SOIL ASSESSMENT FINDINGS

Hazardous Material Assessments, Various Schools Statewide
HDOE Job No. Q61001-11

Prepared for

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ACRONYMS AND ABBREVIATIONS

BMP	best management practice
DU	decision unit
EAL	environmental action level
EPA	U.S. Environmental Protection Agency
HDOE	Hawaii Department of Education
HDOH	Hawaii Department of Health
HEER	Hazard Evaluation and Emergency Response
Integral	Integral Consulting Inc.
OCP	organochlorine pesticide
QA/QC	quality assurance/quality control
SAP	sampling and analysis plan
SBRC	Solubility/Bioavailability Research Consortium
TGM	*Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*
USDA NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
XRF	X-ray fluorescence

1 INTRODUCTION

Integral Consulting Inc. (Integral) was retained by the Hawaii Department of Education (HDOE) to perform a Hazardous Materials Assessment of soils at various schools as described herein. This Soil Assessment Findings report documents the results of sampling and analysis of soils in open spaces and along building perimeters at various schools.

1.1 PROJECT SCOPE OF WORK

The subject project entails environmental hazard screening to assess the potential or actual chemical contamination of surface soils within building-exterior grounds at various Hawaii public school campuses. Based on screening and multi-increment sampling results, and potential or recognized environmental or human health hazards, facilities are prioritized for no further action, future study, or mitigation. The need for such a program has become more pressing based on findings by the Hawaii Department of Health (HDOH) of soil arsenic contamination at schools in the eastern portion of the Island of Hawaii at concentrations exceeding HDOH environmental action levels (EALs). It has become apparent that an inventory, prioritization list, and standard operating procedures for building-exterior contaminated soil hazards across the HDOE school portfolio (starting with the eastern Hawaii District) are necessary to safely conduct school functions and execute capital projects.

Under this project scope of work, the facilities to be evaluated are within the eastern subdistrict of the Hawaii District (Hilo-Laupahoehoe-Waiakea and Kau-Keaau-Pahoa complex areas), as it is an area of known soil arsenic contamination from former sugar cane cultivation. A list of the 23 schools in the current project scope is provided on Table 1-1.

Building-exterior environmental or human health hazards are principally chemical compounds in soil, and may include: 1) arsenic, which was used as a herbicide in sugar cane fields and as an all-purpose weed killer around roadways, building foundations, and other structures; 2) lead, that is commonly in lead-based paint that may have spalled from older building exteriors and contaminated soils around building perimeters; and 3) termiticide compounds such as chlordane and dieldrin (organochlorine pesticides [OCPs]) that were applied around older building foundations and may remain as residuals in soil.

1.2 INFRASTRUCTURE INVENTORY AND FACILITY PLANS

As part of the first phase of the project, a spreadsheet-based inventory of infrastructure has been prepared for each school or support facility, based on information provided by HDOE as well as information gathered during the reconnaissance program. The reconnaissance program is described in detail in Section 2 of this report. The inventory includes information in support of

an initial assessment of potential for building-exterior soil hazards, such as building construction and approximate age, types of surface cover (pavement, dirt, grass, etc.), and campus acreage. The infrastructure inventory is presented in Appendix A. Appendix B provides a set of facility plans that were based on drawings provided by HDOE and subsequently updated after the reconnaissance program.

1.3 SAMPLING AND ANALYSIS PLAN

A Sampling and Analysis Plan (SAP) was developed by Integral (2016) as part of the planning phase (Task 1) of the project, to effectively guide the field sampling and laboratory analysis program conducted under Task 2. The SAP included procedures for collecting, preparing, and analyzing soil samples; and was prepared to be consistent with the *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan* (TGM), issued and maintained by the HDOH Hazard Evaluation and Emergency Response (HEER) Office (HDOH 2009). Field program deviations from the SAP are discussed in Section 2.2.1.5 of this report.

2 SOIL ASSESSMENT PROGRAM

The soil assessment program consisted of two phases of work, an initial reconnaissance phase including X-ray fluorescence (XRF) soil screening for metals (primarily arsenic and lead) and a second phase consisting of multi-increment soil sampling and laboratory analysis for metals and OCPs.

2.1 FIELD RECONNAISSANCE PROGRAM

A field reconnaissance program was implemented as the first component of the project to determine general conditions at each school, and to perform surface soil screening for arsenic and lead using a handheld XRF instrument. The reconnaissance program was implemented in July 2016. Based on study of school grounds, and measurements collected by XRF, priority locations for multi-increment sampling and laboratory analysis were determined (Section 2.2). One of the primary objectives of the XRF screening was to identify surface soils with concentrations of metals potentially exceeding Hawaii action levels.

2.1.1 XRF Soil Screening

At most locations, the surface soils (0 to 6 inch depth) were exposed with a shovel to allow XRF (Olympus Innov-X Delta 4000) measurements of arsenic and lead. Three replicate XRF measurements from soils were collected at each screening location and averaged for reporting. For open space locations, the three measurements were collected from within an approximate 3-ft radius, and along building perimeters the three measurements were approximately 5 to 10 ft apart. Within garden plots, the distance between the three measurements generally ranged from 1 to 5 ft apart. A portable soil moisture meter (Dynamax SM150) was used at the screening location to record soil moisture. Photographs showing the XRF and soil moisture data collection are provided in the photographic log (Appendix C1).

A portable soil moisture meter was used during reconnaissance sampling to determine the moisture content of soils evaluated by XRF. Soil moisture affects XRF response, as soil moisture can impede fluorescence from the measured substrate. Based on prior study (Cutler 2009), XRF instrument counts for arsenic in Hawaii soils was impeded by about 1 percent for each 1 percent of soil moisture. In other words, a soil with 100 mg/kg arsenic and 20 percent moisture would be appear to have 80 mg/kg arsenic as measured by XRF on the moist soil of the field. By collecting soil moisture values at each location, field moist XRF readings can be converted to approximate "dry weight" concentrations. A crossplot of field moisture meter values to lab-measured moisture content shows a robust (correlation coefficient $R^2 = 0.71$) 1:1 linear correlation (Figure 2-1), confirming that the field moisture meter provided accurate moisture content values for XRF response corrections.

XRF instruments may have issues with interference between lead and arsenic spectral peaks. Lead has a secondary fluorescence peak (L-beta) at the same energy (10.5 keV) as the primary arsenic peak (K-alpha). Samples with concentrations of lead significantly higher than arsenic can result in an overestimation of arsenic if determined using the 10.5 keV peak without correcting for the lead contribution to that peak. Newer XRF instruments have high resolution detectors and internal spectral processing software to correct for the lead/arsenic interference. To be certain that the XRF instrument properly handles this interference, one should perform quality assurance testing using a standard reference material with higher lead than arsenic concentrations; for this project Integral used standard reference materials NIST 2710a (arsenic 1540 mg/kg; lead 5520 mg/kg) and NIST 2711a (arsenic 107; lead 1400 mg/kg) to confirm the lead/arsenic interference was properly handled by the instrument.

Screening values for total arsenic and lead were developed as follows. The HDOH utilizes bioaccessible arsenic for most evaluations of potential human health direct contact hazard to arsenic in soils. Bioaccessible arsenic is a fraction of total arsenic that is liberated in a laboratory batch extraction test designed to simulate digestion in the human gastrointestinal tract. Bioaccessible arsenic values exceeding a Tier 2 EAL of 23 mg/kg are considered HDOH Category C soils (moderately impacted), requiring management and potential remediation (HDOH 2012). Work by Cutler (2011) and Cutler et al. (2013) showed that former sugar plantation soils from the Island of Hawaii ("Big Island") had a median value of about 10 percent bioaccessible arsenic (10 percent of total arsenic). Some soils with low iron content or high arsenic contamination showed higher percentages of bioaccessible arsenic. For screening purposes, a total arsenic value below 100 mg/kg was consider to be of low potential to be Category C soil.[1]

For lead, an XRF screening level of 200 mg/kg was utilized, which is the HDOH Tier 1 EAL for direct contact hazard for unrestricted land use. Soils with concentrations of a compound less than the screening level are considered to present minimal potential for environmental or human health hazard.

Integral performed XRF screening at a total of 493 locations at 22 schools (all schools in the program except for Keaau Middle School, which had been previously studied), consisting of 352 open space locations, 102 building perimeter locations, and 39 garden plot locations.

2.1.2 Laboratory Confirmation of XRF Results

A suite of soil samples was collected for confirmation of the moisture meter accuracy and field XRF readings. A total of nine samples were collected and sent to Integral's laboratory in

[1] A soil with 100 mg/kg total arsenic would need to have a 23 percent bioaccessible arsenic to be considered Category C arsenic soil. Soils at this concentration of total arsenic were not observed to exhibit more than 20 percent bioaccessible arsenic fraction in Cutler (2011) studies.

Louisville, Colorado, for determination of moisture content[2], prior to being shipped to the Test America analytical laboratory for total arsenic and lead analysis. As previously discussed, field moisture meter values were comparable to laboratory moisture content values determined by mass loss by air drying.

The nine samples discussed above, along with three Big Island soil samples collected by Cutler (2011) were used to evaluate the accuracy of field XRF measurements for arsenic and lead. Samples were sent from Integral's laboratory in Louisville, Colorado, to the Test America laboratory in Tacoma, Washington, for analysis of arsenic and lead by U.S. Environmental Protection Agency's (EPA) Methods 3050B and 6020 (acid digestion and inductively coupled plasma analysis). Laboratory reports are included in Appendix D1. A total of 11 data pairs were available for arsenic and lead comparison, taking into account a single non-detect value (by XRF) for each element. Figure 2-2 shows a crossplot of total element concentrations as determined by XRF (moisture corrected field readings) to laboratory-reported values. XRF slightly over-reported arsenic (linear regression slope of 0.81) as compared to the lab results.[3] XRF very slightly under-reported lead (linear regression slope of 1.02). In general, field XRF was determined to be a useful tool for screening potential direct contact hazards from arsenic and lead in school soils.

2.2 MULTI-INCREMENT SOIL SAMPLING AND LABORATORY ANALYSIS

Following field reconnaissance, the multi-increment soil sampling and laboratory analysis program was implemented, in accordance with the SAP (Integral 2016). Prior to implementation, a draft SAP was provided to HDOE and HDOH HEER for review and comment. A final SAP was prepared to address comments provided by HDOE and HDOH HEER.

2.2.1 Field Sampling

2.2.1.1 Decision Units

Soil sampling were collected using multi-increment sampling of decision units (DUs), as recommended in the TGM. A DU is a logical sampling area, such as a portion of a school yard or a building perimeter, and a multi-increment sample is an aggregate sample composed of a

[2] Samples were air dried in the Integral laboratory, until no further change in mass over time was observed. Percent moisture on a mass basis was determined for comparison to moisture collecting from the field-portable moisture meter.

[3] This is a common finding in Hawaii soils, as the acid digestion of soil in the lab (EPA Method 3050B) is not always a complete digestion of all solid materials (iron oxyhydroxides) that sorb arsenic.

large number of spatially distributed sample increments from within a DU. The multi-increment sample is designed to be representative of the average soil from within the DU area.

The locations of soils evaluated by XRF screening and layout of multi-increment sampling DUs are presented in Figures 3-1 through 3-23. Based on the results of reconnaissance and XRF screening (Section 3), Integral identified and sampled a total of 97 DUs, consisting of open space, building perimeter, and garden plot soil DUs:

- Thirty-six open space sampling DUs—Based on reconnaissance findings, the chemicals of concern for open space soils were both arsenic and lead.
- Fifty-seven building perimeter sampling DUs—Based on reconnaissance findings, the chemicals of concern for this type of samples are arsenic, lead, and OCPs. Chromium and copper were added as contaminants of concern at five DUs, based on evidence of their presence in XRF readings.
- Four garden DUs—Garden plot soils exceeded screening levels at Kalanianaole Elementary & Intermediate, Hilo Union Elementary, Kapiolani Elementary, and Keaau Elementary, and were evaluated by multi-increment sampling and analysis.

