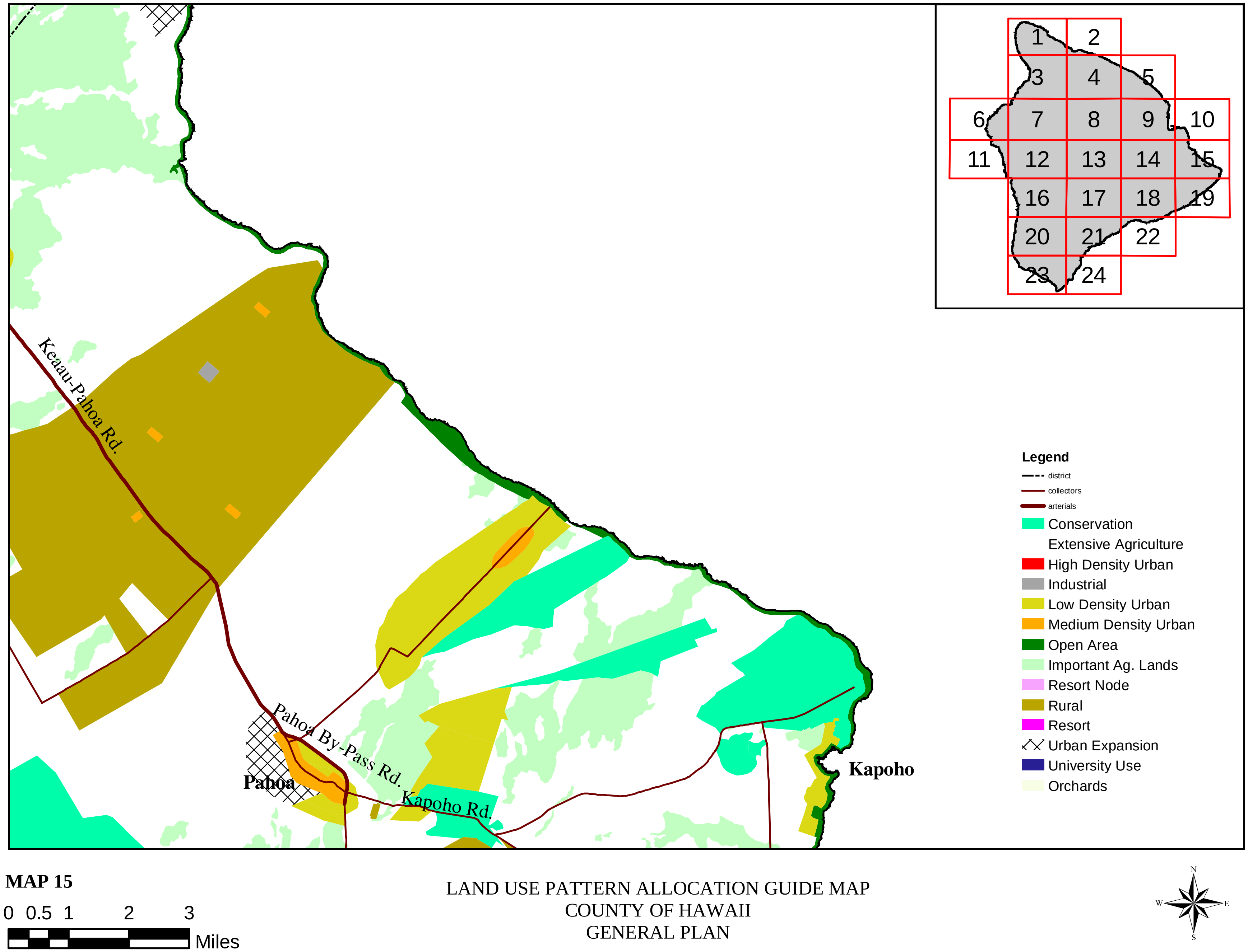
There are various land use mapping systems for Pāhoa. As described in the 2008 CDP, there are three different ones. The Land Study Bureau (LSB) soil classifications are enforced through the HRS. However, this system is still based on the historical pattern of plantation agricultural use in Hawaiʻi. The State Department of Agriculture has developed maps of Agricultural Lands of Importance to the State of Hawaiʻi (ALISH), which more accurately reflect the value of existing agricultural lands. COH's Land Use Pattern Allocation Guide (LUPAG) stems from the General Plan, and adopts a mapping system similar to ALISH.

The 2005 GP depicts the LUPAG zones of Pāhoa (Figure 3-2). Medium density urban zones encompass most of Keaʻau-Pāhoa Road and its immediately adjacent areas. The southwest portions of Pāhoa are categorized as Urban Expansion, and the northeast and southeast areas are designated as Low Density Urban [4].

The CDP describes Pāhoa's village center as two zones (Figure 3-3) [3]. The northern portion (straddling Highway 130 at the intersection with the Bypass Road) is intended for regional uses and services, such as commercial, light industry, new police, fire, and ambulance facilities, and a proposed transit hub. The southern area (straddling Pāhoa Village Road from Apaʻa Street to the intersection of Kapoho Road and Pāhoa-Kalapana Road) is intended for uses oriented primarily to Pāhoa residents. Exceptions are the region-serving post office and intermediate and high school at the southern tip. The commercial, residential, and agricultural zones shown in the CDP seem to be consistent with the map shown on the Hawaiʻi Statewide GIS Program.

The Hawaiʻi Statewide GIS Program map was developed by the COH Planning Department and created from various district and urban zone maps (Figure 3-4). The zones are based on the COH Land Use Zoning Designations in the Hawaiʻi County Code, Chapter 25, Zoning Code. Most of the areas in Pāhoa are zoned as agricultural in this map, with primarily commercial or residential zones along Pāhoa Village Road.

Figure 3-2 Land-Use Presented in the 2005 General Plan




LAND USE PATTERN ALLOCATION GUIDE MAP
COUNTY OF HAWAII
GENERAL PLAN

Revised12/27/12 (Ord. 12-89)

LUPAG-16

Figure 16. Map 15

SUPP. 1 (Ord. No. 12-89)

Figure 3-3 Land-Use Presented in the Puna Community Development Plan

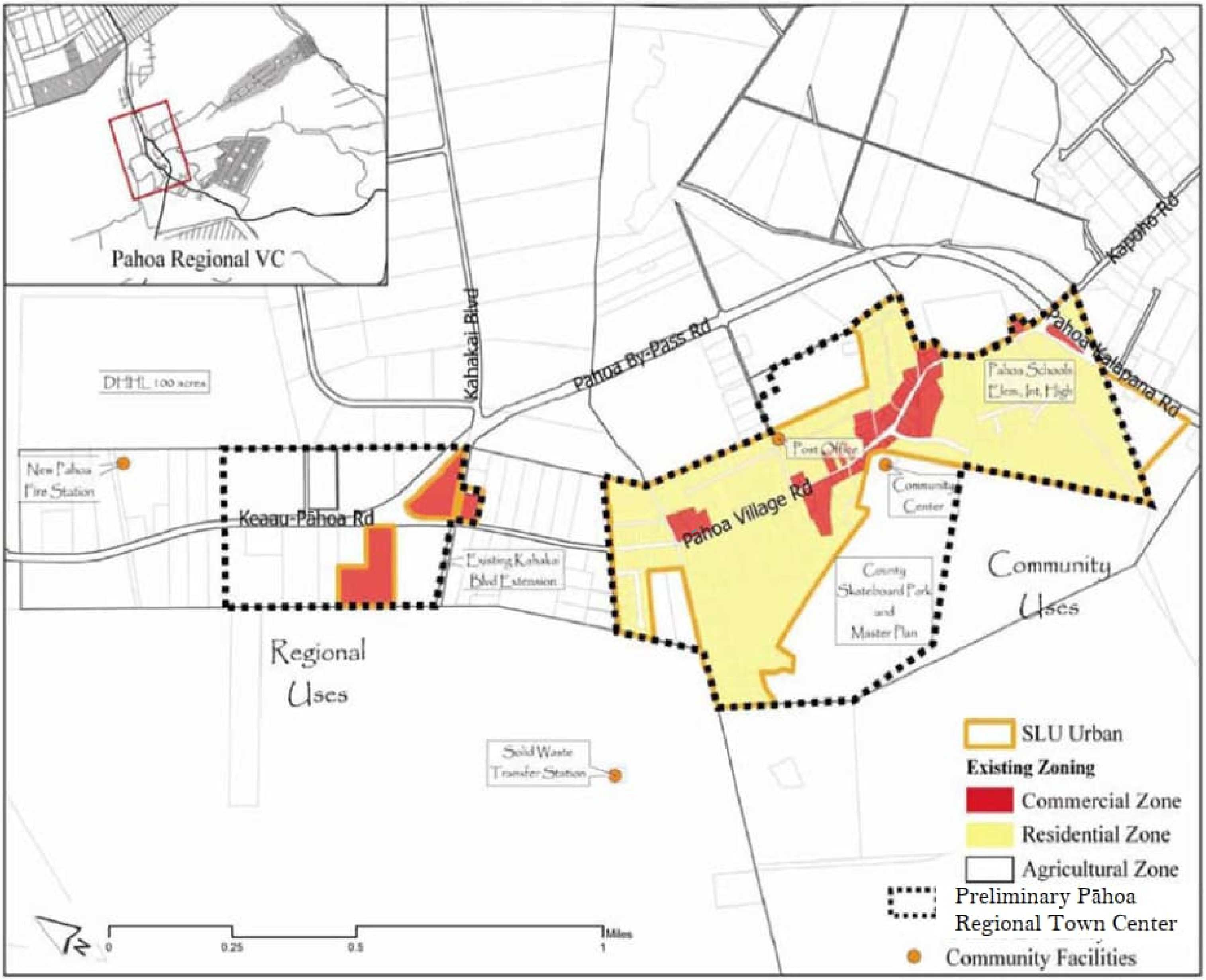


**Figure 3-4**
**Land-Use Data Presented by COH Planning Department**

## 3.4 DEMOGRAPHICS

The estimated 2020 Population for Pāhoa is 1,292, based on those residing within the town. Pāhoa additionally draws from a large geographic area, with residents outside the Project Area boundaries also using the town's services, businesses, schools, parks, and other facilities.

Pāhoa is also identified as a Census Designated Place. In 2016-2020, there were 428 households in Pāhoa Census Designated Place with an average household size of 2.88 people. Here is the breakdown of types of households:

- Married-couple households: 43.2%
- Cohabiting Couples: 4.0%
- Male Householder (No spouse/partner present): 36.4 %
- Female Householder (No spouse/partner present): 16.4%

In Pāhoa Census Designated Place, 25.7% of all households have one or more people under the age of 18. Approximately 27.6% of all households have one or more people 65 years and over. The median age was 43.8 years. An estimated 16.7% of the population was under 18 years, 33.5% was 18 to 44 years, 34.9% was 45 to 64 years, and 15.0% was 65 years and older.

Based on the census data, in 2016-2020, an estimated 71.6% of the people living in Pāhoa were U.S. natives. About 63.1% of the Pāhoa population were born in Hawaiʻi.

In Pāhoa Census Designated Place, 49.8% of the population 16 and over were employed; 45.0% were not in the labor force at the time. An estimated 60.8% of the people employed were private wage and salary workers; 37.5% were federal, state, or local government workers; and 1.7% were self-employed in their own (not incorporated) business.

An estimated 94.5% of Pāhoa workers drove to work alone in 2016-2020, and 2.8% carpooled. Among those who commuted to work, it took them on average 28.3 minutes to get to work.

In 2016-2020, 29.7% of people were in poverty. An estimated 45.1% of children under 18 were below the poverty level, compared with 8.6% of people 65 years old and over. An estimated 30.6% of people 18 to 64 years were below the poverty level. See Section 8.4 for details on affordability.

## 3.5 WATER QUALITY AND USES

### 3.5.1 Groundwater

An assessment was performed on current groundwater quality and uses. Based on the Commission of Water Resource Management (CWRM) database, there are 2 wells located within the Pāhoa project area (Figure 3-5). One is unused, and the other is municipal and owned by COH Department of Water Supply. There are two dots shown for the municipal well in Figure 3-5 because the well site has two pumps for redundancy. There is another municipal Department of Water Supply well just outside the northwestern project boundary.

This site also has two markers in Figure 3-5 to represent its two pumps. Overall, these two municipal wells support the combined potable water/fire flow system for Pāhoa.

Water quality data for these wells is limited. With the presence of cesspools nearby and upstream of these wells, there is potential for cesspool effluent to impact the drinking water quality at these wells. COH Department of Water Supply performs water sampling for chemical compliance and source water monitoring. Samples are analyzed for parameters such as volatile organic compounds, pesticides, polychlorinated biphenyls, metals and water quality metrics (alkalinity, chloride, nitrogen, phosphorus, turbidity, total dissolved solids, and others). In recent water quality data, there have not been exceedances detected in contaminants associated with septic tanks or cesspools. Annual water quality reports are published here: https://www.hawaiidws.org/waterquality/

Construction activities could potentially impact groundwater if encountered during the proposed work. Also, dewatering may be necessary for construction below the groundwater table, which would be conducted in accordance with applicable regulations.

### 3.5.2 Surface water

Surface water quality was also evaluated. The main surface water feature in Pāhoa is Keonepoko Stream (Figure 3-6). Branches of the Keonepoko Stream network are categorized as “non-perennial” by the State of Hawaiʻi Division of Aquatic Resources and as “intermittent” by the National Hydrography Database. CWRM Stream Protection and Management Branch manages general surface water reporting on flow rates, but there are no stream diversions nor gauges in the CWRM network for this stream.

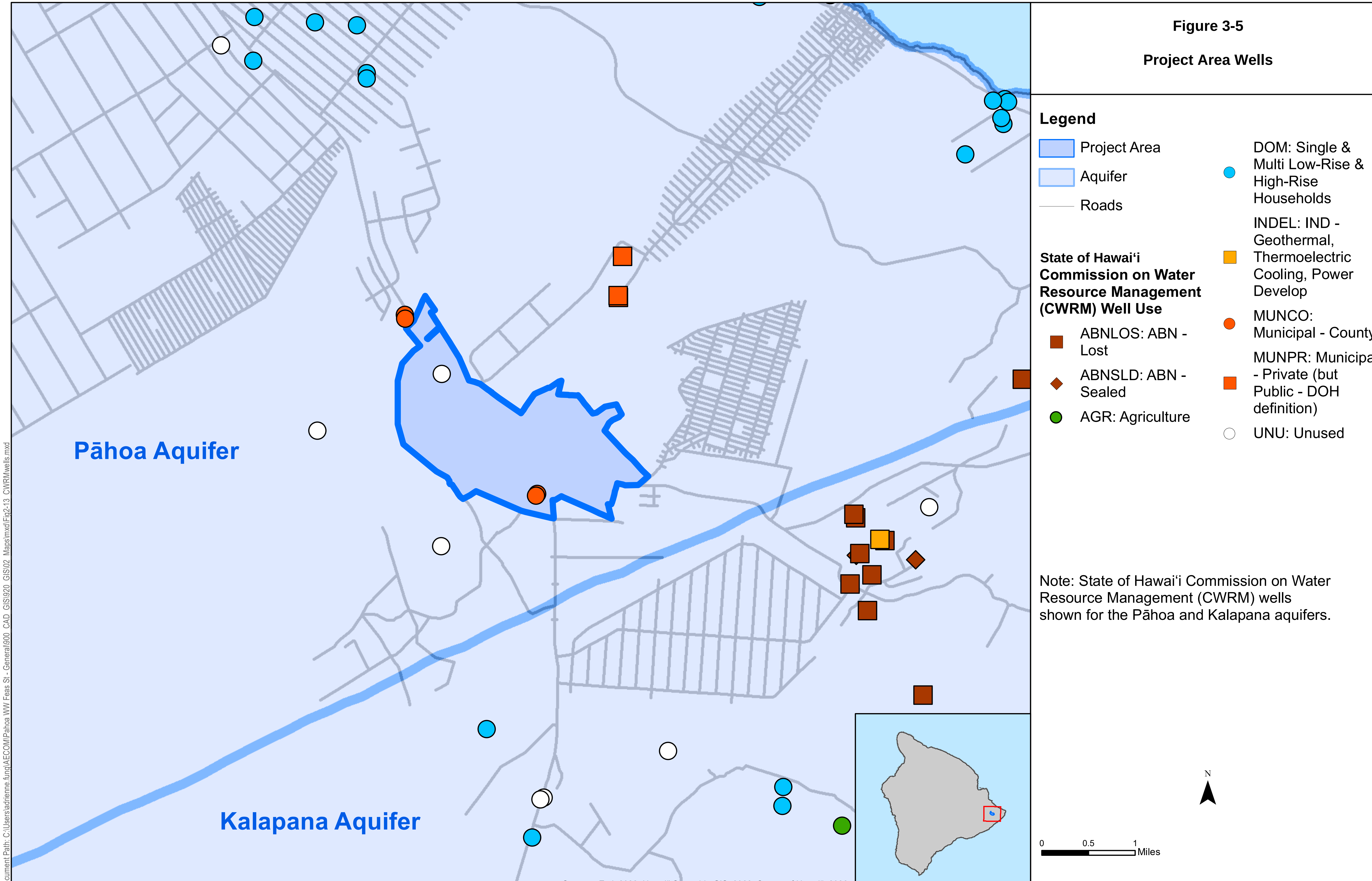
Water quality data for this stream is limited. HDOH CWB occasionally receives external stream data for their biennial water quality assessment report to U.S. EPA. However, they have not received data on the Keonepoko Stream. HDOH monitoring resources typically focus on the coastline and beaches to provide public water quality notifications and advisories.

If constructing a new IWS or sewer system, excavation and land disturbance may contribute to sedimentation and runoff into Keonepoko Stream and other nearby water bodies, and accidental release of construction equipment fluids also could contaminate surface waters. Construction controls required by National Pollutant Discharge Elimination System permits would reduce the risk of sediment and construction-related contaminants reaching surface and coastal waters. For construction using the conventional open trench method, shoring and dewatering techniques would be employed to mitigate potential impacts.

Following construction of a new IWS, polluted runoff can occur when the system does not adequately treat wastewater due to improper siting, inadequate maintenance, leaks, or if the system does not adequately treat, or clean, the wastewater. Accumulated sludge and scum must be removed on a regular basis; otherwise, these materials could move into downstream soil infiltration systems, leading to the failure of these systems. Therefore, it is important to design and construct the IWS properly, and also educate homeowners on maintenance. HDOH Clean Water Branch manages permits, monitoring, and enforcement to protect streams and in general, coastal and inland water resources.

**Figure 3-5**

**Project Area Wells**



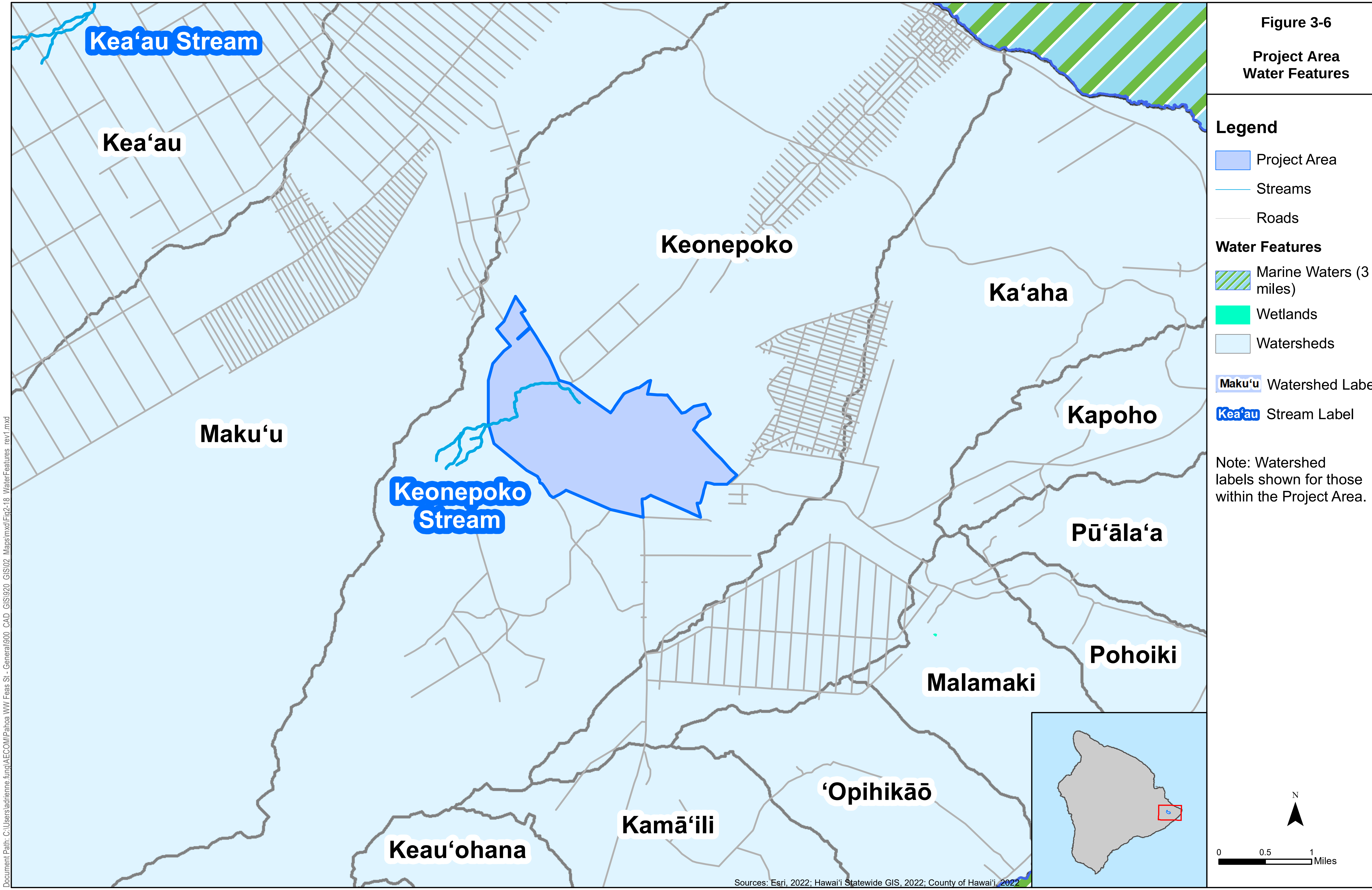


Figure 3-6
Project Area
Water Features
Legend
Project Area
Streams
Roads
Water Features
Marine Waters (3 miles)
Wetlands
Watersheds
Maku'u Watershed Label
Kea'au Stream Label
Note: Watershed labels shown for those within the Project Area.
Kea'au Stream
Kea'au
Keonepoko
Ka'aha
Kapoho
Maku'u
Keonepoko Stream
Pū'āla'a
Pohoiki
Malamaki
'Opihikāō
Kamā'ili
Keau'ohana
N
0 0.5 1 Miles
Sources: Esri, 2022; Hawai'i Statewide GIS, 2022; County of Hawai'i, 2022

## 3.6 ENVIRONMENT

The Pāhoa project area is located in the southeasterly portion of the Puna District on the windward side of Hawaiʻi County. The project area ranges from approximately 550 ft above sea level to approximately 750 ft above sea level. Annual rainfall in the project area is generally dependent on elevation, generally ranging from 59 to 98 inches near the coast in the vicinity of Pāhoa. Temperatures in Pāhoa, which is about 5 miles inland, typically range from 60 to 80 degrees Fahrenheit. Cooler temperatures and heavier rainfall occur during the winter months (October through April) and warmer temperatures and lighter rainfall occur during the summer months (May through September).

Abundant subsurface water flows beneath Pāhoa. This subsurface water typically exits along the coast or near the ocean. In the upper reaches of the Puna District, the underground sources of water are typically pristine, having been filtered through miles of lava rock. However, closer to the coast the underground waters are generally not suitable for public consumption.

Mauna Loa and Kīlauea lava flows have occurred near the Pāhoa project area most recently in 2018. Pāhoa lies along the eastern and southern slopes of Kīlauea. Numerous eruptions over the past two centuries along Kīlauea's East Rift Zone have inundated substantial portions of the land in and around Pāhoa. Volcanic lava flow hazard areas in the Pāhoa project area were identified in the June 2020 COH Volcanic Risk Assessment and in the September 2020 COH Multi-Hazard Mitigation Plan. The following areas within the project area are located within volcanic lava flow hazard zones:

- Southerly portion of Pāhoa is located in lava flow Hazard Zone 1 (highest hazard)
- Northerly portion of Pāhoa is located in lava flow Hazard Zone 2 (lower hazard)
- Mauka Makuʻu is located in lava flow Hazard Zone 3 (lower hazard)

Soils throughout the project area are generally patterned after the underlying geology. There are roughly four soil types within the Pāhoa Project Area as follows (the dominant soil types within the Project Area are approximate):

- Soil symbol 628: Papai extremely cobbly highly decomposed plant material, 2 to 10% slopes (280 acres)
- Soil symbol 660: Olaʻa cobbly hydrous loam, 2 to 10% slopes (300 acres)
- Soil symbol 662: Hakuma highly organic hydrous loam, 2 to 10% slopes (440 acres)
- Soil symbol 653: Keaukaha, highly decomposed plant material, 2 to 10% slopes (840 acres)

These classifications are provided by the U.S. Department of Agriculture Natural Resources Conservation Service.

## 3.7 EXISTING WASTEWATER FLOWS AND TREATMENT SYSTEMS

### 3.7.1 Existing Wastewater Flows

Wastewater flows generated from Pāhoa are estimated from the current population. Census data for the year 2020 is used as the starting point to establish population. Table 3-1 shows the estimated 2020 population for Pāhoa. As mentioned previously, these are based on the population residing within town, but Pāhoa additionally draws from a large geographic area, with outside residents also using the town's services and facilities.

**Table 3-1: Estimated Year 2020 Project Area Census Population**

| Area Name | Census Tract Number | Estimated 2020 Population[3] |
|---|---|---|
| Pāhoa[1] | 211.01/211.07/211.08 | 1,234 |
| Mauka Makuʻu[2] | 211.07/211.08 | 58 |
| Total Population | | 1,292 |

Note:
[1] Pāhoa is a census designated place.
[2] Makuʻu area has approximately 20 cesspools or dwellings. Population estimate is based on 2.88 people/dwelling.
[3] The Pāhoa estimate population is from the American Community Survey 5-Year.

For the first 2 years from 2020 to 2022, the DBEDT annual "residential" growth projections are applied to the estimated 2020 census population of Pāhoa. The estimated 2022 population numbers are then multiplied by the per capita flow of 105 gallons per capita per day (gpcd). This flow rate is based on the CCH Wastewater System Design Standards, which the COH is using for this feasibility study. The 105 gpcd is summed from 70 gpcd of estimated daily sewage flow and 35 gpcd inflow/infiltration. See Table 3-2 for Year 2022 wastewater flow estimates for the project area.

**Table 3-2: Estimated Current Year 2022 Project Area Wastewater Flow**

| Area Name | Census Tract Number | Estimated 2022 Wastewater Flow (mgd)[1] |
|---|---|---|
| Pāhoa | 211.01/211.07/211.08 | 0.130 |
| Mauka Makuʻu | 211.07/211.08 | 0.006 |
| Total Population | | 0.136 |

Note:
(1) Based on 105 gpcpd and 100% of the current Project Area population served by the sewers

## 3.7.2 Existing Wastewater Treatment Systems

### 3.7.2.1 Onsite Sewage Disposal Systems

Currently there is no public sewer system for wastewater generated in Pāhoa. Residential wastewater is currently treated via onsite sewage disposal systems (OSDSs). There is also a WWTP at the Puna Kai Shopping Center for onsite flows.

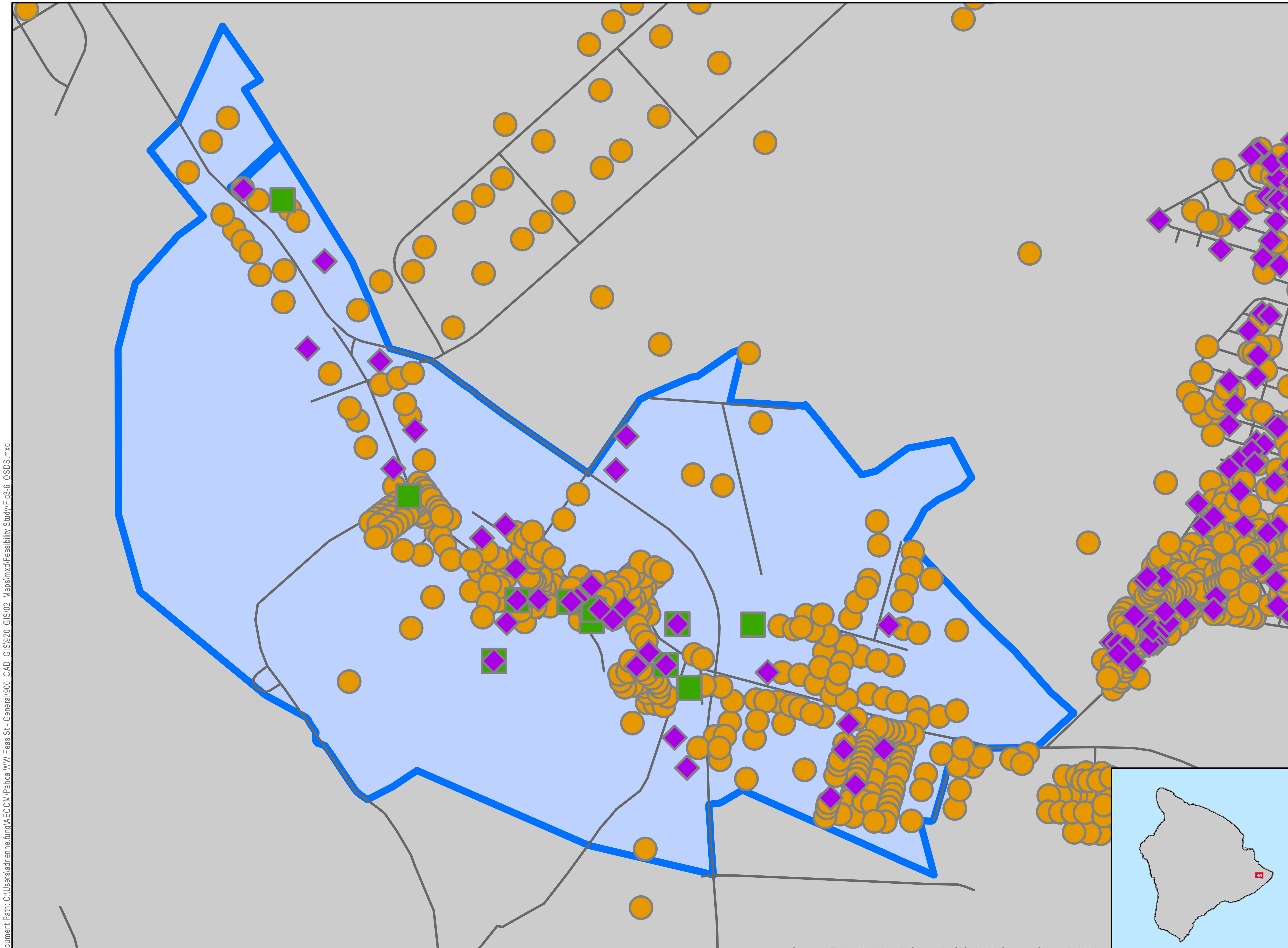
There is a total of approximately 390 OSDSs in Pāhoa town area (Note that the count of 320 cesspools is from the Hawaiʻi Statewide GIS Program database, developed in 2010. In the 2022 Hawaiʻi Cesspool Hazard Assessment & Prioritization Tool report, the count within the project area is about 285 cesspools . This value reflects cesspool closures or conversions and additional changes based on more recent permitting data, county tax records, dwelling database information, and other updates.

Figure 3-7). Of the 390 OSDSs, 50 are Class I OSDSs, 20 are Class II OSDSs, none are Class III OSDS, and 320 are class IV OSDSs (cesspools, which are required to be converted under Acts 125 and 87). HDOH definitions of the four OSDS classes are listed below.

- Class I: any system utilizing soil as a treatment medium
- Class II: a septic tank discharging to a seepage pit
- Class III: an aerobic treatment system discharging to a seepage pit
- Class IV: wastewater discharged directly to a seepage pit with no treatment (i.e., cesspool)

Note that the count of 320 cesspools is from the Hawaiʻi Statewide GIS Program database, developed in 2010. In the 2022 Hawaiʻi Cesspool Hazard Assessment & Prioritization Tool report, the count within the project area is about 285 cesspools [5]. This value reflects cesspool closures or conversions and additional changes based on more recent permitting data, county tax records, dwelling database information, and other updates.

**Figure 3-7**
**OSDS within**
**Pāhoa**




**Legend**

Project Area

Roads

**Onsite Sewage Disposal System (OSDS)**

OSDS Class I

OSDS Class II

OSDS Class IV

Note: Some locations have multiple OSDS classes. The overlapping points are shown in order of Class I, Class II, Class III, and Class IV.

There are no Class III systems in the project area.

N

0 0.125 0.25 Miles

#### 3.7.2.2 PUNA KAI SHOPPING CENTER WWTP

Designed to serve the community of Pāhoa, the Puna Kai Shopping Center is a new retail/commercial facility that features a local grocery store and restaurants on 10 acres, including ½ acre of new parkland. Without access to a nearby sanitary sewer, the shopping center constructed a WWTP to capture, treat, and discharge all of its effluent onsite. The facility was planned to generate approximately 16,800 gallons per day of wastewater effluent that requires treatment prior to discharge [6].

The wastewater treatment system is currently in operation. It is a secondary treatment process consisting of primary tanks, an equalization tank with aerator, trickling filters, a pump basin, constructed wetlands, and drain field disposal. Constructed wetlands are lined, engineered systems designed to mimic the ecological processes that occur in natural wetlands. They are a nature-based wastewater treatment solution designed to filter and remove pollutants such as organic matter, nutrients, and heavy metals as water passes through the rock media and roots of the plants. This treatment process helps to protect pollutants from entering into underlying groundwater supplies and coastal areas.

A map showing the site plan and a field photo showing the constructed wetland are shown in Figure 3-8 [6] and Photo 3-1, respectively.

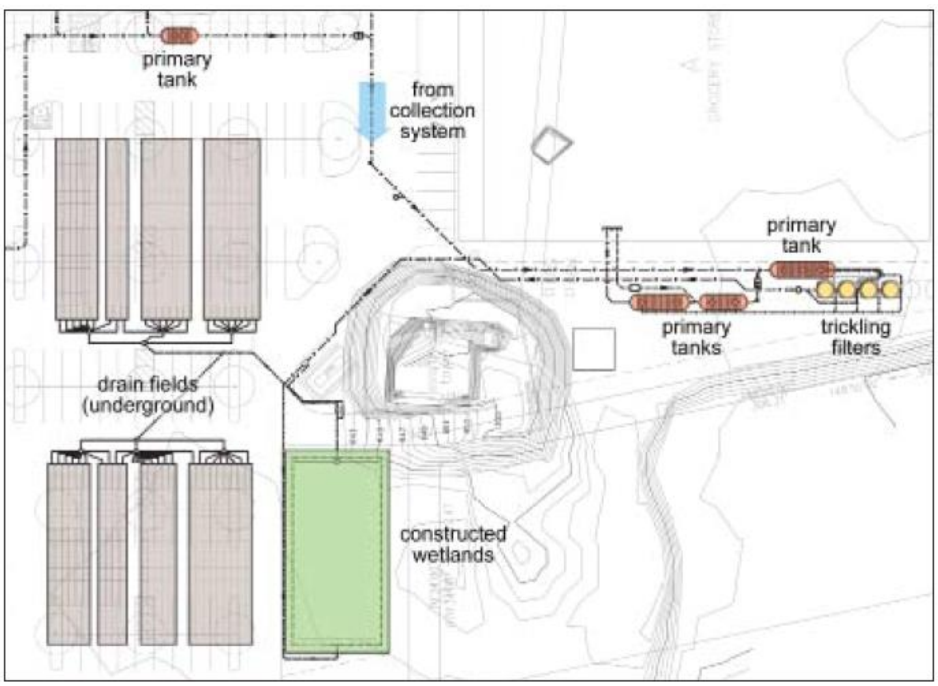



**Figure 3-8 Site Plan of Puna Kai Shopping Center WWTP**

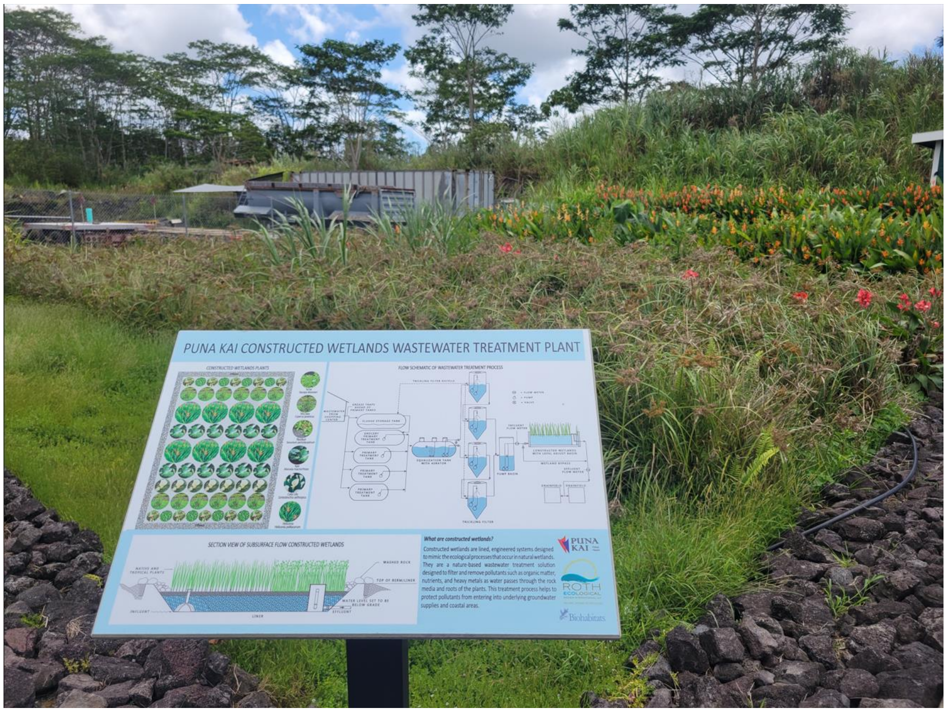



**Photo 3-1 Constructed Wetland at Puna Kai Shopping Center WWTP**

## 3.8 CURRENT INFILTRATION AND INFLOW

The total wastewater flow that is used for sizing and designing a wastewater system would include inflow and infiltration (I/I) allowances. Inflow and infiltration are separate flows, as defined below:

- Inflow: water other than sanitary flow that enters a sewer system from sources which include, but are not limited to, area drains, cross connections between storm sewers and sanitary sewers, stormwater, surface runoff, or drainage. Inflow is generally measured during wet weather.
- Infiltration: groundwater that infiltrates a sewer system through defective pipes, pipe joints, connections, or manholes. Infiltration is generally measured during seasonally high ground water conditions, during a dry period.