Building perimeter DUs were approximately 3–5 ft in width, laid out along the building foundation or building wall in order to determine the presence or absence of pesticides (arsenic or OCPs) applied along the foundation or lead from lead-based paint spalling from the building. Open space DUs were laid out using a measuring tape to define the outer boundaries. Subsequently a series of transects were established within each DU for the collection of sample increments at set distances along each transect. Photographs were taken of each DU and are provided in the photographic logs (Appendix C2).

Actual DUs sampled varied slightly from those planned in the SAP, based on field conditions, access issues, or field decisions on more appropriate sampling locations to achieve the sample objectives. No soil sampling was performed at Keaau Middle School, which has been extensively studied over the past 10 years.

2.2.1.2 Field Sampling Procedures

After the DU and transects were laid out, surface soils sample increments were collected with a spade and a trowel from a depth of approximately 0 to 6 inches. The spade was used to obtain a soil wedge that was put back in place after sample collection, minimally disturbing the ground cover. A target of 45 sample increments was the goal for each multi-increment sample.

2.2.1.3 Field Quality Assurance and Quality Control

For quality control, a set of triplicate multi-increment soil samples were collected at 11 DUs and analyzed to assess the variability associated with field sample collection procedures, laboratory

sample processing, and analytical methodologies. To sample a DU in triplicate, three increments were collected with 1–3 ft of each other, with the actual distance between the three increments depending on the DU size. Each of the three increments was used to prepare three unique multi-increment samples for that DU.

Two equipment rinse blanks were also collected and analyzed for arsenic, lead, and OCPs to help identify possible contamination from the sampling environmental or from the sampling equipment. These samples were collected by pouring laboratory-provided deionized water over the sampling equipment after a decontamination event.

2.2.1.4 Sample Packaging, Transport, and Custody

Samples were placed in re-sealable plastic bags, double-bagged, and labeled with a unique sample identifier. Samples were then packed in a cooler lined with a heavy-duty garbage bag, and covered with ice. Signed custody seals were affixed onto each cooler. The coolers were shipped to the Test America laboratory via FedEx by priority overnight delivery with accompanying chain of custody form.

2.2.1.5 Field Program Deviations

As discussed in Section 2.2.1.1, the DU layout was slightly revised based on field conditions. Two DUs that were planned for sampling in the SAP were not collected. These two DUs were both located at DeSilva Elementary and were to be collected along the perimeters of two school buildings; however, these perimeters were found to be paved with no exposed soil. All other building perimeter samples planned in the SAP were collected at this school. In lieu of these two DeSilva building perimeter samples dropped from the program, an additional set of triplicate samples was collected during the multi-increment soil sampling program, for a total of 11 sets of triplicate samples, instead of the planned 10 sets. No other deviations from the SAP were conducted.

2.2.2 Laboratory Analytical Procedures

Upon receipt by the analytical laboratory, samples were prepared for analysis in accordance with multi-increment sample procedures outlined in the SAP and consistent with the HDOH TGM (HDOH 2009). This included air drying, sieving to less than 2 mm, and multi-increment subsampling to collect analytical aliquots. The mass of analytical aliquots for metals and OCPs were 10 g and 30 g mass, respectively, consistent with the TGM.

Multi-increment samples from open spaces and garden plots were analyzed for total arsenic and lead using EPA Method 3050B (two acid digestion) with analysis by inductively coupled plasma and mass spectrometry using EPA Method 6020. Building perimeter multi-increment samples were analyzed for arsenic and lead by EPA Methods 3050B/6020, and for OCPs by EPA

Method 8081B. If laboratory-reported total arsenic concentrations exceeded 100 mg/kg for a sample, it was considered for analysis of bioaccessible arsenic[4] using a HDOH-approved *in vitro* method (Solubility/Bioavailability Research Consortium [SBRC] gastric phase method; Kelley et al. 2002; Drexler and Brattin 2007; Brattin et al. 2013). At schools with multiple samples exceeding 100 mg/kg total arsenic, only a subset of samples were further analyzed for bioaccessible arsenic.

Total copper and chromium were analyzed by EPA Methods 3050B/6020 analyzed in five building perimeter multi-increment samples where elevated concentrations were observed during XRF screening. Appendix D2 provides a tracking table with all collected samples, laboratory report number, and requested analyses. Laboratory reports for the multi-increment sampling program are included on a CD-ROM (Appendix D3).

2.3 REGULATORY ACTION LEVELS

For most compounds, the screening action levels are HDOH direct-exposure action levels for an unrestricted land use scenario (HDOH 2016, Table I-1). The two exceptions are arsenic and chromium. Arsenic action levels will be described in more detail below. The total chromium action level is set at 1100 mg/kg, based on naturally occurring background levels in Hawaii soils (HDOH 2016, Table K). The hexavalent form of chromium, which is typically formed by man-made processes and is more toxic than other forms, has a lower direct-exposure action level of 30 mg/kg.

Sections 2.3.1 through 2.3.3 and related Tables 2-1 through 2-3 describe applicable action levels and soil categories for the chemicals of potential concern in this study, which are arsenic, lead, and chlordane (an OCP).[5] Integral, in consultation with HDOH HEER, has developed comprehensive soil management recommendations based on arsenic, lead, and chlordane soil categories that are specific to school facilities in Hawaii, as further described in the document entitled *Environmental Hazard Management Plan, Building Exterior Soils, Framework for Schools Statewide* (Framework EHMP, Integral 2017).

Tables 2-1 through 2-3 provide an overview of soil categories in both high activity and low activity areas at a school facility. "High Activity Areas" include play areas, picnic areas, athletic fields, garden plots, unpaved parking areas, drop-off and loading areas and any other area where students congregate on a regular basis. "Low Activity Areas" include open spaces not commonly used by students, building perimeters with landscaping that impedes regular access,

[4] HDOH recommends evaluating soil arsenic risks and the need for mitigation action using bioaccessible arsenic as opposed to total arsenic.

[5] Arsenic, lead, and chlordane were the compounds identified in building-exterior soils in this study at concentrations above screening action levels. A single soil sample exceeded, by a small margin, the screening action level for 4,4'-DDD (a degradation product of 4,4'-DDT). Based on this single occurrence, 4,4'-DDD is not considered a contaminant of potential concern at this time.

building maintenance and storage areas and any other areas where students are not expected to visit or congregate on a regular basis.

2.3.1 Action Levels for Arsenic-Contaminated Soils

HDOH recommends the management of arsenic by evaluation of total and bioaccessible arsenic. Bioaccessible arsenic is the fraction of total arsenic that is extracted from soil using an *in vitro* laboratory test designed to simulate conditions within the human gastrointestinal tract (Drexler and Brattin 2007; Brattin et al. 2013). Only the bioaccessible fraction of arsenic is considered to present a human health risk, not the total amount of arsenic. HDOH (2012) has developed guidance for managing arsenic by formulating four soil categories based on total arsenic (to define background) and bioaccessible arsenic levels to define relative human health risk: Category A (natural background levels, ≤24 mg/kg total arsenic), Category B (minimally impacted, >24 mg/total arsenic but ≤23 mg/kg bioaccessible arsenic), Category C (moderately impacted, >23 and ≤95 mg/kg bioaccessible arsenic), and Category D (heavily impacted, >95 mg/kg bioaccessible arsenic). The lower concentration thresholds for Category C and D soils are equivalent to the direct-exposure action levels for unrestricted and commercial/industrial land use, respectively (HDOH 2016, Tables I-1 and I-2).

Not all soil samples with total arsenic >24 mg/kg were tested for bioaccessible arsenic. In particular, soils with total arsenic ≤100 mg/kg were anticipated to exhibit bioaccessible arsenic ≤23 mg/kg (see Section 2.1.1, footnote 1). Therefore, soils with total arsenic >24 mg/kg but ≤100 mg/kg were assumed to be Category B, without further testing for bioaccessible arsenic.

The HDOH (2012) arsenic soil guidance, and a parallel guidance document for dioxin-contaminated soil (HDOH 2010), provide general recommendations for management of soils based on soil category. In Table 2-1, Categories A through D[6] are defined based on total and bioaccessible arsenic concentrations as per the HDOH (2012) guidance described above.

2.3.2 Action Levels for Lead-Contaminated Soils

Soil categories for lead, and general mitigation actions for schools, are provided in Table 2-2. This matrix is a parallel construct to the one prepared for arsenic, with Categories A through D and recommended actions for high and low activity areas. Lead soil categories are defined by various HDOH action levels. Category A (background) soils exhibit lead levels less than or equal to 73 mg/kg. Low risk Category B soils are above background levels, but below the HDOH direct-exposure action level of 200 mg/kg for an unrestricted land use scenario. This action level is applicable to residential settings, and also appropriate for a school setting with young children. Moderate risk Category C soils are above 200 mg/kg lead but less than or equal

[6] HDOE and HDOH have agreed on a naming convention for soil Categories B through D as "low risk," "moderate risk," and "high risk," respectively. This differs slightly from the terminology in HDOH (2012) for Category B through D soils, which used the terms "minimally impacted," "moderately impacted," and "heavily impacted."

to 800 mg/kg lead. The 800 mg/kg concentration is the HDOH direct-exposure action level for a commercial/industrial land use scenario, and is applicable to adult school workers and contractors. High risk Category D soils have lead concentrations above the 800 mg/kg action levels for school workers and contractors.

2.3.3 Action Levels for Chlordane-Contaminated Soils

Soil categories for chlordane, and general mitigation actions for schools, are provided in Table 2-3. Again, this matrix is a parallel construct to the ones prepared for arsenic and lead. Chlordane soil categories are defined by various HDOH action levels, slightly differently than arsenic and lead. As chlordane is not a naturally occurring compound, there is no natural background level. Category A soils exhibit chlordane levels less than or equal to 7.0 mg/kg, and are considered to have negligible risk. The action level of 7.0 mg/kg is based on a conservative (highly protective) noncancer hazard quotient of 0.2 (one fifth the concentration where health effects might potentially occur due to direct contact). Low risk Category B soils have chlordane above the 7.0 mg/kg action level but less than or equal to the HDOH direct-exposure action level of 17 mg/kg for an unrestricted land use scenario. This action level is applicable to residential settings, and also appropriate for a school setting with young children. Moderate risk Category C soils are above 17 mg/kg but less than or equal to 77 mg/kg chlordane. The 77 mg/kg concentration is the HDOH direct-exposure action level for a commercial/industrial land use scenario, and is applicable to adult school workers and contractors. High risk Category D soils have chlordane concentrations above the 77 mg/kg action levels for school workers and contractors.

2.3.4 Summary of Action Levels, Laboratory Methods, and Detection Limits for Arsenic, Lead, and Chlordane

A summary of action levels, laboratory methods, and laboratory detection levels for arsenic, lead, and chlordane is provided in Table 2-4. The laboratory detection limits are project specific for samples analyzed at the TestAmerica Laboratories, Inc. facility in Tacoma, Washington.

2.4 SHORT-TERM AND LONG-TERM ACTIONS

Soils with concentrations of arsenic, lead and chlordane (or potentially other chemicals if identified) above various actions levels may require short-term and long-term actions to address potential risks. Appropriate actions based on soil category are described in the Framework EHMP (Integral 2017), and are not chemical specific. Short-term actions include "interim actions" for bare Category C and D soil, and should be implemented as soon as possible to prevent potential direct exposure risks. Long-term actions include permanent mitigation actions (remedies) to address soils over a longer time frame (years). Minimum requirements for interim actions and permanent mitigation actions generally consist of growing

and maintaining thick grass cover for lower risk categories and lower activity areas, and soil removal or some form of soil capping for higher risk categories and higher activity areas. Suitable capping options are presented in the Framework EHMP (Integral 2017) along with engineering specifications. In this report, recommendations for interim actions are made for various schools based on the soil assessment findings. More comprehensive recommendations for short- and long-term actions will be provided in school-specific EHMPs.

3 SOIL ASSESSMENT FINDINGS AND RECOMMENDATIONS

This section presents the soil assessment findings, including both the XRF screening and multi-increment soil sampling results. A field reconnaissance program was implemented as the first component of the project to determine general conditions at each school, and to perform soil screening for arsenic and lead using a handheld XRF instrument (Olympus Innov-X Delta 4000). An average of 20 screening locations per school were tested, based on the size and complexity of the school campus. This amount of screening was deemed appropriate to assess the potential for the presence of metals at concentrations above EALs in site soils in select open spaces, building perimeters, and garden plots. Based on study of school grounds, and measurements collected by XRF, priority locations for subsequent multi-increment soil sampling and laboratory analysis were determined.

The reconnaissance findings for each school are provided below. Locations and results of XRF soil screening are provided on Figures 3-1 through 3-23. XRF results are also provided on corresponding Tables 3-1a through 3-23a. Locations and results of multi-increment soil sampling are also provided on Figures 3-1 through 3-23, along with the XRF screening locations. Multi-increment soil sampling results are provided in tabular form on corresponding Tables 3-1b through 3-23b.

Note that the XRF screening and multi-increment sampling and analysis were conducted at a subset of potential locations within a school campus. This assessment phase did not attempt to fully characterize all soils on a given campus. On average, four to five multi-increment samples were collected per school; DUs for multi-increment sampling were selected by professional judgment based on XRF screening results and the age and materials of construction of buildings. Due to budget and time constraints, only a subset of potential open spaces and building perimeters were assessed[7]; the selection of DUs was designed to provide an indication of the potential for soil exceedances of EALs at each campus. Schools with compounds above EALs as identified during this assessment phase will require further soil characterization as described in the Framework EHMP (Integral 2017).

This section also provides recommendations for further soil assessment and interim actions to address potential exposure to high risk bare soils. The school-specific recommendations for further chemical analysis of supplemental soil samples represent a minimum chemical compound list (analyte list). However HDOE may consider expanding the analysis to include all COPCs (arsenic, lead and OCPs) for supplemental samples, considering that the additional cost would be minimal and full COPC analysis would provide greater assurance that site conditions are fully characterized.

[7] All garden plots were assessed by XRF screening.

3.1 HILO HIGH

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.1.1 General Description of School Facilities and Soil Materials

The Hilo High campus consists of tightly clustered school buildings with grass lawns between many buildings. A football field and track are located at the eastern end of the property.

The native soils that have been mapped by the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS) at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. In most cases soils have a silty clay loam texture in both the surface and in the sub-soil. The color is black (Munsell color 10YR2/1) at the surface (0 to 6 inches) and very dark brown (Munsell color 7.5YR2.5/3) below 6 inches. The area has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at the perimeter of some buildings. Depths of soils in the Hilo series are estimated from 4 ft to over 6 ft.

3.1.2 Field Reconnaissance Findings

Field reconnaissance at Hilo High was performed on July 14, 2016. Soil samples were analyzed by XRF at 14 locations across the school property, as shown on Figure 3-1. Thirteen of the sample locations were in open spaces, whereas two sample locations were along building perimeters. As shown on Table 3-1a, no arsenic was measured at concentrations above the screening value of 100 mg/kg. Lead was measured in three samples at concentrations just at or above the screening value of 200 mg/kg.

3.1.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Hilo High on December 16 and 19, 2016. A total of three multi-increment samples were collected as shown on Figure 3-1, consisting of two open space samples, and one building perimeter sample. Laboratory results are provided on Table 3-1b, along with comparison to action levels. The two open space samples were analyzed for arsenic and lead. Sample DU-S1-01 results correspond to Category B soils for both arsenic and lead (low risk). Sample DU-S1-03 results correspond to Category A soils for arsenic (background), and Category B soils for lead (low risk). The building perimeter sample DU-S1-02 was analyzed for total arsenic and lead, and for OCPs. The sample results

correspond to Category B soils for arsenic (low risk), and Category D soils for lead (high risk). Chlordane was not detected in the building perimeter sample.

3.1.4 Summary and Recommendations

Soils in the building perimeter sample are considered Category D for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Arsenic is also recommended for analysis given that it was detected above the total arsenic action level of 100 mg/kg and it is analyzed by the same analytical method. Chlordane was not detected in the only building perimeter sample, but its presence on campus cannot be ruled out considering that the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for building perimeter samples.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.2 HILO INTERMEDIATE

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.2.1 General Description of School Facilities and Soil Materials

The Hilo Intermediate campus consists of a cluster of school buildings with grass lawns. Open space fields are located at the northeastern end of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. In most cases, soils have a silty clay loam texture in both the surface and in the sub-soil. The color is black (Munsell color 10YR2/1) at the surface (0 to 6 inches) and very dark brown (Munsell color7.5YR2.5/3) below 6 inches. The area has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at the perimeter of some buildings. Depths of soils in the Hilo series are estimated from 4 ft to over 6 ft.

3.2.2 Field Reconnaissance Findings

Field reconnaissance at Hilo Intermediate was performed on July 14, 2016. Soil samples were analyzed at 19 locations across the school property, as shown on Figure 3-2. Fifteen of the sample locations were in open spaces, three sample locations were along building perimeters, and one was from a garden area. As shown on Table 3-2a, arsenic and lead were above screening values in two samples; the remaining 17 samples were all below screening levels. Building perimeter samples 11 and 13, along the southeast perimeter of Building A, showed arsenic slightly above the screening level of 100 mg/kg, and lead at 2600 and 3200 mg/kg, significantly above the 200 mg/kg screening value. Samples 14, 15, 16, and 18 were all slightly elevated for lead. Soils in the garden area were below the screening levels for arsenic and lead.

3.2.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Hilo Intermediate on November 25 and on December 3, 2016. A total of four multi-increment samples were collected as shown on Figure 3-2, consisting of three open space samples, and one building perimeter sample. Laboratory results are provided on Table 3-2b, along with comparison to action levels. The three open space samples were analyzed for arsenic and lead. Samples DU-S2-03 and DU-S2-04 results correspond to Category A for arsenic (background) and to Category B for lead (low risk). Sample DU-S2-02 results correspond to Category B soils for arsenic (low risk) and Category C for lead (moderate risk). The building perimeter sample DU-S2-01 was analyzed for arsenic, lead, and for OCPs. Arsenic was measured at 140 mg/kg, and bioaccessible arsenic measured at 3.7 mg/kg, corresponding to Category B soils and considered low risk. Lead was detected at 2100 mg/kg, corresponding to Category D soils and considered high risk. Chlordane was measured at 15 mg/kg, corresponding to Category B soils and considered low risk.

3.2.4 Summary and Recommendations

Soils in the building perimeter sample are considered Category D for lead and Category B for arsenic. Based on these findings, Integral recommends further investigation of building perimeters for the presence of lead in surface soils within 5 ft of building perimeters. Arsenic is also recommended for analysis given that it was detected above the total arsenic action level of 100 mg/kg and it is analyzed be the same analytical method. Considering that chlordane was measured near the Category C action level, OCP analysis of building perimeter samples is also recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.3 KALANIANAOLE ELEMENTARY & INTERMEDIATE

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.3.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns, on terraced sloping terrain. A garden is located at the north end of the property, play areas are located east of the school buildings, and an open play field is located west of the main buildings. Across the road to the west are auxiliary buildings, open space with trees, and a fenced play equipment area.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. In most cases, soils have a silty clay loam texture in both the surface and in the sub-soil. The color is black (Munsell color 10YR2/1) at the surface (0 to 6 inches) and very dark brown (7.5YR2.5/3). The property has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at the perimeter of some buildings. Depths in the Hilo series are estimated from 4 ft to over 6 ft.

3.3.2 Field Reconnaissance Findings

Field reconnaissance at Kalanianaole Elementary & Intermediate was performed on July 13, 2016. Soil samples were analyzed at 22 locations across the school property, as shown on Figure 3-3. Seventeen of the sample locations were in open spaces, two sample locations were along building perimeters, and three were from garden areas. As shown on Table 3-3a, arsenic or lead were above screening values in six sample locations; all other samples were below screening levels. Soils at locations 4 and 8 six in lower elevation areas, and appeared to be local Hilo Series soils (not imported fill). The elevated arsenic in these locations may be indicative of former sugar cane plantation soils. Samples 4, 5, 6, 9, and 12 showed lead above the screening value of 200 mg/kg. Soils in the garden areas were below the screening levels for arsenic and lead.

3.3.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Kalanianaole Elementary & Intermediate on January 2 and 5, 2017. A total of five multi-increment samples were collected as shown on Figure 3-3, consisting of two open space samples, two building perimeter samples

and one garden plot samples. Laboratory results are provided on Table 3-3b, along with comparison to action levels. The two open space samples were analyzed for total arsenic and lead. Sample DU-S3-03 results correspond to Category A soils for arsenic (background) and Category C soils for lead (moderate risk). Sample DU-S3-04 results correspond to Category B soil for both arsenic and lead (low risk). The two building perimeter samples were analyzed for arsenic, lead, and OCPs. Sample DU-S3-02 results correspond to Category B soils for arsenic (low risk), to Category C soils for lead (moderate risk), and to Category A soils for chlordane (measurable presence posing negligible risk) although the measured value is near the Category B action level. Sample DU-S3-05 results correspond to Category A soils for arsenic (background), Category D soils for lead (high risk), and Category B soils for chlordane (low risk). The garden sample DU-S3-01 was analyzed for arsenic and lead. The results of this sample correspond to Category B soils for arsenic (low risk), and Category C soils for lead (moderate risk).

3.3.4 Summary and Recommendations

Soils in the building perimeter samples are considered Category C and Category D for lead (samples DU-S3-02 and DU-S3-05 respectively). Based on these findings, Integral recommends further investigation of building perimeters for the presence of lead in surface soils within 5 ft of building perimeters. Considering that chlordane was measured in the Category B action level but very close to Category C action level, OCP analysis of building perimeter samples is also recommended. Given the observed low arsenic concentrations, arsenic analysis is not recommended. The observed lead concentrations in the garden and open space DUs DU-S3-01 and DU-S3-03 are likely due to historical vehicle exhaust given the proximity of these DUs to the adjacent highway.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils and for the Category C soils identified in the garden area (Table 3-25).

3.4 DESILVA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.4.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A baseball field and play area are located at the west end of the property, and a garden is located east of the main school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils at the school have been mixed/reworked by heavy equipment during construction with off-site fill materials. The native Panaewa soil is typically shallow (less than 20 inches) with a 3 to 5 inch black surface (Munsell color 10YR2/1) over a 5 to 10 inch thick dark brown (Munsell color 7.5YR3/3) subsurface horizon. The Panaewa soil contains over 15 percent basalt fragments below the surface. It appears that this property has been extensively reworked and leveled with fill material consisting of cinder or silty clay loam soil. The exact origin of the fill soil is unknown but the silty clay loam fill material has a color similar to the Hilo series subsurface horizons. Hilo series soils have been mapped in close proximity to the school.

3.4.2 Field Reconnaissance Findings

Field reconnaissance at DeSilva Elementary was performed on July 15, 2016. Soil samples were analyzed at 26 locations across the school property, as shown on Figure 3-4. Nineteen of the sample locations were in open spaces, five sample locations were along building perimeters, and two were from garden areas. As shown on Table 3-4a, arsenic was above screening values in many of the open space and building perimeter sample locations. Lead was detected above the screening value of 200 mg/kg in samples 5 and 14. The high arsenic values in building perimeter soils suggest that arsenical herbicides may have been used for weed control along the buildings. Soils in the garden areas were below screening levels for lead and arsenic.