Due to the absence of public sewer systems in Pāhoa, I/I from long sewer laterals and sewer mains that are typical to a public sewer system can be considered irrelevant. It is still possible for I/I to enter laterals connecting to existing OSDSs. However, the OSDSs should have been designed to account for additional I/I flow.

## 3.9 PERFORMANCE OF EXISTING SYSTEM

The WWTP at the Puna Kai Shopping Center is privately operated and maintained. A site visit by the Pāhoa Feasibility Study project team observed an abundance of thriving plants in the constructed wetland that receives treated effluent.

Wastewater elsewhere in Pāhoa is treated and disposed of through OSDSs. OSDS Class IV (cesspools) make up about 80% of the OSDSs in Pāhoa. They are considered inadequate methods to treat sewage due to human health and environmental concerns [7]. With the passing of Acts 125 and 87 to amend HRS 342D-72, OSDS Class IV systems are required to be converted, upgraded, or decommissioned. Therefore, the performance of the existing system can be improved through achieving higher levels of treatment with more effective OSDSs or through sewering.

# 4.0 FUTURE SITUATION

To plan wastewater services for Pāhoa, it is important to project the town's future direction and growth. This would help with design of the capacity and location of wastewater lines and facilities.

Pāhoa is located within the Puna area, which is experiencing the fastest growth of all COH districts [3]. A community planning effort for Pāhoa started in 2007. COH is currently working on several projects to plan future growth, including this report.

A key player in guiding the development goals of Pāhoa is COH's 2008 Puna CDP. The CDP initiative stems from COH's 2005 General Plan (2005 GP), which serves as a blueprint for long-term development on Hawaiʻi. Building upon this plan, COH is developing a General Plan 2045 (GP 2045). The draft was released September 2023 for public comments. The following sections describe potential future circumstances of Pāhoa, including the case where Pāhoa is not sewered, and general forecasts for land use, demographics, economics, population, and wastewater flows.

## 4.1 FUTURE ENVIRONMENT – NO PROJECT ALTERNATIVE

In the event of no COH sewering project, there would be a "no project" alternative. This would consist of property owners individually complying with HRS 342D-72, which set a deadline of January 1, 2050 for all cesspools to be "upgraded or converted to a septic system or aerobic treatment unit system" or "connected to a sewerage system" [8].

### 4.1.1 General Process for Compliance with HRS 342D-72

A general flowchart is presented in Figure 4-1 to help the homeowner comply with HRS 342D-72 as amended by Acts 125 and 87. The starting step is for a licensed engineer to evaluate the site, as required by HAR 11-62-31.2 [9]. A list of licensed engineers is provided by HDOH (see Step 1 of the link): https://health.hawaii.gov/wastewater/home/iws/

The engineer will perform a site assessment, such as identifying soil types or determining land slope. Based on this information, the homeowner would decide one of three options:

- Connection to a nearby sewer (if applicable). The homeowner would apply for this through COH DEM.
- Apply for an exemption related to physical site conditions, based on HRS 342D-72. This may be granted if the property owner applies for an exemption and presents documentation showing a "legitimate reason that makes it infeasible to upgrade, convert, or connect the cesspools…[A] legitimate reason shall include but not be limited to:
    - Small lot size;
    - Steep topography;
    - Poor soils; or
    - Accessibility issues." [8]

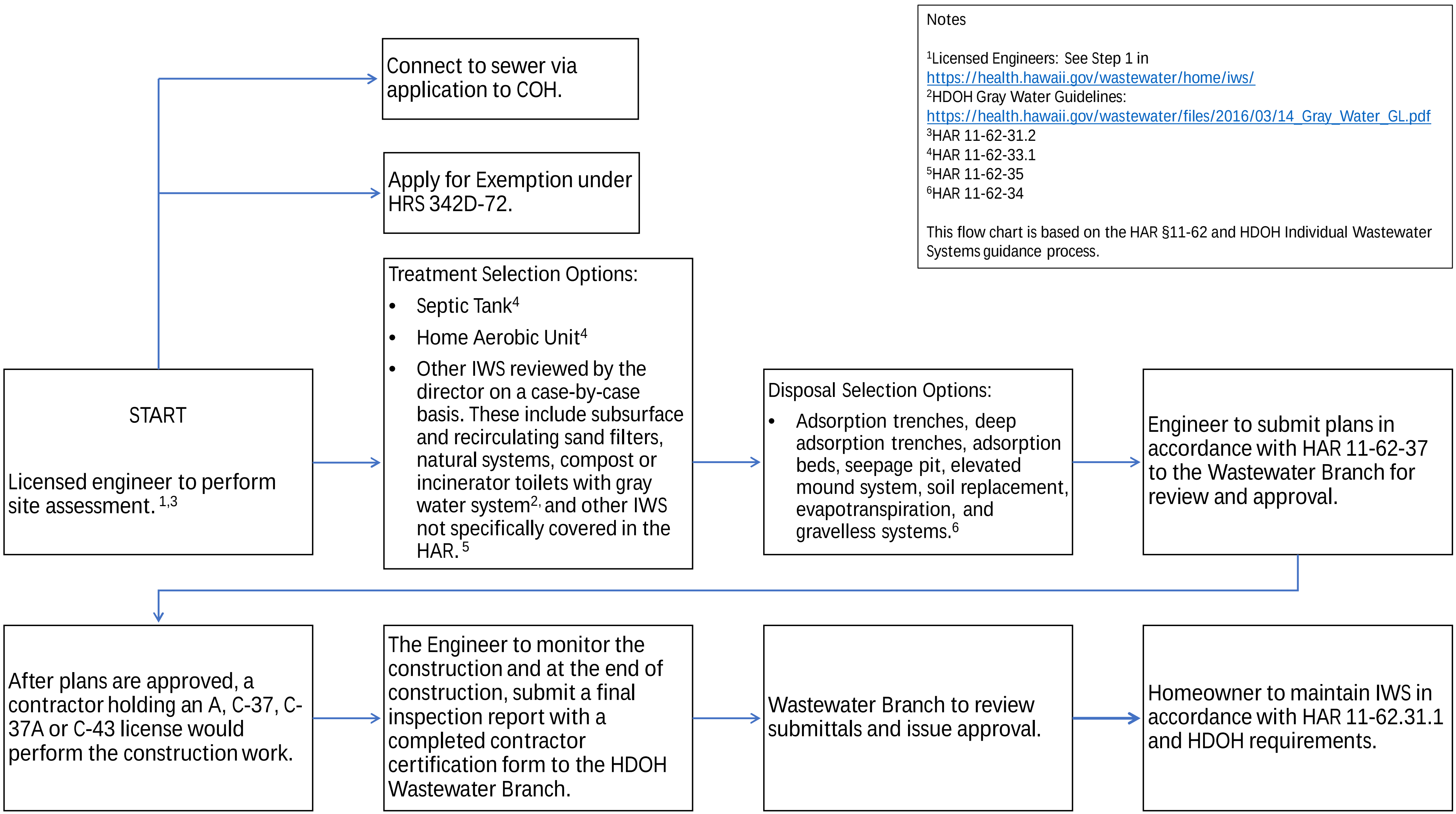
- Proceed to select a treatment and disposal method for the IWS. The engineer would develop and submit the plans to the HDOH Wastewater Branch, following the requirements in HAR 11-62-37.

  After approval, a contractor holding an A, C-37, C-37A, or C-43 license would be needed to construct the IWS or upgrade the cesspool. While the construction takes place, the licensed engineer must monitor the construction of the IWS.

  When construction is complete, the engineer would submit a final construction inspection report and a contractor certification form to the HDOH Wastewater Branch. The Wastewater Branch will issue an approval letter if there are no disparities between the construction inspection report and the contractor certification form.

  The homeowner should maintain the installed IWS and disposal system, as needed, in accordance with HAR 11-62.31.1 and HDOH requirements.

# Figure 4-1. General Flow Chart for Compliance with HRS 342D-72



## 4.2 PLANNING PERIOD

This feasibility study is based on a 30-year planning period, through year 2052. The Hawaiʻi Department of Business, Economic Development and Tourism (DBEDT) provides forecast estimates through 2040. The feasibility study evaluation extends another 12 years from this in order to obtain a 30-year horizon that will include the January 1, 2050 deadline in Acts 125 and 87. These acts mandate every cesspool in the State to be "upgraded or converted to an HDOH director-approved wastewater system; or connected to a sewerage system" by year 2050 (Section 4.1).

## 4.3 LAND USE

Pāhoa is one of the main commercial centers of the Puna district [4]. The town draws from a large geographic area, with residents from elsewhere also using the town's services, businesses, schools, parks, and other facilities. Highway 130 between Keaʻau and Pāhoa carries some of the greatest amount of traffic during peak commuting hours [3]. Further growth is planned for the town.

COH's goals for growth management include re-shaping the pattern of future development to prevent further sprawl and creating new village or town centers with community activities and more convenient access to services. Village centers (or what are town centers for larger settlements) are the model on which future land use patterns in the Puna District will be based. Extensive subdivisions within the Project Area are to be redirected from their present course of sprawl development. Regional Town Centers and different types of village centers are proposed to provide varying levels of services based on location, size, and functional attributes. Pāhoa would be one of three Regional Town Centers identified as providing a wide range of services for the Puna District. The other two are Keaʻau and Hawaiian Paradise Park. As a Regional Town Center, Pāhoa would have expanded commercial uses, farmers market and community gathering places, opportunities for special needs housing, and infrastructure to support more compact development and multi-modal travel. The 2008 CDP proposes Pāhoa as a Special Design District with specific planning, design standards, and review procedures.

Updating facilities may also promote further growth in residents or visitors. The existing aging structures may not meet current building codes and have insufficient parking and restrooms. This has potentially discouraged visitor activities, such as tours, from visiting Pāhoa.

COH has recently acquired a 50-acre parcel near the center of town, which presents a good opportunity to expand the regional park and provide other facilities to stimulate the development of the town core. When headed south from Keaʻau, a short distance before Pāhoa and near the water spigots area, the Puna Community Medical Campus is in development, organized by the Puna Community Medical Center Foundation. The campus will include a hospital; dental center; women's health center; and a medicinal plant garden and Hawaiian Healing Center, which are Phase 1 of the project. The foundation is looking into leasing an additional 12 acres for a future solar farm and WWTP, among other things. [3]

Other opportunities for new expansion include existing land near Keaʻau-Pāhoa Road and Keaʻau-Pāhoa Bypass Road. These areas are primarily lands that had been set aside by a subdivider for community or commercial purposes, and therefore, may be adaptable to a higher rate of development.

### 4.3.1 Development Goals

The 2005 GP is the policy document for long range development on Hawaiʻi. Land use courses of action that pertain to Pāhoa include the following [4]:

- The 2005 GP is the policy document for long range development on Hawaiʻi. Land use courses of action that pertain to Pāhoa include the following [4]: Centralization of commercial activities in Pāhoa Town, rather than along the Pāhoa By-Pass, to serve residents of Lower Puna shall be encouraged (14.3.5.1.2 (a)).
- Service oriented Limited Industrial and/or Industrial-Commercial uses may be permitted in Pāhoa although the area is not currently identified in the LUPAG map (14.4.5.1.2 (c)).

The future GP 2045 will update the 2005 GP. Currently in progress, the draft GP 2045 includes a section on land use planning. The goals are similar to those of the CDP, such as directing growth towards urban and village centers. Policies and actions to achieve these objectives are outlined in the document and are under review by COH [10].

### 4.3.2 Future Zoning

COH is currently reviewing and updating its zoning and subdivision codes (Chapters 25 and 23 of the 1983 Hawaiʻi County Code). The code updates are intended to implement the General Plan, promote smart growth principles, and incorporate best practices in land use and zoning [11]. The project is in the drafting process, and a final draft for public review is planned towards the end of 2023.

The draft 2045 GP depicts future land use designations (Figure 4-2). Low-density urban has been designated for most of Pāhoa, with some areas of medium-density urban, urban expansion reserve, and recreation.

## 4.4 Demographic and Economic Projections

Demographic projections are summarized from the draft GP 2045, since that contains information more recent than the 2005 GP. About 60% of Hawaiʻi County's population lives in rural areas, and minimal change to this is expected through 2045. Population density is relatively low, but expected to gradually increase with the curbing of sprawl development and establishment of village and town centers. Over the next 25 years, however, Hawaiʻi County's population growth rate is expected to decline from an average 2.3% per annum to about 0.9% per annum. Job growth averages 1.4%, mirroring population trends, and is expected to remain at that level for the next several decades. "Senior tsunami" is imminent, since by 2025, the large middle cohort will be retiring. This will present a variety of opportunities and challenges for housing, economic development, and public services.

As a future Regional Village Center, Pāhoa would provide new local employment opportunities and new market venues for local farmers [3]. Village Centers are the model for Puna's future land use pattern, redirecting sprawl development to formation of village and town centers. Pāhoa is one of Puna's largest existing urban settlements with region-serving facilities. Therefore, it is proposed as a Regional Town Center, meant to provide a wide range of services and amenities.

There is an upward trend in visitor arrivals, which will likely increase through 2045 [10]. With emerging interest in native Hawaiian culture and nature, Pāhoa and the Puna district, and especially the Hawaiʻi Volcanoes National Park, have been drawing more visitors. Economic activity is expected to grow as agricultural tourism and eco-tourism become more popular [3]. These provide community-based services while still protecting and nurturing natural and cultural systems.

COH goals in the CDP include promoting agricultural use and other "green" employment, as well as the use of renewable energy [3]. Therefore, new employment is projected within "green" industries such as alternative energy research and development and natural resources management.

## 4.5 FORECASTED POPULATION

Forecasted growth rates are provided in the draft GP 2045 include high overcrowding rates for towns within Upper Puna. For the Pāhoa population forecast, the DBEDT annual "residential" growth rates are applied until Year 2040. For the remaining planning period to 2052 (see Section 4.2 on planning period), the annual average growth rate is extrapolated from the graphed data ending in Year 2040 [2]. The projected 2052 population is 1,464 for the Pāhoa project area. This was used to size and locate the collection system for the feasibility study. The WWTP capacity also includes Mauka Makuʻu, which has an estimated 2052 population of 1,200. As mentioned earlier, Pāhoa provides a variety of region-serving facilities. Therefore, visitors from outside the Pāhoa area will also contribute to growth beyond Pāhoa residents.

## 4.6 FORECASTED FLOWS AND LOADINGS

The forecasted population was multiplied by per capita wastewater flows (Section 3.7). This results in 2052 wastewater flow estimates of 0.154 mgd for the Pāhoa project area collection system. The forecasted flow for Mauka Makuʻu [2] is 0.126 mgd. Adding these two areas together results in a total of 0.28 mgd, which was rounded to 0.3 mgd for sizing the WWTP.

## 4.7 FUTURE IMPACTS TO THE ENVIRONMENT

In accordance with the HAR 11-200, COH is required to consider the significance of potential environmental effects of a proposed Pāhoa wastewater project. This would include evaluation of all phases of a proposed Pāhoa wastewater project, its potential impacts on the quality of the environment, and potential mitigation measures.

Potential future impacts associated with wastewater improvement projects are described in the Puna District Programmatic Environmental Impact Statement [12]. These are based on general planning level details of an infrastructure study. When specific projects within Pāhoa are selected and designed, separate project-specific HRS Chapter 343 documents will be prepared as appropriate. The development of sufficient design details will better inform the assessment of impacts on the environment.

### 4.7.1 Air Emissions/Odor Control

Nuisance odors are a common occurrence at WWPSs, WWTPs and biosolids processing facilities. Wastewater collection systems with WWPSs that have long detention times can result in septic conditions throughout the WWTP and subsequent odor problems in biosolids handling and end use. Biosolids processors are faced with odors during thickening, digestion, dewatering, conveying, storage, truck loading, air drying, composting, heat drying, alkaline stabilization, and/or incineration.

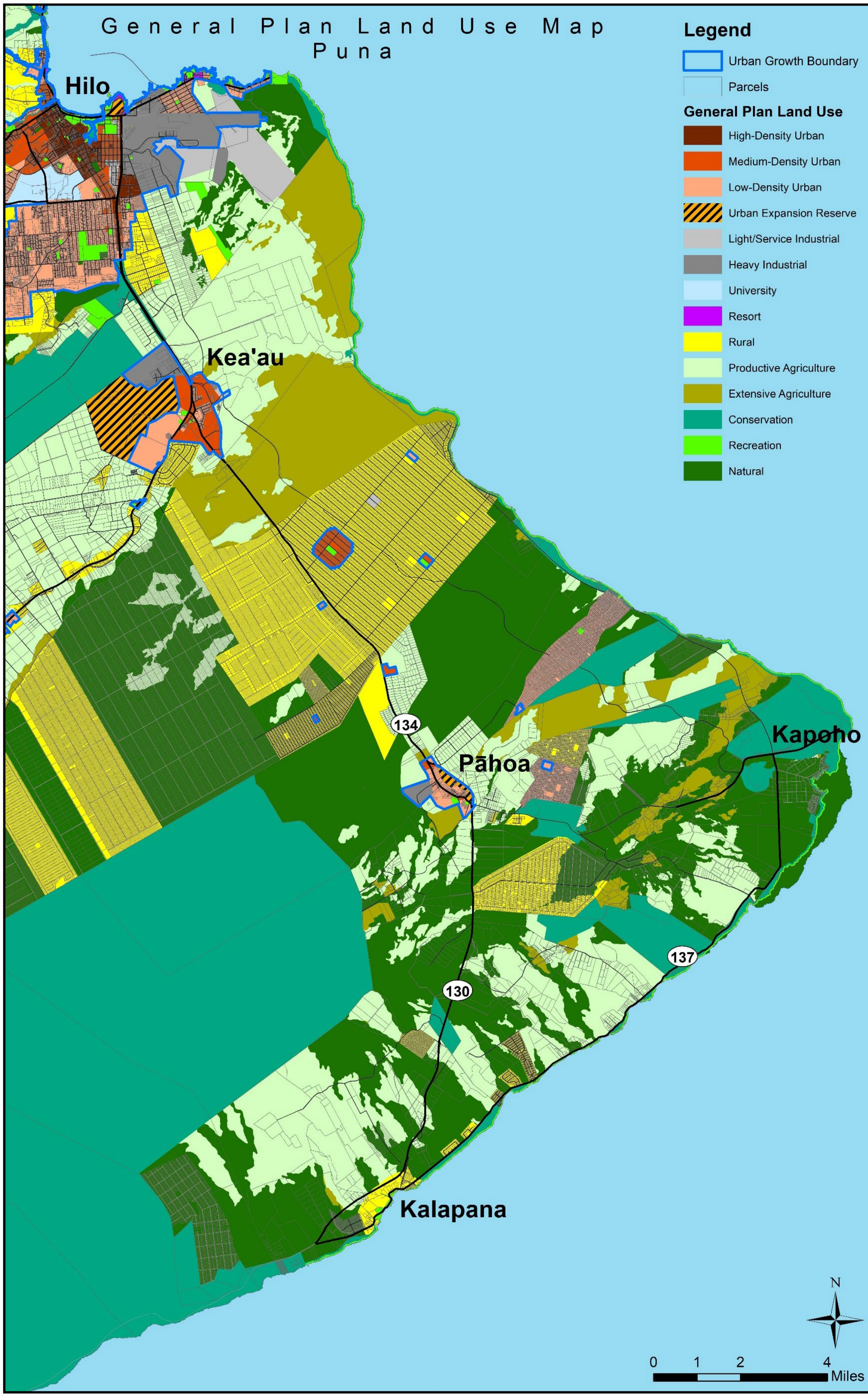
Odors can have detrimental effects on aesthetics, property values, and the quality of life in the community. Odor complaints at operating facilities can also lead to long term problems. Therefore, proper design for odor control should be included for the new WWPSs and WWTP proposed in the centralized system alternatives.

### 4.7.2 Short-Term Impacts

Short-term impacts associated with construction of wastewater systems include use of water, energy, fuel, and other resources. Further, impacts on water resources, flora and fauna, and health, safety, and well-being could be expected. Use of water would be expected during construction and removal of cesspools would improve the surface and groundwater resource quality. Construction would require clearing of vegetation, depending on the specific locations selected. Construction may also affect certain neighborhoods with noise, dust, and traffic, although not expected to be significant nor long-term. Construction worker employment and material acquisition are other short-term impacts.

### 4.7.3 Long-Term Impacts

Impacts on resources could be long-term. For example, a WWTP would require use of fuel and energy for operation. Commitment of the land for the facility could involve the loss of land resources, clearing of trees and vegetation, and use of materials to construct the facility. Beneficial impacts would include direct and indirect employment and support of current and future economic activities and development and growth in the service area. Other probable impacts include air quality (odor and dust), soils (through excavation and possible accidental and planned release of contaminants), visual and aesthetic resources, noise, and transportation (largely vehicular traffic impacts during construction),




Date: 9/6/2023

Figure 4-2

Future Land-Use Data from Draft 2045 General Plan

Source: County of Hawaiʻi Draft General Plan 2045, September 2023

# 5.0 CONCEPTUAL DESIGN

The following outlines the main design criteria and assumptions that support the conceptual design of the proposed wastewater system in Section 6.0.

## 5.1 DESCRIPTION OF DESIGN

Design of the proposed wastewater collection system shall be in accordance with CCH Wastewater Design Standards [13] and Low Pressure Sewer Design Guidelines [14], since there are currently no COH wastewater design standards.

### 5.1.1 Gravity Sewer and Force Main Design Criteria

Key criteria of the CCH Wastewater Design Standards are summarized below.

- Gravity Sewer Design Criteria
  - Gravity sewer hydraulic capacity: not to exceed 85% of pipe’s full flow capacity
  - Minimum velocities and slope: gravity sewers shall be designed with the following minimum slopes for each pipe size in order to provide minimum mean velocities of 2.5 feet (ft) per second (s) (ft/s).
    - 8-inch: 0.0052 ft/ft
    - 10-inch: 0.0039 ft/ft
    - 12-inch: 0.0031 ft/ft
    - 16-inch: 0.0021 ft/ft
    - 18-inch: 0.0018 ft/ft
    - >18-inch: 0.0016 ft/ft
  - Maximum velocity: generally, no more than 10 ft/s is permitted
  - Depth of sewer: in general, sewers should be designed with sufficient depth to serve properties within the tributary area. Properties that are not able to be served by gravity flow due to insufficient sewer depth shall use a pump to discharge to the gravity sewer.
  - Minimum ground cover above gravity sewers: 4.0 ft
  - Easement widths and access:
    - 15 ft for 6-inch and 8-inch lateral and branch sewers
    - 15 ft for trunk and interceptor sewers 8-inch to 16-inch
    - 25 ft for trunk and interceptor sewers larger than 16-inch
- Force Main Design Criteria
  - Velocities in force mains:

        - Minimum: 3.0 ft/sec (desirable)
          1.75 ft/sec (absolute)
        - Maximum: 10.0 ft/sec
    - Total dynamic head: maximum of 100 ft

### 5.1.2 Low Pressure Sewer Design Guidelines

Key criteria of the CCH Low Pressure Sewer (LPS) Design Guidelines are summarized below.

- Pump Station
    - Pump Station Basin
        - The pump station basin shall be watertight and consist of a dry well and wet well section in order to facilitate maintenance duties without confined space entry.
    - Appurtenances
        - A gravity operated flapper-type check valve and flapper-type anti-siphon valve, and isolation valve shall be included within the LPS system pump station basin.
- Pump and Motors
    - Type of Pumps:
        - Semi-positive displacement type grinder pump
        - All LPS system pump types are to be the same in a single LPS system
    - Pump and Motor Performance
        - A minimum of 14 gpm against total dynamic head (TDH) of 0 ft
        - A minimum of 7 gpm against TDH of 185 ft
        - Capable of operating at negative TDH without overloading the motor
        - Pump motors: 1 horsepower, motor speed not exceeding 1,750 rotations per minute
- LPS System Lateral
    - Design
        - Minimum diameter: 1-1/4-inch
        - Velocity: 2 – 6 ft/sec
        - Minimum cover: 12-inch
- LPS Main
    - Design
        - Diameter: 1-1/4 to 4 inch

- Velocity: 2 – 6 ft/sec
- Minimum cover: 4 ft
- Velocities shall be determined based on the maximum anticipated number of simultaneous LPS system pump stations in use given in Table 5-1.

**Table 5-1 Maximum Number of LPS System Pump Stations Operating Simultaneously**

| Total Number of LPS System Pump Stations | Assumed Maximum Number of LPS System Pump Stations Operating Simultaneously |
|---|---|
| 1 | 1 |
| 2-3 | 2 |
| 4-9 | 3 |
| 10-18 | 4 |
| 19-30 | 5 |
| 31-50 | 6 |
| 51-80 | 7 |
| 81-113 | 8 |
| 114-146 | 9 |
| 147-179 | 10 |
| 180-212 | 11 |
| 213-245 | 12 |
| 246-278 | 13 |
| 279-311 | 14 |
| 312-344 | 15 |

- Appurtenances
    - Air valves shall be placed at high points
    - Flushing stations: in-line flushing stations at intervals of at most 1,000 ft for straight runs of pipe, at bends of 45 degrees or greater, where a main joins another main, and at the upstream terminal end of any main
- Other Design Considerations
    - Retention time
        - Preferred to be less than 8 hours to minimize risk of odor
    - System with negative heads
        - Anti-siphon check valves provide for negative head pumping. The use of combination air/vacuum release valves should be considered for systems with negative heads of 25-30 ft or more.

## 5.1.3 Design Assumptions

A topographic survey for Pāhoa has not been performed at this planning phase. Based on a site visit, the project area was observed to have generally rolling terrain. The conceptual design for the collection system (Section 6.1) was largely based on Google Earth elevation data, which is provided by digital elevation model data from the National Aeronautics and Space Administration's Shuttle Radar Topography Mission. In general, it is acceptable for Google Earth elevation data to be used for preliminary studies [15]. This information was used to identify the proposed gravity sewer and FM routes. At this level of planning, these locations should not be taken as specific and may be updated during the more detailed stage of design.

The noted areas that will likely need pumps to send flow to receiving gravity sewers are identified with "Neighborhood Pump Station" in Figure 6-12 and Figure 6-13. During design, topographic survey information would be obtained and could indicate additional areas that may need to pump wastewater to a branch or trunk sewer.

The open cut method is assumed for sewer installation, with a maximum depth of approximately 25 to 30 ft. In areas with rolling terrain, the gravity sewer depth could exceed this 30-ft limit. However, sewer tunneling does not appear to be cost effective, given Pāhoa's unique subsurface geologic formation that is comprised of lava rock. Therefore, if gravity sewer depths exceed 30 ft due to rolling terrain conditions, "Regional Pump Stations" are proposed to pump wastewater from upstream lower ground elevations to downstream higher ground elevations, allowing flow by gravity to continue further downstream.

LPS systems for each clustered package treatment plant are only based on key hydraulic design considerations such as TDH and flow velocity at this planning level. Some design considerations might be needed, such as odor control for potential high wastewater retention time, and the use of combination of air/vacuum releases to accommodate for excessive negative pumping heads.

At the WWTP's described in this feasibility study, stormwater management design would be included for the treatment plant sites. WWTP site stormwater would be handled/disposed of onsite. Collection system improvements would be designed so existing drainage systems aren't impacted. Drainage issues in a sewer service area would need to be resolved independently by COH under a separate program outside of the wastewater program described in this report.

## 5.1.4 Conceptual Design

Conceptual design of a proposed centralized wastewater system is based on the design criteria and assumptions described in this chapter. The suggested pipe network and WWTP and WWPS locations are presented in Section 6.5.

# 6.0 ALTERNATIVES

Currently there are no public wastewater collection and treatment systems for Pāhoa. Wastewater generated in individual lots are continuously treated and disposed of by OSDS. However, by 2050, all Class IV OSDS (i.e., cesspools) are required by HRS 342D-72 to be converted, upgraded, or decommissioned.

Various alternatives were developed based on combinations of treatment, flow quantities, collection, and disposal. The alternative components are listed below and will be described in Section 6.1 for collection, Section 6.2 for treatment, Section 6.3 for disposal or reuse, and Section 6.4 for projected 2052 design average flows.

- **Collection System**
  - Gravity sewers in existing roads
  - Low pressure sewers (LPS)
  - Cross-country gravity sewers in new easements
- **Treatment System**
  - IWS
  - Decentralized cluster system
  - Centralized treatment
- **Disposal System**
  - Onsite (as part of IWS or decentralized system)
  - Disposal (land application ) or reuse
- **Projected 2052 Design Average Flow**

The alternatives are listed below and described in Section 6.5. They are also summarized in Table 6-1.

- Alternative 1A: All IWS or Decentralized Systems
- Alternative 1B: Both Decentralized On-Site Treatment and LPS
- Alternative 2A: Pāhoa WWTP with All Conventional Gravity Sewers
- Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS

They are mostly differentiated by the treatment system, either decentralized or centralized. Alternatives 1A and 1B use onsite collection and decentralized treatment and collection systems, while Alternatives 2A and 2B are based on centralized treatment and collection systems.

The alternatives also differ by their collection system methods. Alternatives 1B and 2B use LPS, while Alternative 2A uses only conventional gravity sewers.

**Table 6-1 Summary of Alternative Descriptions**

| **Wastewater Treatment** | | | | | **Design Average Flow** | **Collection System** | | | | | **Disposal** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alternative Code** | **Alternative Description** | Decentralized Treatment | Centralized Treatment | IWS | | Alternative Sewer Options[1] | Gravity Sewer in Existing Roadway | Regional PS | Neighbor-hood PS | LPS | |
| **1A** | **All IWS or Decentralized Systems** | ✓ | x | ✓ | x | x | x | x | x | x | Onsite |
| **1B** | **Both Decentralized On-Site Treatment and LPS** | ✓ | x | x | 0.3 mgd | LPS | x | x | x | ✓ | |
| **2A** | **Pāhoa WWTP with All Conventional Gravity Sewers** | x | ✓ | x | 0.3 mgd | Gravity Sewers | ✓ | ✓ | ✓ | x | Water Reuse and Land Application |
| **2B** | **Pāhoa WWTP with Both Conventional Gravity Sewers and LPS** | x | ✓ | x | 0.3 mgd | Gravity & LPS | ✓ | ✓ | x | ✓ | |

[1] Intent of the Gravity & LPS option is to use LPS systems to replace neighborhood PSs and associated gravity branch sewers and force mains.

## 6.1 COLLECTION SYSTEM

For the alternatives using decentralized treatment, use of LPS was evaluated. For the alternatives involving centralized systems, two different collection system methods were evaluated: conventional gravity sewers in existing roads, and gravity sewers in combination with LPS in certain areas. A third potential collection system method, cross-country gravity sewers in new easements (Section 6.0), is not needed in Pāhoa based on this planning level evaluation. New easements are typically considered in areas with dead-end roadways sloping away from the main road and installing sewers in easements could eliminate neighborhood pump stations.

### 6.1.1 Conventional Gravity Sewers in Existing Roads

Conventional gravity wastewater collection systems are the most popular method to collect and convey wastewater. Pipes are installed on a slope, allowing wastewater to flow by gravity from a house to the treatment facility.

Typically, 4-inch and 6-inch on-lot laterals collect wastewater from each lot and connect to a branch sewer in the road. The largest sewer size that allows for lateral connection is 16-inch based on City and County of Honolulu (CCH) Wastewater Design Standards (there are currently no COH wastewater design standards). Manholes will be installed at all changes in pipe grade, size, or alignment, and at all points where sewer mains intersect for maintenance purposes. The branch sewer mains flow to a larger trunk sewer or interceptor sewer that will transport wastewater to a central WWTP.

Gravity sewers will be installed by open cut method with a maximum depth of approximately 25 to 30 ft. At this depth in the project area, majority of trench excavation work will be in bedrock. According to the Keaʻau Village Master Plan [16], backhoe trench excavation investigation at 10 locations in the Keaʻau area indicated that bedrock was found generally to be approximately 3 ft below surface. Where the rolling terrain in Pāhoa does not allow for gravity sewer installation, “regional WWPSs” are proposed (Section 6.1.3).

If some streets or a small neighborhood are located at lower elevations that prevent wastewater flow by gravity to the trunk sewer, “neighborhood WWPSs” could be used to pump wastewater from the neighborhood to the trunk sewer (Section 6.1.3).

### 6.1.2 Gravity Sewers and Low Pressure Sewers

If using conventional gravity sewers, neighborhood WWPSs are proposed for small neighborhoods or selected streets that are located at lower elevations that prevent wastewater flow by gravity to the trunk sewer. A potential alternative to these is the use of LPS.

An LPS system uses small diameter force main pipelines, usually constructed of plastic or polyethylene material, which are shallowly buried, and laid in a manner following the surface terrain. LPS diameters range from 1.5 inches to 4 inches, where the smaller diameter lines join at main junctures. The piping network can extend for many thousands of feet at a TDH of up to 185 feet.

Each home uses a small pump, either a septic tank effluent pump (STEP) or a grinder pump, in an underground vault to discharge sewage to the main line. Existing septic tanks that are in good condition can be converted to connect to LPS by adding a STEP. If existing septic tanks are not in good condition or if the home does not have an existing septic tank, a new septic tank with an effluent pump could be an option. The benefit of the STEP system is to convey only liquid wastewater to LPS pipes and the receiving WWTP. Solids will remain in the septic tank, to be pumped out when needed. Another benefit of the STEP system is that the LPS system using STEP might provide a higher hydraulic capacity since flow velocities in LPS pipes could be less than the required scouring velocity of 2 ft/s for solids containing wastewater.

Another type of a LPS system pump is the grinder pump, which will reduce all forms of sanitary waste to a slurry and pump it to the LPS pipes and WWTP. In this option, typical maintenance is required for the pumps and pump basins, but no septic tank and solids will need to be maintained by the homeowner. The grinder pump could be a centrifugal type or semi-positive displacement, progressing cavity type. The progressing cavity grinder pump would provide a more predictable flow over a wide range of typical system pressures. Due to rolling terrains in the project area, the LPS system might operate under negative TDH, and combination air/vacuum release valves would be needed.

### 6.1.3 Neighborhood and Regional WWPSs

If a smaller neighborhood is located downhill from the trunk sewer, then neighborhood WWPSs could be used to pump the wastewater uphill. Neighborhood WWPSs would be submersible with outdoor electrical controls in weatherproof enclosures, 2 constant speed pumps (1 duty + 1 standby), small self-enclosed standby generator, and odor control.

If a larger area was subject to undulating terrain, a regional WWPS could be used. Regional WWPSs are wetwell/drywell configuration with electrical/control building with indoor standby generator, 3 variable speed pumps (2 duty + 1 standby) and odor control.

All WWPS would have security fencing and perimeter landscaping to match the surrounding properties.

## 6.2 TREATMENT SYSTEM

The different options for wastewater treatment consist of IWS, decentralized, and centralized systems.

### 6.2.1 IWS

IWS are regulated by HAR 11-62 Subchapter 3. Requirements include that the total wastewater flow for an IWS shall not exceed 1,000 gallons and each IWS should have at least 10,000 feet of land area. The following sections describe the IWS treatment and disposal systems that are listed in HAR.