Soils on the property, in the vicinity of the school buildings, appear to be imported silty clay loams (likely Hilo Series); the arsenic in open space soils may be residual from former sugar cane herbicides applied in the area where the fill soils originated.

3.4.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at DeSilva Elementary on July 22 and November 11, 2016. A total of 10 multi-increment samples were collected as shown on Figure 3-4, consisting of four open space samples, and six building perimeter samples. Laboratory results are provided on Table 3-4b, along with comparison to action levels. The four open space samples were analyzed for total arsenic and lead. Three of these open space samples were also analyzed for bioaccessible arsenic. All open space sample results correspond to Category B soils for arsenic (low risk). Sample DU-S4-01 results correspond to Category B soils for arsenic (low risk) and Category C for lead (moderate risk). The open space sample DU-S4-012 results correspond to Category A soils for lead (background); samples DU-S4-06 and DU-S4-09 results correspond to Category B soils for lead (low risk); and sample DU-S4-03 results correspond to

Category A soils (background) for lead. The six building perimeter samples were analyzed for arsenic, lead, and OCPs. Three of these samples were also analyzed for bioaccessible arsenic. All building perimeter sample results correspond to Category A for chlordane (measureable presence that poses negligible risk). Sample DU-S4-02 results correspond to Category B soils for arsenic (low risk) and Category A soils for lead (background). Sample DU-S4-04 results correspond to Category D soils for arsenic (high risk) and Category C for lead (moderate risk). Sample DU-S4-05 results correspond to likely Category C soils for arsenic (moderate risk) and Category A soils for lead (background). Sample DU-S4-07 results correspond to likely Category C soils for arsenic (moderate risk) and Category B for lead (low risk). Sample DU-S4-10 results correspond to Category C soils for arsenic (moderate risk) and to Category B soils for lead (low risk).

3.4.4 Summary and Recommendations

The multi-increment sampling program implemented at this school was comprehensive, therefore no further investigation is recommended at this time. Mitigation and long-term soil management is recommended for Category C and D soils that were identified along building perimeters. An interim action was recommended for the identified Category D soils (Table 3-25).

3.5 HAAHEO ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.5.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. Tennis and basketball courts are located to the south, with open areas to the east. There is also a large area of overgrown vegetation to the west of the school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils have a silty clay loam texture in both the surface and in the sub-soil. The color is very dark brown (Munsell color 10YR2/2) from 0 to 6 inches. The property has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at some locations. Depths in the Hilo series are estimated from 4 ft to over 6 ft.

3.5.2 Field Reconnaissance Findings

Field reconnaissance at Haaheo Elementary was performed on July 13, 2016. Soil samples were analyzed at 15 locations across the school property, as shown on Figure 3-5. Eleven of the sample locations were in open spaces, two sample locations were along building perimeters, and two garden samples were collected. As shown on Table 3-5a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in one sample at a concentration above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.5.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Haaheo Elementary on December 20, 2016. A total of two multi-increment samples were collected as shown on Figure 3-5, consisting of one open space sample and one building perimeter sample. Laboratory results are provided on Table 3-5b, along with comparison to action levels. The open space sample DU-S5-01 was analyzed for arsenic and lead, and its results correspond to Category B soils for arsenic (low risk) and Category A soils for lead (background). The building perimeter sample DU-S5-02 was analyzed for arsenic, lead, and OCPs. The results of this sample correspond to Category A for arsenic (background levels), and Category D soils for lead (high risk). Chlordane was not detected.

3.5.4 Summary and Recommendations

Soils in the building perimeter sample are considered Category D for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Chlordane was not detected in the only building sample, but its presence on campus cannot be ruled out considering that most of the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for pre-1988 building perimeter samples. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.6 HILO UNION ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.6.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A basketball court is located between buildings on the west side of the property and a play area is located at the northwest end of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. In most cases, soils have a silty clay loam texture in both the surface and in the sub-soil. The color is black (Munsell color 10YR2/1) at the surface (0 to 6 inches) and dark brown (Munsell color 7.5YR3 /2). The property has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at the perimeter of some buildings. Depths in the Hilo series are estimated from 4 ft to over 6 ft.

3.6.2 Field Reconnaissance Findings

Field reconnaissance at Hilo Union Elementary was performed on July 14, 2016. Soil samples were analyzed at 16 locations across the school property, as shown on Figure 3-6. Nine of the sample locations were in open spaces, four sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-6a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in seven samples at concentrations just at or above the screening value of 200 mg/kg, with two of those exceeding five times the screening values. Soils in the garden areas were below screening level for lead but above the screening level for arsenic.

3.6.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Hilo Union Elementary on November 24, 25, and 27, and on December 1, 2016. A total of seven multi-increment samples were collected as shown on Figure 3-6, consisting of three open space samples, four building perimeter samples, and one garden plot sample. Laboratory results are provided on Table 3-6b, along with comparison to action levels. The two open space samples were analyzed for arsenic and lead. Both samples (DU-S6-04 and DU-S6-07) are considered Category A soils for arsenic (background), and Category B soils for lead (low risk), although the measured lead concentrations were very close to the Category C action level. The garden sample was also analyzed for arsenic and lead, and its results correspond to Category A soils for arsenic (background) but Category C for lead (moderate risk). The four building perimeter samples were analyzed for arsenic, lead, and OCPs. All building perimeter sample results are considered

Category A soils for arsenic (background). Sample DU-S6-01 results correspond to Category C soils for lead (moderate risk) and Category A for chlordane (measurable presence that poses negligible risk). Samples DU-S6-03, DU-S6-05, and DU-S6-06 results correspond to Category D soils for lead (high risk). Sample DU-S6-03 results correspond to Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S6-05 results correspond to Category C soils for chlordane (moderate risk). Sample DU-S6-06 results correspond to Category D soils for chlordane (high risk). An additional OCP, 4,4'-DDD, was measured in this sample at 3.4 mg/kg. This concentration is above the HDOH Tier 1 EAL for residential land use, but below the industrial/commercial EAL. 4,4'-DDD is a metabolite (break-down product) of DDT.

3.6.4 Summary and Recommendations

Soils in the garden sample are considered Category C soils for lead. Soils in the building perimeter samples are considered either Category C or Category D for lead. Two building perimeter samples are considered Category D soils for both lead and chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of lead and chlordane concentrations in surface soils within 5 ft of building perimeters. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils and for the Category C soils in the garden area (Table 3-25).

3.7 KAPIOLANI ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.7.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A basketball court and a large open space are located to the west of the main campus buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils at the school are shallow, less than 20 inches deep, and have been mixed during grading for construction by heavy equipment. This is typical of the Panaewa soil series. In areas with good soil depth, i.e.

baseball field, the surface of the soil is very black (Munsell color 10YR2/1) silty clay loam with over 10 percent organic matter over a dark brown (Munsell color 7.5 YR 3/3) silty clay loam horizon. In areas near the main campus and buildings, the soil is very shallow, less than 10 inches deep, and has a silty clay loam texture, greater than 10 percent organic matter, and are black (Munsell color 10YR 2/1). These soils are formed over a substrate of lithic pahoehoe lava which is exposed at the surface in some areas. Volcanic cinder has been brought to the site as a fill material and is found throughout the campus mixed with original native soil material.

3.7.2 Field Reconnaissance Findings

Field reconnaissance at Kapiolani Elementary was performed on July 15, 2016. Soil samples were analyzed at 33 locations across the school property, as shown on Figure 3-7. Twenty-four of the sample locations were in open spaces, eight sample locations were along building perimeters, and one garden sample was collected. As shown on Table 3-7a, arsenic was measured in 12 samples at concentrations above the screening value of 100 mg/kg, with four of those exceeding five times the screening values. Lead was measured in 10 samples at concentrations just at or above the screening value of 200 mg/kg, with three of those exceeding five times the screening values. Soils in the garden areas were below screening level for lead but above the screening level for arsenic.

3.7.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Kapiolani Elementary on July 22, and November 14, 15, 17, 21, 2016. A total of 11 multi-increment samples were collected as shown on Figure 3-7, consisting of five open space samples, five building perimeter samples and one garden plot samples. Laboratory results are provided on Table 3-7b, along with comparison to action levels. The open space samples were analyzed for arsenic and lead. Three of these samples were also analyzed for bioaccessible arsenic. All open space sample results correspond to either Category A (background) or Category B (low risk) soils for arsenic. The open space sample DU-S7-01 results correspond to Category A soils for lead (background). The remaining open space sample results correspond to Category C soils for lead (moderate risk). The garden sample DU-S7-05 was analyzed for arsenic and lead. The results of this sample correspond to Category B soils for arsenic (low risk) and to Category C soils for lead (moderate risk). The building perimeter samples were analyzed for arsenic, lead, and OCPs. Two of these samples were also analyzed for bioaccessible arsenic. Sample DU-S7-02 results correspond to Category D soils for arsenic (high risk), and Category C for both lead and chlordane (moderate risk). Sample DU-S7-03 results correspond to likely Category B soils for arsenic (low risk), Category B for lead (low risk), and to Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S7-04 results correspond to Category D soils for arsenic (high risk), Category B soils for lead (low risk), and to Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S7-07 results correspond to Category B soils for arsenic and chlordane (low

risk), and Category D soils for lead (high risk). Sample DU-S7-09 results correspond to Category B soils for arsenic (low risk), Category D soils for lead and chlordane (high risk).

3.7.4 Summary and Recommendations

Soils in the garden sample are considered Category C soils for lead. Soils in four out of five building perimeter samples are considered either Category C or Category D for either arsenic or lead, or both. Two building perimeter samples are also considered Category C and D soils for chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of arsenic, lead and chlordane concentrations in surface soils within 5 ft of building perimeters.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils and for the Category C soils in the garden area (Table 3-25).

3.8 KAUMANA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.8.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There is an open grassy play area located in the middle of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hilo soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HILO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils have a silty clay loam texture in both the surface and in the sub-soil. The color is very dark brown (Munsell color 10YR2/2) from 0 to 6 inches and very dark brown (Munsell color 7.5YR2.5/3) in the subsoil. The property has been previously graded to accommodate construction of the school. Cinder or gravel fill material can be found intermixed with native soil at some locations. Soil depths in the Hilo series are estimated from 4 ft to over 6 ft.

3.8.2 Field Reconnaissance Findings

Field reconnaissance at Kaumana Elementary was performed on July 15, 2016. Soil samples were analyzed at 10 locations across the school property, as shown on Figure 3-8. Eight of the

sample locations were in open spaces, whereas two sample locations were along building perimeters. As shown on Table 3-8a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in one sample at a concentration above the screening value of 200 mg/kg.

3.8.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Kaumana Elementary on December 19, 2016. A total of one multi-increment samples were collected as shown on Figure 3-8, consisting of one building perimeter sample. Laboratory results are provided on Table 3-8b, along with comparison to action levels. The building perimeter sample was analyzed for arsenic, lead, and OCPs. The results of this sample correspond to Category A soils for arsenic (background), Category C soils for lead (moderate risk), and Category A soils for chlordane (measurable presence that poses negligible risk).

3.8.4 Summary and Recommendations

Soils in the building perimeter sample are considered Category C for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Chlordane was detected at low levels in the only building sample, and the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for pre-1988 building perimeter samples. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.9 KEAUKAHA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.9.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There is a paved play area at the southeast end of the property, which is surrounded by an open play area.

The native soils that have been mapped by USDA NRCS at the school location belong to the Opihikao soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OPIHIKAO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Native soils in this area consist of very shallow (0 to 6 inches) organic matter over pahoehoe lava. In order to support construction, fill materials must be imported to allow grading and leveling of a flat surface. As a result, soil materials on the property are highly variable mix of native and imported fill materials, consisting of volcanic cinder and coralline sand. Soil textures range from sand, loamy sand to loam. Soil colors are black (Munsell color 10YR2/1) and very dark brown (Munsell color 10YR2/2). Areas with coralline sand are white (Munsell color 10R8/1).