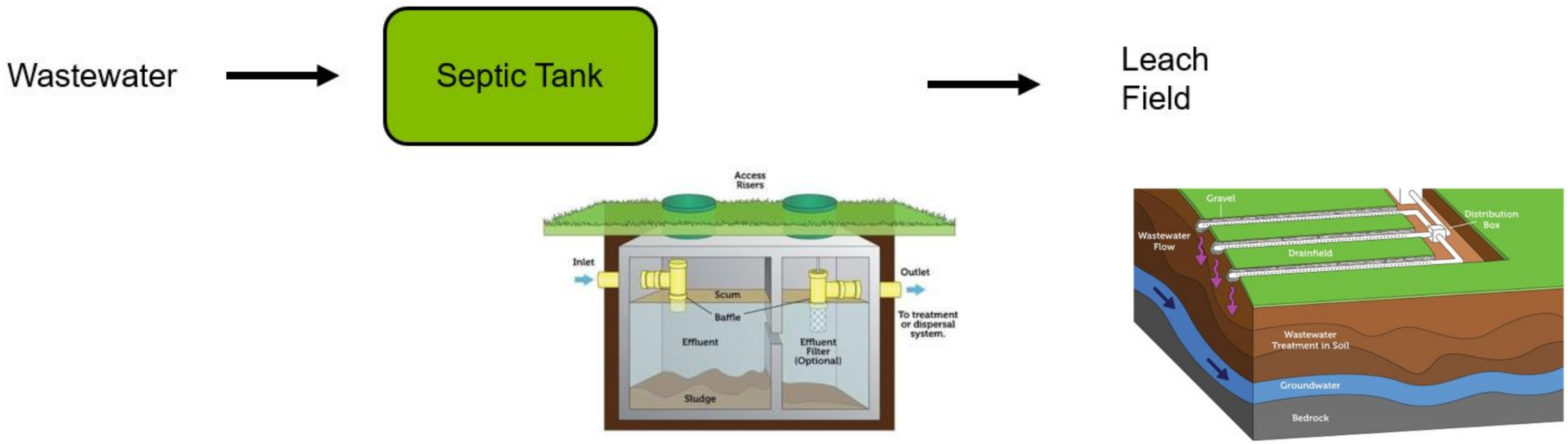
#### 6.2.1.1 SEPTIC TANK AND LEACH FIELD

Septic tanks and leach fields are now fairly common in Hawaiʻi. A septic tank is a holding tank manufactured of polyethylene plastic, fiberglass reinforced plastic, or pre-cast reinforced concrete. Its primary function is to provide adequate holding time for the separation of suspended solids and floatable matter from the wastewater. Figure 6-1 shows a flow schematic of a septic tank and leach field system [17] [18].

Wastewater flows through the septic tank by gravity. The tank employs no mechanical parts. Some anaerobic bacterial decomposition of the settled sludge occurs in the tank, converting organic wastes to gases over time and reducing the solids volume. Septic tanks may be designed with one or two compartments. In either design, the separated liquid is drawn off in the zone between the floating scum and the settled sludge layers.

Biological treatment of the clarified effluent from the septic tank principally occurs during disposal in the leach field. Nutrients in the wastewater promote the formation of a biological growth mat (biomat) which accounts for most of the nitrogen reduction within the leach field.

Maintenance checks must be made regularly to determine when the floatables and sludge in the septic tanks need to be pumped out to prevent excessive buildup. Such buildup causes scum and sludge to escape to the leach field and plug the pipe openings leading to the leach field.




Source: EPA **[17]**

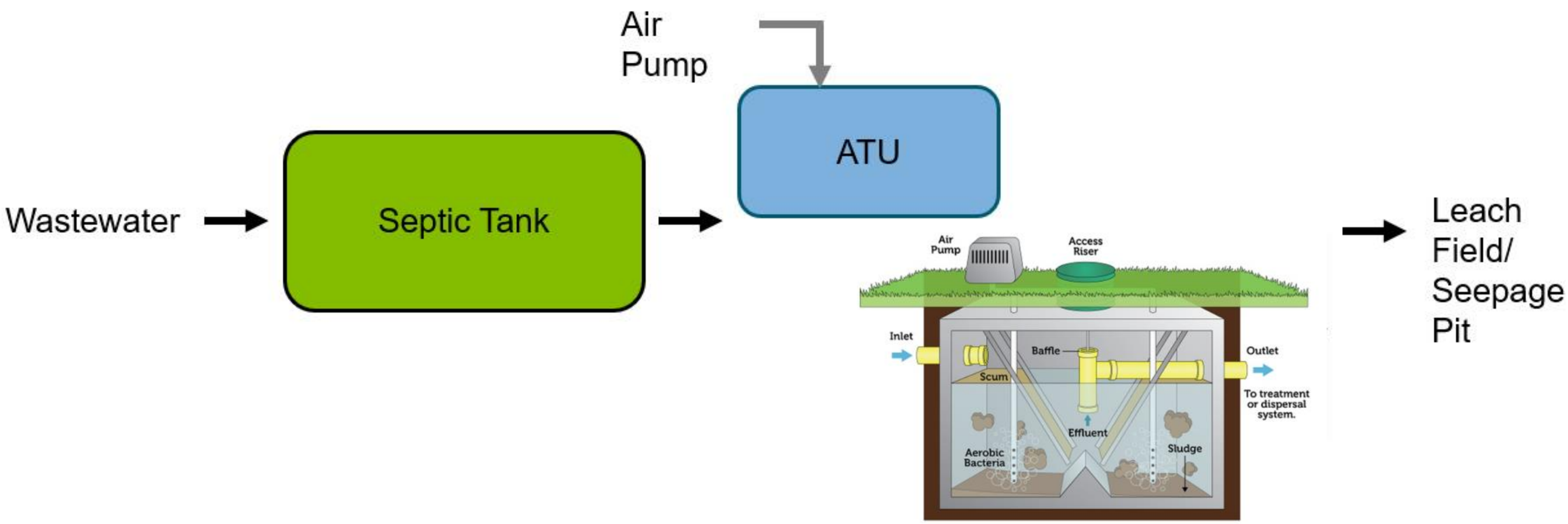
**Figure 6-1 Flow Schematic of Septic Tank and Leach Field**

#### 6.2.1.2 AEROBIC TREATMENT UNIT AND LEACH FIELD

Aerobic treatment units (ATUs) come in a variety of forms. The basic design consists of a single tank that is separated into chambers to permit entering wastewater to be treated in special stages Figure 6-2 [19]. The initial chamber is a settling compartment for the removal of heavy solids and floatable matter. The wastewater then flows to a second chamber, where it undergoes aerobic biological decomposition, typically with air pumped in from an external source. ATUs generally use a flow-through design with no moving parts, except for an external air pump to supply oxygen to a submerged aerator to sustain biological treatment.

Packaged ATUs achieve a high degree of wastewater treatment and can be customized with add-on treatment chambers for enhanced nutrient removal or for filtration of particles. Additionally, after biological treatment, calcium hypochlorite tablets may be stacked in a partially submerged capsule to impart chlorine disinfection of the effluent prior to seepage pit disposal.

An ATU operates effectively as long as the tank is aerated to promote biological degradation of organic matter. Buildup of biological solids occurs at a slower pace than in septic systems due to sustained decay of bacterial matter itself in an aerobic environment. Sludge pumping schedules are typically longer than two years.

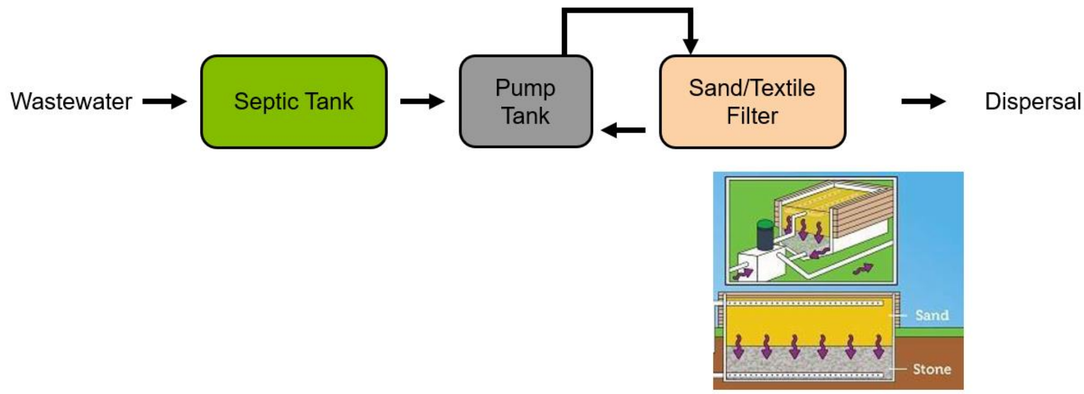



Source: EPA **[17]**

**Figure 6-2 Flow Schematic of ATU System**

### 6.2.1.3 Subsurface and Recirculating Sand Filters

Subsurface and recirculating sand filters are listed in the HAR to be reviewed by HDOH on a case-by-case basis. A recirculating filter is a treatment technology in which septic tank effluent percolates through a bed of sand or textile material, undergoing further biological treatment. Carbon oxidation, nitrification, and denitrification can all occur. A portion of the percolated water is pumped back to the pump chamber or the treatment process, and another portion passes on to a dispersal system, such as drip irrigation or a seepage pit. The nitrate in the recirculated water undergoes denitrification under anaerobic conditions. See Figure 6-3 for an illustration of recirculating filters.



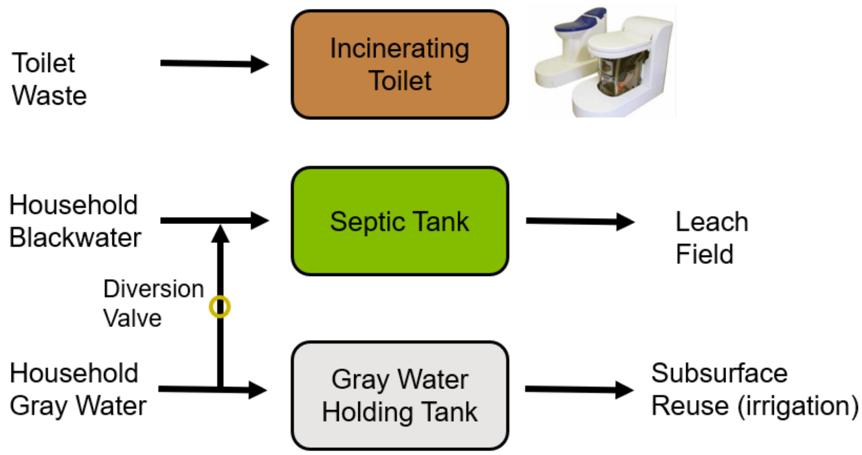

Source: EPA **[17]**

**Figure 6-3 Flow Schematic of Recirculating Sand Filter**

### 6.2.1.4 Alternative Toilets and Innovative Treatment and Disposal Options

Alternative toilets including composting toilets and incinerator toilets were developed for use in locations where water or electricity is scarce. In Hawaiʻi, household gray water (not from toilets and kitchen sinks) must have an overflow pathway to a wastewater treatment and disposal system in accordance with HDOH gray water reuse guidelines [20]. Therefore, if an alternate toilet is installed, it must be in combination with a wastewater and disposal treatment unit. Figure 6-4 shows a flow schematic of the components that must be installed for an alternative toilet system.

Currently, many innovative wastewater treatment systems are commercially available outside of Hawaiʻi. For emerging technologies in the research phase or undergoing pilot testing, such as nano membrane toilets (“Gates toilet”), they are reviewed and approved by the HDOH director on a case-by-case basis.




Source: Incinerating Toilets, Inc. **[21]**

**Figure 6-4 Flow Schematic of Alternative Toilet System**

## 6.2.2 Decentralized Cluster System

Per HAR regulation, if total development of an area exceeds 50 single family dwelling units or if flow exceeds 15,000 gallons per day for buildings other than dwellings, an IWS may not be used. In these situations, decentralized cluster packaged treatment units would be an option.

Available cluster wastewater treatment technologies include extended aeration activated sludge, membrane bioreactors (MBRs), attached growth bioreactors, moving bed bioreactors (MBBRs), and other package treatment plants. These treatment technologies are available in pre-engineered, self-contained treatment units of various specific treatment capacities. Installation generally would involve pouring of a concrete pad for the system, bringing in power supply, influent piping, and possibly seeding with a source of bacteria. The system would then be ready to start operations.

Available effluent disposal methods include leach fields for smaller flows or other methods (see Section 6.3.1) for larger flows. For solids handling at decentralized cluster systems, it may be more economical for biosolids to be hauled to an existing larger WWTP for further processing.

### 6.2.2.1 Extended Aeration Activated Sludge

This is a variation of the conventional activated sludge (CAS) process, but uses longer aeration time and longer sludge age to provide removal of biodegradable organic wastes under aerobic conditions without primary settling. The long aeration time means a larger aeration tank than CAS. The process has a high BOD removal efficiency and generates less sludge than CAS.

#### 6.2.2.2 SEQUENCING BATCH REACTOR

Sequencing Batch Reactor (SBR) systems are designed for batch treatment of waste water. An SBR is typically used for sewer systems that have a wide range of inflow and/or organic loadings. The SBR system requires limited operator attention. The SBR systems generally produce a stable, high quality effluent. SBR plants can be designed to be mechanically simple, flexible and easy to operable. The biochemistry in the SBR process is similar to the extended aeration AS process. Aeration, un-aerated mixing, settling, decanting effluent, and solids wasting are all accomplished within a single pair of tanks. While one tank is filling with wastewater and running through the un-aerated mixing, and aeration cycles the other tank is idle with no flow entering it while the solids settle, effluent is decanted, and the waste sludge is removed. At the end of the cycle the tanks alternate. After the waste sludge pumping cycle is completed the influent valves switch to begin filling the tank that had been decanted, and the other tank that was in the react mode would be put into “idle” mode allowing the solids settle, the effluent to be decanted, and the waste sludge to be removed.

#### 6.2.2.3 MEMBRANE BIOREACTOR

Membrane Bioreactor (MBR) is an activated sludge process that uses membrane filtration instead of a secondary clarifier to separate mixed liquor from treated effluent. Fine screening is an essential pre-treatment step to protect the membranes from damaging debris and particles. Fine screens extend the membrane life, reduce operating costs, and guarantee a higher sludge quality. MBR systems nearly always have an anoxic tank and internal pumping of mixed liquor to facilitate nitrogen removal via denitrification. An MBR is a recommended process for water reuse applications, since the membranes provide a barrier to many pathogens. Better effluent quality does come with higher capital, operation, and energy costs, which may present hurdles to implementing MBR systems for cluster systems.

#### 6.2.2.4 AERATED LAGOONS

Aerated lagoons can be used to treat municipal and industrial wastewaters that are low (100 to 200 mg/L BOD5 and TSS concentration) to medium (200 to 300 mg/L BOD5 and TSS concentration) strength. Aerated lagoons require a relatively large amount of land compared to other alternatives. O&M requirements are typically less than those required for extended aeration AS, SBR, or MBR technologies considered for this report. Aerated lagoons typically include lining systems, inlet and outlet structures, hydraulic controls, aeration equipment, and aeration system anchorage/restraint cables. For secondary treatment applications effluent filters are suggested for effluent polishing to remove suspended solids/algae from the effluent as needed to meet HDOH effluent limits for BOD and TSS (typically 30 mg/L) .

#### 6.2.2.5 ATTACHED GROWTH BIOREACTORS

These take advantage of biological treatment by promoting biological mass to grow as a biofilm on the surface of a media or disk, as opposed to suspended flocculated biomass in an activated sludge process. The media should have a large surface area to volume ratio to support microbial growth and form biofilms. Some versions of the process eliminate secondary clarifiers, decreasing associated cost and space requirements.

#### 6.2.2.6 Moving Bed Bioreactor

This process is a combination of activated sludge (suspended growth) and attached growth processes. It uses plastic floating media within an aeration basin to carry attached growth on biofilms. Pre-treated (settled) influent enters the aeration basin for treatment and may enter a second basin for further treatment (full nitrification). Fine-bubble aeration with high oxygen transfer efficiency is commonly used for mixing/suspension. In order to keep the carrier media in the tank, there is a strainer attached to the aeration basin effluent pipe. The aeration effluent, which contains sloughed biofilm and suspended solids, is conveyed either to a secondary settling tank or, more commonly, to a dissolved air flotation separator.

### 6.2.3 Centralized Treatment System

For Alternatives 2A and 2B, the proposed WWTP site is located south of the Pāhoa Fire Station and Driver License & Registration Office site along Keaʻau-Pāhoa Rd. The site is approximately 10 acres. Since the site is adjacent to commercial and residential lots, buffer zones should be provided from the WWTP.

In a centralized treatment system, wastewater is collected by a network of sewer lines that discharge to a WWTP. The WWTP would consist of facilities and equipment for pretreatment (e.g., screens, grit chambers, and/or equalization basin), primary treatment (e.g., primary clarifiers), biological (secondary) treatment (e.g., activated sludge, SBR, MBR, attached growth process such as trickling filters, aerated lagoon, moving bed reactor etc.), and tertiary treatment (e.g., filtration, disinfection). The treated wastewater would continue to disposal (see Section 6.3 on disposal options). Solids would be processed (e.g., dewatering, thickening, and stabilization) (Section 6.2.3.1) and sent to disposal or reuse (Section 6.3.2). Odor control would be provided at all centralized WWTP (example: chemical addition, air treatment such as activated carbon, chemical scrubbers, biofilters, biotrickling filters etc.). A typical WWTP conceptual site layout is shown on Figure 6-5.

#### 6.2.3.1 Solids Handling and Disposal/Reuse Options

Options for wastewater sludge handling and disposal for the centralized system alternatives are discussed in this section. These include thickening, stabilization, and dewatering. It may also be economical for biosolids to be hauled to another WWTP, such as Hilo WWTP, for further processing.

**Dewatering and Thickening**

Dewatering and thickening is the process by which biosolids are condensed to produce a concentrated solids product and a relatively solids-free supernatant. Thickening of wastewater solids reduces the volume of residuals, improves operation, and reduces costs for subsequent storage, processing, transfer, end use or disposal. Thickening is often used before anaerobic digestion or lime stabilization to reduce capital costs of stabilization equipment. There are several different methods for thickening biosolids, including belt filter press, centrifugal thickening, gravity belt thickening, and heat drying.

*Belt Filter Press:* A belt filter dewaters by applying pressure to the biosolids to squeeze out the water. Biosolids sandwiched between two tensioned porous belts are passed over and under rollers of various diameters. Increased pressure is created as the belt passes over rollers which decrease in diameter. Belt filter presses can be used to dewater most biosolids generated at municipal WWTPs and are a common type of mechanical dewatering equipment. Using mechanical equipment to dewater solids may not be the most cost-effective alternative for WWTPs operating at less than about 4 mgd, which is the case for Pāhoa. In these situations, it may be less expensive to haul liquids to another facility, such as Hilo WWTP, for dewatering and processing or disposal rather than installing dewatering equipment [22].

*Centrifuge Thickening and Dewatering:* This is a high speed process that uses the force from rapid rotation of a cylindrical bowl to separate wastewater solids from liquid. Thickening before digestion or dewatering reduces the tankage needed for digestion and storage by removing water. Centrifugal thickening can be cost effective for small plants. WWTPs that must landfill wastewater solids may benefit from the use of a centrifuge [23].

*Gravity Thickening:* This uses the natural tendency of higher-density solids to settle out of liquid to concentrate the solids. Gravity thickeners consist of a circular tank (usually with a conical bottom) that is fitted with collectors or scrapers at the bottom. Primary and/or secondary solids are fed into the tank through a center well, which releases the solids at a low velocity near the surface of the tank. The solids settle to the bottom of the tank by gravity, and the scrapers slowly move the settled, thickened solids to a discharge pipe at the bottom of the tank. A v-notch weir located at the top of the tank allows the supernatant to return to a clarifier [24].

*Heat Drying:* In this process, heat from direct or indirect dryers is used to evaporate water from wastewater solids. A major advantage of heat drying versus other biosolids improvement methods is that heat drying is ideal for producing Class A biosolids (see Section 6.3.2 for the different classes of biosolids). Heat drying does require a substantial capital investment and a large amount of energy [25].

**Stabilization**

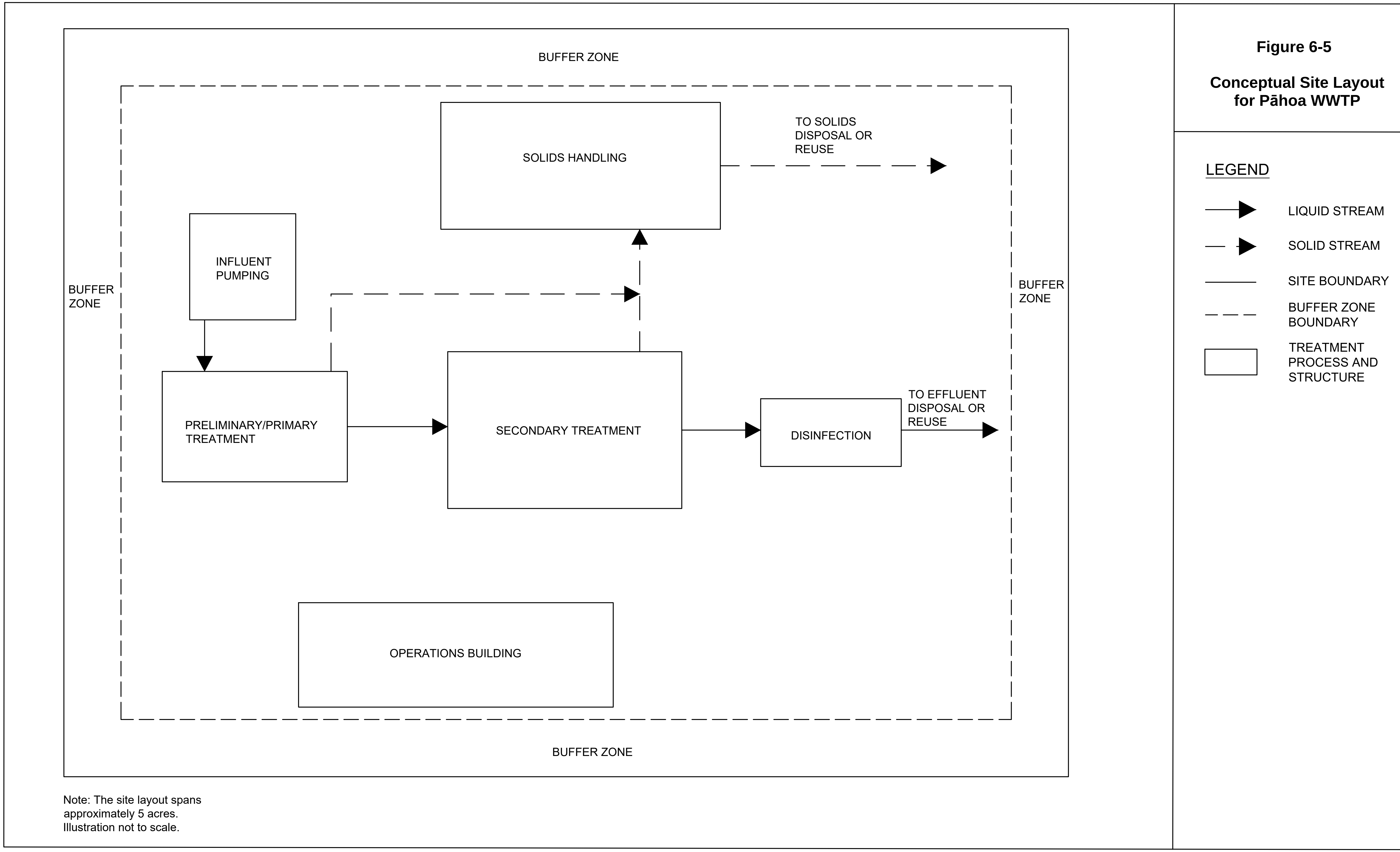
Wastewater solids need to be processed or stabilized before they can be beneficially used. Stabilization helps to minimize the potential for odor generation, destroys pathogens (disease causing organisms), and reduces the material's vector attraction potential. One method of stabilization is to add alkaline materials to raise the pH level to make conditions unfavorable for the growth of organisms (such as pathogens).

Alkaline stabilization can achieve the minimum requirements for both Class A and Class B biosolids (see Section 6.3.2 for the different classes of biosolids) with respect to pathogens, depending on the amount of alkaline material added and other processes employed. Generally, alkaline stabilization meets the Class B requirements when the pH of the mixture of wastewater solids and alkaline material is at 12 or above after 2 hours of contact. Class A requirements can be achieved when the pH of the mixture is maintained at or above 12 for at least 72 hours, with a temperature of 52°C maintained for at least 12 hours during this time.

Where lime or another alkaline additive (for example, recycled kiln dust), is relatively inexpensive, alkaline stabilization is often the most cost-effective process for wastewater solids stabilization. Alkaline stabilization is also practical at small WWTPs that store wastewater solids for later transportation to larger facilities for further treatment [26].

#### Anaerobic Digestion

Anaerobic digestion is a naturally occurring biological process in which large numbers of anaerobic bacteria convert organic matter into methane and carbon dioxide (a mixture called biogas) in the absence of air. It is a widely used biological process for treating wastewater solids. This process stabilizes the organic matter in wastewater solids, reduces pathogens and odors, and reduces the total solids/sludge quantity by converting part of the volatile solids fraction to biogas. Anaerobic digestion results in a product that contains stabilized solids, as well as some available forms of nutrients such as ammonia-nitrogen [27].


BUFFER ZONE
SOLIDS HANDLING
TO SOLIDS DISPOSAL OR REUSE
INFLUENT PUMPING
BUFFER ZONE
BUFFER ZONE
PRELIMINARY/PRIMARY TREATMENT
SECONDARY TREATMENT
DISINFECTION
TO EFFLUENT DISPOSAL OR REUSE
OPERATIONS BUILDING
BUFFER ZONE
Note: The site layout spans approximately 5 acres.
Illustration not to scale.
Figure 6-5
Conceptual Site Layout for Pāhoa WWTP
LEGEND
LIQUID STREAM
SOLID STREAM
SITE BOUNDARY
BUFFER ZONE BOUNDARY
TREATMENT PROCESS AND STRUCTURE

# 6.3 DISPOSAL OR REUSE OPTIONS

In the IWS and decentralized system alternative, disposal would occur onsite (see Section 6.2.1).

After wastewater treatment in the centralized system alternatives, the effluent and solids would have to be disposed of or reused appropriately. The subsections below describe these different disposal or reuse options.

## 6.3.1 Effluent Disposal or Reuse

For a WWTP, available effluent disposal options include land application, water reuse, underground injection well, and surface water discharge. A meeting with HDOH Clean Water Branch (CWB) confirmed that primary methods that will be considered for effluent disposal in Pāhoa include:

- Land Application
- Recycled Water

Disposal by injection wells/groundwater discharge is also possible in some situations as discussed below.

### 6.3.1.1 LAND APPLICATION

Land application refers to an effluent disposal system in which treated wastewater is applied to land using infiltration basins. Infiltration is typically a shallow (about 6-foot deep) earthen depression with an inlet pipe and berm around its perimeter. Water disposal occurs by seepage, evaporation, and plant transpiration. During seepage, effluent undergoes further treatment as it percolates through the soil matrix to the groundwater. Wastewater that is applied to land generally must have passed through both primary and secondary treatment at a minimum.

There are other types of land application for effluent disposal, such as slow-rate land application. This can provide additional treatment in removing nutrients as wastewater effluent percolates through plant root zones and soil. However, land area requirements for slow-rate land application are significantly greater than infiltration basins.

For regulatory requirements on effluent limitations, see Section 2.2.2.

### 6.3.1.2 RECYCLED WATER

There are three types of recycled water regulated by the HAR and HDOH: R-1, R-2, and R-3. For regulatory requirements on effluent limitations, see Section 2.2.1. It is important to keep in mind that water reuse is not considered a disposal method; therefore, a backup disposal system, such as land disposal, is required. Below is a list of suitable uses for recycled water that are potentially applicable to Pāhoa:

- R-1 Water (oxidized, filtered, and disinfected effluent) is applicable to all landscape and agricultural irrigation; drinking water for livestock and poultry with the exception of dairy animals that produce milk for human consumption; supply to restricted recreational impoundments; dust control; washing aggregate and concrete manufacturing; and industrial processes and industrial cooling.

- R-2 Water (oxidized and disinfected effluent) is applicable to subsurface drip irrigation for golf course and landscaping, and surface drip or subsurface drip irrigation for non-edible vegetation in areas with limited public access.
- R-3 Water (oxidized wastewater effluent) is applicable to drip or subsurface drip irrigation for non-edible vegetation in areas with limited public access.

According to HDOH Reuse Guidelines, recycled water shall only be applied (e.g., sprayed) in approved areas. Three categories of areas are designated by the Reuse Guidelines:

- Unrestricted Areas: recycled water application is unconditionally allowed.
- Conditional Areas: recycled water application is currently allowed, but may, in the future, be subject to monitoring requirements or restrictions.
- Restricted Areas: recycled water application is prohibited.

Areas on Hawaiʻi designated for unrestricted, conditional and restricted use of recycled water are shown in Figure 6-6 [28]. Pāhoa is regulated as an unrestricted area for recycled use.

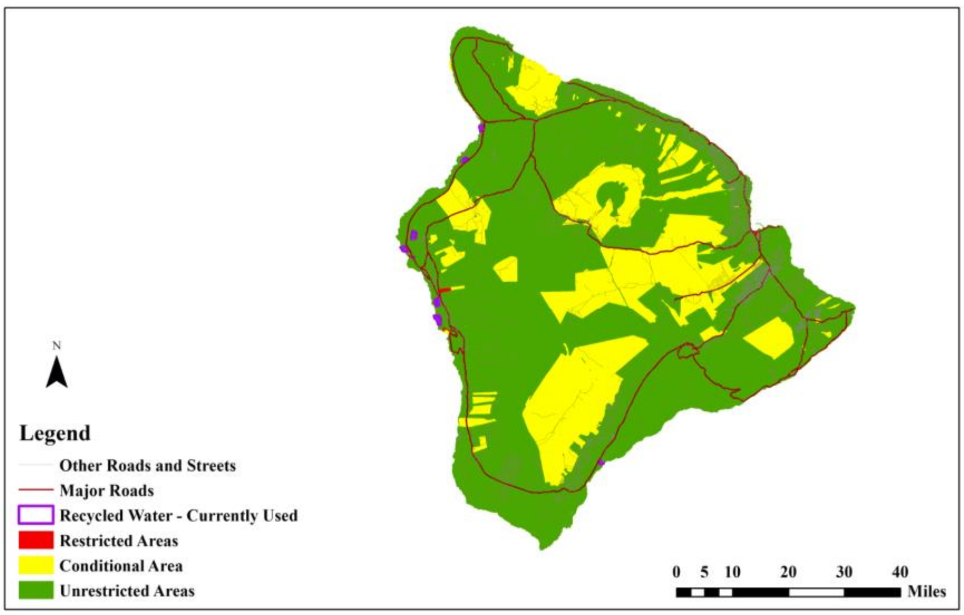



**Figure 6-6 Recycled Water Use on the Island of Hawaiʻi**

When considering water reuse for agricultural or landscaping irrigation, a soil water balance should be evaluated to prevent surface runoff from the applied recycled water. The fate of water that is added to the ground, either by rainfall or irrigation, is determined in a shallow layer of soil at the surface. The rainfall or irrigation water will either evaporate to the atmosphere through direct evaporation; be absorbed by plants and later transported to the atmosphere through transpiration; or percolate through soil and recharge the underlying groundwater aquifer. The remaining water will impact soil moisture or surface flow through runoff. The soil water balance can be summarized by the following equation:

Rainfall + Irrigation = Transpiration + Recharge + Change in Soil Moisture + Runoff

Mean annual rainfall and evapotranspiration for the Island of Hawaiʻi are shown in Figure 6-7 and Figure 6-8.

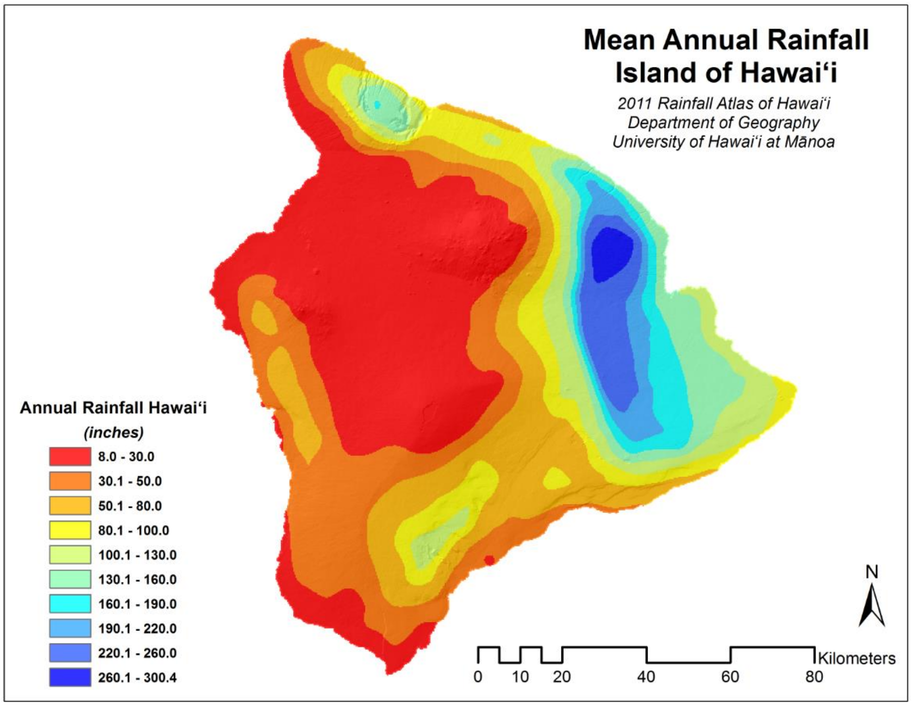



**Figure 6-7 Mean Annual Rainfall for Island of Hawaiʻi**

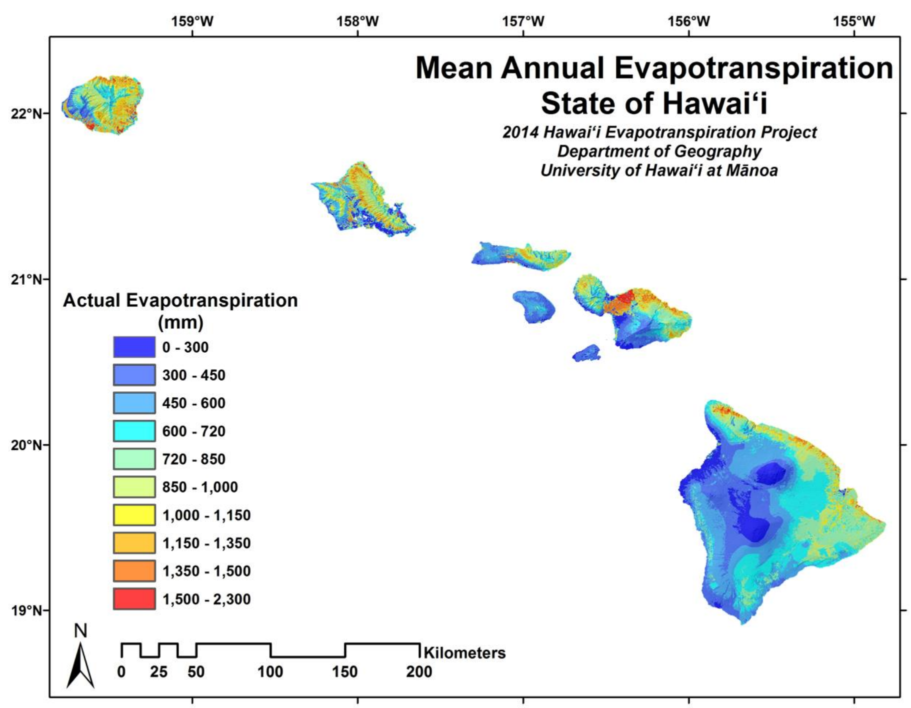



**Figure 6-8 Mean Annual Evapotranspiration for State of Hawaiʻi**

#### 6.3.1.3 Surface Water Discharge

Discharge to state surface waters is regulated by the NPDES program under the federal CWA. For regulatory requirements on effluent limitations, see Section 2.2.3. Surface water discharge in Pāhoa is not an option, since there are no suitable surface water bodies in the project area to receive treated effluent. Additionally, distance to the marine waters would make discharge to their cost prohibitive.

#### 6.3.1.4 Injection Wells/Groundwater Discharge

Underground injection wells are used for injecting water or other fluids into a groundwater aquifer. HAR 11-23 regulates the location, construction, and operation of injection wells so that injected fluids do not migrate and pollute underground sources of drinking water. Section 4 of HAR 11-23 describes the criteria for classifying aquifers as those that are designated as underground sources of drinking water and those that are not. The boundary between exempted aquifers and underground sources of drinking water is generally referred to as the “UIC Line”. Aquifers designated as sources of drinking water are above the UIC line and are not allowed to have underground injection wells. Additional regulatory information is provided in Section 2.2.4.

Figure 6-9 shows the UIC line for the Island of Hawaiʻi. The UIC line nearest Pāhoa is located approximately 1 mile inland from the coast. Since Pāhoa is farther inland, it is located above the UIC line and the associated aquifer is considered a source of drinking water. Therefore, underground injection wells would not be allowed in the project area.


**Figure 6-9**
**UIC Line for Hawaiʻi County**

### 6.3.2 Solids Disposal or Reuse

Options for wastewater sludge disposal or reuse for the centralized system alternatives are discussed in this section. It may also be economical for biosolids to be hauled to another WWTP, such as Hilo WWTP, for further processing.

Processed biosolids can be either disposed of by landfill or reuse with land application of Class A or Class B biosolids.

EPA’s 40 CFR Part 503, Standards for the Use and Disposal of Sewage Sludge, (the Part 503 Rule) defines two types of biosolids with respect to pathogen reduction: Class A (no detectable pathogens) and Class B (a reduced level of pathogens). Both classes are considered safe, but additional requirements are necessary with Class B biosolids. Class A biosolids are not subject to use restrictions and can generally be used like any commercial fertilizer [29].

Biosolids landfilling options include disposal in a monofill (a landfill that accepts only WWTP biosolids), or in a co-disposal landfill (a landfill that combines biosolids with municipal solid waste) [30].