3.9.2 Field Reconnaissance Findings

Field reconnaissance at Keaukaha Elementary was performed on July 16, 2016. Soil samples were analyzed at 23 locations across the school property, as shown on Figure 3-9. Seventeen of the sample locations were in open spaces, four sample locations were along building perimeters, and two garden samples were collected. As shown on Table 3-9a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in two samples at concentrations just at or above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.9.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Keaukaha Elementary on January 9, 2017. A total of two multi-increment samples were collected as shown on Figure 3-9, consisting of two building perimeter samples. Laboratory results are provided on Table 3-9b, along with comparison to action levels. The two building perimeter samples were analyze for arsenic, lead, and OCPs. Sample DU-S9-01 results correspond to Category A soils for arsenic (background) and chlordane (measurable presence that poses negligible risk), and Category C soils for lead (moderate risk). Sample DU-S9-02 results correspond to Category B soils for arsenic (low risk), Category D soils for lead (high risk), and Category A soils for chlordane (measurable presence that poses negligible risk).

3.9.4 Summary and Recommendations

Soils in the building perimeter samples are considered Category C and D for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Chlordane was detected at low levels, and most of the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for pre-1988 building perimeter samples. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.10 LAUPAHOEHOE HIGH & ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.10.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A baseball field and play area are located at the southeast side of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Ookala soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OOKALA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils have a silty clay loam texture in both the surface and in the sub-soil. Surface color (0–6 inches) is very dark brown (Munsell color 10YR2/2). The campus has been graded to accommodate construction of school facilities. Cinder or gravel fill material can be found intermixed with native soil at the perimeter of some buildings. Perimeters of buildings have significant amounts of bare soil. Depths in the Ookala series are estimated from 4 ft to over 6 ft.

3.10.2 Field Reconnaissance Findings

Field reconnaissance at Laupahoehoe High & Elementary was performed on July 11, 2016. Soil samples were analyzed at 22 locations across the school property, as shown on Figure 3-10. Fourteen of the sample locations were in open spaces, five sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-10a, arsenic was measured in one sample at a concentration just above the screening value of 100 mg/kg. Lead was measured in three samples at concentrations above the screening value of 200 mg/kg, with one of those exceeding five times the screening values. Soils in the garden areas were below screening levels for lead and arsenic.

3.10.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Laupahoehoe High & Elementary on December 12, 13, and 19, 2016. A total of three multi-increment samples were collected as shown on Figure 3-10, consisting of three building perimeter samples. Laboratory results are

provided on Table 3-10b, along with comparison to action levels. The three building perimeter samples were analyzed for arsenic, lead, and OCPs. All sample results correspond to Category A soils for arsenic (background). Sample DU-S10-01 and DU-S10-03 results correspond to Category C soils for lead (moderate risk), and chlordane was not detected. Sample DU-S10-02 results correspond to Category B soils for lead (low risk) and Category A for chlordane (measurable presence that poses negligible risk).

3.10.4 Summary and Recommendations

Soils in two building perimeter sample are considered Category C for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Chlordane was detected at low levels in one building sample, and the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for building perimeter samples. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.11 WAIAKEA HIGH

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.11.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. Baseball fields and a football field surrounded by a track are located east of the school buildings. There are tennis courts to the south.

The native soils that have been mapped by USDA NRCS at the school location belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils at the school are very shallow with less than 4 inches of fine material over basalt cobbles. The materials have been mixed by heavy equipment during construction grading. This is typical for facilities built in areas of Panaewa soil series. Soil in the large open area at the front of the campus appears to be native Panaewa: black (Munsell color 10YR2/1) silty clay loam or loam with over 10 percent organic matter over a dark brown (Munsell color 7.5 YR 3/3) silty clay loam horizon. These soils are formed over a substrate of broken pahoehoe lava and range from 0–35 percent basalt gravels

or cinder in the upper 6 inches. Soils observed at the perimeters of buildings consist of volcanic cinder and silty clay loam material that has been brought to the site as a fill material. The cinder soil material has a color ranging from black (Munsell 10YR2/1) to dark reddish brown (Munsell 5YR3/2) and can be found throughout the campus mixed with original native soil material.

3.11.2 Field Reconnaissance Findings

Field reconnaissance at Waiakea High was performed on July 12, 2016. Soil samples were analyzed at 23 locations across the school property, as shown on Figure 3-11. Fourteen of the sample locations were in open spaces, eight sample locations were along building perimeters, and one garden sample was collected. As shown on Table 3-11a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was not measured in samples at concentrations above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.11.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Waiakea High on December 23 and 26, 2016. A total of three multi-increment samples were collected as shown on Figure 3-11, consisting of one open space sample, and two building perimeter samples. Laboratory results are provided on Table 3-11b, along with comparison to action levels. The open space sample results correspond to Category B soils for arsenic (low risk) and Category A soils for lead (background). The two building perimeter samples were analyzed for arsenic, lead, and OCPs. All building perimeter sample results correspond to either Category A soil (background, negligible risk) or Category B soils (low risk) for all analysis.

3.11.4 Summary and Recommendations

No Category C and no Category D soils were identified at this school. However, chlordane was detected at low levels in one building perimeter sample. Several buildings were constructed before the 1988 EPA ban of chlordane; therefore, further investigation of building perimeters is recommended for the determination of chlordane concentrations in surface soils within 5 ft of pre-1988 building perimeters.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.12 WAIAKEA INTERMEDIATE

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.12.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. Open grassy areas are located to the north and the south of the school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. The soils observed at this property were dominantly cinder fill material along the perimeters of buildings. The texture of the soil material is cindery loamy sand and the soil color ranges from black (Munsell color 10YR2/1) to dark reddish brown (Munsell color 5YR3/2). Fine silt material from surrounding areas has been deposited in some areas over the cinder fill material. Native soil was observed in some locations away from buildings, with depth of 2 to 6 inches, but at some locations the underlying basalt is exposed at the surface.

3.12.2 Field Reconnaissance Findings

Field reconnaissance at Waiakea Intermediate was performed on July 12, 2016. Soil samples were analyzed at 19 locations across the school property, as shown on Figure 3-12. Sixteen of the sample locations were in open spaces, two sample locations were along building perimeters, and one garden sample was collected. As shown on Table 3-12a, arsenic was measured in one sample at a concentration above the screening value of 100 mg/kg. Lead was measured in one sample at a concentration the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.12.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Waiakea Intermediate on December 9 and 12, 2016. A total of two multi-increment samples were collected as shown on Figure 3-12, consisting of two building perimeter samples. Laboratory results are provided on Table 3-12b, along with comparison to action levels. The two building perimeter sample results correspond to Category B for lead (low risk). Sample DU-S12-01 results correspond to Category B for arsenic (low risk), and chlordane was not detected. Sample DU-S12-02 results correspond to Category D soils for arsenic (high risk) and Category A for chlordane (measurable presence that poses negligible risk).

3.12.4 Summary and Recommendations

Soils in one building perimeter sample are considered Category D for arsenic. Based on these findings, further investigation of building perimeters is recommended for the determination of arsenic concentrations in surface soils within 5 ft of building perimeters. Chlordane was detected at low levels in one building sample, and the school was constructed prior to the 1988 EPA ban of chlordane; therefore, chlordane analysis is recommended for building perimeter samples. Lead analysis is also recommended because it was measured at concentrations close to Category C soils in one building perimeter sample.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.13 WAIAKEA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.13.1 General Description of School Facilities and Soil Materials

The campus is located to the east of Waiakea Intermediate and consists of school buildings with grass lawns. There is an open play area on the east side of the property.

The native soils that have been mapped by USDA NRCS at the school belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at school during the reconnaissance work and multi-increment soil sampling. Native soils at the school are very shallow with less than 4 inches of fine material over basalt cobbles. The native soil materials have been mixed during construction grading by heavy equipment. This is typical of the Panaewa soil series. In areas with good soil depth, the surface of the soil is black (Munsell color 10YR2/1) silty clay loam or loam with over 10 percent organic matter over a dark brown (Munsell color 7.5 YR 3/3) silty clay loam horizon. These soils are formed over a substrate of lithic pahoehoe lava. Volcanic cinder has been brought to the site as a fill material and is found throughout the campus mixed with the original native soil material.

The entire campus has been graded (leveled) for construction forming a set of tiered plateaus. The large open area, where higher levels of arsenic were found during the reconnaissance sampling, consists of a black (Munsell color 10YR2/1) silty clay loam surface and greater than

35 percent basalt fragments, and is believed to be native soils originally used for sugar cane cultivation.

3.13.2 Field Reconnaissance Findings

Field reconnaissance at Waiakea Elementary was performed on July 12, 2016. Soil samples were analyzed at 22 open space locations across the school property, as shown on Figure 3-13. As shown on Table 3-13a, arsenic was measured in 10 samples at concentrations above the screening value of 100 mg/kg. Lead was not measured in samples at concentrations above the screening value of 200 mg/kg.

3.13.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Waiakea Elementary on December 5, 6, 9, and 26, 2016. A total of six multi-increment samples were collected as shown on Figure 3-13, consisting of four open space samples, and two building perimeter samples. Laboratory results are provided on Table 3-13b, along with comparison to action levels. The four open space samples were analyzed for arsenic and lead. Two of these samples were also analyzed for bioaccessible arsenic. All open space sample results correspond to Category B soils for arsenic (low risk) and Category A soils for lead (background). The two building perimeter samples were analyzed for arsenic, lead, and OCPs. All building perimeter sample results correspond to Category B soils for arsenic (low risk), Category A soils for lead (background), and Category A for Chlordane (measurable presence that poses negligible risk).

3.13.4 Summary and Recommendations

No Category C and no Category D soils were identified at this school. However, chlordane was detected at low levels in the building perimeter samples. Several buildings were constructed before the 1988 EPA ban of chlordane. Therefore, further investigation of building perimeters is recommended for the determination of chlordane concentrations in surface soils within 5 ft of pre-1988 building perimeters.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.14 WAIAKEAWAENA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.14.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A baseball field and play area are located at the east end of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Panaewa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PANAEWA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils consist of weathered fill material composed of silty clay loam or loam textured material mixed with volcanic cinder. Colors consist are black (Munsell color 10YR2/1) and very dark brown (Munsell color 10YR2/2). Native Panaewa soil depth is from 3 to 6 inches over pahoehoe lava, therefore fill material was imported to the property to facilitate construction.

3.14.2 Field Reconnaissance Findings

Field reconnaissance at Waiakeawaena Elementary was performed on July 18, 2016. Soil samples were analyzed at 24 locations across the school property, as shown on Figure 3-14. Fourteen of the sample locations were in open spaces, nine sample locations were along building perimeters, and one garden sample was collected. As shown on Table 3-14a, arsenic was measured in two samples at concentrations above the screening value of 100 mg/kg. Lead was measured in three samples at concentrations just at or above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.14.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Waiakeawaena Elementary on January 5 and 9, 2017. A total of four multi-increment samples were collected as shown on Figure 3-14, consisting of two open space samples, and two building perimeter samples. Laboratory results are provided on Table 3-14b, along with comparison to action levels. The two open space samples were analyzed for arsenic and lead. One of these samples was also analyzed for bioaccessible arsenic. Sample DU-S14-01 results correspond to Category B soils for arsenic (low risk) and Category A soils for lead (background). Sample DU-S14-02 results correspond to Category B soils for both arsenic and lead (low risk). The two building perimeter samples were analyzed for arsenic, lead, and OCPs. Sample DU-S14-03 results correspond to Category B soils for arsenic (low risk), Category C for lead (moderate risk), and Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S14-04 results correspond to Category B soils for arsenic (low risk), Category A soils for lead (background), and Category C soils for chlordane.