If reused with land application, biosolids may be utilized in home gardening, commercial agriculture, silviculture, greenways, recreational areas and reclamation of drastically disturbed sites such as those subjected to surface mining [31]. Biosolids are often rich in nutrients such as nitrogen and phosphorus, and contain valuable micronutrients.

For centralized WWTPs in Alternatives 2A and 2B, the facility plan assumes biosolids stabilization to meet Class B criteria, followed by thickening and dewatering. This will allow the material to be beneficially reused on restricted sites or disposed in a landfill. For decentralized WWTPs in Alternatives 1A and 1B, cost estimates include thickening and hauling of sludge to the Hilo WWTP for stabilization and dewatering. Future upgrades or expansion at the Hilo WWTP may be needed to provide reliable and effective sludge treatment as decentralized WWTPs are developed and installed.

## 6.4 PROJECTED 2052 DESIGN AVERAGE FLOW

In Alternatives 1B, 2A, and 2B, all Pāhoa residences are assumed to connect to a sewer line for an approximate flow of (0.154 mgd). There would be no IWS in these alternatives. In this feasibility study, the interceptor sewers were sized to account for this flow of 0.154 mgd. Trunk and interceptor sewers along highways would be constructed by COH. The collection system for the Mauka Makuʻu area is assumed to be constructed by a future developer and is not included in this feasibility study. The treatment plant capacity is 0.3 mgd, which includes flows from both Pāhoa and Mauka Makuʻu (Section 4.6).

## 6.5 DESCRIPTIONS OF ALTERNATIVES

This section describes the different alternatives listed at the beginning of Section 6.0.

### 6.5.1 Alternative 1A: All IWS or Decentralized Systems

In this alternative, there are no publicly owned wastewater collection, treatment, and disposal system (i.e., the “no project” alternative in Section 4.1). This alternative is considered as “no action” and “no cost” to COH. Wastewater within Pāhoa would continue to be treated and disposed of through current and future (cesspool conversions) residential IWS, the commercial WWTP at Puna Kai Shopping Center, and any future clustered WWTPs.

There are currently approximately 390 OSDS, 320 of which are Class IV (cesspools) (brown dots in Figure 6-10). Under this alternative, these Class IV OSDS would need to be decommissioned and converted to a HDOH-approved system (see HAR 11-62) by 2050 in order to comply with Acts 87 and 125. Current cesspools may or may not qualify for conversion to seepage pits, depending on HDOH approval. Requirements include justification to show that there is insufficient land space for a leach field, slopes exceeding 12%, or percolation rates faster than 60 minutes per inch.

To prevent cumulative impacts of cesspool conversions, the HAR 11-62 requirements should be followed. These include limiting IWS to no more than one per acre. If a development has a maximum of 50 dwellings, then each dwelling may have an IWS if there is at least 10,000 square feet of land area per dwelling lot. For an existing lot less than 10,000 square feet and created and recorded before August 30, 1991, one IWS is allowed per lot.

Additional IWS or decentralized treatment systems will be required to support future growth. Based on the projected future flow, it is assumed that the number of additional IWS or decentralized treatment systems will increase proportionally to the population growth. Currently there are a total of 390 OSDS within the project area. Projected future (Year 2052) total OSDS is estimated to be 608 using the growth factor of 1.56. Therefore, in the future approximately 218 additional IWS or decentralized treatment systems would be needed (small red dots in Figure 6-10).

In Alternative 1A, all residential lots will use IWS for on-site treatment and disposal, and decentralized package plants are proposed for commercial areas and schools. One plant would be near the town center, two would be near Pāhoa High and Intermediate School and the Hawaiʻi Academy of Arts and Sciences, and one would serve Mauka Makuʻu (large red dots in Figure 6-10). For flow of the decentralized package plants, refer to Appendix B. The proposed numbers of future IWS and package plants are presented in Table 6-2.

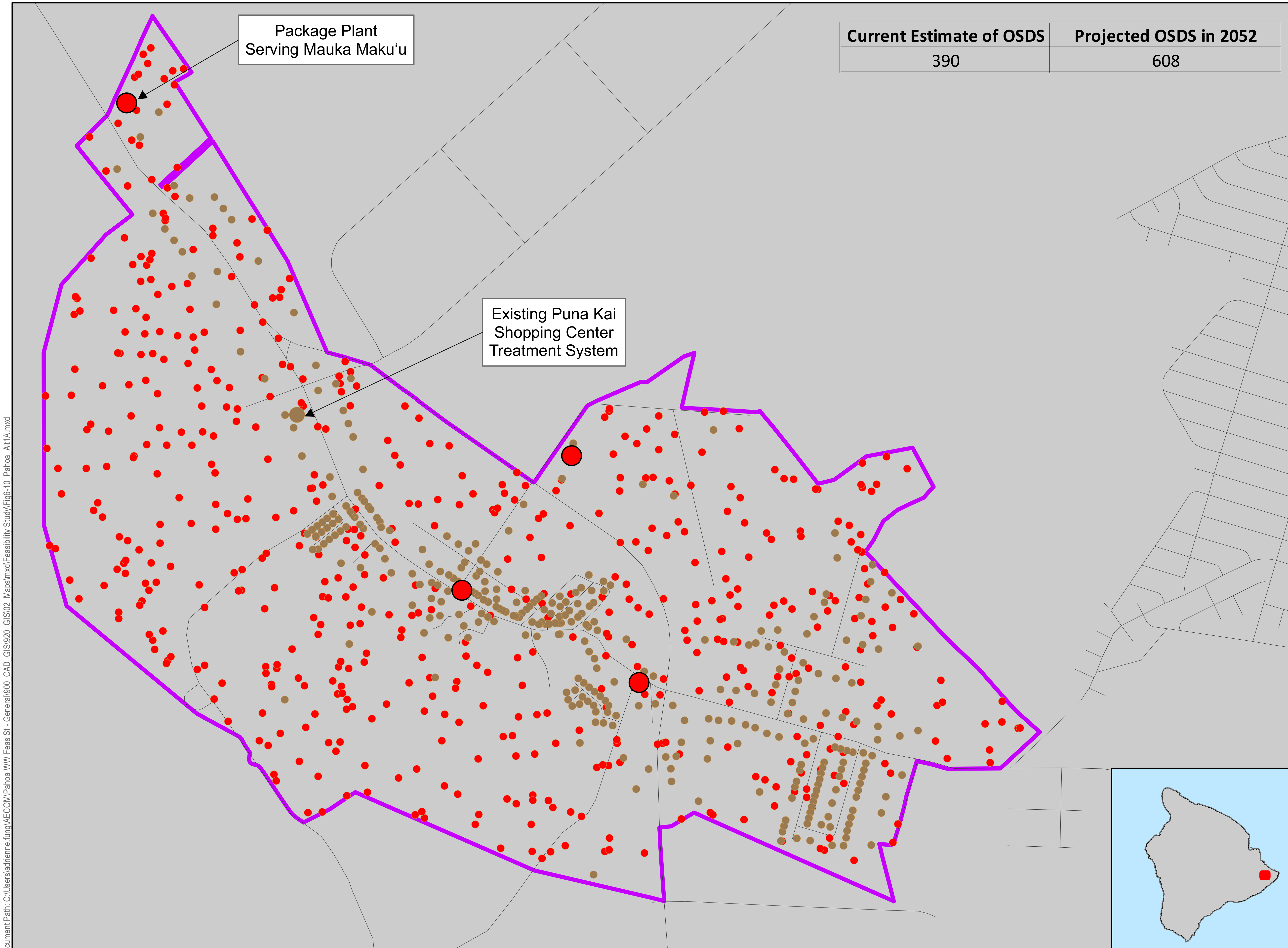
**Table 6-2 Collection and Treatment System for Alternative 1A**

| Alternative | Sewer Type | Length (ft) | Decentralized Treatment | |
|---|---|---|---|---|
| | | | # of IWS | # of Package Plant |
| 1A | NA | NA | 608 | 4 |

Note: NA: not applicable

## Figure 6-10

**Alternative 1A: All IWS or Decentralized Systems**




| Current Estimate of OSDS | Projected OSDS in 2052 |
|---|---|
| 390 | 608 |

Project Area
Roads

**Alternative 1A**

Existing OSDS
Potential Future OSDS
Potential Package Plant Locations

See above table for 2052 projections of the projected increases in OSDSs. Locations of potential future OSDSs are randomly distributed through project area.

OSDS: onsite sewage disposal system

N

0 0.125 0.25 Miles

### 6.5.2 Alternative 1B: Both Decentralized On-Site Treatment and LPS

Similar to Alternative 1A, wastewater management for Alternative 1B would be based on a decentralized system, with a total design average flow of 0.3 mgd (6.4). In Alternative 1B, decentralized cluster treatment with three package plants is proposed for the project area (Figure 6-11). One of these plants has a 50,000 gallons per day (gpd) capacity and would be in the southeast area of Pāhoa. The second plant has a capacity of 120,000 gpd and is located near the town center. The third plant has a capacity of 130,000 gpd and would serve Mauka Makuʻu.

The cost to COH for this alternative depends on the responsible entities for constructing and maintaining the LPS collection system in the roads, the decentralized plants, and the grinder pump and piping that is on the resident's lot.

LPS collection systems would be used to convey wastewater from residential and commercial properties to the two package plants serving Pāhoa. By using the LPS system instead of conventional gravity sewers, Alternative 1B avoids the need for neighborhood WWPSs and force mains, and regional WWPSs and force mains. However, the maintenance requirement of the on-lot low pressure pumps and in-street low pressure pipes and valves is expected to be more involved than conventional gravity sewers and pump stations. The key benefit for Alternative 1B is that treated effluent will be disposed of in a more favorable way at select locations, rather than IWS disposal on each lot. Additionally, treated effluent would be of higher quality than septic tank effluent. LPSs are also more accommodating of lots that are too small for an IWS and can help mitigate negative cumulative impacts of cesspool conversions for the project area.

The collection and treatment components of Alternative 1B are summarized in Table 6-3.

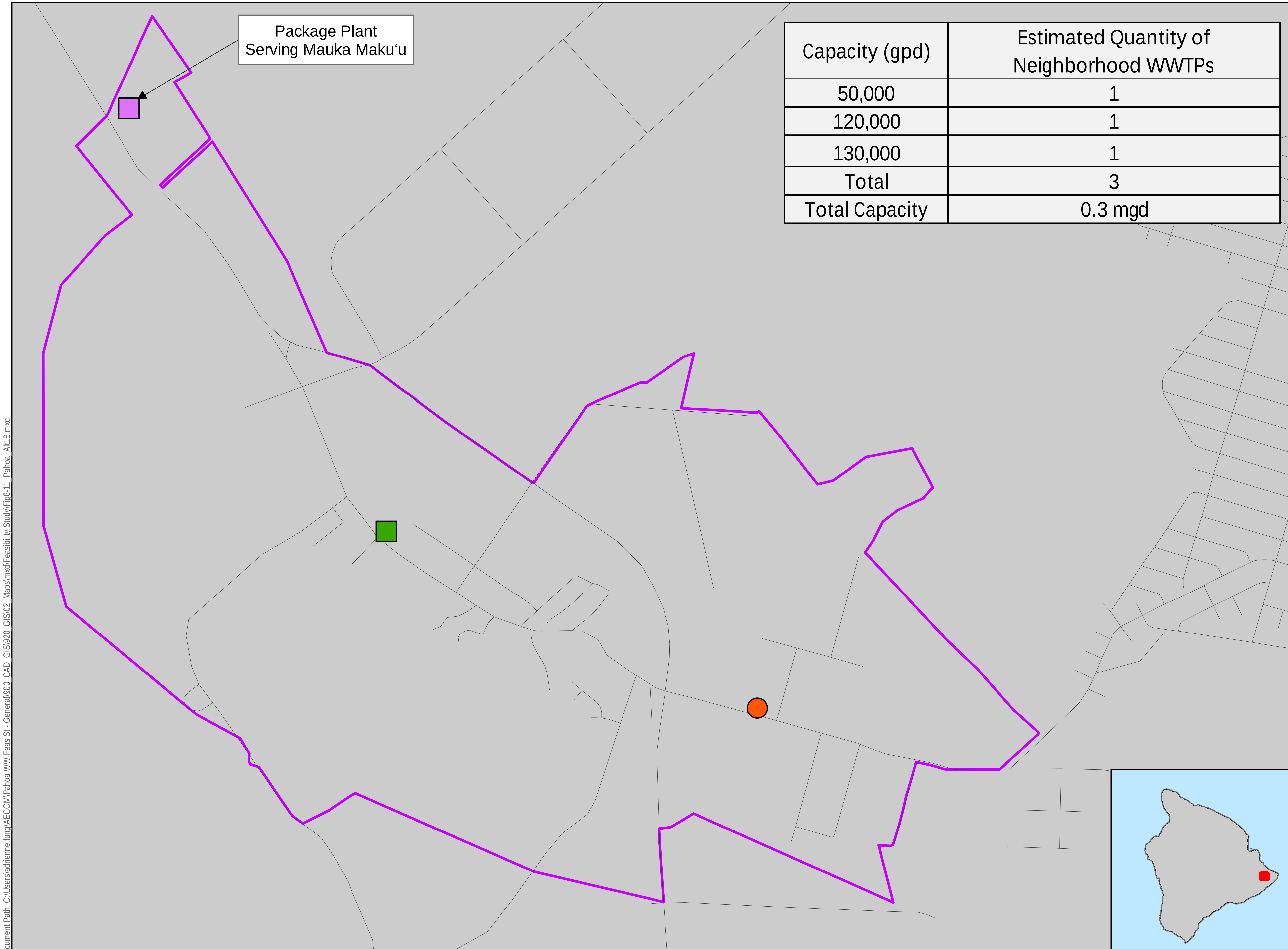
**Table 6-3 Collection and Treatment System for Alternative 1B**

| Alternative | Sewer Type | Length (ft) | Decentralized Treatment | |
|---|---|---|---|---|
| | | | # of IWS | # of Package Plant |
| 1B | LPS | 63,000 | NA | 3 |

**Figure 6-11**

**Alternative 1B: Decentralized Package Plants and LPS**

| Capacity (gpd) | Estimated Quantity of Neighborhood WWTPs |
|---|---|
| 50,000 | 1 |
| 120,000 | 1 |
| 130,000 | 1 |
| Total | 3 |
| Total Capacity | 0.3 mgd |




Project Area
Roads

**Potential Package WWTP Location**

**Capacity (gpd)**

- 50,000
- 120,000
- 130,000

Note: LPS would typically be installed primarily along neighborhood roadways, where properties will be sewered for the potential package WWTPs.

0 0.125 0.25 Miles

### 6.5.3 Alternative 2A: Pāhoa WWTP with All Conventional Gravity Sewers

This alternative is based on having a sewer system and centralized Pāhoa WWTP. The project area would be sewered using conventional gravity lines, with a design average flow of 0.3 mgd (6.4). The centralized treatment (6.2.3) and effluent and solids disposal or reuse options (6.3) would apply. The proposed layout and sewering sizes are presented in Figure 6-12. Due to the rolling terrain, two regional WWPSs would convey wastewater in trunk sewers on Kapoho Village Road and Keaʻau-Pāhoa Road to the proposed WWTP. There are also five proposed neighborhood WWPSs for collecting wastewater from locations that are at lower elevations than the trunk sewer.

As shown in Figure 6-12, 8-inch sewers will be installed in each street where residential or commercial lots need wastewater services, and two segments of 12-inch sewer would convey flow to the proposed WWTP. Sewer and pump station calculations were based on the CCH Wastewater System Design Standards and are included in Appendix A.

The collection system components are summarized in Table 6-4.

**Table 6-4 Collection System for Alternative 2A**

| Alternative | Sewer Type | Pāhoa (0.3 mgd) |
|---|---|---|
| 2A | Gravity Sewer (ft) | 44,200 |
| | Force Main (ft) | 13,700 |
| | Neighborhood WWPS | 5 |
| | Regional WWPS | 2 |

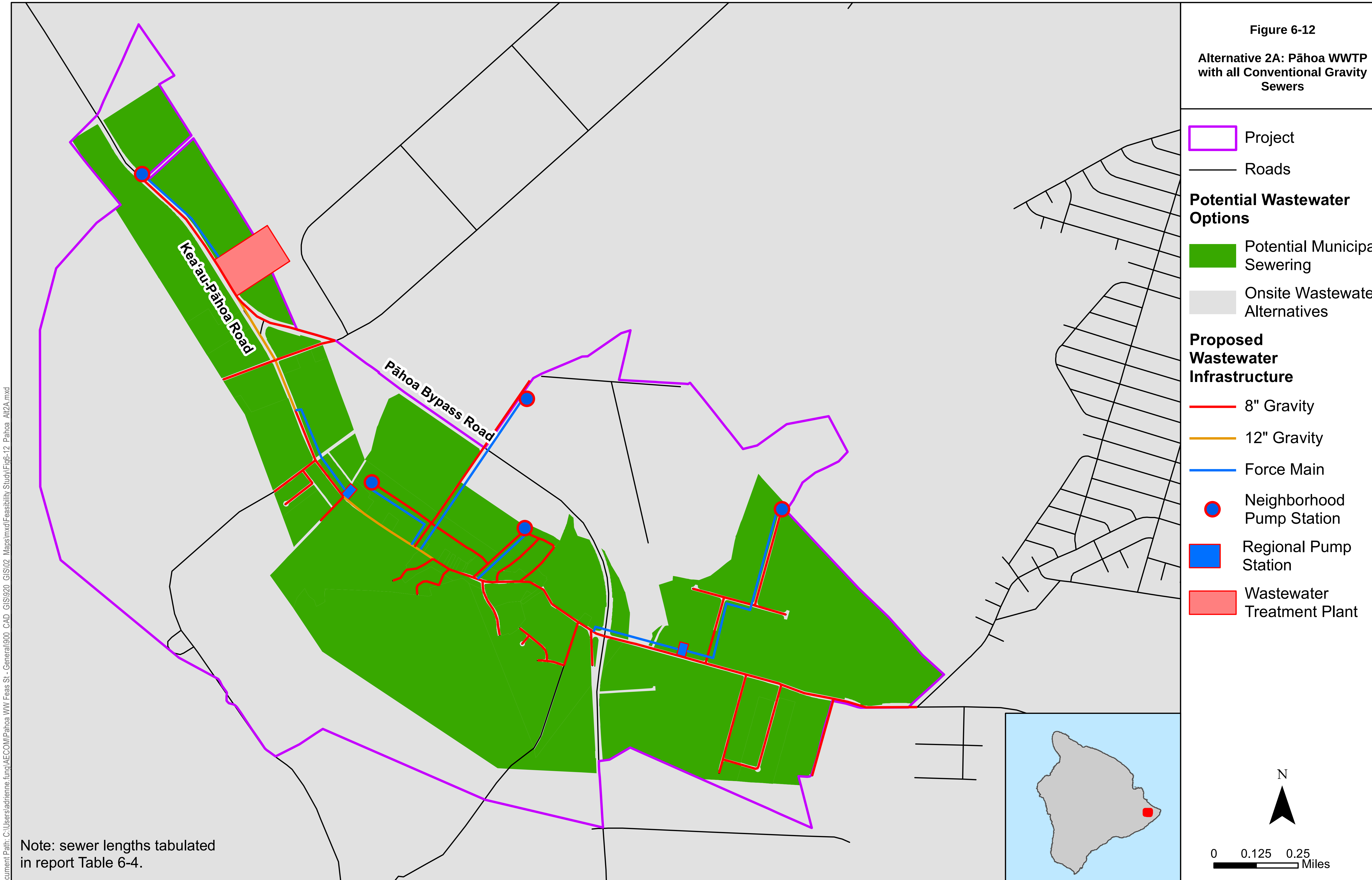



**Figure 6-12**

**Alternative 2A: Pāhoa WWTP with all Conventional Gravity Sewers**

### 6.5.4 Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS

Similar to Alternative 2A, this alternative is based on having a sewer system and centralized Pāhoa WWTP. The centralized treatment (6.2.3) and effluent and solids disposal or reuse options (6.3) would apply. The design average flow is also 0.3 mgd.

Different from Alternative 2A, this alternative would use LPS to replace neighborhood WWPSs and associated sewer lines. This would reduce the lengths of gravity sewers and force mains. The proposed layout and sewering types are presented in Figure 6-13. Due to the rolling terrain, two regional WWPSs would convey wastewater in trunk sewers on Kapoho Village Road and Keaʻau-Pāhoa Road to the proposed WWTP.

As shown in Figure 6-13, 8-inch sewers or LPS would be installed in each street where residential or commercial lots need wastewater services, and two segments of 12-inch sewer would convey flow to the proposed WWTP. Sewer and pump station calculations were based on the CCH Wastewater System Design Standards and are included in Appendix A.

The collection system components are summarized in Table 6-5.

**Table 6-5 Collection System for Alternative 2B**

| **Alternative** | **Sewer Type** | **Pāhoa** (0.3 mgd) |
|---|---|---|
| 2A | Gravity Sewer (ft) | 29,600 |
| | LPS (ft) | 14,700 |
| | Force Main (ft) | 3,000 |
| | Neighborhood WWPS | 0 |
| | Regional WWPS | 2 |

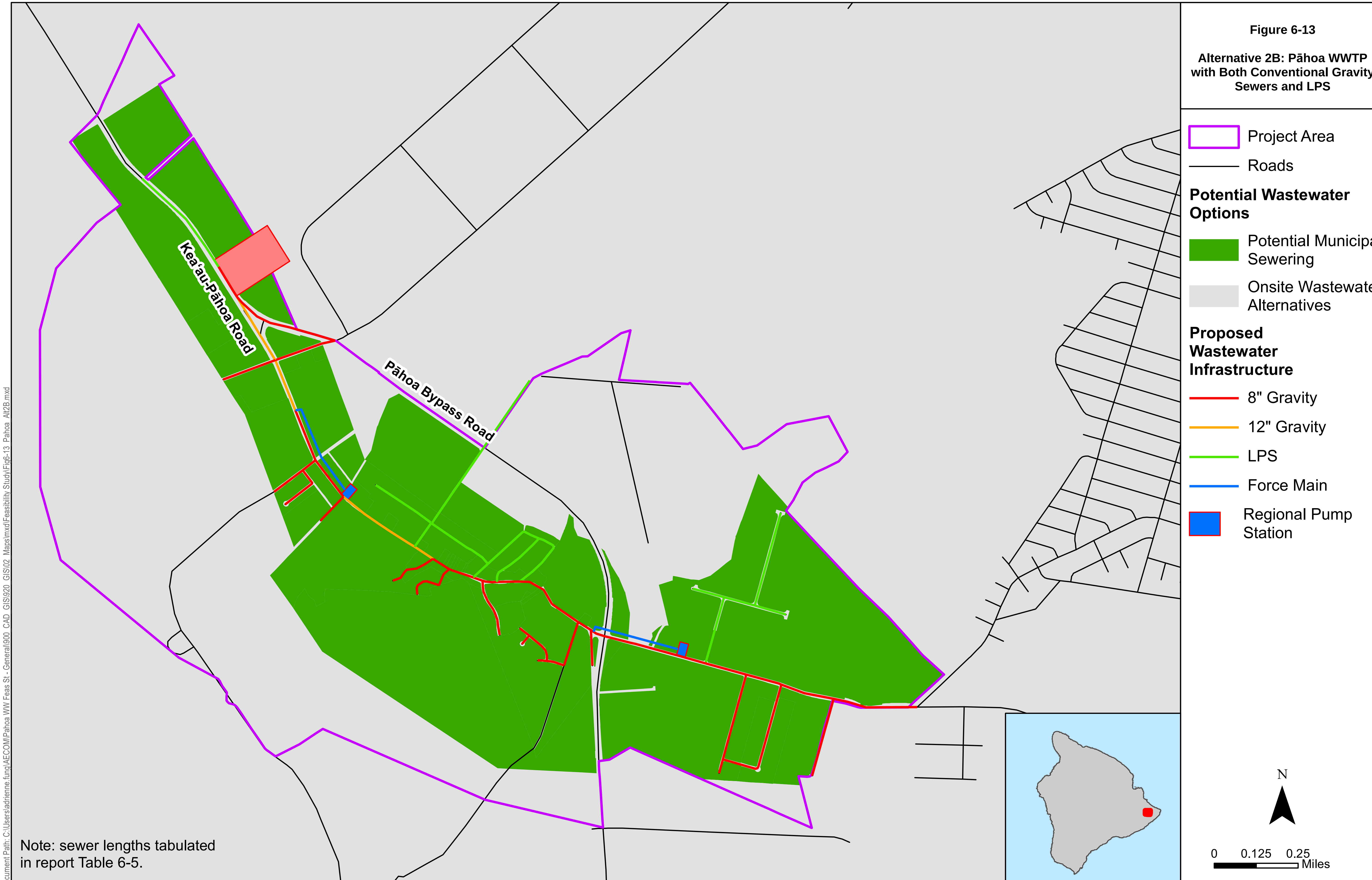



**Figure 6-13**

**Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS**

## 6.6 SCHEDULE CONSIDERATIONS

The work related to all wastewater alternatives would need to be executed in the following steps:

- Preliminary Design
- Environmental assessments/environmental impact statements
- Final Design and permitting
- Right-of-way acquisition
- Bidding and Award
- Construction of wastewater improvements
- Startup and Commissioning

The implementation schedules may be impacted by the following items:

- The time needed to procure, fabricate, and deliver major systems and equipment
- The ability to receive the shop drawings from the Contractor in a timely manner for the review and approval of the major equipment
- Any demolition and renovation work required for the new facilities

### 6.6.1 Alternative 1A: All IWS or Decentralized Systems

The implementation of Alternative 1A - IWS or Decentralized Systems is anticipated to be spread over the 27-year period from now until the Year 2050 Act 125 deadline requiring approximately 25 to 30 conversions per year.

### 6.6.2 Alternative 1B: Both Decentralized On-Site Treatment and LPS

The Preliminary Construction Schedule for Alternative 1B is based on the following assumptions:

- There would be a preliminary engineering/environmental assessment phase requiring approximately 2 years
- Final design bid packages would be prepared for the following types of improvements:
    - Decentralized WWTPs (assumes 1 contract)
    - LPS force mains (assumes 3 contracts with approximately 20,000 LF of LPS in each contract)
    - On-site grinder pump stations (assumes 3 contracts with approximately 200 grinder pumping units and on-site piping connections in each contract)
- Each final design package would require approximately 2-3 years including permitting and right-of-way acquisition
- Bids for the decentralized treatment would be advertised/awarded first. When the decentralized treatment plants are close to completion the pressure sewer contracts would be bid/awarded. When the pressure sewer contracts are completed the three grinder pump contracts would be bid/awarded approximately 1 month apart.

- All of the construction contracts would be planned to have a 2-year time of completion

It is anticipated that execution of this program would require approximately 10 years based on the above-mentioned assumptions.

### 6.6.3 Alternative 2A: Pāhoa WWTP with All Conventional Gravity Sewers

The Preliminary Construction Schedule for Alternative 2A is based on the following assumptions:

- There would be a preliminary engineering/environmental assessment phase requiring approximately 2 years
- Final design bid packages would be prepared for the following types of improvements:
    - Sewers and force mains (assumes 3 contracts approximately 20,000 LF each)
    - WWPSs (assumes 3 contracts, 2 contracts for the main lift stations and one contract for the 5 neighborhood pump stations)
    - WWTP (assumes 1 contract)
- Each final design package would require approximately 2-3 years including permitting and right-of-way acquisition
- Bids would be advertised/awarded approximately 6 months apart
- All of the construction contracts would have a 5-year time of completion

It is anticipated that execution of this program would require approximately 10 years based on the above-mentioned assumptions.

### 6.6.4 Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS

The Preliminary Construction Schedule for Alternative 2B is similar to conventional centralized gravity and pumping for Alternative 2A. The contract for the individual grinder pumping systems at each property replaces the contract for the 5 neighborhood pump stations. The contract for the LPS force mains replaces the contract for the gravity sewers.

It is anticipated that execution of this program would require approximately 10 years based on the above-mentioned assumptions.

# 7.0 EVALUATION OF ALTERNATIVES

The text below outlines the estimated cost and non-monetary considerations for evaluating the wastewater management alternatives described in Section 6.0.

## 7.1 EVALUATION CRITERIA

Evaluation criteria for the wastewater collection and treatment options include estimated costs and non-monetary factors. Alternatives with low initial construction cost may merit higher consideration, but it is also important to consider non-monetary factors. These include O&M challenges and social and environmental impacts of the alternatives that may favor another alternative.

All criteria can be considered priorities depending on whose perspective and which site is being considered. Thus, this report will rank the wastewater collection and treatment options for each criterion from the perspective of COH DEM. DEM is also obtaining feedback as to the ranking beliefs of different stakeholder groups such as the Pāhoa residents, COH administration, and regulators (HDOH).

DEM is preparing seven regional wastewater master plans to cover every region across COH as well as an overall Countywide Integrated Wastewater Masterplan. The wastewater collection and treatment options will then be prioritized across COH through this Masterplan process. Estimated costs, budgets, rate structure alternatives, and availability of regional grant funding will be considered when providing this Countywide prioritization.

## 7.2 BASIS OF CONSTRUCTION COST ESTIMATES

The American Association of Cost Engineers (AACE) guidelines were used for development of opinions of probable project and construction costs (referred to as cost estimates). A conceptual level construction cost estimate and a 30-year life cycle cost (LCC) analysis were conducted for the alternatives evaluated in Section 6.5. The LCC consists of the initial capital costs, as well as recurring annual O&M costs and equipment replacement costs at the end of their design life (typically 20 years for electrical and motorized equipment and 50 years for hydraulic structures, piping, and valves, and 75 years for sewers).

The Feasibility Study cost estimates are AACE Class 4, which are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. These estimates include all costs for the alternatives, although they may not be borne by the same funder. This is to allow an overall alternative comparison.

Main cost estimate assumptions are listed below, with additional ones provided in Appendix B-1. These apply to each of the alternatives. Parameters that are more specific to the type of wastewater system (e.g., decentralized or centralized) are described in the following sections.

- 10 year average discount rate (nominal) of 3.11% (based on 30-year Treasury interest rates for different maturities, as of 2023)

- Annual escalation rate (nominal) of 3.37% (based on 10 year average of ENR cost index)
- Effective interest rate (real) of -0.26% was calculated from nominal discount rate and nominal escalation rate
- 30-year period of analysis
- Estimated power cost based on $0.44 per kilowatt-hour [32]
- Estimated operation and maintenance costs including inflation (see subsections below for specific components)

A 20 percent contingency was applied to the estimated construction cost estimates to account for uncertainties and undefined work that will be quantified as the project proceeds. A 20 percent allowance for project services was also included in the project cost estimates to cover engineering and other implementation costs as follows:

- Preliminary design +/- 2 percent
- Final design and permitting +/- 8 percent
- Construction engineering and inspection +/- 9 percent
- Legal and fiscal expenses +/- 1 percent

### 7.2.1 Cost Estimating for Decentralized Treatment System

Conceptual level costs were used for the following components of a decentralized treatment system: IWS, LPS, and package plants. The values are detailed in Appendix B, so a summary of their basis is presented here.

#### 7.2.1.1 Cost Estimates of Cesspool Conversions

From the Hawaiʻi Cesspool Conversion Working Group (CCWG)'s Final Report to the 2023 Regular Session Legislature, costs of cesspool upgrades range from "$9,000 to $60,000 or more depending on the wastewater system capacity (based on bedroom count), technology, and location or site constraints" [33]. These cited costs are in 2020 dollars, so escalating to 2023 dollars, the range becomes $11,000 to $69,000.

To determine which estimate to use for the Pāhoa Feasibility Study, the geological conditions of Pāhoa were considered. The U.S. Geological Survey maps depict roughly 80% of the Puna district, where Pāhoa is located, as having hydraulic conductivity (which affects soil percolation rates) between 0 to 2 feet per day. This can be translated to 60 minutes/inch or slower. This also appears to be confirmed by the Keaʻau Village Master Plan [16], which involved excavating test pits in the Keaʻau area. These test pits indicate bedrock at about 29 to 47 inches below ground surface. This is not ideal for leach field design, since HAR 11-62 requires absorption trenches/beds to have a minimum vertical separation of 36 inches to bedrock. Therefore, due to the prevalence of underlying rock and high groundwater across most of the Project Area, cesspool conversions in Pāhoa may be closer to the higher end of $69,000 in the cost range as cited by the CCWG.

Furthermore, based on a wastewater feasibility study in Kapoho [34], the 2023 cost estimates are between $25,000 for a system with a leach field and $50,000 for a system with off-site granular soils. Based on the Pāhoa geology, it is more appropriate to use the upper end of the cost estimating range ($50,000). Ultimately, $60,000 per cesspool conversion was calculated by averaging and rounding the CCWG report estimate of $69,000 and the Kapoho report estimate of $50,000.

To verify the cost estimates listed in the CCWG report and Kapoho report, AECOM obtained quotes in April 2023 for various types of IWS from a local Hawai'i IWS supplier and obtained invoices through October 2023 for IWS submitted to HDOH.

It may also be worth mentioning that the Statewide estimate from the CCWG report excludes engineering, permitting, and land acquisition [35]. As described in Section 7.2, the Feasibility Study cost estimates include project services, land acquisition costs, and contingency to account for uncertainties and undefined work as the project proceeds.

In the cost estimate for O&M of IWS, $900 was used as the annual basis, which was scaled from the Kapoho feasibility study. This includes labor, electricity, and maintenance.

#### 7.2.1.2 Cost Estimates of LPS

To estimate the cost for LPS, the Kapoho feasibility study and recent LPS vendor information were used. This resulted in $25,300 per lot to cover the on-lot costs. To verify this estimate, AECOM obtained quotes in April 2023 for installing LPS from a local Hawai'i vendor. Their cost estimates closely match with the $25,300.

Estimated unit costs per linear foot are used for in-street LPS. These range from $300 to $600, depending on the pipe size. This Feasibility Study does not determine the specific entity (private or public) that will cover these costs, as this will depend on future coordination among homeowners, developers, and COH.

In the cost estimate for LPS, the O&M of in-street LPS is included in the unit costs mentioned above. On-lot LPS O&M are roughly $500 per lateral kit, which includes all components typically needed to connect an on-lot pump to the in-street sewer main. These O&M values were scaled from the Kapoho feasibility study.

#### 7.2.1.3 Cost Estimates of Decentralized Cluster Plants

A cluster plant with a capacity of 15,000 gpd (the starting limit based on 11-62-31.1) was estimated to cost $2 million, using previous projects in the area, such as the Kapoho feasibility study and the Puna Kai Shopping Center WWTP. To set the upper capacity limit of a cluster plant, 250,000 gpd is an acceptable industry standard of the breakeven point between a cluster (package) plant and an in-ground constructed WWTP. This was estimated at $12 million, based on $40 per gallon of wastewater treated (from similar previous projects; see Appendix G-2) with another $2 million for odor control, buffer zone, and other costs. For estimated costs of cluster plants with capacities between 15,000 gpd and 250,000 gpd, interpolation calculations between the $2 million (for 15,000 gpd) and $12 million (for 250,000 gpd) were used.

The estimated O&M costs for decentralized cluster plants include power costs, labor and materials. Power costs are based on $0.44 per kilowatt-hour and depend on how much plant capacity needs to be pumped. Labor and materials costs are based on historical local WWTP costs.

### 7.2.2 Cost Estimating for Centralized Treatment System

Preliminary conceptual site plans were prepared for sewers, force mains, WWPS and WWTPs using available GIS topography. Field observations of the project area were conducted to observe conditions of roads and identify existence of potential existing utilities.

Sewer and force main cost estimates are based on available bidding costs for recent water, sewer, and force main projects on Oʻahu and Hawaiʻi islands, including in Paukaʻa and Lono Kona (Appendix B-1). Average costs from within the last ten years for six COH bids and five CCH bids were used. COH projects had smaller pipe diameters, and CCH projects involved larger pipe diameters. Estimated costs were prorated for sizes that were not used in those past projects.

The cost estimates also account for an outer island factor. COH costs include fewer large contractors and less competition, higher costs for shipping and material delivery, and more rural project settings with less traffic control requirements. On the other hand, CCH cost factors account for more large-scale contractors with more competition, lower costs for shipping and material delivery, and urban project sites with rigorous traffic control and utility relocations. In summary, the CCH costs were lower than COH in terms of competition and shipping factors, but higher than COH costs in terms of traffic control. These effects canceled each other out, so the CCH costs for these particular projects could be used as they were without further adjustment.

Estimated costs were escalated from the bid date to present (year 2023) using the Engineering News Record (ENR) Construction Cost Index (CCI). The ENR CCI used for the cost estimates is 13,473 (August 2023). Estimated construction costs for the overall project are summarized below (details are in Appendix B-2):

- Gravity sewer cost estimates range from $1,600 to $19,500 per linear foot depending on the sizes, which range from 8-inch to 54-inch diameter pipes.
- Force main cost estimates range from $600 to $17,400 per linear foot for pipe sizes of 4-inch to 48-inch diameter.
- LPS cost estimates range from $300 to $600 per linear foot for 2-inch to 4-inch diameter pipes.

Treatment plant cost estimates include treatment to produce R-1 recycled water, but do not include recycled water pumping and distribution systems.

Estimated O&M costs for a centralized treatment system include inspections, cleaning, and maintenance of the collection system sewer lines and WWTP and WWPS equipment and materials. These differ depending on the alternative's design, average flow, and plant capacities.

### 7.2.3 Validation of Cost Estimates with CCWG Report

The CCWG report presents some of the latest and most comprehensive cost estimates for Hawaiʻi. These values were used to validate the cost estimates used in this Feasibility Study.

- Overall cesspool conversion cost estimate
  - CCWG Report: $9,000 to $60,000 per conversion
  - Pāhoa Feasibility Study: $60,000, based on escalating the CCWG report costs to 2023 dollars and accounting for Pāhoa geology (see Section 7.2.1.1). This is close to the higher end of the CCWG Report range, due to anticipated shallower depth to bedrock in Pāhoa.
- O&M cost estimate of IWS
  - CCWG Report: $400 to $1,300
  - Pāhoa Feasibility Study: $900, based on historical cost estimates near Pāhoa. This is close to the average of $850 from the CCWG Report.
- Sewering cost estimate
  - CCWG Report: While specific costs are not identified, the report notes the following regarding feasibility of sewering:
    - "…there are significant capital investments required by counties of private developers, and connections to centralized systems may not be feasible for many cesspool conversions."
    - "Within the rural areas of Hawaiʻi, which are extensive, the costs to dig and construct long sewer systems from remote locations to a centralized treatment facility are substantial."
    - "Since many of the cesspools are in rural areas without centralized wastewater systems, conversion to Onsite Wastewater Treatment System and disposal may still be the most cost-effective option for some homeowners, as long as permitted engineering for disposal is possible."
  - The CCWG report also compares typical average monthly sewer bills ($40 for a single family in Hawaiʻi County) to monthly cesspool conversion costs (between $94 and $339 for low and high cost scenarios, respectively). From this, it appears that monthly cesspool conversion costs are higher than monthly sewer bills. However, it is key to consider that the monthly sewer bills are for areas that already have sewers in place, many funded by grants. The construction cost for new sewers would not be reflected in the current sewer bills. Therefore, it does not mean that sewering would cost less than cesspool conversions. As the CCWG report mentions, it would be "reasonable to assume that additional funding will be required to make conversions affordable for most residents."
  - Pāhoa Feasibility Study: while there are no CCWG Report costs to compare with, estimated sewering costs for this Feasibility Study are based on local

Hawaiʻi utility construction bids, including projects in Paukaʻa and Lono Kona.

## 7.3 COMPARISON OF COST ESTIMATES

A summary of the LCC analysis for the alternatives is shown in Table 7-1. Supporting calculations are included in Appendix B. Findings from comparing the alternatives' cost estimates are summarized below.

The estimated LCC is calculated by estimated Total Capital Cost plus Net Present Value of O&M minus the Residual Value. The Total Capital Cost is the estimated construction and installation cost of the IWS, sewer lines, WWPS, and/or WWTP. Net Present Value of O&M is the 30-year period total of estimated O&M in present day dollars. Residual Value is the remaining value of the equipment, materials, and/or sewer lines at the end of the 30-year period. (30 years is used as this facility plan's period of analysis; see Section 4.2.) Therefore, the LCC is the cost of a system over its full life. It is only realized at the end of the system's life, hence its name as "life cycle."

### 7.3.1 Breakdown of Estimated Capital Costs between Collection and Treatment Costs

Table 7-2 is a summary of the estimated initial capital cost distribution between different types of wastewater infrastructure (piping, pump station, and WWTP). Additional details are included in Appendix B. For decentralized Alternative 1A (all IWS for residential and decentralized treatment for commercial areas and schools), 100% of the estimated initial capital cost is for wastewater treatment. For decentralized alternative 1B (on-site treatment and LPS), approximately 67% of the estimated initial capital cost is for the LPS collection system and 33% is for treatment. For both centralized alternatives 2A and 2B, 87% to 90% of the estimated initial capital cost is for the collection system, with piping cost at approximately 73% and WWPS cost ranging from 15% to 17%. The remaining costs, less than 13% of the initial capital cost, are for wastewater treatment.

### 7.3.2 Breakdown of Estimated Life Cycle Costs between Homeowners and Managing Entities

The estimated costs in Table 7-1 are broken down in Alternative  to show potential costs to homeowners and the managing entities (e.g., COH or a neighborhood association). In general, homeowners would be responsible for what is on their lot, and managing entities would be responsible for the collection system and treatment. It is also possible for a managing entity to cover what is on a homeowner's lot as well, but the costs here assume the former case.

In Alternative 1A, the LCC per homeowner includes installation and O&M of their IWS, while the LCC to managing entities is to cover the decentralized plants. In Alternative 1B, homeowners are assumed to pay for the on-lot portion of the LPS. The LCC to the managing entities would be for the in-street LPS network and decentralized package plants. Since Alternatives 2A and 2B are based on having a sewer collection system and centralized WWTP, the costs to homeowners would be for initial connection and their monthly sewer bill. Estimated costs to the managing entities would be those listed in Table 7-1.

### 7.3.3 Alternative with the Lowest Estimated Costs

A summary of the LCC analysis for the alternatives is shown in Table 7-1. Alternative 1A, the IWS/Decentralized alternative, has the lowest estimated capital cost and LCC. This agrees with the CCWG report's finding that cesspool conversions may be the most cost-effective solution, given that most cesspools are in rural areas without centralized wastewater systems. The CCWG report states, "Hawaiʻi County also has the greatest proportion of households, without centralized sewers than any other county (71%), indicating that connection to a centralized sewer system is unlikely to be available for most properties. Without options to connect to an existing sewer, the only option for many cesspool owners in Hawaiʻi County is likely the installation of an approved onsite system." Alternative 1A is also considered as "no action" because there are no COH capital improvement projects.

The estimated cost for Alternative 1A in Table 7-1 assumes replacement of about 390 existing IWS (either cesspool conversions or replacement of IWS at the end of their service life) and installation of about 218 new IWS to accommodate projected growth and development. Additional analysis was performed to evaluate conversion of just the existing 390 cesspools, and these estimated costs are presented in Table 7-4.

### 7.3.4 Impact of Collection System Option on Cost Estimates

Comparing the collection system options between 2A and 2B, the LCC decreases from the base scenario A (all conventional gravity sewers/force mains in existing roadways) to B (both gravity sewers and LPS). See Sections 6.1 and 6.5 for details on comparing the different collection systems within each alternative.

The higher LCC for Alternative 2A is mainly due to high excavation costs for deep sewers within lava rock and also construction of multiple pump stations to account for the rolling terrain in Pāhoa. For a project of this size, the WWTP costs in the centralized system alternatives are a relatively small percentage of the overall wastewater program cost. The majority of the costs are from laying the sewer collection network.

Alternative 2B with LPS has lower estimated capital costs and LCCs due to the smaller sizes and shallower depths of LPS and elimination of neighborhood pump stations. Estimated O&M cost is higher though due to maintenance of pressure pumps and valves within each lot.

### 7.3.5 Impact of Lava Hazard Zone on Cost Estimates

Hawaiʻi Island is divided into nine lava hazard zones as defined by the U.S. Geological Survey [36]. Zone 1 is the most hazardous, including summits and rift zones of Kīlauea and Mauna Loa, where vents have been repeatedly active. Zone 2 covers areas adjacent to and downslope of Zone 1. Therefore, there is increased risk of lava flow and destruction of future sewer systems in Zones 1 and 2. In the event that occurs, it is also possible for disaster financial assistance to support the re-construction of the sewer system.

If COH decided not to construct public sewers or centralized WWTP in Zones 1 and 2, then there would be no municipal wastewater services in Pāhoa, since the town is located within Zone 1.

### 7.3.6 Estimated Cost Summary Tables

**Table 7-1 Pāhoa Wastewater Management Alternatives LCC Analysis Summary**

| Alternative No. | Description | Capital Cost | NPV of O&M Cost | Residual Value | Total LCC |
|---|---|---|---|---|---|
| 1A | All IWS or Decentralized Systems | $80M | $23M | $16M | $79M |
| 1B | Both Decentralized On-Site Treatment and LPS | $90M | $23M | $33M | $80M |
| 2A | Pāhoa WWTP with All Conventional Gravity Sewers | $174M | $14M | $72M | $117M |
| 2B | Pāhoa WWTP with Both Conventional Gravity Sewers and LPS | $140M | $18M | $56M | $101M |

**Table 7-2 Breakdown of Estimated Capital Costs between Collection and Treatment Costs**

| Alternative | Collection System Costs as Percent of Capital Cost | Treatment Costs as Percent of Capital Cost |
|---|---|---|
| 1A | 0% | 100% |
| 1B | 67% | 33% |
| 2A and 2B | 87% - 90%[1] | 10% - 13% |

Note:
[1]Within the collection system, the piping costs are approximately 73% of the capital cost, and WWPS costs range from 15% to 17% of the capital cost.

**Table 7-3 Breakdown of Costs between Homeowners and Managing Entity**

| Alternative | Capital Cost to Homeowners | | Capital Cost to Other Entities[3] | Capital Cost to COH | Total Capital |
|---|---|---|---|---|---|
| | Total[1] | Per Homeowner[2] | | | |
| 1A | $36M[4] | $60K[4] | $27M | $0 | $80M |
| 1B | $23M | $37k | $67M | $0 | $90M |
| 2A | $3M | $5k | $0 | $171M | $174M |
| 2B | $8M | $14k | $0 | $132M | $140M |

Notes:
[1]Includes all costs for treatment and collection systems
[2]To estimate the total LCC per homeowner, the total LCC to homeowners is divided by 608, which is the total of existing and projected number of IWS in 2052.
[3]Entities may include institutions (schools) or private commercial developments
[4]Does not include markups for contingency and project costs, which are included in overall Capital Costs
M: Million, K: thousand

**Table 7-4 Alternative 1A with Existing Cesspool Conversions Only (no growth)**

| Capital Cost | Capital Cost per Homeowner[1] |
|---|---|
| $19M | $60K |

Note:
[1] To estimate the cost per homeowner, the total cost is divided by 320 existing cesspools.

## 7.4 ALTERNATIVES RATING

A relatively simple six criteria rating system has been prepared to evaluate the alternatives and assist with the selection of a preferred treatment alternative. The rating system allows the comparison of each alternative. The following rating scale is used:

3 = Excellent
2 = Good
1 = Fair

**Table 7-5 Pāhoa Wastewater Management Alternatives Rating**

| Criteria | Alternatives | | | |
|---|---|---|---|---|
| | 1A: All IWS or Decentralized Systems | 1B: Both Decentralized On-Site Treatment and LPS | 2A: Pāhoa WWTP with All Conventional Gravity Sewers | 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS |
| | Score | Score | Score | Score |
| Estimated Construction Cost | | | | |
| Estimated Annual O&M Cost | | | | |
| Operational Ease and Maintainability | | | | |
| Ability to meet Potential Future Requirements | | | | |
| Utilization and Acquisition of Land | | | | |
| Environmental/Regulatory Permitting | | | | |
| **Total Score** | | | | |

Notes:
- 3 is the most favorable alternative, 1 is the least favorable alternative.
- The highest total score is the most favorable alternative.
- Scores are preliminary. May be updated pending review by DEM and other project stakeholders.

## 7.5 RATING CRITERIA

The following criteria were identified and reviewed to compare the various wastewater treatment and collection system alternatives for Pāhoa described in Section 6.0. The six criteria are:

- Estimated Construction Cost
- Estimated Annual O&M Cost
- Operational Ease and Maintainability
- Flexibility to meet Potential Future Requirements
- Utilization and Acquisition of Land
- Environmental Concerns/Regulatory Permitting

The following sections describe each criterion. Ratings are assigned based on the COH DEM perspective.

### 7.5.1 Estimated Construction Cost

This criterion includes the estimated cost of the capital improvement, including labor and materials as well as indirect costs to design and construct the wastewater WW system; constructability (ease or efficiency that the facility can be built) which makes it more economical; construction implementation schedule.

The most favorable alternatives are Alternative 1A: All IWS or Decentralized Systems and 1B: Decentralized On-Site Treatment and Low Pressure Sewers. Both have the lowest estimated construction cost of all alternatives.

### 7.5.2 Estimated Annual O&M Cost

This criterion is the annual cost of labor, consumables, and energy to operate the wastewater system. This criterion includes a comparison of how much energy is required for different options to provide the same service. Smaller treatment facilities would require less energy to operate than larger treatment facilities. However, factors such as the length of pipe between structures and the difference in topography would also have an impact on the energy efficiency of the facilities.

The most favorable alternatives are Alternative 2A: Pāhoa WWTP with All Conventional Gravity Sewers and Alternative 2B: Pāhoa WWTP with Conventional Gravity Sewers and Low Pressure Sewers. Both have the lowest estimated annual O&M cost of all the alternatives.

### 7.5.3 Operational Ease and Maintainability

This criterion is the ease with which the wastewater system can be kept functioning in a safe and reliable manner. Operational ease is the capability to keep the wastewater treatment equipment and systems functioning in a safe and reliable manner in accordance with the prescribed operating requirements. Systems that are more complex or have more processes and/or functions are more difficult to operate than simpler systems.

This criterion includes operator availability (if certified operators are required), and the level of skills needed to operate and maintain systems. For example, maintenance of IWS will be handled by each homeowner and maintenance of a centralized wastewater treatment plant will be handled by the County.

Maintainability is the probability that a successful repair action can be performed within its designated allowable time schedule. Maintainability measures the ease and/or speed with which a system can be restored to operational status after a failure occurs. Systems that have more equipment or devices are more difficult to maintain than smaller scale systems. Maintainability is also impacted by the work setting, lighting, size, and available space around the equipment. One factor is the concept of "carry your own kuleana". This refers to the maintenance responsibility to keep a wastewater system functioning if it is kept closer to the user versus the flushing of problems "away" and some other community handling it.

The most favorable alternative is Alternative 1A: All IWS or Decentralized Systems. Maintenance would be managed by each individual property owner. The wastewater/septic waste would still require COH participation for treatment (example: trucking septage to the Hilo WWTP which is the closest facility to the project area). One facility will operate and handle the wastewater or septic tank waste and it will be maintained by the County of Hawaiʻi.

### 7.5.4 Flexibility to meet Potential Future Requirements

This criterion is the ability to meet potential future regulation changes including wastewater treatment levels and effluent disposal/use; sustainable solids handling strategy; ability to meet future demands and ability to meet future water quality requirements. All wastewater treatment options will produce additional quantities of solids compared to the current situation of using cesspools as the primary method of handling wastewater in Pāhoa. The quantity of additional solids, along with the operating complexity of solids producing processes, are considered.

Also considered is the Lava Zones designated by the County. The county is considering an infrastructure policy for areas in lava zones 1 and 2.

The resilience of an alternative to climate change is a consideration. Resiliency is the ability of an infrastructure system to adapt to and withstand various climate-related stressors: which may include lava, earthquakes, floods, droughts, wildfires, etc. Resilient infrastructure is planned, designed, built and operated in a way that anticipates, prepares for, and adapts to changing climate conditions. It can also withstand, respond to, and recover rapidly from disruptions caused by these climate conditions.

"Recycled water" is treated wastewater that is intended, or used, for beneficial purposes. HDOH advocates the use of recycled water if public health and water resources are not compromised. The use of recycled water may become more significant due to COH's growing population, limited potable water resources, and wastewater disposal issues. The ability to produce recycled water and the operating complexity of the recycled water treatment systems impact the comparison of the alternatives.

Having separate decentralized treatment plants would make it easier to distribute and reuse the water throughout the Project Area. The alternatives with a single water reclamation facility make it more difficult to distribute the water to the more remote areas away from the facility.

In 2016, the HRS were amended by Act 248, which added a new section related to wastewater treatment. The new section prohibits the discharge of treated or raw sewage into state waters after December 31, 2026, unless the wastewater treatment systems produce “clean energy.” Therefore, the quantity of clean energy and the operating complexity of energy producing systems play a role in comparing alternatives if the alternative discharges into state waters.

The flexibility to meet and adapt to future regulations, along with resilience and ability to handle solids favors Alternatives 1A: all IWS or Decentralized Systems and Alternative 1B: Both Decentralized On-Site Treatment and LPS. If the potential use and distribution of recycled water is given more importance, then Alternative 1B is the most favorable alternative, since the decentralized treatment units would create the most recycled water and be located throughout the community. This allows reuse distribution networks to be smaller and able to adjust for each area.

### 7.4.6 Utilization and Acquisition of Land

This criterion considers site acquisition; site layout efficiency; availability of county land; ability to obtain easements for collection system; impact on land use during construction; ease in meeting security requirements to prevent unauthorized entry and vandalism.

One factor is the difficulty in obtaining easements over private lands for the collection system. Many of the subdivisions in Pāhoa are on private lands, including private roadways where the trunk lines may be.

The most favorable Alternative is Alternative 1A: All IWS or Decentralized Systems because there is no COH property acquisition required.

### 7.5.5 Environmental Concerns/Regulatory Permitting

This criterion evaluates the environmental concerns and regulatory permitting requirements for each alternative. The alternative ranking evaluates the difficulty in permitting the project for construction, implications for the design and construction, and ability to mitigate impacts such as odor and vector control. The environmental concerns include evaluation of the State prioritization of areas for cesspool, potential impact on drinking water due to existing cesspools and future use of effluent. Other environmental impacts include air quality, water quality, biological resources, archaeological, historic and cultural resources, aesthetic resources, noise and vibration, transportation, other public services, and socioeconomic factors. The Puna Programmatic PEIS describes the impacts and mitigation at a programmatic level for all alternatives considered for the Puna District (including Pāhoa).

The most favorable alternative is Alternative 1A: All IWS or Decentralized Systems because permitting the numerous sites is less onerous than permitting a treatment plant, collection system, and pump stations for construction. Environmental impacts of small discrete IWS are less concerning that impacts due to larger treatment plants and the attendant air, water, biological, archaeological, historical and cultural resources. Alternatives 1B, 2A and 2B would likely require an environmental assessment for the treatment plant and collection system.

### 7.5.6 Overall Rating Results

A relatively simple multi-criteria rating system has been prepared to evaluate the alternatives and assist with the selection of a preferred treatment alternative. The rating system allows the comparison of each alternative.

- 3 = Most Favorable
- 2 = Favorable
- 1= Less Favorable

The alternative with the highest score is most favorable and the alternative with the lowest score is least favorable.

The above criteria have been used to evaluate the alternatives for Pāhoa, however the selection of an alternative also needs to include countywide assessments of the improvements required to meet the cesspool conversion and other required improvements. The County is currently in the process of planning for multiple areas and beginning a countywide plan for implementation. Selection of the best alternative for Pāhoa should include input from this countywide process.

Table 7-6 shows a summary comparison of the multi-criteria ratings for the alternatives from the perspective of the Department of Environmental Management. The most favorable alternative is Alternative 1A: All IWS or Decentralized Systems. Similarly, the HDOH Wastewater Branch also ranked the alternatives and determined that Alternative 1A: All IWS or Decentralized Systems was the first priority alternative. As discussed earlier, the county is working on a county-wide master plan which will allow cross prioritization of capital projects across the various districts. Thus, scores are preliminary and will be updated pending review by the County, DEM, and other project stakeholders.

In evaluating the alternatives, all six criteria were weighted the same. It is interesting to note that during the October 21, 2023, Revitalize Puna, 39 members of the public participated in a “game” designed to solicit community feedback on what they thought were the three most important criteria. The results were (numbers of “votes” in parentheses):

- Estimated Construction Cost (20)
- Estimated Annual O&M Cost (24)
- Operational Ease and Maintainability (17)
- Flexibility to meet Potential Future Requirements (16)

- Utilization and Acquisition of Land (16)
- Environmental Concerns/Regulatory Permitting (24)

Criteria weighting could be a tool to compare proposed alternatives. The weights from this Revitalize Puna sample could be applied to the alternatives evaluation to determine the highest-ranking alternative. When the weights from Revitalize Puna were applied to the DEM rating, it also resulted in the prioritization Alternative 1A. There was not enough of a difference between the weights of the criteria to change the DEM rating order of the alternatives.

**Table 7-6 Comparison of Wastewater Alternatives Rating from DEM Perspective**

| Criteria | Alternatives | | | |
|---|---|---|---|---|
| | 1A: All IWS or Decentralized Systems | 1B: Both Decentralized On-Site Treatment and LPS | 2A: Pāhoa WWTP with All Conventional Gravity Sewers | 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS |
| | Score | Score | Score | Score |
| Estimated Construction Cost | 3 | 3 | 1 | 1 |
| Estimated Annual O&M Cost | 2 | 2 | 3 | 3 |
| Operational Ease and Maintainability | 3 | 2 | 1 | 1 |
| Flexibility to meet Potential Future Requirements | 3 | 3 | 2 | 2 |
| Utilization and Acquisition of Land | 3 | 1 | 2 | 2 |
| Environmental/Regulatory Permitting | 3 | 2 | 1 | 1 |
| **Total Score** | **17** | **13** | **10** | **10** |

Notes:
- 3 is the most favorable score, 1 is the least favorable score.
- The highest total score is the most favorable alternative.
- Scores are preliminary and may be updated pending review by DEM and other project stakeholders.

# 8.0 FUNDING AND FINANCING CONSIDERATIONS

This section covers institutional and financial support for implementing cesspool conversions and recommends strategies to consider.

## 8.1 INSTITUTIONAL STRUCTURE

To allow development of a plan of operation for this feasibility plan, the existing institutional arrangement should be reviewed, and a financial program should be developed after selection of a plan and design. The plan of operation should include preliminary allocation of the costs among various users of the wastewater system. Feasibility of the plan requires agreement among participating entities and stakeholders on the plan implementation. Preparation of a plan of operation is critical, which should include the staffing, management, training, operation, maintenance, and analysis to ensure effective operation of the infrastructure.

### 8.1.1 Existing Regulations

In the State of Hawaiʻi, there are currently 83,000 documented cesspools. Hawaiʻi Island is estimated to have 48,303 cesspools releasing an estimated 27.3 million gallons of effluent daily [37]. Property owners and operators must comply with all federal and state requirements for cesspools, including the requirement that cesspools of any size be upgraded, converted, or closed by January 1, 2050.

Act 125, which came into effect in 2017, mandates that all cesspools in Hawaiʻi must be replaced by 2050. Act 132, established in 2018, created a Cesspool Conversion Working Group (CCWG) attached to the Department of Health (DOH), which will develop a plan for cesspool conversion statewide by 2050. The final report was required to be provided to the State of Hawaiʻi legislature no later than 60 days before the 2023 legislative session. The CCWG submitted it November 2022.

The HDOH Wastewater Branch oversees and permits all onsite wastewater systems, including cesspools. Act 125 directed HDOH to evaluate residential cesspools in the state, develop a Report to the Legislature that includes a prioritization method for cesspool upgrades, and work with the Department of Taxation on possible funding options to reduce the financial burden on homeowners. As the CCWG continued to develop a conversion plan, additional research and planning progressed, including reports on conversion or upgrade alternatives, prioritization of locations, and financing options.

Act 87 was passed in 2022, amending Act 125 by broadening the upgrade or conversion options that are available for cesspools.

COH DEM oversees sewer O&M. See Section 3.2 for more information.

## 8.2 PRIORITY AREAS

Understanding prioritization of areas for cesspool conversions may help with formulating a plan for funding and scheduling wastewater projects. HDOH has prioritized cesspools for corrective action based on the risk the cesspools pose and existing infrastructure such as nearby sewer mains to receive wastewater flows. Also considered are the density of cesspools in an area; soil characteristics; proximity to drinking water sources, streams, and shorelines; other groundwater inputs including agriculture and injected wastewater; and the physical characteristics of coastal waters that may compound the impacts of wastewater on bays and inlets. In the 2017 Report to the Twenty-Ninth Legislature, the HDOH proposes that cesspool replacement efforts be focused by geographic area, and prioritized using the following broad categories [37]:

1) Priority 1: Significant risk of human health impact, drinking water impacts, or draining to sensitive water.
2) Priority 2: Potential to Impact Drinking Water.
3) Priority 3: Potential Impacts on Sensitive Waters.
4) Priority 4: Impacts not Identified.

In 2021, the Hawaiʻi Cesspool Prioritization Tool (HCPT) was released, which provided the CCWG and its Data and Prioritization Subgroup with updated information and data to help make informed decisions. An updated HCPT was published in 2022. The HCPT identifies a comprehensive list of factors that assisted in the creation of a new cesspool prioritization and hazard assessment. Every cesspool in the state was assessed and prioritized. The tool is designed for the purpose of categorizing cesspools based on potential or realized harm to humans and the environment. A site-based process was used to evaluate factors, determining if a cesspool at a given location has a higher or lower potential to cause negative social and environmental impacts. It is a geographic information system (GIS) tool and examined and categorized previously uncategorized (i.e., Priority Level 4 from the previous 2017 prioritization) cesspools. The HCPT prioritization method places each geographic area into three Prioritization Categories that include:

1) Priority Level 1: Greatest contamination hazard.
2) Priority Level 2: Significant contamination hazard.
3) Priority Level 3: Pronounced contamination hazard.

Cesspools in the Pāhoa project area are assigned Priority Level 3. Every cesspool in the inventory was assigned a priority ranking, on the basis that none are exempt from conversion. However, rather than reviewing every single system individually, the tool results are consolidated into prioritization areas using census boundaries at multiple resolutions.

The HCPT tool is a starting point for assessing the areas with the most significant hazards and is meant to support the development of a cesspool conversion plan. The tool is not meant to inform cesspool conversion prioritization timelines. However, the hazard categories provide a framework to prioritize cesspool conversions by the CCWG.

## 8.3 CESSPOOL CONVERSION IMPLEMENTATION

Generally, options for upgrade or closure include:

- Closure and connection to an existing nearby sewer system with available capacity.
- Closure and connection to a new private or public sewer system.
- Closure and connection to a community-scale package wastewater treatment system.
- Upgrade to an onsite septic tank and/or aerobic treatment unit system.

Regarding resources required, this is from the 2017 HDOH Report to the Legislature [37]:

> *Replacement of each existing cesspool with an improved treatment method could cost $20,000 or more per system, for a total cost around **$1.75 billion** for the 87,900 currently inventoried cesspools (an average construction investment of $54.7 million per year from 2018 through 2049). However, costs may vary from this amount if other options such as connecting to existing sewage treatment systems, joining multiple homes in small-scale community package sewer or joint septic systems, or constructing new larger-scale sewage treatment systems are considered.*

A subsequent 2021 report prepared by Carollo Engineers for HDOH stated the following [38]:

> *Historical costs of cesspool upgrades to approved systems range widely from approximately $9,000 to $60,000 or more depending on the wastewater system capacity (based on bedroom count), technology, and location or site constraints. Assuming an average conversion cost of $23,000, the potential magnitude of the financial burden to convert all 88,000 cesspools is over two billion dollars. (2020 dollars)*

Cesspool conversion costs will be a financial burden to many residents in Hawaiʻi. The Legislature tasked the Cesspool Conversion Working Group to develop a strategy to aid the funding and financing of the cesspool upgrades.

### 8.3.1 Financing Available to Individual Homeowners

Options for cesspool conversion funding mechanisms include tax credits or rebates, federal, state, or county grants, and private/mortgage loans (affordability is described in Section 8.3.2) [39]:

- Private/Mortgage Loans
- State Tax Credits or Rebate Programs: Act 120, the temporary tax credit program, expired on December 31,2020
- Grants and Loans: most programs require a public entity or agency as the applicant, but sub loans may be possible.

- Clean Water State Revolving Fund (CWSRF) Program: low interest loans provided to public entities, and counties could funnel funding to individuals.

In June 2022, the following bills related to financing were adopted into law:

- Act 183 HB2088 HD3 SD2: creates the commercial property assessed financing program. The Counties may authorize the Hawaiʻi green infrastructure authority to offer commercial property assessed financing utilizing a non-ad valorem special tax assessment to pay the cost of qualifying improvements.
- Act 153 HB2195 HD2 SD1 CD1: establishes a Cesspool Compliance Pilot grant project to assist low- and moderate-income property owners to upgrade or convert a cesspool (in priority levels 1 or 2). HDOH shall grant awards not to exceed $20,000. The Bill also appropriated $5 million from the general fund for the fiscal year 2022-2023.

  Although Act 153 does not affect cesspools in Pāhoa (no priority levels 1 or 2 cesspools in Pāhoa), it could be useful for other locations on the Island of Hawaiʻi. Application guidelines are presented in Appendix C.

### 8.3.2 Financing Alternatives for County of Hawaiʻi

#### 8.3.2.1 Bonds

General obligation (GO) bonds are backed by the general revenue of COH. Revenue bonds are supported by a specific revenue source, such as income from sewer fees.

#### 8.3.2.2 Grants

**EDA**

The U.S. Economic Development Administration grants help to fulfill regional economic development strategies designed to accelerate innovation and entrepreneurship, advance regional competitiveness, create higher-skill, living-wage jobs, generate private investment, and fortify and grow industry clusters. COH received an EDA Grant in 2021 for Puna District non-construction projects, and is currently utilizing it for economic adjustment assistance, short term planning, and technical assistance programs under Sections 203, 207 and 209 of the Public Works and Economic Development Act of 1965, as amended, 42 U.S.C. §§ 3143, 3147 and 3149.

Eligible applicants for EDA grants include states, political subdivisions of states, district organizations, institutions of higher education, and non-profits working with a political subdivision of a state. To apply, specific criteria and requirements must be met, such as meeting economic distress criteria (e.g., higher unemployment rate or lower per capita income compared to national averages) or demonstrating a "special need" as determined by the EDA. Proposals should be based on a locally developed comprehensive economic development strategy or an equivalent document. Cost sharing or matching is generally required, with the EDA's investment not exceeding 50% of the total project cost. Applications can be submitted through the Federal government's official grant website or the appropriate EDA regional office. EDA accepts applications at any time and evaluates proposals based on investment policy guidelines and funding priorities. Although specific to the grant program and guidelines set by the EDA, grant money can often be used for planning, design, and construction. Per the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA), EDA evaluates how the proposed project could impact the environment and historic properties.

**USBR**

The U.S. Bureau of Reclamation (USBR) WaterSMART program awards grants to water districts and other project sponsor seeking to reuse water and add to water supplies. The Title XVI/WIIN Water Reclamation and Reuse grant aims to identify and explore opportunities to reclaim and reuse wastewaters, as well as impaired ground and surface water. The program provides as much as 25 percent of construction costs with a maximum of $20 million. From 1992 through 2017, it awarded about $715 million. About $703 million went towards construction projects that recycled water. The DEM is currently submitting a USBR Grant application to fund some of the Kealakehe WWTP R-1 improvements.

Under Title XVI, USBR provides funding support for planning, designing, and constructing water recycling and reuse projects in collaboration with local government entities. Projects must meet specific criteria to be eligible for funding, including complying with the National Environmental Policy Act (NEPA) and having a completed Feasibility Study that the USBR has reviewed. The Feasibility Study must fulfill all the Reclamation Manual Release WTR 11-01 requirements. Additionally, the findings of USBR's review must be officially transmitted to Congress for authorization. Once the project is considered eligible for funding, it is recommended in the President's annual budget request by the USBR.

**EPA Technical Assistance**

The EPA has several programs to provide technical assistance. The following describes examples of programs that may be available for COH.

- Urban Waters Small Grants program: fund research, investigations, experiments, training, surveys, studies, and demonstrations that will advance the restoration of urban waters by improving water quality through activities that also support community revitalization and other local priorities. The Urban Waters Small Grants are completed and awarded every two years. Eligible applicants include States, local governments, Indian Tribes, public and private universities and colleges, public or private nonprofit institutions/organizations, intertribal consortia, and interstate agencies. Projects should meet the following four program objectives: address local water quality issues related to urban runoff pollution, provide additional community benefits, actively engage underserved communities, and foster partnership. The EPA Pacific Southwest (Region 9) office should be contacted for more information on the pre-application/pre-proposal process.
- Water Infrastructure and Resiliency Finance Center: works with on-the-ground partners to provide financial technical assistance to communities. The

organization provides financial advice to help communities make informed decisions on funding drinking water, wastewater, and stormwater infrastructure projects. Utilities may also access tools to help with financing decisions to meet local infrastructure needs. In November 2022, EPA selected the Hawaiʻi Community Foundation (HCF) as an Environmental Finance Center to provide technical assistance and help communities develop and submit project proposals, including State Revolving Fund (SRF) applications for Bipartisan Infrastructure Law funding. The finance center will support underserved communities with technical assistance to identify sustainable infrastructure solutions. It will provide states, Tribes, and local governments with technical assistance services to advance equitable health and environmental protection.

- HCF recently established the Hawaiian Islands Environmental Finance Center (HIEFC) as an EPA Finance Center to address water infrastructure needs in Hawaiʻi. HIEFC and its partners plan to collaborate to identify innovative and actionable projects focused on sustainability and water resilience, mainly promoting equity in disadvantaged communities. They will assist in federal funding applications, guiding partners through project visioning, conceptual design, grant writing, and other project development and management aspects. They will also engage with key stakeholders through training, exploratory design, and planning while contributing technical content to funding proposals and other written materials. Additionally, they will support HIEFC partners with federal funding awards, including post-award processes, project management, and hands-on project implementation. For comprehensive details regarding future applications/requests for the proposal process, it is advised to contact the Hawaiʻi Community Foundation. They can provide further information and guidance about the application requirements and procedures.

**USDA Rural Development Loan and Grant Assistance**

The U.S. Department of Agriculture (USDA) forges partnerships with rural communities, funding projects that bring housing, community facilities, business guarantees, utilities, and other services to rural America. USDA Rural Development works with low-income individuals, State, local and Indian tribal governments, as well as private and nonprofit organizations and user-owned cooperatives. The USDA Rural Development has a Water and Environmental Program that provides loans, grants, and loan guarantees for drinking water, sanitary sewer, and storm drainage facilities in rural areas, cities, and towns with populations of 10,000 or less. Public bodies, non-profit organizations, and recognized Indian tribes may qualify for assistance.

Grant funds can be allocated towards financing various aspects of sewer infrastructure, including the acquisition, construction, and improvement of sewer collection, transmission, treatment, and disposal systems. Additionally, in certain instances, funding may cover expenses such as legal and engineering fees, land acquisition, water and land rights, permits, equipment, start-up operations, and maintenance costs. It is important to note that this program operates under the regulations outlined in 7 CFR, Part 1780 and 1782, and Section 306 of the Consolidated Farm and Rural Development Act. Funding applications are accepted throughout the year, and applicants can file electronically via RD Apply or through their local RD office. Information can be accessed online through the official RD website for further program details and resources.

**U.S. Department of Housing and Urban Development, Community Development Block Grants**

The U.S. Department of Housing and Urban Development provides funds for long-term community needs, including rehabilitation, construction, or purchase of public facilities and infrastructure for water treatment and centralized and decentralized wastewater systems.

The County of Hawaiʻi currently administers a Community Development Block Grant (CDBG) program to foster viable communities' development. This program strives to provide decent housing, create suitable living environments, and expand economic opportunities for individuals with low to moderate incomes. CDBG funds are allocated to the County of Hawaiʻi annually through a formula-based approach, enabling the county to address high-priority housing and community development needs outlined in its 5-year Consolidated Plan, primarily focusing on benefiting low- and moderate-income individuals. Each project that receives funding must fulfill one of the following national objectives:

- Principally benefiting low- and moderate-income persons.
- Aiding in the prevention or elimination of slums or blight.
- Addressing a need of urgency is known as an urgent need.

CDBG funds are allocated through a thorough Request for Proposal (RFP) process, wherein projects are meticulously evaluated and awarded based on a weighted point system. The Application Packet includes the specific Project Evaluation and Rating System employed. Eligible applicants for CDBG funding encompass non-profit agencies, government agencies, and community-based development organizations (CBDO), as outlined in Title 24 CFR 570.204. To ensure compliance, it is essential to refer to the federal and state regulations (cross-cutters) available on the County of Hawaiʻi's Office of Housing and Community Development website.

**Build Back Better Act**

The Build Back Better Act (BBBA) established key priority areas for local governments and included programs to support workforce development, increase housing affordability and improve climate resilience. The version that passed the House also included grant funding for five critical water infrastructure programs: 1) Lead Remediation, 2) Assistance for Low-Income Water Users, 3) Alternative Water Source Project Grants ($125 million to support investment in alternative water source projects, including projects for groundwater recharge and potable reuse), 4) Sewer Overflow and Stormwater Reuse Municipal Grants ($1.850 billion to invest in sewer overflow and stormwater reuse projects, as well as for a greater federal cost share of projects that serve financially distressed communities), and 5) Individual

Household Decentralized Wastewater Treatment System Grants ($150 million for the installation, repair, or replacement of domestic septic systems, including investment in connecting households with failing septic systems to public sewer systems). This last of the five programs targets half of the investment to low-income households that lack access to sewage treatment technologies, including households that currently use cesspools to capture sewage. Monitoring should be conducted of the mechanisms to execute these programs and which specific programs the County of Hawaiʻi may be able to utilize.

**Water Pollution Control Grants Program (Section 106 of the Clean Water Act)**

Under Section 106 of the Clean Water Act (33 U.S. Code §1256), EPA provides federal assistance to States, Territories, the District of Columbia, Indian Tribes, and Interstate Agencies to establish and implement ongoing water pollution control programs. Section 106 funds can be used for water quality monitoring and assessment, water quality standards and Total Maximum Daily Load Development and Implementation, National Pollutant Discharge Elimination System permitting and enforcement, source water protection, and ground water protection. A possible program would be to identify and protect the public water system from contaminant sources or activities within the source water protection area (watershed).

Preapplication coordination is a necessary step. Providing environmental impact information is not mandatory for this program. To learn about the application process required by the State of Hawaiʻi for seeking assistance, the applicant should consult an EPA office or an official designated as the single point of contact. Informal meetings are scheduled as necessary between the regional office, State, territorial, and Indian tribe applicant agencies during the development of the work plan. The grant agreement should accurately represent the priorities outlined in the EPA Strategic Plan and any State/EPA Agreements. Unless the Agency has approved limited circumstances, all initial funding applications must be submitted by applicants through the Federal government's official grant website.