3.14.4 Summary and Recommendations

Soils in building perimeter samples are considered Category C for lead and chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of lead and chlordane concentrations in surface soils within 5 ft of building perimeters. Arsenic is also recommended for analysis given that it was detected in one sample above the total arsenic action level of 100 mg/kg and it is analyzed by the same analytical method.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.15 KAU HIGH & PAHALA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.15.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. Baseball fields are located on the west side of the property, with additional open space east of the school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Naalehu and Puueo soil series. See complete descriptions at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/N/NAALEHU.html
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PUUEO.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils have a silty clay loam texture and are black (Munsell color 10YR2/1) in the soil surface. Soil depth is variable, ranging from exposed pahoehoe bedrock to soils greater than 20 inches in depth. Cinder can be found intermixed with native soil material along building perimeter, and was imported to support facility development.

3.15.2 Field Reconnaissance Findings

Field reconnaissance at Kau High & Pahala Elementary was performed on July 21, 2016. Soil samples were analyzed at 39 locations across the school property, as shown on Figure 3-15. Twenty-two of the sample locations were in open spaces, 14 sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-15a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in nine samples at concentrations above the screening value of 200 mg/kg,

with three of those exceeding five times the screening value. Soils in the garden areas were below screening levels for lead and arsenic.

3.15.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Kau High & Pahala Elementary on January 16, 2017. A total of seven multi-increment samples were collected as shown on Figure 3-15, consisting of one open space sample, and six building perimeter samples. Laboratory results are provided on Table 3-15b, along with comparison to action levels. The open space sample was analyzed for arsenic and lead, and its results correspond to Category A for arsenic (background), and Category B for lead (low risk). The building perimeter samples were analyzed for arsenic, lead, and OCPs. All building perimeter sample results correspond to Category A soils for arsenic (background). Samples DU-S15-02, DU-S15-06, and DU-S15-07 results correspond to Category C soils for lead (moderate risk) and Category A soils for chlordane (negligible risk). Sample DU-S15-01 results correspond to Category D soils for lead (high risk), and Category A soils for chlordane (negligible risk). Sample DU-S15-03 results correspond to Category C soils for lead (moderate risk) and Category B soils for chlordane (low risk). Sample DU-S15-04 results correspond to Category C soils for lead and chlordane (moderate risk risk).

3.15.4 Summary and Recommendations

Soils in all building perimeter samples are considered either Category C or Category D for lead. One building perimeter sample is also considered Category C soils for chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of lead and chlordane concentrations in surface soils within 5 ft of building perimeters. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.16 NAALEHU ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.16.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There is a large open space to the north of the school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Naalehu soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/N/NAALEHU.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils have a silty clay loam texture and are very dark brown (Munsell color 10YR2/2) and very dark gray (10YR3/1) in the soil surface. Cinder can be found intermixed with this soil material along building perimeters, apparently imported to support facility construction. Soil depths in the native Naalehu series are estimated from 4 ft to over 6 ft.

3.16.2 Field Reconnaissance Findings

Field reconnaissance at Naalehu Elementary was performed on July 21, 2016. Soil samples were analyzed at 21 locations across the school property, as shown on Figure 3-16. Ten of the sample locations were in open spaces, eight sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-16a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in five samples at concentrations above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.16.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Naalehu Elementary on January 17, 2017. A total of four multi-increment samples were collected as shown on Figure 3-16, consisting of building perimeter samples. Laboratory results are provided on Table 3-16b, along with comparison to action levels. The building perimeter samples were analyzed for arsenic, lead, and OCPs. All building perimeter sample results correspond to Category A soils for arsenic (background), Category C soils for lead (moderate risk), and Category A soils for chlordane (measurable presence that poses negligible risk).

3.16.4 Summary and Recommendations

Soils in two building perimeter samples are considered Category C for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Chlordane was detected at low levels in one building sample, and the school was constructed prior to the 1988 EPA ban

of chlordane; therefore, chlordane analysis is recommended for building perimeter samples. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.17 KEAAU HIGH

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.17.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A baseball field and football field with surrounding track are located to the north of the school buildings, and an undeveloped forested area is to the west.

The native soils that have been mapped by USDA NRCS at the school location belong to the Olaa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OLAA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Across most of the developed campus, surface soils consisted of cinder fill material with a loamy sand texture. This cinder fill was imported to support construction of school facilities. Soil color in the surface 3 inches is black (Munsell color 10YR2/1) and dark reddish brown (Munsell color 10YR3/2) from 3 to 6 inches. Basalt cobbles and gravels are found at depths greater than 6 inches.

3.17.2 Field Reconnaissance Findings

Field reconnaissance at Keaau High was performed on July 19, 2016. Soil samples were analyzed at 31 locations across the school property, as shown on Figure 3-17. Twenty-eight of the sample locations were in open spaces, and three sample locations were in gardens. As shown on Table 3-17a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was not measured in samples at concentrations above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.17.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Keaau High on January 9, 2017. A total of one multi-increment samples were collected as shown on Figure 3-17, consisting of one building perimeter sample. Laboratory results are provided on Table 3-17b, along with comparison to action levels. The building perimeter sample was analyzed for arsenic, lead, and OCPs, and its results correspond to Category A soils (background) for all chemicals of concern.

3.17.4 Summary and Recommendations

No Category C and no Category D soils were identified at this school. This school was built in 1999; therefore, chlordane is not assumed to be of concern around any of the building perimeters. No further action is recommended at this school.

3.18 KEAAU MIDDLE

Field reconnaissance and multi-increment soil sampling were not performed at this facility because characterization data has already been collected between 2004 and 2014. Figure 3-18 provides an aerial view of the school campus.

3.18.1 Previous Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Keaau Middle School in 2004 (HDOH and AMEC 2007), 2008 (ERM 2009), and 2014 (KJC 2014). A total of 13 multi-increment samples were collected during the three studies, consisting of four open space samples, seven building perimeter samples, and two garden plot samples. The various investigations identified a limited open space area with Category D soils for arsenic and Category C soils for lead; building perimeters with Category D soils for lead and Category C soils for arsenic; and a former garden area[8] with Category D soils for arsenic. OCPs in soil were investigated only in the 2008 sampling conducted by ERM, where only one building perimeter sample was investigated, and no OCPs were present above action levels.

3.18.2 Recommendations

Category D soils for arsenic were identified north of Buildings D2 and E1 and in a former garden area. Category C and D soils for both lead and arsenic were identified around several older buildings that are planned for demolition. Based on the prior investigation work, arsenic, lead, and chlordane testing is recommended for all standing buildings that have not been

[8] HDOH HEER Office informed Keaau Middle School of the elevated arsenic in the garden upon receipt of 2004 sampling results. The garden area has been revegetated and is not in use.

previously investigated or demolished (except for recently constructed buildings surrounded by known clean fill soils), and around newly constructed buildings that will be erected on the footprint of the old ones. Supplemental soil sampling is suggested to delineate the extent of Category C and D arsenic soils in the vicinity of Buildings D2 and E1.

3.19 KEAAU ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.19.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There are open play areas in courtyards between the buildings as well as a larger play area to the west.

The native soils that have been mapped by USDA NRCS at the school location belong to the Olaa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OLAA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. The soil has a silty clay loam texture with high amounts of organic material, and between 10 to 20 percent cinders and basalt gravels. The soil appears to be a mixture of native soils and cinder fill imported to support facility construction. Surface soil color is black (Munsell color 10YR2/1); this material is deposited over basalt gravel and cinder and graded `a`a lava. Depth is 0 to 4 inches over the gravel/cinder fill.

3.19.2 Field Reconnaissance Findings

Field reconnaissance at Keaau Elementary was performed on July 18, 2016. Soil samples were analyzed at 19 locations across the school property, as shown on Figure 3-19. Eighteen of the sample locations were in open spaces, and one sample location was in a garden. As shown on Table 3-19a, arsenic was measured in nine samples at concentrations above the screening value of 100 mg/kg. Lead was not measured in samples at concentrations above the screening value of 200 mg/kg. Soils in the garden areas were below screening level for lead but above the screening level for arsenic.

3.19.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Keaau Elementary on January 9, 10, and 11, 2017, with sample S19-04R (a re-sampling of original sample S19-04) collected on

August 1, 2017.[9] A total of eight multi-increment samples were collected as shown on Figure 3-19, consisting of seven open space samples, and one building perimeter sample. Laboratory results are provided on Table 3-19b, along with comparison to action levels. The open space samples were analyzed for arsenic and lead. All open space sample results were above background levels (>24 mg/kg) for total arsenic. The two samples with highest total arsenic were analyzed for bioaccessible arsenic, and both were Category B (<23 mg/kg bioaccessible). All open space sample results correspond to Category A soils for lead (background). The building perimeter sample was analyzed for arsenic, lead, and OCPs. The results of this sample correspond to Category B soils for arsenic (low risk), and Category A for lead and chlordane (negligible risk).

3.19.4 Summary and Recommendations

No Category C or Category D soils were identified at this school. This school was built in 1997; therefore, chlordane is not assumed to be of concern around any of the building perimeters. No further action is recommended at this school.

3.20 MOUNTAIN VIEW ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.20.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. Open play areas are located to the east and southeast of the campus buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Waiakea soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/W/WAIAKEA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. Soils at the Mountain View school fit within the description of the Waiakea soil series. These soils are similar to the Olaa soil series in that they are moderately deep and form from volcanic ash over `a`a lava. Both of these soil types were used extensively for sugarcane cultivation, although Waiakea soils would have been limited to the lower elevations in which this soil occurs.

[9] The original sample S19-04 was reported to contain 470 mg/kg lead. This result was considered anomalous since elevated lead was not observed in any XRF screening samples or other multi-incremental samples on the campus. The re-sample of decision unit S19-04 reported 28 mg/kg lead, consistent with other site samples.

The school property has been graded and leveled for construction of facilities, and subsoil and surface materials were mixed as a result. Depth to the underlying rock varies and could not be estimated. Texture of the soil is silty clay loam in most areas of the campus, but can be sandy loam or loam at some building perimeters where cinder or gravel fill material has been deposited. Soil colors are black (Munsell color 10YR2/1) in the soil surface and dark brown (Munsell color 7.5 YR 3/3) in subsurface horizons. Fragments can range from 15 to 35 percent basalt gravels or cinder.

3.20.2 Field Reconnaissance Findings

Field reconnaissance at Mountain View Elementary was performed on July 18, 2016. Soil samples were analyzed at 25 locations across the school property, as shown on Figure 3-20. Seventeen of the sample locations were in open spaces, seven sample locations were along building perimeters, and one garden sample was collected. As shown on Table 3-20a, arsenic was measured in six samples at concentrations above the screening value of 100 mg/kg, with one of those exceeding five times the screening value. Lead was measured in five samples at concentrations above the screening value of 200 mg/kg, with three of those exceeding five times the screening value. Soils in the garden areas were below screening levels for lead and arsenic.

3.20.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Mountain View Elementary on November 18, 2016. A total of five multi-increment samples were collected as shown on Figure 3-20, consisting of one open space sample, and four building perimeter samples. Laboratory results are provided on Table 3-20b, along with comparison to action levels. The open space sample was analyzed for arsenic and lead, and its results correspond to Category B soils for both arsenic and lead (low risk). The four building perimeter samples were analyzed for arsenic, lead, and OCPs. Two of these samples were also analyzed for bioaccessible arsenic. All building perimeter sample results correspond to Category B soils for arsenic (low risk) and Category A for chlordane (negligible risk). The results of one sample, DU-S20-03, correspond to Category D soils for lead (high risk), while the remaining three sample results correspond to Category C soils for lead (moderate risk).