#### 8.3.2.3 Loans

**EPA Funding of Clean Water State Revolving Fund**

The Clean Water State Revolving Fund (CWSRF) Program assists in financing the construction of water pollution control projects necessary to prevent contamination of our groundwater and coastal water resources and to protect and promote the health, safety, and welfare of the citizens of the State of Hawaiʻi. The CWSRF uses federal, state, and other program funds to provide low-interest loans to communities for water quality projects. States may customize loan terms to meet the needs of small, disadvantaged communities, which typically have fewer financing options. To be included in the annual priority list, projects must submit an Intended Use Plan (IUP). Applications are available online on the DOH Wastewater Branch website for this purpose.

Projects Eligible for CWSRF Funding include point source projects such as:

- New, expanded, or rehabilitated wastewater treatment plants.

- Publicly-owned water reuse systems and distribution lines.
- New or rehabilitated collector, trunk, and interceptor sewers.
- Sludge reuse, treatment, and disposal facilities.
- Septage handling, marine vessel pump out, and treatment facilities.

Non-Point Source Projects eligible for funding include:

- Watershed planning/assessment or implementation of projects needed to restore NPS impaired waters.
- Cesspool replacement with septic tanks, aerobic units, constructed wetlands, or treatment plants.
- Brownfield projects involving site assessments, underground storage tank removal and disposal, contaminated soil or sediment removal and disposal, capping wells, soil remediation, controlling stormwater runoff, and monitoring groundwater and surface water for contaminants.

The DOH is responsible for conducting an environmental review of projects funded through the CWSRF, as mandated by the Code of Federal Regulations (CFR). This review process follows the EPA-approved State Environmental Review Process. Furthermore, the State must adhere to the Federal cross-cutting authorities outlined in 40 CFR §35.3145 specifically for the CWSRF.

**WIFIA**

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) established the WIFIA program, a federal credit program administered by EPA for eligible water and wastewater infrastructure projects. Eligible borrowers are:

- Local, state, tribal, and federal government entities
- Partnerships and joint ventures
- Corporations and trusts
- Clean Water and Drinking Water State Revolving Fund (SRF) programs

The WIFIA program can fund development and implementation activities for eligible projects, such as those eligible for the CWSRF. These activities include:

- Development phase activities, including planning, preliminary engineering, design, environmental review, revenue forecasting, and other pre-construction activities.
- Construction, reconstruction, rehabilitation, and replacement activities.
- Acquisition of real property or an interest in real property, environmental mitigation, construction contingencies, and acquisition of equipment.
- Capitalized interest necessary to meet market requirements, reasonably required reserve funds, capital issuance expenses and other carrying costs during construction.

The WIFIA application process involves two phases. In the first phase, prospective borrowers submit letters of interest to the EPA, providing information about project eligibility, creditworthiness, feasibility, and alignment with EPA's priorities. EPA selects projects based on these reviews and invites them to proceed. Starting from FY 2022, letters of interest can be submitted on a rolling basis for year-round access to funding. In the second phase, invited applicants apply for the WIFIA loan, undergo a detailed financial and engineering review, and negotiate terms and conditions with the WIFIA program. Approval from the EPA Administrator and the Office of Management and Budget is required before closing. At closing, the borrower signs the credit agreement to receive WIFIA funds. Some environmental cross-cutters include Environmental Justice Executive Order 12898, the National Preservation Act, and the Endangered Species Act.

**Special Improvement Financing**

COH has several regulations enabling creation of Special Improvement Districts or Community Facility Districts. A Sewer System Improvement District is an area that has been designated by COH as an Improvement District (ID). A district may be established to finance the purchase, construction, installation, expansion, improvement, or rehabilitation of any real or other tangible property with a useful life estimated by the council to be five years or longer.

Wastewater systems are an example of special improvements that may be financed by a district. An example of this is the Lono Kona Sewer Improvement District in North Kona (6). It was a Special Improvement District specifically created to address the EPA's requirement to close large-capacity cesspools. This program funded the connection of 110 parcels to the COH wastewater system. A similar funding mechanism could be employed for funding a neighborhood's cesspool conversions.

A tax is levied on property owners within the ID who will benefit from sewer improvements. This tax is used to pay the bond costs for the improvements and is different from a general tax because it is only levied on properties that will receive a special benefit from the improvements.

For example, if COH decides to install new sewer infrastructure in a neighborhood, the cost of the project may be divided among the property owners in the area. Each property owner would be assessed a certain amount based on the size and value of their property, or perhaps based on expected sewer flows. This assessment would be used to pay for the installation of the new sewer lines.

The infrastructure will subsequently be dedicated to COH. The ID funds do not cover the private hookup portions or any other private construction. The coordination and cooperation between the responsible director, the participating departments, and the landowners in the ID is critical. COH would manage the improvements, so the construction needs to be according to codes and standards.

There are four ways to initiate an ID:

1. Initiation by Council: by resolution and passage by one reading, Council can direct the DEM Director to prepare and submit to Council a report on the improvements proposed, method of assessment, surveys, lands to be acquired, costs, plans, details, specs.

2. Initiation by petition by 60% of owners: If a petition is filed by 60% (or greater) of the owners requesting the construction of special improvements, then Council may reject or accept the petition. The petition must include the surveys, maps, plans and other preliminary data and estimates mentioned previously.

3. Petition by 20% of owners: If the owners of at least 20% based on frontage along any street, alley or highway designated by them or of twenty percent of the area of land designated by them as a proposed ID, file a petition with Council requesting the construction of special improvements. The petition, together with the surveys, maps, plans and other preliminary data and estimates mentioned earlier, may be rejected or accepted by Council.

4. Petition by owners of 100% of frontage or area: If a petition is filed by 100% of the owners of the proposed ID, the notice and hearing requirement is unnecessary. The petition with the surveys, maps, etc., may be rejected or accepted by Council.

Council may, by resolution, propose the making of an ID, requiring one reading for adoption of the proposed ID process.

The resolution fixes a date for the public hearing on the proposed improvement, giving at least 15 days' notice in at least one newspaper of general circulation in the county. The duration of the notice is longer for petitions with only 20% of owners.

Council may adopt the plans and estimates, which shall be incorporated by reference in the resolution.

After adoption of the resolution fixing the date for the public hearing, the COH clerk publishes notices of the public hearing (newspaper, post copies, mail notices) to all owners who may be assessed.

Decision Making: Should 51% or more of the owners of the assessment units fail to object prior to or at the hearing, the proposed improvement by assessment shall be approved by Council passing a resolution requiring one reading for its adoption. However, no ID shall be approved unless:

1. The assessed valuation for taxation purposes of the assessment units to be improved is at least twice the estimated costs of the proposed improvement; or

2. The council finds the appraised value of such assessment units as improved is at least twice the estimated cost of the proposed improvement. The appraisal shall be conducted in accordance with prevailing standards for appraisals used by banks for loans.

3. No ID shall be approved unless the council finds that such improvement is in the public interest.

The owner of an assessment unit may file any protest, objection, or suggestions. If the owners of assessment units which are proposed to have 50% or more of the total assessments (whether such assessments are to be assessed by frontage, area or otherwise) file written protests, duly acknowledged by such owners, against making all or part of the proposed improvements or against the methods by which such assessments are to be made, or the inclusion of certain costs therein, then the improvements or methods of assessment shall not be made contrary to the written protests.

Upon a final decision, Council fixes the cost assessment against the assessment units and owners by ordinance.

## 8.4 AFFORDABILITY

### 8.4.1 Water Affordability and Clean Water Act Implementation

Investments to meet federal wastewater requirements can impose a significant financial burden on the community. The intent of the EPA's affordability criteria is to indicate when mandates would cause economic distress in a community. This is from the Affordability Assessment Tool for Federal Water Mandates prepared for the U.S. Conference of Mayors [40]:

> *With the intention of providing a mechanism for relieving undue economic stress in the face of wastewater-related mandates, EPA has developed "affordability" criteria to indicate when such mandates would cause substantial and widespread economic distress in the community. In the case of undue economic stress caused by wastewater requirements, the Agency might be willing to exercise some flexibility in the mandate by allowing a longer timeframe to achieve compliance or by relaxing compliance standards. (from Affordability Assessment Tool for Federal Water Mandates, Stratus Consulting, Boulder, Colorado, c. 2013, U.S. Conference of Mayors, AWWA and WEF)*

A large weakness of EPA's affordability criteria guidelines is that they are aimed at the national level's affordability of regulatory options for small communities and do not assess individual utilities, or small utilities. If the EPA affordability criteria were implemented consistently at more local levels, economic hardship on lower income households may have more impact on policy decisions. The key factor is for EPA to exercise flexibility in meeting the mandate by allowing a longer timeframe or relaxing compliance standards.

EPA's view is that EPA would consider a combined annual water and wastewater bill of less than 4.5% of median household income (MHI) to be "affordable." The breakdown is 2.5% for water plus 2% for wastewater services and combined sewer overflow controls [41].

EPA issued its Proposed 2022 CWA Financial Capability Assessment (FCA) Guidance for public comment in February 2022. The proposed guidance outlines strategies for communities to support affordable utility rates, while planning investments in water infrastructure that are essential for CWA implementation.

The FCA Guidance is used by municipalities when devising plans to dramatically reduce discharges. During that process, municipalities and EPA negotiate schedules with specific timeframes for implementation. The Proposed 2022 FCA Guidance describes the financial information and formulas the agency intends to use to evaluate the financial resources a community has available to implement control measures and timeframes associated with implementation.

Once finalized, the Proposed 2022 FCA will replace the 1997 FCA Guidance to evaluate a community's capability to fund CWA control measures in both the permitting and enforcement context. The 2022 FCA will also supplement the public sector sections of the 1995 Water Quality Standard (WQS) Guidance to assist states and authorized tribes in assessing the degree of economic and social impact of potential WQS decisions.

Under the proposal, if a municipality is concerned that clean water compliance costs would drive unaffordable rate increases for low-income households, it must seek to mitigate cost burdens on low-income households without dragging out compliance.

EPA provides a checklist of "financial alternatives" for utilities to consider, which can reduce burdens on low-income households. These include creating "lifeline" rates with a low charge for an initial amount of usage to meet essential needs; capping water bills for low-income households at a percentage of income; offering bill discounts to low-income households; helping low-income customers repair plumbing leaks and replace old, water-guzzling toilets; charging non-residential properties for their fair share of stormwater costs; securing grants and subsidized loans to reduce the costs of capital improvements for all ratepayers; and ensuring that ratepayer revenues aren't diverted to non-utility purposes.

### 8.4.2 Statewide Affordability

Using EPA guidelines, a homeowner is financially burdened if the average monthly cost exceeds 2% of their annual income [39]. Assuming $210 (capital and O&M) is the estimated average monthly cost to convert a cesspool to an approved OSDS, homeowners with an annual income of less than $126,000 would realize a financial hardship by the cost to convert. If a hypothetical $10,000 rebate for the conversion were provided to homeowners, the estimated average monthly cost to convert would drop to $150. This would lower the threshold so that homeowners with an annual income of less than $90,000 per year would be financially burdened.

Approximately 97% of all residents with cesspools in Hawaiʻi have an income less than $126,000 and thus would be financially burdened by the cost to convert. If a $10,000 rebate were provided to each household, approximately 85% would be financially burdened.

### 8.4.3 Affordability in the County of Hawaiʻi

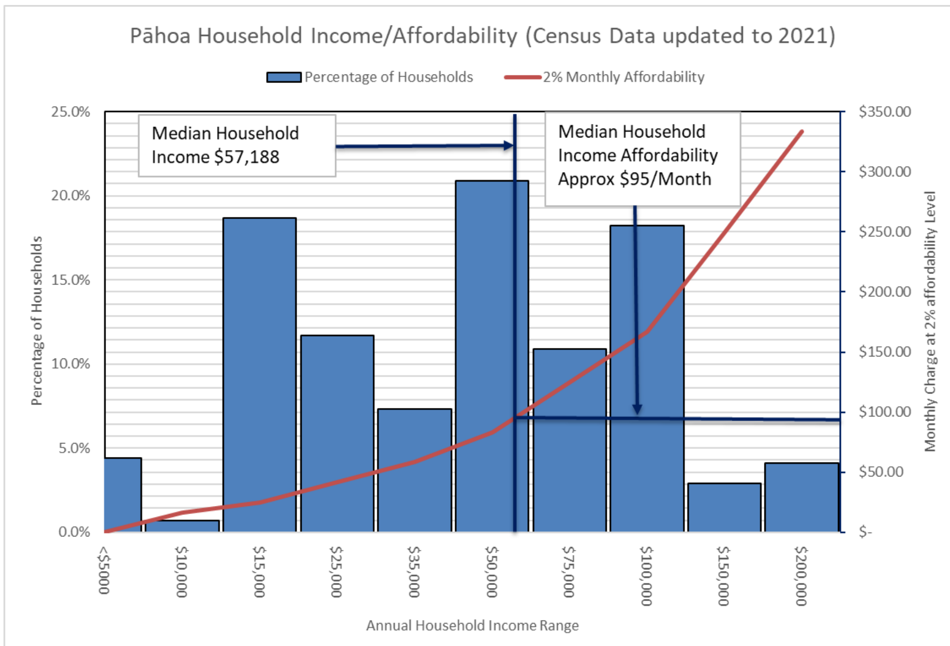
With approximately 48,303 cesspools, Hawaiʻi County has the largest number of cesspools in the State [39]. Hawaiʻi County also has the most residents facing affordability challenges.

It has the greatest proportion of households without centralized sewers than any other county (71%). The most likely option for Hawai'i County residents with cesspools is installation of an approved onsite system.

For comparison, the MHI for Pāhoa is $57,188. Using the 2% affordability criteria, rates in excess of $95 per month would be a financial burden.

A homeowner is financially burdened if the average monthly cost exceeds 2% of their annual income [39]. **Error! Reference source not found.** shows the variability in income for t he Pāhoa area (each bar represents the percentage of Pāhoa households with that income level), the 2% affordability for each income level, and the affordability level for the median household income.

**Figure** 8-1 **Pāhoa Affordability based on 2% of MHI**




## 8.5 COUNTY OF HAWAI'I RATE IMPACTS

Initial rate analysis using the DEM rate spreadsheet model indicates the following:

- Rates which cover the cost of debt service (paying back capital investments and interest) are not affordable by the 2% of MHI standards even if the capital costs are 80% grant funded.
  - Due to the small size of the Pāhoa area, the rates are not affordable if not spread countywide
  - Adding connection fees can lower monthly sewer rates but not significantly.

Other financing options still need to be considered. An independent rate study should be performed. The creation of an Enterprise Fund for Wastewater like O'ahu should be considered. This fund makes DEM independent, and all costs and revenues would funnel through the Enterprise Fund.

The results from these preliminary rate analyses indicate that none of the options will be affordable based on the 2% of median household income criteria, especially if they need to cover the debt service for the capital costs. It should be noted that these are preliminary results but provide an indication of the need to address the gaps between affordability and the high capital costs of these alternatives. This evaluation was for the Pāhoa area alone so the cost impacts of the islandwide projects need to be evaluated. The original County rate spreadsheet utilized 20-year financing. Using a 40-year capital loan period reduces monthly rates between 20 to 33%. However, it does not achieve affordable rates.

## 8.6 Potential Income Sources

A preliminary evaluation of potential income from increases in septage and new reclaimed water sources was performed.

### 8.6.1 Septage Income

Conversion of cesspools to IWS and regular maintenance of the IWS would probably increase the volume of septage to be received and treated at the Hilo WWTP, increasing income to COH. Future upgrades or expansion may be needed to provide reliable and effective treatment as flows and loadings increase.

The existing septage hauling quantity from the Pāhoa area is unknown. An estimate of septage quantity from septic tanks used the following assumptions:

- new Septic Tanks are pumped every 3 years (per EPA recommendation)
- septage charges inflate by 3% per year
- cesspool conversions and growth are straight line over the study period

The initial year septage income for Alternative 1A is approximately $981 and the year 2051 income is approximately $89,399. The first-year income is 0.4% of the existing Hilo income. Pumping frequencies of 5 and 10 years would reduce that income. COH charges are currently the highest of the outer islands. No estimate of increased solids handling costs at the receiving plant (Hilo) was included.

### 8.6.2 Recycled Water Income

DEM has prepared a Feasibility Study for Kealakehe WWTP R-1. A plan is under preparation for funding the proposed water reclamation project's construction, operation, maintenance, and replacement costs. According to the 1999 Kealakehe Effluent Reuse Master Plan, typical funding sources that support a water reuse program are reclaimed water rates, wastewater discharge fees, developer fees, and potable water sales revenue.

For Pāhoa, the estimate of income from reclaimed water used the following assumptions:

- the entire Pāhoa WWTP capacity (0.3 mgd) can be converted to R1
- R1 water can be sold at the same cost as Department of Water Supply water

The potential income at full treatment capacity for Alternatives 2A and 2B is approximately $735,840 per year at current potable water rates. This compares to an estimated annual

O&M cost of $126,158 for Alternative 2A. For context purposes, the essential needs or Tier 1 usage rates per 1000 gallons is $4.46 for Honolulu Board of Water Supply and $1.14 for Hawaiʻi Department of Water Supply.

However, recycled water is rarely charged at the equivalent rate of municipal water, due to its more limited uses. The calculated annual income would be $214,620 using Honolulu R1 rates and $169,725 using Maui R1 rates. This income still exceeds the estimated annual O&M costs for Alternative 2A. This analysis did not include capital and O&M cost estimates of additional treatment required to produce R1 water. More importantly, the R1 water value is dependent on having year-round customers and a system to distribute to the customers.

## 8.7 IMPLEMENTATION STRATEGY

The feasibility of sewer projects in Pāhoa should consider the following:

- Whether the 2% of MHI threshold for sewer service should be used to determine what and how quickly COH should implement sewer projects.
- Consider lowest cost alternatives, including grants and financing alternatives, as the first choice when comparing alternatives.
- Complete a thorough assessment of all financing options for sewer systems and for IWS to lower costs to each household as much as possible. For example, evaluate if financing by an agency like HDOH's SRF could be transformed into per household financing for individual cesspool conversion.
- Optimize the application of financing options for the municipality as well as individual cesspool owners in order to maximize benefits for all.
- Get EPA or HDOH support for grants to assist residential homeowners. Support HDOH in promulgating rules to administer the grant program in Act 153.
- Prioritize cesspool conversion using the HCPT Tool and incorporate the priority list into the areas the COH is considering for sewer service (new or expansion).
- Discuss with EPA and HDOH to extend the Act 87 deadline for Priority 3 (Section 8.2) cesspool conversions by using the FCA (Financial Capability Assessment) guidance applied to individual small communities.
- Revise the rate structure and obtain better cost of service estimates.

# 9.0 SUMMARY AND CONCLUSIONS

## 9.1 SUMMARY OF FINDINGS

This feasibility study evaluated various wastewater management alternatives for Pāhoa:

- Alternative 1A: All IWS or Decentralized Systems
- Alternative 1B: Both Decentralized On-Site Treatment and LPS
- Alternative 2A: Pāhoa WWTP with All Conventional Gravity Sewers
- Alternative 2B: Pāhoa WWTP with Both Conventional Gravity Sewers and LPS

The components of each alternative (e.g., collection, treatment, and disposal) are described in Section 6.0. They are compared with each other based on conceptual level construction costs and other environmental and technical factors (Sections 7.3, 7.4, and 7.5).

Key observations are listed below:

- The majority of the costs for the centralized sewer alternatives is from laying the sewer collection network, compared to the WWTP costs. Therefore, the higher costs are primarily from excavation for sewers within lava rock.
- Alternative 2B has a lower capital cost than its gravity sewer-only counterpart (Alternative 2A) because of the smaller size and shallower depths of pressure sewers, as well as the elimination of neighborhood pump stations that are needed in Alternative 2A.
- O&M costs for Alternative 2B are higher than Alternative 2A, due to more maintenance needs of LPS compared to gravity sewers.
- The NPV O&M costs for Alternatives 1A and 1B are similar, due to IWS maintenance costs in Alternative 1A (sludge pumping and leachfield maintenance) and LPS maintenance costs in Alternative 1B (LPS pump station equipment maintenance and replacement).

Feedback from DEM and HDOH indicate Alternative 1A as the most favorable alternative, especially in estimated construction cost, operational ease and maintenance, flexibility to meet potential future requirements, utilization and acquisition of land, and environmental concerns/regulatory permitting. The selection of an alternative also needs to include Countywide assessments of the improvements required for cesspool conversions and other required improvements. COH is currently in the process of planning for multiple areas and beginning a Countywide plan for implementation. Selection of the best alternative for Pāhoa should include input from this countywide process.

## 9.2 RECOMMENDATIONS

As development occurs in Pāhoa in the future, Alternative 1A can evolve into Alternative 1B by adding LPS to expand the service area of the commercial/institutional decentralized treatment plants. If further wastewater collection/treatment needs occur, Alternative 1B can evolve further into Alternative 2B by expanding the collection system service area using various other potential alternatives such as gravity sewers (in selected areas), LPS, and potentially cross-country sewers if demand for wastewater collection and treatment in the area is sufficient to support upgrade/expansion of the sewered area.

Alternative 2A (all conventional sewers and WWPS) is not likely to be viable for Pāhoa due to the geology (lava rock close to or at the ground surface) and undulating terrain in the project area. For these reasons Alternative 2A can be given a lower priority moving forward.

When planning for any of these alternatives, it is important to assess future development goals, population and flow forecasts, and potential impacts on the environment (Section 4.0). A fundamental component of implementation is also funding and financing (Section 8.0). The research and findings in this feasibility study will be used by COH to assess and later select a wastewater management plan to support the growth of Pāhoa.

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# Appendix A:
# Hydraulic Analysis Calculations

Computation of Wastewater Flow for Pāhoa Sewering

Sewer: Pāhoa 1, Pāhoa 2, Pāhoa 3 segments
District: Pāhoa
Reference Maps: Hawaii Statewide GIS Program


Computed by: Adrienne Fung, Tieshi Huang
Date: December 15, 2022

| Sewer Location | | | Tributary Area (Acres) | | Tributary Equivalent Population | | | | | | | | | | Wastewater Flow Computation | | | | | | | | | ( ) Exisiting Sewer Study (X) Ultimate Sewer Study | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Residential | | | | | Other | | Total | | | | | | | | | | | | | | | | | | |
| | | | | | Homes | | | Apartment | | | | | | | | | | | | | | | | | | | | | | |
| District Zone or Street | Segment Name | Point (Start to End) | Increment | Total | Lots | Increment | Total | Increment | Total | Increment | Total | Increment | Total | Base Sanitary Flow - BSF @ 70 gpcd (MGD) | Flow Factor | Peak Base Sanitary Flow - PBSF (MGD) | Ground Water Infiltration - GWI @ 35 gpcd (MGD) | Average Dry Weather Flow - ADWF (MGD) | Peak Dry Weather Flow - PDWF (MGD) | Area Used for Wet Weather I/I Calculation (acres) | Wet Weather I/I @ 3000 gpad (MGD) | Design Peak Flow - $Q_{DES}$ (MGD) | Pipe Diameter (in) | Slope (%) | Velocity at Full Pipe - $V_{FULL}$ (fps) | Full Pipe Flow - $Q_{FULL}$ (MGD) | Design Flow - $Q_{DES}$ (MGD) / Full Pipe Flow - $Q_{FULL}$ (MGD) | Velocity at Design Flow - $V_{DES}$ (fps) [a] | Depth at Design Flow - $D_{DES}$ (in) [a] |
| **Pāhoa** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pāhoa 1 | 1 | Kapoho Rd./Nanawale Blvd. (Kaululaau NH dis.) | 11 | 11 | 40 | 108 | 108 | 0 | 0 | 0 | 0 | 108 | 108 | 0.008 | 2.5 | 0.02 | 0.004 | 0.011 | 0.02 | 11 | 0.032 | 0.05 | 8 | 0.52 | 2.50 | 0.56 | 0.10 | 1.59 | 1.7 |
| Pāhoa 1 | 2 | Kapoho Rd./Lehualani Pl. | 4 | 15 | 16 | 43 | 152 | 0 | 0 | 0 | 0 | 43 | 152 | 0.011 | 2.5 | 0.03 | 0.005 | 0.016 | 0.03 | 15 | 0.045 | 0.08 | 8 | 0.52 | 2.50 | 0.56 | 0.14 | 1.77 | 2.0 |
| Pāhoa 1 | 3 | Kapoho Rd./Ho Opili St. | 10 | 25 | 36 | 96 | 248 | 0 | 0 | 0 | 0 | 96 | 248 | 0.017 | 2.5 | 0.04 | 0.009 | 0.026 | 0.05 | 25 | 0.074 | 0.13 | 8 | 0.52 | 2.50 | 0.56 | 0.22 | 2.03 | 2.6 |
| Pāhoa 1 | 4 | Kapoho Rd./Tangerine Rd. | 7 | 32 | 28 | 75 | 323 | 0 | 0 | 0 | 0 | 75 | 323 | 0.023 | 2.5 | 0.06 | 0.011 | 0.034 | 0.07 | 32 | 0.096 | 0.16 | 8 | 0.52 | 2.50 | 0.56 | 0.29 | 2.15 | 2.9 |
| Pāhoa 1 | 5 | Kapoho Rd./Naele Rd. (Naele NH dis.) (Combined flow to PS site) | 16 | 48 | 61 | 165 | 488 | 0 | 0 | 0 | 0 | 165 | 488 | 0.034 | 2.5 | 0.09 | 0.017 | 0.051 | 0.10 | 48 | 0.145 | 0.25 | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pāhoa 2 | 1 | Keeau-Pahoa Rd./Kaohe Homestead Rd. | 12 | 60 | 43 | 117 | 605 | 0 | 0 | 0 | 0 | 117 | 605 | 0.042 | 2.5 | 0.11 | 0.021 | 0.064 | 0.13 | 60 | 0.179 | 0.31 | 8 | 0.52 | 2.50 | 0.56 | 0.54 | 2.56 | 4.2 |
| Pāhoa 2 | 2 | Keeau-Pahoa Rd./Kauhale St. | 8 | 67 | 28 | 77 | 681 | 0 | 0 | 0 | 0 | 77 | 681 | 0.048 | 2.5 | 0.12 | 0.024 | 0.072 | 0.14 | 67 | 0.202 | 0.35 | 8 | 0.52 | 2.50 | 0.56 | 0.61 | 2.63 | 4.6 |
| Pāhoa 2 | 3 | Keeau-Pahoa Rd./Akeakamai Loop (Akeakamai NH dis.) | 18 | 85 | 67 | 182 | 863 | 0 | 0 | 0 | 0 | 182 | 863 | 0.060 | 2.5 | 0.15 | 0.030 | 0.091 | 0.18 | 85 | 0.256 | 0.44 | 8 | 0.52 | 2.50 | 0.56 | 0.78 | 2.76 | 5.3 |
| Pāhoa 2 | 4 | Keeau-Pahoa Rd./Pahoa Village Center Mall | 4 | 89 | 15 | 42 | 905 | 0 | 0 | 0 | 0 | 42 | 905 | 0.063 | 2.5 | 0.16 | 0.032 | 0.095 | 0.19 | 89 | 0.268 | 0.46 | 8 | 0.52 | 2.50 | 0.56 | 0.81 | 2.78 | 5.5 |
| Pāhoa 2 | 5 | Keeau-Pahoa Rd./Pahoa village Rd. | 4 | 93 | 13 | 36 | 941 | 0 | 0 | 0 | 0 | 36 | 941 | 0.066 | 2.5 | 0.16 | 0.033 | 0.099 | 0.20 | 93 | 0.279 | 0.48 | 12 | 0.31 | 2.53 | 1.28 | 0.37 | 2.34 | 5.1 |
| Pāhoa 2 | 6 | Keeau-Pahoa Rd./Post Office Rd. (Post Office NH dis.) | 10 | 103 | 38 | 102 | 1043 | 0 | 0 | 0 | 0 | 102 | 1043 | 0.073 | 2.5 | 0.18 | 0.037 | 0.110 | 0.22 | 103 | 0.309 | 0.53 | 12 | 0.31 | 2.53 | 1.28 | 0.41 | 2.40 | 5.4 |
| Pāhoa 2 | 7 | Keeau-Pahoa Rd./Apaa St. (Combined flow to PS site) | 17 | 120 | 65 | 175 | 1218 | 0 | 0 | 0 | 0 | 175 | 1218 | 0.085 | 2.5 | 0.21 | 0.043 | 0.128 | 0.26 | 120 | 0.361 | 0.62 | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pāhoa 3 | 1 | 3.1b Flow along Keeau Pahoa Rd./Kahakai Blvd. | 18 | 138 | 67 | 182 | 1400 | 0 | 0 | 0 | 0 | 182 | 1400 | 0.098 | 2.5 | 0.25 | 0.049 | 0.147 | 0.29 | 138 | 0.415 | 0.71 | 12 | 0.50 | 3.21 | 1.63 | 0.44 | 3.10 | 5.5 |
| Pāhoa 3 | 2 | Flow along Keeau-Pahoa Rd. south of WWTP (Combined flow to PS site) | 6 | 145 | 24 | 64 | 1464 | 0 | 0 | 0 | 0 | 64 | 1464 | 0.102 | 2.5 | 0.26 | 0.051 | 0.154 | 0.31 | 145 | 0.434 | 0.74 | | | | | | | |

Notes and Assumptions

1. Minimum slope is used for undulating roadway segments in which sewers are planned to mimimize sewer depth.
2. The sewer length ratio was used to calculate the residential home increment. This is based on the following proportion: (tributary street length/entire sewer neighborhood length) = (tributary population/entire sewer neighborhood population).
3. The OSDS ratio was used to calculate population in the sewer neighborhood. This is based on the following proportion: (OSDS in sewer neighborhood/OSDS in census tract) = (population in sewer neighborhood/population in census tract).
4. For the tributary area, the acre/TMK is based on the average area for TMKs less than 0.4 acres, which is equivalent to about 350 LF of lateral. Even if a lot is much larger than 0.4 acres, it does not follow that the lateral is that many times longer. There is still a cap on the lateral length. If a structure is significantly far from the branch sewer (such as > 300 ft), then a pump would likely be used, which reduces the potential for I/I.
5. The population/TMK is calculated by 2020 population/No. TMKs with OSDSs.

| | |
|---|---|
| **Pipe Friction Loss Hazen-Williams =>** | $h_L$=L(ft)*((2.314 Q(ft$^3$/s))/(C*D(ft)$^{2.63}$))$^{1.852}$ (ft) |
| **Pipe & Valve Minor Loss Equation =>** | $h_M$=K*V$^2$/2g (ft) |

Mile to ft 5280

Assumption:
1. pipe length and surface elevation were based on Google Earth profile
2. C value of 140 for PVC pipe
3. station loss of 15 ft at this planning level
4. 10% of FM friction loss to account for minor loss along FM routeat this planing level
5. Pipe inside diameter, C900 DR18 (235 psi)

Quick notes to check FM calculation:
1. maintain FM velocity between 3-5 ft to minimize friction loss
2. TDH shold be less than 100 ft per CCH Design Standard at this planning level.

| DR18 PVC inside diameter | | |
|---|---|---|
| 4" | 4.266 | in |
| 6" | 6.134 | in |
| 8" | 8.044 | in |
| 10" | 9.866 | in |
| 12" | 11.734 | in |
| 14" | 13.6 | in |
| 16" | 15.466 | in |
| 18" | 17.334 | in |
| 20" | 19.2 | in |
| 24" | 22.934 | in |

**C900/RJ Certa-Lok® PVC Pressure Pipe** | Restrained Joint

| C900/RJ CERTA-LOK PIPE & COUPLING DIMENSIONS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pipe | | | | | | | Coupling | | |
| Nom. Size | Outside Diameter (OD) | DR | Min. Wall Thickness (T) | Internal Diameter (ID) | X | W | D | P | Weight (lb/ft) | BOD | L | Weight (lb/ft) |
| 4" | 4.800 | 18 | 0.267 | 4.266 | 3.000 | 0.375 | 0.135 | 0.302 | 2.5 | 5.964 | 8.250 | 4.0 |
| | | 14 | 0.343 | 4.114 | | | | | 3.1 | | | |
| 6" | 6.900 | 18 | 0.383 | 6.134 | 3.000 | 0.500 | 0.135 | 0.302 | 5.1 | 8.366 | 8.250 | 7.1 |
| | | 14 | 0.493 | 5.914 | | | | | 6.4 | | | |
| 8" | 9.050 | 18 | 0.503 | 8.044 | 3.163 | 0.500 | 0.145 | 0.634 | 8.7 | 10.947 | 10.500 | 15.5 |
| | | 14 | 0.646 | 7.758 | | | | | 11.0 | | | |
| 10" | 11.100 | 18 | 0.617 | 9.866 | 3.625 | 0.750 | 0.215 | 0.634 | 13.2 | 13.361 | 11.125 | 23.9 |
| | | 14 | 0.793 | 9.514 | | | | | 16.6 | | | |
| 12" | 13.200 | 18 | 0.733 | 11.734 | 3.625 | 0.750 | 0.215 | 0.634 | 18.6 | 15.836 | 12.000 | 36.1 |
| | | 14 | 0.943 | 11.314 | | | | | 23.5 | | | |
| 14" | 15.300 | 25 | 0.612 | 14.076 | 3.610 | 0.750 | 0.215 | 0.634 | 18.3 | 16.400 | 12.000 | 26.9 |
| | | 21 | 0.729 | 13.842 | | | | | 21.7 | | | |
| | | 18 | 0.850 | 13.600 | | | | | 25.0 | | | |
| 16" | 17.400 | 25 | 0.696 | 16.008 | 3.610 | 0.750 | 0.215 | 0.634 | 23.7 | 18.875 | 12.000 | 39.8 |
| | | 21 | 0.829 | 15.742 | | | | | 28.0 | | | |
| | | 18 | 0.967 | 15.466 | | | | | 32.4 | | | |
| | | 14 | 1.243 | 14.914 | 3.673 | 0.875 | 0.265 | 0.634 | 40.9 | | | |
| 18" | 19.500 | 25 | 0.780 | 17.940 | 4.035 | 1.100 | 0.300 | 0.750 | 29.8 | 20.870 | 15.000 | 47.0 |
| | | 21 | 0.929 | 17.642 | | | | | 35.1 | | | |
| | | 18 | 1.083 | 17.334 | | | | | 40.6 | | | |
| 20" | 21.600 | 25 | 0.864 | 19.872 | 4.035 | 1.100 | 0.300 | 0.750 | 36.5 | 23.120 | 15.000 | 55.7 |
| | | 21 | 1.029 | 19.542 | | | | | 43.1 | | | |
| | | 18 | 1.200 | 19.200 | | | | | 49.8 | | | |
| 24" | 25.800 | 25 | 1.032 | 23.736 | 4.035 | 1.100 | 0.300 | 0.750 | 52.1 | 27.620 | 15.000 | 81.3 |
| | | 21 | 1.224 | 23.342 | | | | | 61.5 | | | |
| | | 18 | 1.433 | 22.934 | | | | | 71.1 | | | |

| Pipe D (in) | Pipe D (ft) | Pipe A (ft2) | Pipe L (mi) | Pipe L (ft) | PS Surface Ele. (ft) | Incoming Sewer Depth (ft) | Wet Well Ele. (ft) | Discharge Surface Ele. (ft) | Minimum Cover (ft) | Discharge Ele. (ft) | Static H (ft) | Q (mgd) | Q (gpm) | Q (ft$^3$/s) | V (ft/s) | C | Friction Slope (ft/ft) | Friction $H_L$ (ft) | Station $H_L$ (ft) | Minor $H_L$ (ft) | TDH (ft) | check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pāhoa PS1 Pahoa only | | | | | | | | | | | | | | | | | | | | | | |
| 4.266 | 0.36 | 0.099 | 0.33 | 1742 | 641 | 20 | 621 | 674 | 10 | 664 | 43 | 0.25 | 174 | 0.39 | 3.90 | 140 | 0.0133 | 23.2 | 15 | 2.3 | 83.5 | ok |
| Pāhoa PS2 Pahoa only | | | | | | | | | | | | | | | | | | | | | | |
| 6.134 | 0.51 | 0.205 | 0.24 | 1267 | 623 | 20 | 603 | 639 | 10 | 629 | 26 | 0.62 | 431 | 0.96 | 4.67 | 140 | 0.0122 | 15.5 | 15 | 1.5 | 58.0 | ok |
| Pāhoa PS1 Puna Flow | | | | | | | | | | | | | | | | | | | | | | |
| 9.866 | 0.82 | 0.531 | 0.33 | 1742 | 641 | 20 | 621 | 674 | 10 | 664 | 43 | 1.42 | 986 | 2.20 | 4.14 | 140 | 0.0056 | 9.7 | 15 | 1.0 | 68.7 | ok |
| Pāhoa PS2 Puna Flow | | | | | | | | | | | | | | | | | | | | | | |
| 13.6 | 1.13 | 1.009 | 0.24 | 1267 | 623 | 20 | 603 | 639 | 10 | 629 | 26 | 3.29 | 2,285 | 5.09 | 5.05 | 140 | 0.0056 | 7.0 | 15 | 0.7 | 48.7 | ok |
| Pāhoa NH PS1 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0.17 | 0.022 | 0.25 | 1320 | 655 | 10 | 645 | 656 | 10 | 646 | 1 | 0.05 | 35 | 0.08 | 3.55 | 140 | 0.0270 | 35.7 | 15 | 3.6 | 55.3 | ok |
| Pāhoa NH PS1 | | | | | | | | | | | | | | | | | | | | | | |
| 3.5 | 0.29 | 0.067 | 0.56 | 2957 | 589 | 10 | 579 | 643 | 10 | 633 | 54 | 0.09 | 63 | 0.14 | 2.08 | 140 | 0.0053 | 15.6 | 15 | 1.6 | 86.1 | ok |
| Pāhoa NH PS3 | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | 0.21 | 0.034 | 0.21 | 1109 | 626 | 10 | 616 | 649 | 10 | 639 | 23 | 0.09 | 63 | 0.14 | 4.09 | 140 | 0.0271 | 30.0 | 15 | 3.0 | 71.0 | ok |
| Pāhoa NH PS4 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0.17 | 0.022 | 0.18 | 950 | 620 | 10 | 610 | 649 | 10 | 639 | 29 | 0.05 | 35 | 0.08 | 3.55 | 140 | 0.0270 | 25.7 | 15 | 2.6 | 72.3 | ok |
| Pāhoa NH PS5 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0.17 | 0.022 | 0.37 | 1954 | 594 | 10 | 584 | 614 | 10 | 604 | 20 | 0.05 | 35 | 0.08 | 3.55 | 140 | 0.0270 | 52.8 | 15 | 5.3 | 93.1 | ok |

Note:
Cells in gray are based on user-input values for population, pipe diameter, pipe slope, or FlowMaster (for velocity and depth at design flow).

# Appendix B:
# Conceptual Level Construction Cost Estimate and LCC Analysis

Appendix B Construction Cost Estimation and Life Cycle Cost (LCC) Analysis

B-1: LCC Analysis Summary and Assumptions

B-2: Pipe, IWS, and WWTP Unit Costs

B-3: Alternative 1A Construction Cost and LCC Analysis

B-4: Alternative 1B Construction Cost and LCC Analysis

B-5: Alternative 2A Construction Cost and LCC Analysis

B-6: Alternative 2B Construction Cost and LCC Analysis

# B-1: LCC Analysis Summary and Assumptions

| JOB #: | Pahoa Wastewater Feasibility Study | **AECOM** |
|---|---|---|
| DATE: | October 9, 2023 | **Construction Cost Estimate** |
| LOCATION: | Pahoa | **Conceptual Level** |
| PREPARED BY: | T. Huang | **Wastewater Feasibility Estimates** |
| REVIEWED BY: | B. Stallings/A. Symonds | ********************************* |
| | | **G R A N D   S U M M A R Y** |

| Alternative No. | DESCRIPTION | Capital Cost | NPV of O&M Cost | Residual Value | Total LCC |
|---|---|---|---|---|---|
| 1A | IWS for All Residential + Decentralized Treatment for Commercial/Institutions | $79,891,200 | $23,492,783 | $15,757,000 | $78,803,983 |
| 1B | Decentralized On-Site Treament_Low Pressure Sewer | $90,180,036 | $23,023,863 | $33,148,000 | $80,055,899 |
| 2A | Pahoa WWTP (0.3 mgd)_All Gravity Sewer | $174,092,567 | $14,366,445 | $71,653,000 | $116,806,012 |
| 2B | Pahoa WWTP (0.3 mgd)_Both Gravity Sewer and Low Pressure Sewer | $139,781,649 | $17,526,273 | $56,430,000 | $100,877,922 |

**Capital Cost Percentage for Different Type of WW Infrastructures**

| Alternative No. | DESCRIPTION | Capital Cost | Capital Cost % | | |
|---|---|---|---|---|---|
| | | | Piping | PS | WWTP |
| 1A | IWS for All Residential + Decentralized Treatment for Commercial/Institutions | $79,891,200 | 0.0% | 0.0% | 100.0% |
| 1B | Decentralized On-Site Treament_Low Pressure Sewer | $90,180,036 | 67.4% | 0.0% | 32.6% |
| 2A | Pahoa WWTP (0.3 mgd)_All Gravity Sewer | $174,092,567 | 73.3% | 16.7% | 10.0% |
| 2B | Pahoa WWTP (0.3 mgd)_Both Gravity Sewer and Low Pressure Sewer | $139,781,649 | 72.9% | 14.6% | 12.5% |

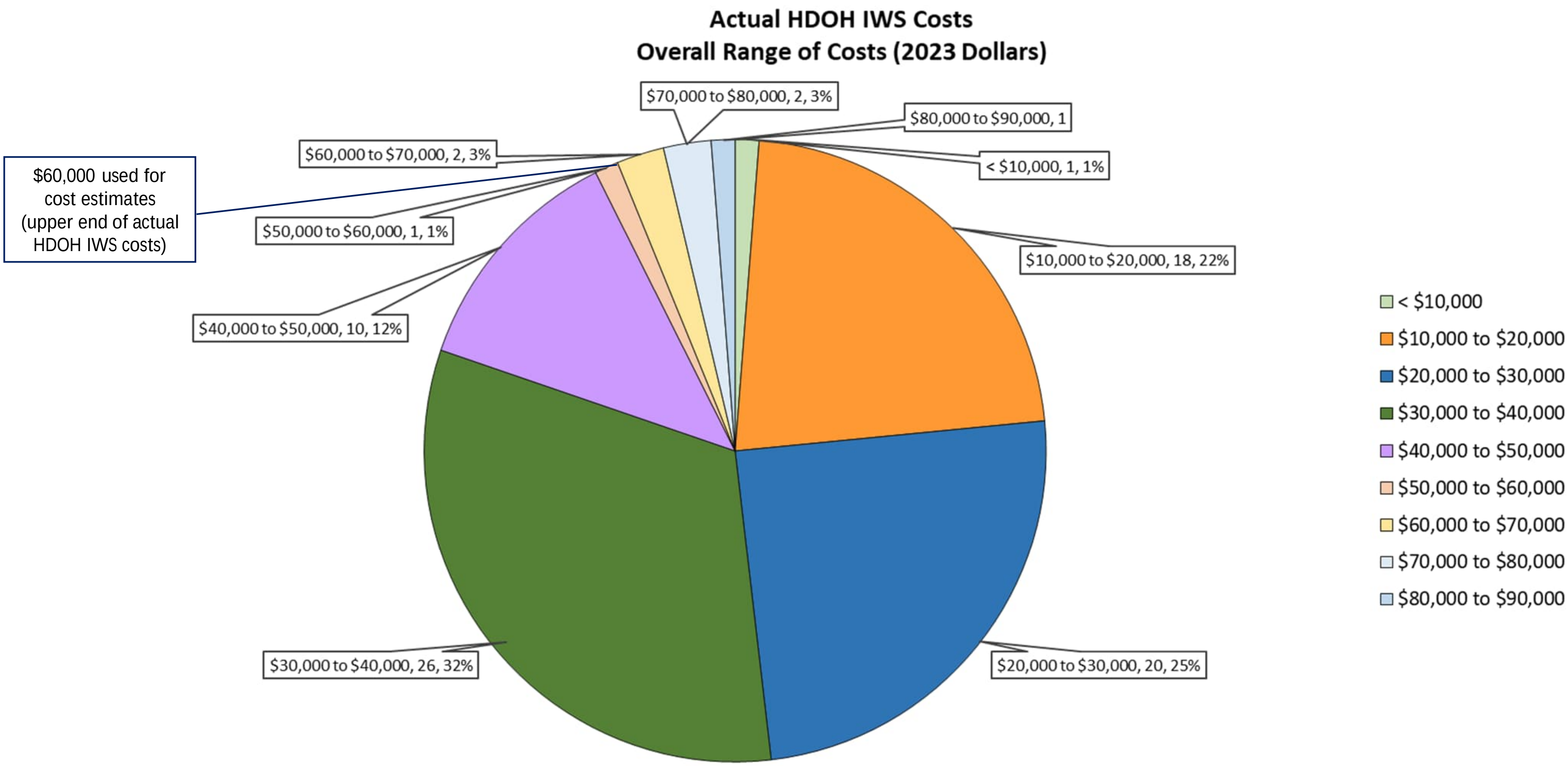
**Life-Cycle Cost Assumptions**

| *Item* | *Criteria* | *Notes* |
|---|---|---|
| **Cash Flow Assumptions** | | |
| Economic Base Year | 2021 | |
| Analysis Period | 30 | years |
| Discount Interest Rate (Nominal) | 3.11% | 10 year average of Nominal Treasury Interest Rates for Different Maturities (30 years) |
| Escalation rate (Nominal) | 3.37% | 10 year average of ENR construciton cost index |
| Effective Interest Rate (Real) | -0.26% | Calculated from discount interest rate (nominal) and escalation rate (nominal) |
| Planning cycle | 30 | years |
| | | |
| | | |
| **Residual Value** | | |
| Residual Value at End of Design Life | 0 | |
| **Percentage of Capital Cost** | | |
| Piping, Valves, etc | 20% | Percentage of capital cost |
| Electrical and Motorized Equipment | 30% | Percentage of capital cost |
| Hydraulic Structures and Buildings | 50% | Percentage of capital cost |
| **Design Life** | | |
| Gravity Sewers/New Force Mains | 75 | years |
| Electrical and Motorized Equipment | 20 | years |
| Hydraulic Structures and Buildings & Piping, valves | 50 | years |
| Septic Tank/Leach Field | 50 | years |

**O&M Cost Assumptions**

| *Item* | *Unit Cost* | *Unit* | *Notes* |
|---|---|---|---|
| Sewer Inspection - CCTV | $ 14.00 | per FT | every 10 years |
| Sewer Cleaning | $ 7.00 | per FT | every 20 years |
| Force Main Assessment | $ 70.00 | per LF | every 20 years |
| Linear asset labor | $ 0.70 | Hr/ Day | |
| Average Electrical rate | $ 0.44 | per kWh | |
| GST inspection | $ 70.00 | per LF | 2 years after construction and every 10 years thereafter |
| GST cleaning | $ 70.00 | per LF | every 20 years |

# B-2: Pipe, IWS, and WWTP Unit Costs


Actual HDOH IWS Costs
Overall Range of Costs (2023 Dollars)
$70,000 to $80,000, 2, 3%
$80,000 to $90,000, 1
$60,000 to $70,000, 2, 3%
< $10,000, 1, 1%
$60,000 used for cost estimates (upper end of actual HDOH IWS costs)
$50,000 to $60,000, 1, 1%
$10,000 to $20,000, 18, 22%
$40,000 to $50,000, 10, 12%
$30,000 to $40,000, 26, 32%
$20,000 to $30,000, 20, 25%
< $10,000
$10,000 to $20,000
$20,000 to $30,000
$30,000 to $40,000
$40,000 to $50,000
$50,000 to $60,000
$60,000 to $70,000
$70,000 to $80,000
$80,000 to $90,000

**Basis of Pipe Unit Cost**

| Project | Bid Date | Size, in | Length, ft | Low Bid | High Bid | Average Bid | Cost Per Foot | Ratio of Avg. bid to Low Bid | Escalation Factor | Escalated Cost/ft | Cost/ft used, rounded | Average Size, inch |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| CCH Aala Drive WWPS Force Main | September 30 2019 | 8 | 612 | $2,170,000 | $7,300,000 | $4,500,000 | $7,353 | 2.07 | 1.12 | $8,235 | | |
| CCH Ahuimanu Pre-Treatment FM | April 6 2017 | 16 to 24 | 3657 | $7,700,000 | $9,570,000 | $8,800,000 | $2,406 | 1.14 | 1.22 | $2,936 | | |
| **CCH Dowsett - Nuuanu** | **February 28 2018** | **8 to 24** | **6575** | **$21,260,000** | **$44,300,000** | **$32,600,000** | **$4,958** | **1.53** | **1.17** | $5,801 | **$5,800** | **16** |
| CCH Dowsett - Pali Hwy | March 2 2018 | 12 to 18 | 9763 | $41,560,000 | $52,850,000 | $48,200,000 | $4,937 | 1.16 | 1.17 | $5,776 | | |
| CCH Kahanahou WWPS FM | April 13 2017 | 12 to 24 | 4733 | $14,700,000 | $21,800,000 | $18,400,000 | $3,888 | 1.25 | 1.22 | $4,743 | | |
| **COH DWS Paukaa** | **January 12 2017** | **6** | **680** | **$318,350** | **$653,500** | **$492,390** | **$724** | **1.55** | **1.25** | $905 | **$900** | **6** |
| COH DWS Paukaa | June 16 2016 | 6 | 2956 | $648,555 | $1,168,560 | $926,706 | $314 | 1.43 | 1.28 | $401 | | |
| **COH Lono Kona** | **January 29 2018** | **8** | **6744** | **$7,728,427** | **$10,726,943** | **$9,009,168** | **$1,336** | **1.17** | **1.21** | **$1,617** | **$1,600** | **8** |
| COH Lanihau FM | April 9 2020 | 8 | 677 | $990,700 | $2,403,424 | $1,611,473 | $2,380 | 1.63 | 1.08 | $2,571 | | |
| COH Kaloko Heights | 2021 | 8 to 12 | 12115 | $8,753,520 | Unknown | $10,204,137 | $842 | 1.17 | 1.09 | $918 | | |
| COH Lono Kona Rebid | March 29 2018 | 8 | 6386 | $8,522,630 | Unknown | $9,934,984 | $1,556 | 1.17 | 1.20 | $1,867 | | |

## Summary of Estimated Construction Cost Per Foot*

| Gravity Sewer | | Force Main | | LPS | |
|---|---|---|---|---|---|
| Size, inch | Unit Cost | Size, inch | Unit Cost | Size, inch | Unit Cost |
| 8 | $1,600 | 4 | $600 | 2 | $300 |
| 12 | $3,700 | 6 | $900 | 3 | $450 |
| 16 | $5,800 | 8 | $1,600 | 4 | $600 |
| 18 | $6,525 | 10 | $2,650 | | |
| 24 | $8,700 | 12 | $3,700 | | |
| 30 | $10,875 | 14 | $4,750 | | |
| 36 | $13,050 | 16 | $5,800 | | |
| 42 | $15,200 | 18 | $6,525 | | |
| 48 | $17,400 | 24 | $8,700 | | |
| 54 | $19,500 | 30 | $10,875 | | |
| | | 36 | $13,050 | | |
| | | 42 | $15,200 | | |
| | | 48 | $17,400 | | |

Notes:
* for the project.
Cost estimates for pipes with 2-inch to 14-inch diameter are based on COH projects and already account for an Island of Hawai‘i factor.

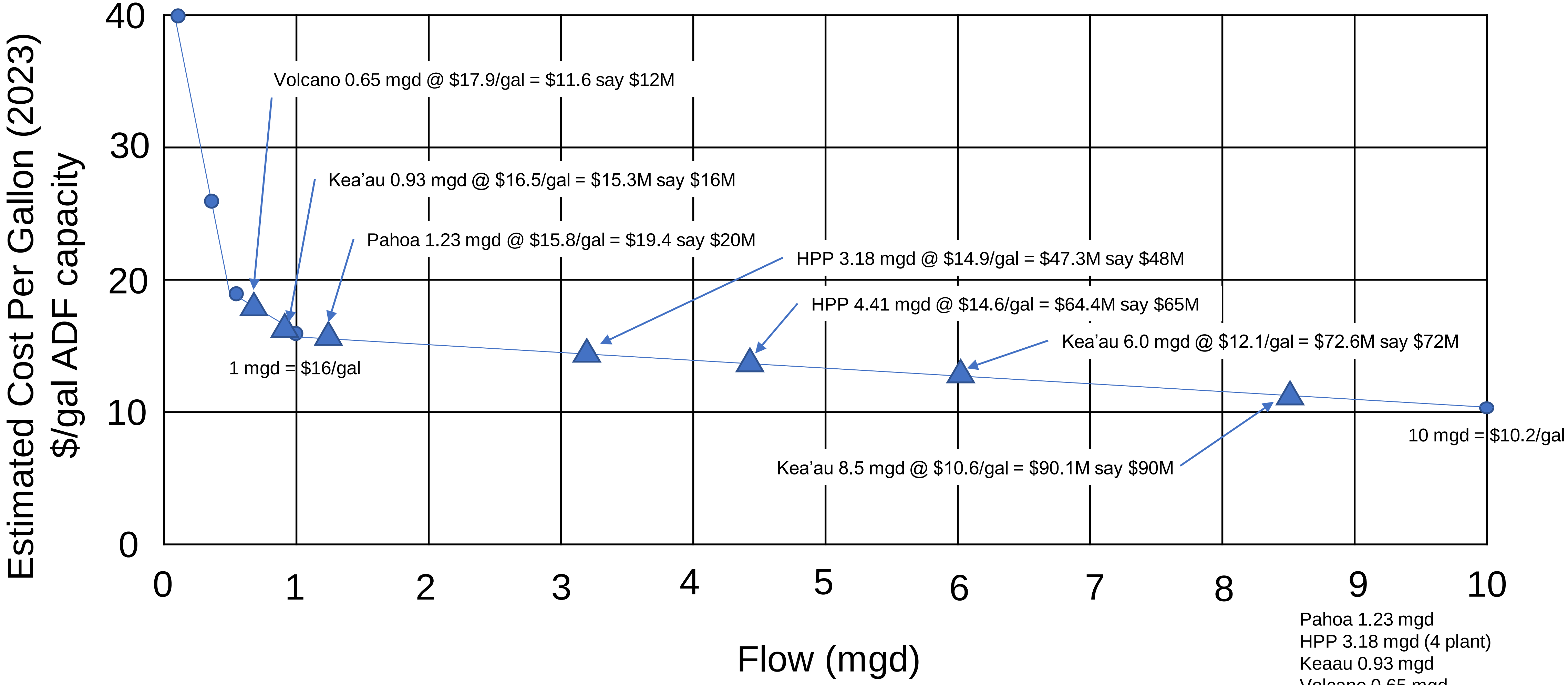
Pahoa 1.23 mgd
HPP 3.18 mgd (4 plant)
Keaau 0.93 mgd
Volcano 0.65 mgd
HPP 4.41 mgd (3 plant).
Keaau 6.0 mgd (1 plant)
Keaau 8.5 mgd (1 plant full flow)

| 4 plant | |
|---|---|
| Pahoa | $20M |
| HPP | $48M |
| Keaau | $16M |
| Volcano | $12M |
| **Total** | **$96M** |

| 3 plant | |
|---|---|
| HPP | $65M |
| Keaau | $16M |
| Volcano | $12M |
| **Total** | **$93M** |

| 1 plant (6 mgd) | |
|---|---|
| Keaau | $72M |
| **Total** | **$72M** |

| 1 plant (8.5 mgd) | |
|---|---|
| Keaau | $90M |
| **Total** | **$90M** |




Pahoa 1.23 mgd
HPP 3.18 mgd (4 plant)
Keaau 0.93 mgd
Volcano 0.65 mgd
HPP 4.41 mgd (3 plant).
Keaau 6.0 mgd (1 plant)
Keaau 8.5 mgd (1 plant full flow)

# 5 Alternatives Analysis

## 5.1 Estimated Capital Cost

A summary of the opinion of probable construction cost (cost estimate) for the Waimea WWTP Upgrade and Expansion is outlined in this report. The cost estimates are based on unit pricing from recent local Hawaii wastewater pumping and treatment projects, and local vendor quotes for major process equipment. The cost estimate is in current September 2016 dollars. ($ENR_{20\ Cities}$ Index = 10,132). The following allowances are included in the estimate to cover the contractor's general office expenses:

- Mobilization at 5 percent of the raw construction cost.
- General Contractor's home office overhead and profit at 10 percent of the total estimated construction cost.
- Sales tax at 4.166 percent of the estimated materials cost.
- Vehicle/auto insurance at 0.5 percent of the raw construction cost, builder's risk insurance at 1.0 percent of the raw construction cost and general liability insurance at 1.5 percent of the raw construction cost (3.0 percent total allowance).
- Bond costs for the payment and performance bonds at 2.0 percent of the raw construction cost.
- Miscellaneous home office expenses at approximately 1 percent of the raw construction cost.

The preliminary construction cost estimate for the Waimea WWTP Upgrade and Expansion for the three biological treatment alternatives is shown **Table 5-1**.

**Table 5-1: Waimea WWTP Upgrade and Expansion Estimated Construction Cost**

| Description | Estimated Cost PHASE 1 and 2 | | | Estimated Cost PHASE 3 | | |
|---|---|---|---|---|---|---|
| | Extended Air AS | SBR | Aerated Lagoon | Extended Air AS | SBR | Aerated Lagoon |
| Division 0 - General Conditions | 1,323,443 | 1,167,269 | 1,588,277 | 602,921 | 484,354 | 1,105,507 |
| Division 1 - Contractor Field Office | 322,640 | 322,640 | 322,640 | 244,480 | 244,480 | 244,480 |
| Division 2 - Sitework | 508,350 | 157,100 | 1,438,500 | 384,500 | 78,000 | 1,156,300 |
| Division 3 - Concrete | 1,505,500 | 1,670,500 | 198,000 | 532,000 | 603,400 | 60,000 |
| Division 4 - Masonry | 50,400 | 50,400 | 50,400 | 0 | 0 | 0 |
| Division 5 - Metals | 30,300 | 75,600 | 12,000 | 6,300 | 28,800 | 0 |
| Division 6 - Wood and Plastics | 64,200 | 1,200 | 476,000 | 157,500 | 94,500 | 476,000 |
| Division 7 - Roofing & Insulation | 23,100 | 23,100 | 23,100 | 0 | 0 | 0 |
| Division 8 - Doors &Windows | 7,800 | 7,800 | 7,800 | 0 | 0 | 0 |
| Division 9 - Finishes | 117,000 | 126,000 | 6,000 | 34,500 | 81,000 | 6,000 |
| Division 10 - Specialties | 1,200 | 1,200 | 300 | 300 | 300 | 300 |
| Division 11 - Equipment | 2,033,750 | 1,627,500 | 2,090,000 | 857,500 | 537,500 | 1,582,000 |
| Division 12 - Furnishings | 1,650 | 1,650 | 1,650 | 0 | 0 | 0 |
| Division 13 - Special Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| Division 14 - Conveying Systems | 18,000 | 27,000 | 9,000 | 0 | 9,000 | 0 |
| Division 15 - Mechanical | 391,000 | 340,040 | 571,000 | 215,000 | 215,000 | 371,450 |
| Division 16 - Electrical | 510,000 | 485,000 | 1,466,000 | 125,000 | 120,000 | 833,630 |
| Division 17 - Instrumentation | 175,000 | 166,000 | 156,000 | 90,000 | 87,000 | 81,000 |

| Description | Estimated Cost PHASE 1 and 2 | | | Estimated Cost PHASE 3 | | |
|---|---|---|---|---|---|---|
| | Extended Air AS | SBR | Aerated Lagoon | Extended Air AS | SBR | Aerated Lagoon |
| Subtotal of Divisions 1 to 17 | $5,759,890 | $5,082,731 | $ 6,828,390 | $2,647,079 | $2,098,980 | $4,811,160 |
| Division 0 | $1,323,443 | $1,167,269 | $1,588,277 | $602,921 | $484,354 | $1,105,507 |
| Subtotal of Divisions 0 to 17 | $7,083,333 | $6,250,000 | $8,416,667 | $3,250,000 | $2,583,334 | $5,916,667 |
| 20 percent Contingency | $1,416,667 | $1,250,000 | $1,683,333 | $650,000 | $516,667 | $1,183,333 |
| **Total Estimated Construction Cost** | **$8,500,000** | **$7,500,000** | **$10,100,000** | **$3,900,000** | **$3,100,000** | **$7,100,000** |

## 5.2 Estimated O&M Costs

This section reviews projected operation and maintenance costs for various biological treatment and solids handling system improvements. Annual Operation and Maintenance (O&M) Cost Estimates are costs associated with the annual operation and maintenance of the asset and do not include costs associated with replacement of equipment or structures that are at the end of their service life. Annual O&M Cost Estimates are derived from estimated electrical usage, labor, chemical usage, and allowances for miscellaneous utility usage such as water, gas, fuel, and oil. Allowances for the cost of sampling and analysis are also included. The general assumptions used in this report for local Hawaii annual O&M cost estimates include:

- Energy rates of $0.28/kilowatt-hour using estimated motor horsepower sizes provided by the manufacturer, and the operating times of the “duty” equipment. The “redundant” or standby equipment is not included in the estimated energy costs.
- Labor rates of $40/hour including fringe benefits using person-hour requirements based on other similar size operating systems (or facilities).
- Concentrated polymer cost of $7.00 per gallon, and approximately 4 lbs of active polymer per gallon of concentrated polymer solution.
- Combined biosolids processing, transport and tipping fee of $90 per wet ton.
- An average interest rate of approximately 3 percent over a twenty year period is used to amortize the value of the estimated construction cost of each alternative.
- Residual or salvage value is not included in these comparative cost evaluations since most items have a typical service life of twenty years or more which is the time period used for the life cycle cost comparisons.

The following are the typical service life for each major component of well-maintained wastewater systems:

- Reinforced concrete or masonry structures: 50 or more years.
- Concrete or iron piping: 50 or more years
- Iron valves: 20 or more years
- Mechanical and electrical equipment inside buildings: 20 or more years
- Immersed equipment: 15 or more years
- Exposed plastics (piping, valves, liners etc.): Less than 15 years

The annual O&M cost estimates for each alternative are based on current 2016 dollars using the 1 mgd Phase 3 design flow as the basis of the estimate for the purpose of comparing alternatives. Actual operating costs should be lower during initial operation at lower influent flows and loads.

The preliminary annual cost evaluation for the solids handling improvement alternatives related to the Waimea WWTP Upgrade and Expansion is shown **Table 5-2**.

$12.4M + $10.6M + $17.2M / 3 = $13.4M Avg
$13.4 x 13200 /10,132 ENR Index 2016 to 2023 = $17.46M
$17.46M / 1.2 contingency = $14.6M x 1.1 area adjustment = $16/gal for 1 mgd w/o contingency



**Table 5-2: Waimea WWTP Upgrade and Expansion Solids Handling Annual Cost Evaluation**

| Description | Solids Handling Alternative | | | | |
|---|---|---|---|---|---|
| | Solar Drying | Screw Press | Rotary Press | Belt Press | Centrifuge |
| **Estimated Construction Cost** | | | | | |
| Sitework | $175,000 | $15,000 | $15,000 | $15,000 | $15,000 |
| Reinforced Concrete | $725,000 | $30,000 | $30,000 | $60,000 | $30,000 |
| Dewatering System | $0 | $300,000 | $320,000 | $225,000 | $360,000 |
| Polymer Feed System | $0 | $22,000 | $22,000 | $22,000 | $22,000 |
| Electrical | $0 | $36,000 | $38,000 | $27,000 | $43,000 |
| Instrumentation | $0 | $24,000 | $26,000 | $18,000 | $29,000 |
| **Total Estimated Construction Cost** | **$900,000** | **$427,000** | **$451,000** | **$367,000** | **$499,000** |
| **Estimated Annual O&M Cost – Phase 3 Flows** | | | | | |
| Labor | $10,400 | $50,000 | $50,000 | $50,000 | $50,000 |
| Rental Equipment | $11,600 | $0 | $0 | $0 | $0 |
| Power | $0 | $500 | $1,400 | $1,300 | $6,500 |
| Chemicals | $0 | $9,500 | $9,600 | $7,700 | $11,500 |
| Solids Disposal | $124,000 | $109,000 | $109,000 | $116,000 | $98,000 |
| **Total Estimated Annual O&M Cost** | **$146,000** | **$169,000** | **$170,000** | **$175,000** | **$166,000** |
| **Total Annual Cost** | | | | | |
| Amortized Construction Cost (3% Interest, 20 years) | $60,000 | $29,000 | $30,000 | $25,000 | $34,000 |
| Estimated Annual O&M Cost | $146,000 | $169,000 | $170,000 | $175,000 | $166,000 |
| **Total Estimated Annual Cost** | **$206,000** | **$198,000** | **$200,000** | **$200,000** | **$200,000** |

Based on the review of solids handling alternatives the screw press dewatering system has the lowest estimated annual cost and would be used as the basis of the capital cost estimates and comparison of biological treatment alternatives.

The preliminary annual cost evaluation for the biological treatment alternatives related to the Waimea WWTP Upgrade and Expansion is shown **Table 5-3**.

**Table 5-3: Waimea WWTP Upgrade and Expansion Biological Treatment Annual Cost Evaluation**

| Description | Biological Treatment Alternative | | |
|---|---|---|---|
| | Extended Air AS | SBR | Aerated Lagoon |
| **Estimated Construction Cost** | | | |
| Estimated Construction Cost Phase 1 | $8,500,000 | $7,500,000 | $10,100,000 |
| Estimated Construction Cost Phase 2 | $3,900,000 | $3,100,000 | $7,100,000 |
| **Total Estimated Construction Cost** | **$12,400,000** | **$10,600,000** | **$17,200,000** |
| **Estimated Annual O&M Cost – Phase 3 Flows** | | | |
| Labor | $208,000 | $208,000 | $166,000 |
| Rental Equipment | $0 | $0 | $18,000 |
| Power | $171,000 | $167,000 | $274,000 |
| Chemicals | $0 | $0 | $0 |
| Replacement Parts | $23,000 | $18,000 | $29,000 |
| Solids Disposal | $169,000 | $169,000 | $57,000 |
| **Total Estimated Annual O&M Cost** | **$571,000** | **$562,000** | **$544,000** |
| **Total Annual Cost** | | | |

| | | | |
|---|---:|---:|---:|
| Amortized Construction Cost (3% Interest, 20 years) | $834,000 | $713,000 | $1,156,000 |
| Estimated Annual O&M Cost | $571,000 | $562,000 | $544,000 |
| **Total Estimated Annual Cost** | **$1,405,000** | **$1,275,000** | **$1,700,000** |

Based on the review of biological treatment alternatives the SBR biological treatment system has the lowest estimated annual cost.

## 5.3 Other Technical Considerations

The following “other technical considerations” were identified. These other technical considerations would be reviewed to compare the various biological treatment alternatives for the Waimea WWTP upgrade and expansion. The comparison helps to differentiate between the three treatment alternatives. The following considerations and technical criteria are considered in the ranking of each biological treatment alternative:

- Site utilization and layout efficiency
- Constructability
- Energy efficiency
- Operability
- Maintainability
- Security
- Biosolids treatment and disposal
- Odor and vector control
- Hawaii HB 2030 adaptability
- Future ability to produce R2 or R1 effluent
- Implementation schedule

A relatively simple multi-criteria rating system has been prepared to evaluate the alternatives and assist with the selection of a preferred treatment alternative. The rating system allows the comparison of each alternative. The following rating scale is used:

- A plus “+” sign means the alternative is better than the others.
- A minus “-“ sign means the Alternative is worse than the others.
- A zero “0” sign means the Alternatives are all equal.

It is possible to add additional numerical ratings to weight the importance of each evaluation criteria. **Table 5-4** shows a summary of the multi-criteria ratings for the three alternatives.

**Table 5-4: Evaluation of Biological Treatment Alternatives**

| Criteria | Treatment Alternative<br>Extended Aeration AS | <br>SBR | <br>Aerated Lagoon | Discussion |
|---|---|---|---|---|
| Site utilization & layout efficiency | - | + | - | SBR has smallest footprint |
| Constructability | - | + | - | SBR requires minimal excavation |
| Energy efficiency | + | + | - | SBR and AS have the lowest equipment horsepower |
| Operability | - | - | + | Lagoon requires minimal operator intervention |
| Maintainability | - | + | - | SBR has least amount of equipment |
| Security | - | + | - | SBR has most compact layout to secure |
| Biosolids treatment and disposal | - | - | + | Lagoon aerobically digests solids |
| Odor and vector control | - | + | - | SBR footprint is small and easy to cover |
| Hawaii HB 2030 adaptability | + | + | - | Waste solids could be used to produce biogas |

## B-3: Alternative 1A Construction Cost and LCC Analysis

JOB #: Pahoa Wastewater Feasibility Study
DATE: October 17, 2023
LOCATION: Pahoa
PREPARED BY: T. Huang

**AECOM**
Construction Cost Estimate
Conceptual Level
Wastewater Feasibility Estimates

| | DESCRIPTION | QUAN | UN | | | UNIT COST | TOTAL DIRECT COST |
|---|---|---|---|---|---|---|---|
| **Alternative 1A** IWS and Decentralized Treatment for Commercial/Schools | | | | | | | |
| | Septic tank and leach field with new soil | 608 | EA | | | 60,000 | $36,480,000 |
| | Cluster treatment plant (25,000 gpd) for commercial | 1 | EA | | | 3,000,000 | $3,000,000 |
| | Cluster treatment plant (50,000 gpd) for Pahoa Ele/Int/High Schools | 1 | EA | | | 4,000,000 | $4,000,000 |
| | Cluster treatment plant (50,000 gpd) for Hawaii Academy of Arts | 1 | EA | | | 4,000,000 | $4,000,000 |
| | Cluster treatment plant (130,000 gpd) for Mauka Makuu | 1 | EA | | | 8,000,000 | $8,000,000 |
| | Subtotal of Estimated Construction Cost | | | | | | **$55,480,000** |
| | Contingency | 20% | | | | | $11,096,000 |
| | Total Estimated Project Cost | | | | | | **$66,576,000** |
| | Project services | 20% | | | | | $13,315,200 |
| | **TOTAL CAPITAL COST** | | | | | | **79,891,200** |

**O&M**

| | Item | QUAN | UN | Unit cost | Total Annual |
|---|---|---|---|---|---|
| | Electricity | 61584 | kWH | $ 0.44 | $27,097 |
| | Labor and Materials | $ 556,100 | LS | - | $556,100 |
| **Annual O&M** | | | | | **$583,197** |

| Year | Year | Annual $ | Additional Cost | Total | |
|---|---|---|---|---|---|
| 0 | | $ - | | $ - | |
| 1 | | $ 602,876 | | $602,876 | |
| 2 | | $ 623,219 | | $623,219 | |
| 3 | | $ 644,248 | | $644,248 | |
| 4 | | $ 665,987 | | $665,987 | |
| 5 | | $ 688,459 | | $688,459 | |
| 6 | | $ 711,690 | | $711,690 | |
| 7 | | $ 735,705 | | $735,705 | |
| 8 | | $ 760,530 | | $760,530 | |
| 9 | | $ 786,192 | | $786,192 | |
| 10 | | $ 812,721 | | $812,721 | |
| 11 | | $ 840,144 | | $840,144 | |
| 12 | | $ 868,493 | | $868,493 | |
| 13 | | $ 897,799 | | $897,799 | |
| 14 | | $ 928,093 | | $928,093 | |
| 15 | | $ 959,410 | | $959,410 | |
| 16 | | $ 991,783 | | $991,783 | |
| 17 | | $ 1,025,249 | | $1,025,249 | |
| 18 | | $ 1,059,844 | | $1,059,844 | |
| 19 | | $ 1,095,607 | | $1,095,607 | |
| 20 | | $ 1,132,576 | | $1,132,576 | |
| 21 | | $ 1,170,792 | $ 11,442,985 | $12,613,778 | replace electrical/ motorized equipment |
| 22 | | $ 1,210,298 | | $1,210,298 | |
| 23 | | $ 1,251,137 | | $1,251,137 | |
| 24 | | $ 1,293,355 | | $1,293,355 | |
| 25 | | $ 1,336,996 | | $1,336,996 | |
| 26 | | $ 1,382,111 | | $1,382,111 | |
| 27 | | $ 1,428,747 | | $1,428,747 | |
| 28 | | $ 1,476,957 | | $1,476,957 | |
| 29 | | $ 1,526,795 | | $1,526,795 | |
| 30 | | $ 1,578,313 | | $1,578,313 | |
| | | **Present value of O&M** | | **$23,492,783** | |

**Residual Value**

| Item Description | Electrical/ Motorized Equipment | Pipes, valves, hydraulic structure, etc | Septic Tank and Leach Field | |
|---|---|---|---|---|
| Present Cost | $ 5,700,000 | $ 13,300,000 | $ 36,480,000 | |
| Design Life (Years) | 20 | 50 | 50 | |
| Residual Value at End of Design Life | $0 | $0 | $0 | |
| Effective Interest Rate | -0.26% | -0.26% | -0.26% | |
| Planning Cycle (Years) | 30 | 30 | 30 | |
| Remaining Life | 10 | 20 | 20 | |
| **Present Value of Residual Value** | **$3,078,000** | **$5,745,000** | **$15,757,000** | |

**NET PRESENT Value (Total Capital Cost + Net Present Value of O&M - Residual Value)** **78,803,983**

**IWS Unit Cost Estimation - Alternative 1A**

| Kapoho | 2009 cost | 2023 cost |
|---|---|---|
| Septic Tank/Leach Field | $ 16,000.00 | $ 25,000 |
| Septic Tank/Mound System | $ 32,000.00 | $ 50,000 |

| Carollo | 2020 cost | 2023 cost |
|---|---|---|
| IWS Low | $ 9,000.00 | $ 11,000 |
| IWS High | $ 60,000.00 | $ 70,000 |
| IWS Average | $ 23,000.00 | $ 27,000 |

| Pahoa | | 2023 cost |
|---|---|---|
| IWS | | $ 60,000 |
| | | |

Note: Pahoa IWS will be in the range of $50,000 (Kapoho) and High DOH IWS Cost.
Take average, roughly $60,000

**Pahoa IWS Quantity - Alternative 1A**

| Year | Quantity |
|---|---|
| Current (2022) | 390 |
| Growth Factor (2052 pop/2020 pop) | 1.56 |
| Future (2052) | 608 |

**Cluster Package Plant Unit Cost - Alternative 1A**

| Ref. 1: Kapoho | 2009 cost | 2023 cost |
|---|---|---|
| Cluster plant (0.33 mgd) | $ 1,000,000 | $ 1,544,000 |
| SBR+injection well, included 15% contingency and 15 project service | | |
| Ref. 2: Puna Kai Shopping Center WW | 2020 cost | 2023 cost |
| design 0.02 mgd | $ 1,600,000 | $ 1,847,000 |
| Trickling filter/constured wetland, including. site collection and disposal | | |
| adjusted to 0.015 mgd | | $ 1,400,000 |
| Ref. 3: 2023 MBR proposal | | 2023 cost |
| MBR package unit only | | $ 880,000 |
| Adding 20% contractor's markup and civil/elec. cost, et | | $ 1,556,000 |
| **Pahoa** | | **2023 cost** |
| Cluster package plant (0.015 mgd), to account for | | $ 2,000,000 |
| potential odor control, buffer zone, etc. | | |
| **Cluster package plant (0.025 mgd)** | | **$ 3,000,000** |
| **Cluster package plant (0.050 mgd)** | | **$ 4,000,000** |
| **Cluster package plant (0.075 mgd)** | | **$ 5,000,000** |
| **Cluster package plant (0.130 mgd)** | | **$ 8,000,000** |

**Annual Power Estimation - Alternative 1A**

| Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff) | | | | | |
|---|---|---|---|---|---|
| 1 HP to KW | 0.7457 | | | | |
| Neighborhood PS (NA) | | Regional PS (NA) | | WWTP | |
| | | | | 0.224 | mgd, wwtp |
| | | | | 156 | gpm |
| | | | | 60 | ft |
| | | | | 0.75 | efficiency |
| | | | | 3.14 | hp |
| | | | | 2.34 | kw |
| | | | | 1 | ea, total |
| | | | | 2.34 | kw, |
| | | | | 20,528 | pumping kwh annual |
| | | | | 41,056 | other kwh annual, approx 2x pumping |
| total power | 61584 | kwh annual | | | |

**Labor and Material Estimation - Alternative 1A**

| | | | |
|---|---|---|---|
| Honouliuli WWTP 2014 total | $ 584,000 | 39.6 | mgd, flow |
| Honouliuli WWTP 2023 estimated | $ 787,892 | 39.6 | mgd, flow |
| Flow prorated for Puna WWTPs, total | $ 4,457 | 0.224 | mgd, total flow |
| **Pahoa Use** | **$ 8,900** | | Assume 2x due to extra cost for small plant |

**Septic Tank Mound System O&M - Alternative 1A**

| O&M Cost | | | | |
|---|---|---|---|---|
| Kapoho | Labor | Electricity | Maintenance | Total |
| Septic/Mound System (2009) | 310 | 30 | 200 | $ 540 |
| Septic/Mound System (2023) | 480 | 50 | 310 | $ 840 |
| Septic/Leach Field (2009) | 240 | | 130 | $ 370 |
| Septic/Leach Field (2023) | 380 | | 210 | $ 590 |
| | | | | |
| **O&M Cost** | | | | |
| **Pahoa** | | | | |
| IWS, including septic/Leach field with new soil or mound system, use | | | | $ 900 |
| Number of IWS units | | | | 608 |
| **Total** | | | | **$ 547,200** |

Note: drain field last 20 to 50 years, when well designed and maintained, can last 50 years.
Added some Maintenance cost and assume 50 years life.