3.20.4 Summary and Recommendations

Soils in the building perimeter sample are considered Category C and D for lead. Based on these findings, further investigation of building perimeters is recommended for the determination of lead concentrations in surface soils within 5 ft of building perimeters. Arsenic is also recommended for analysis given that it was detected in one sample above the total arsenic action level of 100 mg/kg and it is analyzed by the same analytical method. Chlordane was detected at low levels in building perimeter samples. Several buildings were constructed before the 1988 EPA ban of chlordane. Therefore, further investigation of building perimeters is

recommended for the determination of chlordane concentrations in surface soils within 5 ft of pre-1988 building perimeters.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils and for the Category C soils in the garden area (Table 3-25).

3.21 PAHOA HIGH & INTERMEDIATE

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.21.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There is a track and other open grassy areas to the southwest.

The native soils that have been mapped by USDA NRCS at the school location belong to the Papai and Hakuma soil series. See complete descriptions at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PAPAI.html
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HAKUMA.html

The following is a general description of the surface soils that were encountered at the school during the reconnaissance work and multi-increment soil sampling. The soils consist of cinder and gravel fill mixed with finer textured mineral material. Soil textures found were loamy sand, sandy loam, and loam. Imported fill has been mixed with native soils during construction grading activities. Colors are black (Munsell color 10YR2/1), very dark brown (Munsell color 10YR2/2), dark reddish brown (Munsell 5YR3/3), and gray (Munsell 10YR4/1). Colors and textures vary according to the type and quantity of fill material used. Depth to the pahoehoe bedrock below native soils is 2 to 8 inches.

3.21.2 Field Reconnaissance Findings

Field reconnaissance at Pahoa High & Intermediate was performed on July 20, 2016. Soil samples were analyzed at 28 locations across the school property, as shown on Figure 3-21. Sixteen of the sample locations were in open spaces, nine sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-21a, arsenic was measured in three samples at concentrations above the screening value of 100 mg/kg, with one of those exceeding five times the screening value. Lead was measured in three samples at concentrations above the screening value of 200 mg/kg, with two of those exceeding five times the screening value. Soils in the garden areas were below screening levels for lead and arsenic.

3.21.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Pahoa High & Intermediate on December 27, 2016. A total of four multi-increment samples were collected as shown on Figure 3-21, consisting of four building perimeter samples. Laboratory results are provided on Table 3-21b, along with comparison to action levels. The four building perimeter samples were analyzed for arsenic, lead, and OCPs. Two of these samples were also analyzed for bioaccessible arsenic. Sample DU-S21-01 results correspond to Category C soils for arsenic (moderate risk), Category D for lead (high risk), and Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S21-02 results correspond to Category B soils for arsenic (low risk), Category D for lead (high risk), and Category A for chlordane (measurable presence that poses negligible risk). Sample DU-S21-03 results correspond to Category B soils for arsenic and lead (low risk), and Category D for chlordane (high risk). Sample DU-S21-04 results correspond to Category B soils for arsenic (low risk), Category A for lead (background), and Category A for chlordane (it was not detected).

3.21.4 Summary and Recommendations

Soils in most building perimeter samples are considered either Category C or Category D for either arsenic or lead. One building perimeter sample is also considered Category D soils for chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of arsenic, lead, and chlordane concentrations in surface soils within 5 ft of building perimeters.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation. An interim action is recommended for the identified Category D soils (Table 3-25).

3.22 KEONEPOKO ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.22.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. There are open play areas to the west of the school buildings.

The native soils that have been mapped by USDA NRCS at the school location belong to the Olaa soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OLAA.html

The following is a general description of the surface soils that were encountered at school during the reconnaissance work and multi-increment soil sampling. Soils consist of cinder and gravel fill material mixed with fine textured soil materials. Textures observed were sand, loam, and silty clay loam. Colors are black (Munsell color 10YR2/1), very dark Soil brown (Munsell color 10YR2/2), and gray (Munsell 10YR4/1). Colors and textures vary according to fill material used. Fill materials appear to have been deposited at different times, often covering or intermixing with underling or adjacent materials. Depth to underlying `a`a lava beneath native soil is approximately 6 inches.

3.22.2 Field Reconnaissance Findings

Field reconnaissance at Keonepoko Elementary was performed on July 19, 2016. Soil samples were analyzed at 21 locations across the school property, as shown on Figure 3-22. Nineteen of the sample locations were in open spaces, one sample location was along building perimeters, and one garden sample was collected. As shown on Table 3-22a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was not measured in samples at concentrations above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.22.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Keonepoko Elementary on December 29, 2016, and January 10, 2017. A total of two multi-increment samples were collected as shown on Figure 3-22, consisting of one open space sample, and one building perimeter sample. Laboratory results are provided on Table 3-22b, along with comparison to action levels. All sample results correspond to Category B Soils for arsenic (low risk) and Category A soils for lead (background). The building perimeter corresponds to Category A for chlordane (negligible risk).

3.22.4 Summary and Recommendations

No Category C and no Category D soils were identified at this school. This school was built in the 1990s; therefore, chlordane is not assumed to be of concern around any of the building perimeters. No further action is recommended at this school.

3.23 PAHOA ELEMENTARY

The following sections describe the results of field reconnaissance and multi-increment soil sampling and analysis programs.

3.23.1 General Description of School Facilities and Soil Materials

The campus consists of school buildings with grass lawns. A baseball field and play area are located at the east end of the property.

The native soils that have been mapped by USDA NRCS at the school location belong to the Hakuma soil series. See a complete description at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HAKUMA.html

The following is a general description of the surface soils that were encountered at school during the reconnaissance work and multi-increment soil sampling. Soils consist of cinder and gravel fill. Soil textures found were loamy sand and loam. Color is black (Munsell color 10YR2/1) from 0 to 6 inches. The soil materials are intermixed with other cinder and gravel fill that have been deposited on the soil surface along building perimeters. Colors and textures vary according to fill material used. Depth of native soils to the pahoehoe bedrock is 2 to 8 inches.

3.23.2 Field Reconnaissance Findings

Field reconnaissance at Pahoa Elementary was performed on July 20, 2016. Soil samples were analyzed at 20 locations across the school property, as shown on Figure 3-23. Eleven of the sample locations were in open spaces, six sample locations were along building perimeters, and three garden samples were collected. As shown on Table 3-23a, arsenic was not measured in samples at concentrations above the screening value of 100 mg/kg. Lead was measured in one sample at a concentration above the screening value of 200 mg/kg. Soils in the garden areas were below screening levels for lead and arsenic.

3.23.3 Multi-increment Sampling and Laboratory Analysis Results

Multi-increment surface soil sampling was conducted at Pahoa Elementary on January 2, 2017. A total of three multi-increment samples were collected as shown on Figure 3-23, consisting of building perimeter samples. Laboratory results are provided on Table 3-23b, along with comparison to action levels. The building perimeter samples were analyzed for arsenic, lead, and OCPs. Sample DU-S23-01 results correspond to Category B soils for arsenic (low risk), Category C soils for lead (moderate risk), and Category A soils for chlordane (not detected). Sample DU-S23-02 results correspond to Category A soils for arsenic and lead (background), and chlordane (negligible risk). Sample DU-S23-03 results correspond to Category A soils for arsenic (background), and Category C for both lead and chlordane (moderate risk).

3.23.4 Summary and Recommendations

Soils in two of three building perimeter samples are considered Category C for lead. One building perimeter sample is also considered Category C soils for chlordane. Based on these findings, further investigation of building perimeters is recommended for the determination of lead and chlordane concentrations in surface soils within 5 ft of building perimeters. Given the observed low arsenic concentrations, arsenic analysis is not recommended.

Mitigation and long-term soil management is recommended for Category C and D soils that will be identified in a school-wide investigation.

3.24 SUMMARY OF SOIL ASSESSMENT FINDINGS

A summary of soil screening findings is provided in Table 3-24a, which shows the percentage of samples with concentrations exceeding the screening levels for arsenic and lead. The schools in the table are sorted highest to lowest by exceedances of screening levels for either arsenic or lead. DeSilva Elementary has the highest number of screening exceedances, at 50 percent of samples. Three schools, Waiakea High, Keaau High, and Keonepoko Elementary, had no exceedances. Keaau Middle, which has already had extensive soil investigations, was not sampled during this project, but is shown at the top of the school list due to known soil arsenic issues.

A summary of multi-increment sampling findings is provided in Table 3-24b, which shows whether schools have any Category C (moderate risk) or Category D soils (high risk), for what contaminants (arsenic, lead, chlordane), and in what type of samples (open space, building perimeter, or garden). Table 3-24b also proves a summary of our recommendations at each school for no further actions, further investigation, and mitigation.

The main findings of the multi-increment soil sampling program are as follows:

- Five schools did not have any Category C or Category D soils.
- There are only three contaminants of concern: arsenic, lead, and chlordane (an OCP).
- Category D soils were identified at 12 schools and interim actions are recommended to cover bare soils and prevent direct contact. [10]
- Category C and Category D soils were identified in building perimeters.
- Category C soils but no Category D soils were identified in open spaces.[11]

[10] High priority interim actions are recommended in this report for bare Category D soils. More comprehensive recommendations for interim actions for Category C and D soils will be provided in school-specific EHMPs.
[11] With the excepting of a sample collected at Keaau Middle in 2008 (ERM 2009).

- Category C soils but no Category D soils were identified in garden areas.[12]
- The majority of Category D soils are associated with lead impacts in building perimeters.
- Further investigation and mitigation is recommended at most schools.

Five samples were analyzed for total copper, total chromium, and hexavalent chromium. All results are well below either action levels or background levels.

Additionally, Table 3-25 provides a summary of the areas with observed Category D soils as part of this investigation. The table provides information on buildings, such as year of construction and material, and on ground conditions, such as presence of bare soil. Overall, Category D soils appear to be associated with older wood buildings. There are three instances of Category D soils around newer buildings; these buildings were constructed in 1962 and 1970 and surrounding soils are impacted with either arsenic or chlordane. Table 3-25 also includes the recommended interim actions for Category D soils associated with bare ground conditions.

[12] With the excepting of a sample collected at Keaau Middle School in 2007 (HDOH and AMEC 2007)

4 QUALITY ASSURANCE/QUALITY CONTROL

This section presents the quality assurance/quality control (QA/QC) procedures that were implemented to ensure that the investigation data results are defensible and usable for their intended purpose.

4.1 FIELD QUALITY CONTROL CHECKS

Field replicate samples were collected and analyzed in order to assess variability associated with sample processing and laboratory variability. A total of 11 DUs were sampled in triplicate fashion. Triplicate sample results are provided in Tables 3-1b through 3-23b. In the tables, triplicates are identified with the letters A, B, C placed after the sample ID (for example samples S3-02A, S3-02B, and S3-02C). Triplicate results posted on Figures 3-1 through 3-23 were averaged so that only one value is shown on the figures.

The results of the field replicate samples were statistically evaluated by calculating the relative standard deviation, following the procedures outlined in Section 4.2.7.3 of the HDOH TGM (HDOH 2009). The relative standard deviation provides a measure of the precision of the multi-increment sampling method, with the lower relative standard deviation indicating more reproducible and more precise data. The calculated relative standard deviation ranges from 0 to 28 percent for most sets of triplicate samples, which is below the target value of 35 and indicates "good precision." There are four exceptions, here listed. The triplicate set of samples S13-02A, -02B, and -02C has a relative standard deviation of 48 percent for lead results and 50 for chlordane results. The relative standard deviation of the arsenic results associated with the same triplicate is, however, 5 percent. A relative standard deviation greater than 35 percent but lower than 50 percent indicates "moderate precision." The triplicate sets of samples S13-02A, -02B, and -02C, and S13-06A, -06B, and -06C have a relative standard deviation of 69 and 44 percent respectively for chlordane analysis. The relative standard deviation of the arsenic and lead analyses associated with the same sets of triplicates ranges from 2 percent to 7 percent. Overall, the three chlordane results discussed above are very low concentrations that easily generate large standard deviations. The relative standard deviation calculations are provided in Table 4-1.