**Septic Tank / Leach Field Maintenance Cost Estimate**

| Item | Estimated Cost | Unit | **Once every "x" years - low range** | **Once every "x" years - mid range** | **Once every "x" years - high range** | **Annual Cost - Low End ($/yr)** | **Annual Cost - Mid Range ($/yr)** | **Annual Cost - High End ($/yr)** |
|---|---|---|---|---|---|---|---|---|
| Clean/Pump Tank | $ 500 | $ each | 5 | 4 | 3 | $ 100 | $ 125 | $ 167 |
| Inspect System | $ 500 | $ each | 5 | 4 | 3 | $ 100 | $ 125 | $ 167 |
| Pumping Power Cost | $ 70 | $ year | 0 | 1 | 1 | $ - | $ 70 | $ 70 |
| Pump Replacement Cost | $ 1,500 | $ each | 0 | 15 | 5 | $ - | $ 100 | $ 300 |
| Leach Field Replacement Cost | $ 20,000 | $ each | 60 | 40 | 15 | $ 333 | $ 500 | $ 1,333 |
| | | | | | | $ 533 | **$ 920** | $ 2,037 |

**Use $900**

| Source | Source |
|---|---|
| | Carollo Report |
| | EPA |

Alternative 1A Package Plant flows

| | Student | Teacher | Total count | school avg gpcd | Res. Equiv. population | avg. gpcd | GW Infil. Gpcd | current avg. flow, gpd | growth factor | 2052 avg., glow, avg | Capacity used to be conservative |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pahoa Ele./Inter/High School | 1014 | 69 | 1083 | 25 | 387 | 70 | 0 | 27,090 | 1.56 | 43,000 | 50,000 |
| Hawaii Academy of Arts | 711 | 42 | 753 | 25 | 269 | 70 | 0 | 18,830 | 1.56 | 30,000 | 50,000 |
| Pahoa Towncenter | | | | | | | | | | 25,000 | 25,000 |
| Mauka Makuu | | | | | | | | | | 126,000 | 130,000 |

# B-4: Alternative 1B Construction Cost and LCC Analysis

JOB #: Pahoa Wastewater Feasibility Study
DATE: October 17, 2023
LOCATION: Pahoa
PREPARED BY: T. Huang

**AECOM**
Construction Cost Estimate
Conceptual Level
Wastewater Feasibility Estimates

| **Alternative 1B** | **DESCRIPTION** | **QUAN** | **UN** | | | **UNIT COST** | **TOTAL DIRECT COST** |
|---|---|---|---|---|---|---|---|
| Pahoa Flow Only Decentralized Treatment Low Pressure Sewer | | | | | | | |
| | In-Street Low Pressure (2") | 25,000 | LF | | | $ 300 | $7,500,000 |
| | In-Street Low Pressure (3") | 32,000 | LF | | | $ 450 | $14,400,000 |
| | In-Street Low Pressure (4") | 6,000 | LF | | | $ 600 | $3,600,000 |
| | Low pressure sewer (On-Lot) | 608 | EA | | | $ 26,000 | $15,808,000 |
| | Neighborhood On-Site treatment plant, 50,000 gpd (Pahoa 1) | 1 | EA | | | $ 4,000,000 | $4,000,000 |
| | Neighborhood On-Site treatment plant, 120,000 gpd (Pahoa 2) | 1 | EA | | | $ 8,000,000 | $8,000,000 |
| | Neighborhood On-Site treatment plant, 130,000 gpd (Mauka Makuu) | 1 | EA | | | $ 8,000,000 | $8,000,000 |
| | Subtotal of Estimated Construction Cost | | | | | | **$61,308,000** |
| | Right of Way | 66 | Ac | | | $ 20,000 | $1,317,025 |
| | Contingency | 20% | | | | | $12,525,005 |
| | Total Estimated Project Cost | | | | | | **$75,150,030** |
| | Project services | 20% | | | | | $15,030,006 |
| | **TOTAL CAPITAL COST** | | | | | | **90,180,036** |

**O&M**

| | Item | QUAN | UN | Unit cost | Total Annual |
|---|---|---|---|---|---|
| | Electricity | 82479 | kWH | $ 0.44 | $36,291 |
| | Labor and Materials | $ 360,999 | LS | - | $360,999 |
| **Annual O&M** | | | | | **$397,290** |

| Year | Year | Annual $ | Additional Cost | Total | |
|---|---|---|---|---|---|
| 0 | | $ - | | $ - | |
| 1 | | $ 410,695 | | $410,695 | |
| 2 | | $ 424,553 | | $424,553 | |
| 3 | | $ 438,879 | | $438,879 | |
| 4 | | $ 453,688 | | $453,688 | |
| 5 | | $ 468,997 | | $468,997 | |
| 6 | | $ 484,823 | | $484,823 | |
| 7 | | $ 501,182 | | $501,182 | |
| 8 | | $ 518,093 | | $518,093 | |
| 9 | | $ 535,575 | | $535,575 | |
| 10 | | $ 553,647 | | $553,647 | |
| 11 | | $ 572,329 | | $572,329 | |
| 12 | | $ 591,641 | | $591,641 | |
| 13 | | $ 611,605 | | $611,605 | |
| 14 | | $ 632,242 | | $632,242 | |
| 15 | | $ 653,576 | | $653,576 | |
| 16 | | $ 675,630 | | $675,630 | |
| 17 | | $ 698,427 | | $698,427 | |
| 18 | | $ 721,995 | | $721,995 | |
| 19 | | $ 746,357 | | $746,357 | |
| 20 | | $ 771,541 | | $771,541 | |
| 21 | | $ 797,575 | $ 21,565,812 | $22,363,387 | replace electrical/ motorized equipment |
| 22 | | $ 824,488 | | $824,488 | |
| 23 | | $ 852,309 | | $852,309 | |
| 24 | | $ 881,068 | | $881,068 | |
| 25 | | $ 910,798 | | $910,798 | |
| 26 | | $ 941,531 | | $941,531 | |
| 27 | | $ 973,301 | | $973,301 | |
| 28 | | $ 1,006,143 | | $1,006,143 | |
| 29 | | $ 1,040,094 | | $1,040,094 | |
| 30 | | $ 1,075,190 | | $1,075,190 | |
| | | **Present value of O&M** | | **$23,023,863** | |

**Residual Value**

| Item Description | Electrical/ Motorized Equipment | Pipes, valves, hydraulic structure, etc | Gravity Sewer/New Force Main | |
|---|---|---|---|---|
| Present Cost | $ 10,742,400 | $ 25,065,600 | $ 25,500,000 | |
| Design Life (Years) | 20 | 50 | 75 | |
| Residual Value at End of Design Life | $0 | $0 | $0 | |
| Effective Interest Rate | -0.26% | -0.26% | -0.26% | |
| Planning Cycle (Years) | 30 | 30 | 30 | |
| Remaining Life | 10 | 20 | 45 | |
| **Present Value of Residual Value** | **$5,800,000** | **$10,827,000** | **$16,521,000** | |

**NET PRESENT Value (Total Capital Cost + Net Present Value of O&M - Residual Value) 80,055,899**

### Length of LPS - Alternative 1B

| | | |
|---|---|---|
| Total LPS, ft | 63,226 | percentage |
| LPS, 2" | 25,000 | 40% |
| LPS, 3" | 32,000 | 50% |
| LPS, 4" | 6,000 | 10% |
| | | |
| Full Flow Total LPS, ft | 63,226 | percentage |
| LPS, 2" | 25,000 | 40% |
| LPS, 3" | 32,000 | 50% |
| LPS, 4" | 6,000 | 10% |

### Pahoa LPS Lot Quantity - Alternative 1B

| Year | Quantity |
|---|---|
| Current (2022) | 390 |
| Growth Factor (2052 pop/2020 pop) | 1.56 |
| Future (2052) | 608 |

### Easement Area Estimation - Alternative 1B

| WW Infrastructure | Length, ft | Width, ft | Area, ft2 | Area, Ac |
|---|---|---|---|---|
| Sewer | 63000 | 40 | 2520000 | 58 |
| Regional PS | | | | |
| Neighborhood PS | | | | |
| WWTP | | | | 8 |
| Total | | | | 66 |

### Cluster Package Plant Unit Cost - Alternative 1B

| # of plant | Flow, mgd | total flow, gpd | unit Cost |
|---|---|---|---|
| | 15,000 | - | $ 2,000,000 |
| | 25,000 | - | $ 3,000,000 |
| 1 | 50,000 | 50,000 | $ 4,000,000 |
| | 75,000 | - | $ 5,000,000 |
| | 100,000 | - | $ 6,000,000 |
| 1 | 120,000 | 120,000 | $ 8,000,000 |
| 1 | 130,000 | 130,000 | $ 8,000,000 |
| | 150,000 | - | $ 8,000,000 |
| | 200,000 | - | $ 10,000,000 |
| | 250,000 | - | $ 12,000,000 |
| Total | | 300,000 | |

**Annual Power Estimation - Alternative 1B**

| Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff) | | | | | |
|---|---|---|---|---|---|
| 1 HP to KW | 0.7457 | | | | |
| Neighborhood PS | | Regional PS | | WWTP | |
| 0.05 | mgd, Avg. | 0.53 | mgd, Avg. | 0.3 | mgd, avg. |
| 35 | gpm | 365 | gpm | 208 | gpm |
| 60 | ft | 80 | ft | 60 | ft |
| 0.75 | efficiency | 0.75 | efficiency | 0.75 | efficiency |
| 1 | hp | 10 | hp | 4 | hp |
| 0.5 | kw | 7.3 | kw | 3.1 | kw |
| 0 | ea | 0 | ea | 1 | ea, total |
| 0.00 | kw | 0.00 | kw | 3.14 | kw |
| | | | | | |
| | | | | | |
| | | | | | |
| - | kwh annual | - | kwh annual | 27,493 | pumping kwh annual |
| | | | | 54,986 | other kwh annual, approx 2x pumping |
| **Total Power** | **82,479** | **kwh annual** | | | |

**Labor and Material Estimation - Alternative 1B**

| | | | | |
|---|---|---|---|---|
| Honouliuli WWTP 2014 total | | $ 584,000 | 39.6 | mgd, flow |
| Honouliuli WWTP 2023 estimated | | $ 787,892 | 39.6 | mgd, flow |
| Flow prorated for Pahoa WWTPs, total | | $ 5,969 | 0.3 | mgd, total flow |
| Halawa WWPS 2014 total | | $ 6,534 | 1.8 | mgd, flow |
| Halawa WWPS 2023 estimated | | $ 8,815 | 1.8 | mgd, flow |
| Waimalu WWPS 2014 total | | $ 36,164 | 5.3 | mgd, flow |
| Waimalu WWPS 2023 estimated | | $ 48,790 | 5.3 | mgd, flow |
| Flow prorated for Pahoa Regional WWPSs | | $ 15,211 | 2.36 | mgd, each |
| Flow prorated for Pahoa Regional WWPSs, t | | $ - | | total |
| Flow prorated for Pahoa NH WWPSs | | $ 182 | 0.05 | mgd, each |
| Flow prorated for Pahoa H WWPSs, total | | $ - | | total |
| **Total for WWTP, Regional PS, and NH PS** | | **$ 5,969** | | |

**Pump Station Weighted Average and Peak Flows - Alternative 1B**

| Area | # of Re PS | Avg Peak Flow, | #*Peak Flow | Peak to Avg rat | Avg. Flow, mgd | #*Avg. Flow |
|---|---|---|---|---|---|---|
| Pahoa | 2 | 2.36 | 4.72 | 4.49 | 0.53 | 1.05 |
| | | | | | | |
| Weighted Average | 2 | 2.36 | 4.72 | | 0.53 | 1.05 |

**O&M Estimation for Pahoa LPS - Alternative 1B**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Basis of LPS Unit Cost (Kapoho) | | | | | | | | | | |
| In-Street | LF | 2009 total cost | 2023 total cost | 2023 cost/LF | 2009 Op cost | 2009 Main cost | | 2009 total OM | 2023 total OM | 2023 OM/LF |
| LP pipe, valves, etc. | 3400 | | | Use $450/LF | $ 1,700 | $ 70 | | $ 1,770 | $ 2,732 | $ 0.81 |
| On-Lot | # of lots | 2009 total cost | 2023 total cost | 2023 cost/lot | 2009 Op cost | 2009 Main cost | 2009 Elec. Cos | 2009 total OM | 2023 total OM | 2023 OM/Lot |
| lat Kits, etc. | 36 | $ 592,000 | $ 913,875 | $ 26,000 | $ 3,600 | $ 5,800 | $ 2,200 | $ 11,600 | $ 17,907 | $ 500.00 |
| **Pahoa LPS OM Cost** | | | | | | | | | | |
| In-Street | LF | 2023 cost/LF | 2023 cost | 2023 OM/LF | 2023 total OM | | | | | |
| LP pipe, valves, etc. | 63000 | $ 450 | $ 28,350,000 | 0.81 | **$ 51,030** | | | | | |
| On-Lot | # of lots | 2023 cost/lot | 2023 cost | 2023 OM/Lot | 2023 total OM | | | | | |
| lat Kits, etc. | 608 | $ 26,000 | $ 15,808,000 | 500 | **$ 304,000** | | | | | |

# B-5: Alternative 2A Construction Cost and LCC Analysis

JOB #: Pahoa Wastewater Feasibility Study
DATE: October 17, 2023
LOCATION: Pahoa
PREPARED BY: T. Huang

**AECOM**
Construction Cost Estimate
Conceptual Level
Wastewater Feasibility Estimates

| **Alternative 2A** | **DESCRIPTION** | **QUAN** | **UN** | | | **UNIT COST** | **TOTAL DIRECT COST** |
|---|---|---|---|---|---|---|---|
| Pahoa Flow Only<br>All Gravity Sewer | | | | | | | |
| | Gravity Sewer 8 inch | 40,505 | LF | | | $ 1,600 | $64,808,000 |
| | Gravity Sewer 12 inch | 3,712 | LF | | | $ 3,700 | $13,732,950 |
| | Force main 4 inch | 10,747 | LF | | | $ 600 | $6,448,200 |
| | Force main 6 inch | 2,969 | LF | | | $ 900 | $2,672,100 |
| | Low pressure sewer 3 inch | - | LF | | | $ 450 | $0 |
| | Regional PS | 2 | EA | | | $ 7,000,000 | $14,000,000 |
| | Neighborhood PS | 5 | EA | | | $ 1,200,000 | $6,000,000 |
| | WWTP 0.3 mgd | 1 | EA | | | $ 12,000,000 | $12,000,000 |
| | Subtotal of Estimated Construction Cost | | | | | | **$119,661,250** |
| | Right of Way | 62 | Ac | | | $ 20,000 | $1,236,366 |
| | Contingency | 20% | | | | | $24,179,523 |
| | Total Estimated Project Cost | | | | | | **$145,077,139** |
| | Project services | 20% | | | | | $29,015,428 |
| | **TOTAL CAPITAL COST** | | | | | | **174,092,567** |

**O&M**

| | Item | QUAN | UN | Unit cost | Total Annual |
|---|---|---|---|---|---|
| | Electricity | 233840 | kWH | $ 0.44 | $102,890 |
| | Labor and Materials | $ 37,299 | LS | - | $37,299 |
| **Annual O&M** | | | | | **$140,188** |

| Year | Year | Annual $ | Additional Cost | Total | |
|---|---|---|---|---|---|
| 0 | | $ - | | $ - | |
| 1 | | $ 144,919 | | $144,919 | |
| 2 | | $ 149,809 | | $149,809 | |
| 3 | | $ 154,864 | | $154,864 | |
| 4 | | $ 160,089 | | $160,089 | |
| 5 | | $ 165,491 | | $165,491 | |
| 6 | | $ 171,075 | | $171,075 | |
| 7 | | $ 176,848 | | $176,848 | |
| 8 | | $ 182,815 | | $182,815 | |
| 9 | | $ 188,984 | | $188,984 | |
| 10 | | $ 195,361 | | $195,361 | |
| 11 | | $ 201,953 | | $201,953 | |
| 12 | | $ 208,768 | | $208,768 | |
| 13 | | $ 215,812 | | $215,812 | |
| 14 | | $ 223,094 | | $223,094 | |
| 15 | | $ 230,622 | | $230,622 | |
| 16 | | $ 238,404 | | $238,404 | |
| 17 | | $ 246,448 | | $246,448 | |
| 18 | | $ 254,764 | | $254,764 | |
| 19 | | $ 263,361 | | $263,361 | |
| 20 | | $ 272,247 | | $272,247 | |
| 21 | | $ 281,434 | $ 19,272,396 | $19,553,830 | replace electrical/ motorized equipment |
| 22 | | $ 290,930 | | $290,930 | |
| 23 | | $ 300,747 | $ 619,033 | $919,780 | sewer inspection at yr 10 of service |
| 24 | | $ 310,895 | | $310,895 | |
| 25 | | $ 321,386 | | $321,386 | |
| 26 | | $ 332,230 | | $332,230 | |
| 27 | | $ 343,441 | | $343,441 | |
| 28 | | $ 355,030 | | $355,030 | |
| 29 | | $ 367,009 | | $367,009 | |
| 30 | | $ 379,393 | | $379,393 | |
| | | **Present value of O&M** | | **$14,366,445** | |

**Residual Value**

| Item Description | Electrical/ Motorized Equipment | Pipes, valves, hydraulic structure, etc | Gravity Sewer/New Force Main | |
|---|---|---|---|---|
| Present Cost | $ 9,600,000 | $ 22,400,000 | $ 87,661,250 | |
| Design Life (Years) | 20 | 50 | 75 | |
| Residual Value at End of Design Life | $0 | $0 | $0 | |
| Effective Interest Rate | -0.26% | -0.26% | -0.26% | |
| Planning Cycle (Years) | 30 | 30 | 30 | |
| Remaining Life | 10 | 20 | 45 | |
| **Present Value of Residual Value** | **$5,183,000** | **$9,675,000** | **$56,795,000** | |

**NET PRESENT Value (Total Capital Cost + Net Present Value of O&M - Residual Value) 116,806,012**

**Annual Power Estimation - Alternative 2A**

| | | | | | |
|---|---|---|---|---|---|
| Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff) | | | | | |
| 1 HP to KW | 0.7457 | | | | |
| Neighborhood PS | | Regional PS | | WWTP | |
| 0.05 | mgd, Avg. | 0.53 | mgd, Avg. | 0.3 | mgd, avg. |
| 35 | gpm | 365 | gpm | 208 | gpm |
| 60 | ft | 80 | ft | 60 | ft |
| 0.75 | efficiency | 0.75 | efficiency | 0.75 | efficiency |
| 1 | hp | 10 | hp | 4 | hp |
| 0.5 | kw | 7.3 | kw | 3.1 | kw |
| 5 | ea | 2 | ea | 1 | ea |
| 2.62 | kw | 14.66 | kw | 3.14 | kw |
| 22,911 | kwh annual | 128,450 | kwh annual | 27,493 | pumping kwh annual |
| | | | | 54,986 | other kwh annual, approx 2x pumping |
| **Total Power** | **233,840** | **kwh annual** | | | |

**Labor and Material Estimation - Alternative 2A**

| | | | | |
|---|---|---|---|---|
| Honouliuli WWTP 2014 total | $ | 584,000 | 39.6 | mgd, flow |
| Honouliuli WWTP 2023 estimated | $ | 787,892 | 39.6 | mgd, flow |
| Flow prorated for Pahoa WWTPs, total | $ | 5,969 | 0.3 | mgd, total flow |
| Halawa WWPS 2014 total | $ | 6,534 | 1.8 | mgd, flow |
| Halawa WWPS 2023 estimated | $ | 8,815 | 1.8 | mgd, flow |
| Waimalu WWPS 2014 total | $ | 36,164 | 5.3 | mgd, flow |
| Waimalu WWPS 2023 estimated | $ | 48,790 | 5.3 | mgd, flow |
| Flow prorated for Pahoa Regional WWPSs | $ | 15,211 | 2.36 | mgd, each |
| Flow prorated for Pahoa Regional WWPSs, | $ | 30,422 | | total |
| Flow prorated for Pahoa NH WWPSs | $ | 182 | 0.05 | mgd, each |
| Flow prorated for Pahoa H WWPSs, total | $ | 908 | | total |
| **Total for WWTP, Regional PS, and NH PS** | **$** | **37,299** | | |

**Pump Station Weighted Average and Peak Flows - Alternative 2A**

| Area | # of Re PS | Avg Peak Flow | #*Peak Flow | Peak to Avg ratio | Avg. Flow, mgd | #*Avg. Flow |
|---|---|---|---|---|---|---|
| Pahoa | 2 | 2.36 | 4.72 | 4.49 | 0.53 | 1.05 |
| | | | | | | |
| Weighted Averag | 2 | 2.36 | 4.72 | | 0.53 | 1.05 |

**Easement Area Estimation - Alternative 2A**

| WW Infrastructur | Length, ft | Width, ft | Area, ft2 | Area, Ac |
|---|---|---|---|---|
| Sewer | 57933 | 40 | 2317304 | 53 |
| Regional PS | 150 | 150 | 45000 | 1 |
| Neighborhood PS | 150 | 150 | 112500 | 3 |
| WWTP | | | 218000 | 5 |
| Total | | | | 62 |

# B-6: Alternative 2B Construction Cost and LCC Analysis

| | |
|---|---|
| JOB #: | Pahoa Wastewater Feasibility Study |
| DATE: | October 17, 2023 |
| LOCATION: | Pahoa |
| PREPARED BY: | T. Huang |

**AECOM**
Construction Cost Estimate
Conceptual Level
Wastewater Feasibility Estimates

| **Alternative 2B** | **DESCRIPTION** | **QUAN** | **UN** | | | **UNIT COST** | **TOTAL DIRECT COST** |
|---|---|---|---|---|---|---|---|
| Pahoa Flow Only Both Gravity Sewer & Low pressure sewer | | | | | | | |
| | Gravity Sewer 8 inch | 25,853 | LF | | | $ 1,600 | $41,364,800 |
| | Gravity Sewer 12 inch | 3,712 | LF | | | $ 3,700 | $13,732,950 |
| | Force main 4 inch | - | LF | | | $ 600 | $0 |
| | Force main 6 inch | 2,969 | LF | | | $ 900 | $2,672,100 |
| | Low Pressure Sewer In-Street (3 inch) | 14,652 | LF | | | $ 450 | $6,593,400 |
| | Low pressure sewer (On-Lot) | 220 | EA | | | $ 26,000 | $5,720,000 |
| | Regional PS | 2 | EA | | | $ 7,000,000 | $14,000,000 |
| | Neighborhood PS | - | EA | | | $ 1,200,000 | $0 |
| | WWTP 0.3 mgd | 1 | EA | | | $ 12,000,000 | $12,000,000 |
| | Subtotal of Estimated Construction Cost | | | | | | **$96,083,250** |
| | Right of Way | 49 | Ac | | | $ 20,000 | $987,339 |
| | Contingency | 20% | | | | | $19,414,118 |
| | Total Estimated Project Cost | | | | | | **$116,484,707** |
| | Project services | 20% | | | | | $23,296,941 |
| | **TOTAL CAPITAL COST** | | | | | | **139,781,649** |

**O&M**

| | Item | QUAN | UN | Unit cost | Total Annual |
|---|---|---|---|---|---|
| | Electricity | 210929 | kWH | $ 0.44 | $92,809 |
| | Labor and Materials | $ 157,819 | LS | - | $157,819 |
| **Annual O&M** | | | | | **$250,628** |

| Year | Year | Annual $ | Additional Cost | Total | |
|---|---|---|---|---|---|
| 0 | | $ - | | $ - | |
| 1 | | $ 259,085 | | $259,085 | |
| 2 | | $ 267,827 | | $267,827 | |
| 3 | | $ 276,865 | | $276,865 | |
| 4 | | $ 286,207 | | $286,207 | |
| 5 | | $ 295,865 | | $295,865 | |
| 6 | | $ 305,848 | | $305,848 | |
| 7 | | $ 316,168 | | $316,168 | |
| 8 | | $ 326,837 | | $326,837 | |
| 9 | | $ 337,865 | | $337,865 | |
| 10 | | $ 349,266 | | $349,266 | |
| 11 | | $ 361,051 | | $361,051 | |
| 12 | | $ 373,234 | | $373,234 | |
| 13 | | $ 385,828 | | $385,828 | |
| 14 | | $ 398,847 | | $398,847 | |
| 15 | | $ 412,305 | | $412,305 | |
| 16 | | $ 426,218 | | $426,218 | |
| 17 | | $ 440,600 | | $440,600 | |
| 18 | | $ 455,467 | | $455,467 | |
| 19 | | $ 470,836 | | $470,836 | |
| 20 | | $ 486,723 | | $486,723 | |
| 21 | | $ 503,146 | $ 19,103,763 | $19,606,909 | replace electrical/ motorized equipment |
| 22 | | $ 520,124 | | $520,124 | |
| 23 | | $ 537,675 | $ 413,905 | $951,579 | sewer inspection at yr 10 of service |
| 24 | | $ 555,817 | | $555,817 | |
| 25 | | $ 574,572 | | $574,572 | |
| 26 | | $ 593,960 | | $593,960 | |
| 27 | | $ 614,002 | | $614,002 | |
| 28 | | $ 634,721 | | $634,721 | |
| 29 | | $ 656,138 | | $656,138 | |
| 30 | | $ 678,278 | | $678,278 | |
| | | **Present value of O&M** | | **$17,526,273** | |

**Residual Value**

| Item Description | Electrical/ Motorized Equipment | Pipes, valves, hydraulic structure, etc | Gravity Sewer/New Force Main | |
|---|---|---|---|---|
| Present Cost | $ 9,516,000 | $ 22,204,000 | $ 64,363,250 | |
| Design Life (Years) | 20 | 50 | 75 | |
| Residual Value at End of Design Life | $0 | $0 | $0 | |
| Effective Interest Rate | -0.26% | -0.26% | -0.26% | |
| Planning Cycle (Years) | 30 | 30 | 30 | |
| Remaining Life | 10 | 20 | 45 | |
| **Present Value of Residual Value** | **$5,138,000** | **$9,591,000** | **$41,701,000** | |

**NET PRESENT Value (Total Capital Cost + Net Present Value of O&M - Residual Value) 100,877,922**

**Annual Power Estimation - Alternative 2B**

| | | | | | |
|---|---|---|---|---|---|
| Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff) | | | | | |
| 1 HP to KW | 0.7457 | | | | |
| Neighborhood PS | | Regional PS | | WWTP | |
| 0.05 | mgd, Avg. | 0.53 | mgd, Avg. | 0.3 | mgd, avg. |
| 35 | gpm | 365 | gpm | 208 | gpm |
| 60 | ft | 80 | ft | 60 | ft |
| 0.75 | efficiency | 0.75 | efficiency | 0.75 | efficiency |
| 1 | hp | 10 | hp | 4 | hp |
| 0.5 | kw | 7.3 | kw | 3.1 | kw |
| 0 | ea | 2 | ea | 1 | ea |
| 0.00 | kw | 14.66 | kw | 3.14 | kw |
| - | kwh annual | 128,450 | kwh annual | 27,493 | pumping kwh annual |
| | | | | 54,986 | other kwh annual, approx 2x pumping |
| **Total Power** | **210,929** | **kwh annual** | | | |

**Labor and Material Estimation - Alternative 2B**

| | | | |
|---|---|---|---|
| Honouliuli WWTP 2014 total | $ 584,000 | 39.6 | mgd, flow |
| Honouliuli WWTP 2023 estimated | $ 787,892 | 39.6 | mgd, flow |
| Flow prorated for Pahoa WWTPs, total | $ 5,969 | 0.3 | mgd, total flow |
| Halawa WWPS 2014 total | $ 6,534 | 1.8 | mgd, flow |
| Halawa WWPS 2023 estimated | $ 8,815 | 1.8 | mgd, flow |
| Waimalu WWPS 2014 total | $ 36,164 | 5.3 | mgd, flow |
| Waimalu WWPS 2023 estimated | $ 48,790 | 5.3 | mgd, flow |
| Flow prorated for Pahoa Regional WWPSs | $ 15,211 | 2.36 | mgd, each |
| Flow prorated for Pahoa Regional WWPSs, | $ 30,422 | | total |
| Flow prorated for Pahoa NH WWPSs | $ 182 | 0.05 | mgd, each |
| Flow prorated for Pahoa H WWPSs, total | $ - | | total |
| **Total for WWTP, Regional PS, and NH PS** | **$36,391** | | |

**Pump Station Weighted Average and Peak Flows - Alternative 2B**

| Area | # of Re PS | Avg Peak Flow, | #*Peak Flow | Peak to Avg ratio | Avg. Flow, mgd | #*Avg. Flow |
|---|---|---|---|---|---|---|
| Pahoa | 2 | 2.36 | 4.72 | 4.49 | 0.53 | 1.05 |
| | | | | | | |
| Weighted Averag | 2 | 2.36 | 4.72 | | 0.53 | 1.05 |

**Easement Area Estimation - Alternative 2B**

| WW Infrastructur | Length, ft | Width, ft | Area, ft2 | Area, Ac |
|---|---|---|---|---|
| Sewer | 47186 | 40 | 1887424 | 43 |
| Regional PS | 150 | 150 | 45000 | 1 |
| Neighborhood PS | 150 | 150 | 0 | 0 |
| WWTP | | | 218000 | 5 |
| Total | | | | 49 |

**O&M Estimation for Puna LPS - Alternative 2B**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Basis of LPS Unit Cost (Kapoho) | | | | | | | | | | |
| In-Street | LF | 2009 total cost | 2023 total cost | 2023 cost/LF | 2009 Op cost | 2009 Main cost | | 2009 total OM | 2023 total OM | 2023 OM/LF |
| LP pipe, valves, etc. | 3400 | | | Use $450/LF | $ 1,700 | $ 70 | | $ 1,770 | $ 2,732 | $ 0.81 |
| On-Lot | # of lots | 2009 total cost | 2023 total cost | 2023 cost/lot | 2009 Op cost | 2009 Main cost | 2009 Elec. Cost | 2009 total OM | 2023 total OM | 2023 OM/Lot |
| lat Kits, etc. | 36 | $ 592,000 | $ 913,875 | $ 26,000 | $ 3,600 | $ 5,800 | $ 2,200 | $ 11,600 | $ 17,907 | $ 498.00 |

| | | | | | |
|---|---|---|---|---|---|
| **Pahoa LPS OM Cost** | | | | | |
| In-Street | LF | 2023 cost/LF | 2023 cost | 2023 OM/LF | 2023 total OM |
| LP pipe, valves, etc. | 14652 | $ 450 | $ 6,593,400 | 0.81 | **$ 11,868** |
| On-Lot | # of lots | 2023 cost/lot | 2023 cost | 2023 OM/Lot | 2023 total OM |
| lat Kits, etc. | 220 | $ 26,000 | $ 5,720,000 | 498 | **$ 109,560** |

# Appendix C: Overview of State of Hawaiʻi Department of Health Cesspool Pilot Grant Program

# Overview: HDOH Cesspool Pilot Grant Program

- Up to $20,000 in reimbursements per applicant
- First-come, first-served basis
- Note: 9 months requirement to complete conversion or connection (based on expiration of funds that HDOH receives)
- For more information: https://health.hawaii.gov/wastewater/home/ccpgp/

Starting March 15, 2023

- Determine Eligibility[1]

→

- Complete & Submit Grant Application by mail or submit in person

→

Est. 1-2 Weeks

- HDOH review
- HDOH issues Grant Qualification Letter (starts 9-month clock)

→

9 Months

- Convert to IWS
  - Obtain construction plans, submit to HDOH for plan approval, receive HDOH Approval-to-Construct (HDOH review est. 3-4 weeks)
  - Install IWS, submit final inspection report, receive HDOH Approval-To-Use letter (HDOH review est. 1-2 weeks)
- If connecting to sewer, apply to County sewer agency
- Submit grant documents[2] to HDOH

→

Est. 1-2 Weeks

- Issue of grant reimbursement

[1] Eligibility Requirements

a) Applicant must be owner of real property or DHHL lessee.

b) Cesspool must be in Priority Level 1 or 2 (see Slide 2).

c) Household income for most recent closed taxable year must be less than 140% of the area median income (see Slide 3).

d) Cesspools upgraded/converted with Approval-To-Use date or connected to sewer before 7/1/2022 are *not* eligible.

[2] Grant Documents

a) Design plans prepared by HI-licensed engineer (must comply with HAR 11-62 or utility standards for sewer connection) and approved by HDOH

b) Engineer's final construction inspection report w/photos, as-builts, certifications

c) Copy of Approval-To-Use letter from HDOH

d) Receipts of payment made to engineer and contractor

Step B of Eligibility Criteria:
Determine Cesspool Priority

- Areas shaded in red are Priority 1 or 2
- https://histategis.maps.arcgis.com/apps/webappviewer/index.html?id=8708c5c6d0404d299de2139348442a3a

- Can also look up by TMK
- https://health.hawaii.gov/wastewater/files/2023/02/EligibleTMKList_Hawaii.pdf

# Step C of Eligibility Criteria: Determine Area Median Income

1. Create list of number of adults and children (all HM) that occupy home.
2. Collect 1040 Federal Tax Returns for most recent year for all HM generating income.
3. Determine each HM's income by using the Adjusted Gross Income on the 1040 Federal Tax Return.
4. Add up the adjusted gross income for all HMs to determine Total Household Income.
5. Review chart and determine if Total Household Income is equal or less than the 140% AMI.

HM: household member

**2021 – 140% Area Median Income (AMI)**

| | Family Size (# of Persons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Hawaii County** | $84,000 | $95,900 | $107,940 | $119,840 | $129,500 | $139,020 | $148,680 | $158,200 |
| **Maui County** | $101,360 | $115,780 | $130,200 | $144,620 | $156,240 | $167,860 | $179,340 | $190,960 |
| **Kauai County** | $99,960 | $106,080 | $119,340 | $132,470 | $143,130 | $153,790 | $164,320 | $174,980 |
| **City & County of Honolulu** | $118,440 | $135,380 | $152,320 | $169,120 | $182,700 | $196,280 | $209,720 | $223,300 |

**2022 – 140% Area Median Income (AMI)**

| | Family Size (# of Persons) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Hawaii County** | $93,380 | $106,680 | $119,980 | $133,280 | $144,060 | $154,700 | $165,340 | $175,980 |
| **Maui County** | $111,860 | $127,820 | $143,780 | $159,740 | $172,620 | $185,360 | $198,100 | $210,980 |
| **Kauai County** | $111,720 | $127,680 | $143,340 | $159,600 | $172,480 | $185,220 | $197,960 | $210,700 |
| **City & County of Honolulu** | $128,100 | $146,300 | $164,640 | $182,840 | $197,540 | $212,000 | $226,800 | $241,360 |