Two equipment rinse blanks were collected. One was analyzed for total arsenic and lead, and the other blank was analyzed for organochlorine pesticides. One equipment rinse blank had traces of gamma-BHC, commonly known as lindane, detected at a concentration of 0.000054 mg/L. The second equipment rinse blank had traces of lead, detected at a concentration of 0a.00017 mg/L and qualified as an estimated value given that the reported concentration is above the method detection limit but below the reporting limit. These very low concentrations are considered acceptable and not compromising data quality.

4.2 LABORATORY QUALITY CONTROL CHECKS

Laboratory quality control samples include, but are not limited to, laboratory method blanks, surrogate standards, laboratory control samples, and matrix spike/matrix spike duplicate samples. Extensive and detailed requirements for laboratory quality control procedures are provided in EPA and standard method protocols that were used for this study. Every method protocol includes descriptions of quality control procedures, and many incorporate additional quality control requirements by reference to separate quality control chapters in the protocols. Quality control requirements include control limits and requirements for corrective action in many cases. Quality control procedures were completed by the laboratory, as required in each protocol.

As required by EPA SW-846 methods, performance-based control limits are established by the laboratory. These and all other control limits specified in the method descriptions were used by the laboratory to establish the acceptability of the data or the need to reanalyze the samples. Laboratory QC procedures are provided in the laboratory reports, included in this report as Appendix D3.

4.3 DATA VALIDATION AND USABILITY ANALYSIS

An Integral chemist performed data validation on all laboratory generated data, with the exception of the total solids data which was requested for informational purposes only. The data underwent a Level II (Stage 2A) validation that included a review of all laboratory summary forms of quality control check results. The data validation was based upon criteria described in the EPA's functional guidelines for organic and inorganic data review (USEPA 2016a,b), and the referenced analytical methods.

A total of 2060 results were reported. Of the 2060 results, a total of 822 (40 percent) were qualified as estimated using J, UJ, or NJ qualifiers. The majority of metals results estimated J were due to matrix spike recovery values outside laboratory-established control limits, which is indicative of matrix effects on analysis.[13] Additionally, a number of results were also J-flagged by the laboratory because the numerical result was between the minimum detection limit and the laboratory reporting limit indicating an estimated quantity.

A total of 27 non-detected pesticide results (1.3 percent) were rejected because of very low recoveries in the associated matrix spike analyses. Overall completeness for the data set was greater than 98 percent.

[13] This is not attributed to poor laboratory performance. Iron-rich volcanic soils in Hawaii commonly sequester metals that are not fully released in a matrix recovery test.

The data meet the criteria set forth in the referenced quality assurance documents, with the exceptions noted during data validation. All results, with the exception of the rejected results, are acceptable for their intended use.

4.4 EFFECTIVENESS OF FIELD XRF SCREENING

One of the primary objectives of the XRF screening program was to identify surface soils likely to have metals (arsenic and lead) concentrations above action levels. The effectiveness of XRF screening, in the manner performed by Integral for this project, was tested by comparing XRF screening results with subsequent multi-increment sampling results from similar locations.

To review, XRF screening consisted of triplicate XRF analyses of soils within a small screening area, with the average of the three measurements reported. For open space locations, the three measurements were collected from within an approximate 3-ft radius area, and along building perimeters the three measurements were approximately 5 to 10 ft apart. Within garden plots, the distance between the three measurements generally ranged from 1 to 5 ft apart. Multi-increment sampling DUs were much larger sampling areas, as shown on Figures 3-1 through 3-23.

To test the effectiveness of XRF screening in identifying soils with concentrations of arsenic or lead above action levels, we compared XRF results to multi-increment sample results in common areas. For each multi-increment sampling DU, XRF results for screening locations within the DU were compared to multi-increment sample laboratory results (see Table 4-2). A total of 92 DUs had one or more XRF screening location within the DU footprint. For most DUs, there was only a single XRF screening location; however, for 19 DUs there were 2 XRF locations and for 7 DUs there were 3 or more XRF locations. For comparison, results for multiple XRF locations within a single DU were averaged. Triplicate multi-increment sample results from eight DUs were also averaged.

The effectiveness of XRF screening in identifying soils with arsenic or lead above action levels was tested. The action levels for this test were 200 mg/kg for lead (the unrestricted land use EAL) and 100 mg/kg for arsenic—a conservative screening level below which it is unlikely that bioaccessible arsenic would exceed 23 mg/kg (see Section 2.1.1 for more discussion of the project-specific total arsenic screening level).

A comparison test was performed to determine whether XRF screening results were a correct predictor of whether the multi-increment sample result in that DU was at or above the action level. If the both the XRF screening result and the multi-increment sample result exceeded the action level, then the XRF screening was deemed successful. If the XRF screening result was at or above the action levels, but the multi-increment sample result was below the action level, the XRF screening was deemed to have resulted in a "false positive" prediction. Conversely, if the XRF screening result was below the action levels, but the multi-increment sample result was at

or above the action level, the XRF screening was deemed to have resulted in a "false negative" prediction. While false positive XRF predictions might lead to unwarranted concern for a soil area, a false negative prediction might lead to dismissal of a soil area that actually contains arsenic or lead above the action level. Therefore, to be of high value, the XRF predictions should avoid false negative results to the extent possible.

As shown on Table 4-2, out of the 92 DUs tested by XRF screening, arsenic at a test criteria of 100 mg/kg had 11 false positives (12 percent) and only 1 false negative (1 percent). For lead, with a test criteria of 200 mg/kg, there were 13 false positives (14 percent) and 5 false negatives (5 percent). The higher occurrence of false positives and negatives for lead may be due to the likely higher nugget factor in soils impacted by lead-based paint chips. To improve the performance of XRF predictions for lead, one can use a lower XRF screening criteria of 150 mg/kg as a predictor of lead at or greater than 200 mg/kg in the multi-increment sample. Using 150 mg/kg, only one false negative (1 percent) was observed (see last column in Table 4-2).

In summary, soil screening by XRF is an excellent tool to identify arsenic and lead (or other metals) in soil, and can be used to accurately predict whether soils are likely to exceed action levels in subsequent multi-increment sampling and laboratory analysis. With limited XRF screening locations per subsequent DU and limited replicate measurements (three) per XRF screening location, XRF screening as performed for this project is not suitable to accurately predict the actual average concentration of arsenic or lead in a subsequent multi-increment sampling DU. However, field XRF screening could be enhanced to mimic multi-increment sampling, where 30 to 50 XRF measurements could be taken within a DU. Integral believes this enhanced XRF screening methodology would provide similar average metal concentrations as determined by multi-increment sampling and lab analysis.

4.5 BIOACCESSIBLE ARSENIC

Bioaccessible arsenic concentrations were determined using the SBRC gastric-phase *in vitro* test (Kelley et al. 2002; Drexler and Brattin 2007) in a select subset (n = 26) of multi-increment samples with total arsenic[14] values greater than 100 mg/kg (ranging from 100 to 2500 mg/kg). A subsample of the multi-increment sample was prepared for bioaccessible arsenic testing by sieving to <0.25 mm ("fine fraction"). Concentrations of total arsenic in the fine fraction were on average 20 percent higher than in the <2mm fraction. Concentrations of bioaccessible arsenic in these samples ranged from 3.7 to 320 mg/kg, and the percentage of bioaccessible arsenic[15] ranged from 1 to 13 percent, with the exception of one sample at 34 percent. These values of

[14] Total arsenic in the <2 mm soil fraction, which is the fraction used for standard analysis of multi-increment samples.

[15] Percentage of bioaccessible arsenic is concentration of bioaccessible arsenic divided by the concentration of total arsenic, both measured in the <0.25 mm particle size fraction ("fine fraction").

bioaccessible arsenic, in both concentration and percentage basis, are within the range observed by Cutler (2011) for soils in the eastern portion of the Island of Hawaii. See Table 4-3 for total and bioaccessible arsenic results.

Cutler (2011) showed that the concentration of bioaccessible arsenic in iron-rich volcanic-derived soils in Hawaii was controlled by the total arsenic concentration and the total or reactive iron concentration. While a general prediction of bioaccessible arsenic can be made if total arsenic and iron concentrations are known, the *in vitro* bioaccessibility test must be performed to accurately determine bioaccessible arsenic in a given soil sample.

5 LIMITATIONS

Integral has prepared this report for HDOE under contract No. C1101049, Job No. Q61001-11, Project: Various Schools Statewide, Hazardous Materials Assessment. The conclusions presented in this report are based on Integral's observations during field investigations and on chemical analytical data. The findings of this assessment should be considered as a professional opinion based on Integral's evaluation of limited data.

Integral's services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. Integral makes neither express nor implied representations, warranties, guarantees or certifications regarding the results of this limited investigation.

Integral does not purport to give legal advice. Any reference to legal issues or terms is provided as part of the general environmental assessment and is not a substitute for the advice of competent legal counsel.

6 REFERENCES

Brattin, W., J. Drexler, Y. Lowney, S. Griffin, G. Diamond, and L. Woodbury. 2013. An *in vitro* method for estimation of arsenic relative bioavailability in soil. *J. Toxicol. Environ. Health*. 76(7):458–478.

Cutler, W. 2009. Arsenic field mapping by XRF: A quantitative comparison of field and laboratory methods. Nineteenth Annual AEHS Meeting and West Coast Conference on Soils, Sediments, and Water, San Diego, CA.

Cutler, W. 2011. Bioaccessible arsenic in soils of the Island of Hawaii. A dissertation submitted to the graduate division of the University of Hawaii at Manoa in partial fulfillment of the requirements for the degree of Doctor of Philosophy in geology and geophysics. May 2011.

Cutler, W., R. Brewer, A. El-Kadi, N. Hue, P. Niemeyer, J. Peard, and C. Ray. 2013. Bioaccessible arsenic in soils of former sugar cane plantations, Island of Hawaii. *Sci. Total Environ.* 442:177–188.

Drexler, J.W., and W.J. Brattin. 2007. An *in vitro* procedure for estimation of lead bioavailability: With validation. *Hum. Ecol. Risk Assess.* 13:383–401.

ERM. 2009. Combined phase I & II environmental site assessment, Keaau Middle School, Keaau, Hawaii. Prepared for County of Hawaii, Department of Environmental Management. Environmental Resources Management, Honolulu, HI. February.

HDOH and AMEC. 2007. Hawaii Department of Health, Hazard Evaluation and Emergency Response Office and Earth and Environmental, Inc. Soil arsenic assessment study, Keaau, Hawaii. Honolulu. December.

HDOH. 2009. Technical guidance manual for the implementation of the Hawai'i contingency plan. Interim final (November 2009), as updated at http://www.hawaiidoh.org/tgm.aspx. Hawaii State Department of Health, Honolulu, HI.

HDOH. 2012. Update to soil action levels for inorganic arsenic and recommended soil management practices. http://www.hawaiidoh.org/. Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response. November 25, 2011; updated September 2012.

HDOH. 2016. Evaluation of environmental hazard at sites with contaminated soil and groundwater. Hawaii Edition. Hawaii Department of Health, Environmental Management Division, Honolulu, HI. Summer 2016; updated November 2016.

Integral. 2016. Sampling and analysis plan, hazardous materials assessments, various schools statewide, HDOE Job No. Q61001-11. Integral Consulting Inc., Waipahu, HI. October 28.

Integral. 2017. Environmental hazard management plan, building exterior soils, framework for schools statewide, HDOE Job No. Q61001-11. Integral Consulting Inc., Waipahu, HI. December 19.

Kelley, M.E., S.E. Brauning, R.A. Schoof, and M.V. Ruby. 2002. *Assessing oral bioavailability of metals in soil*. Battelle Press, Columbus, OH.

KJC. 2014. Soil testing report, Keaau Middle School, Building B, D, E, and G demolition, Honolulu. Kennedy/Jenks Consultants. April 22.

USEPA. 2016a. National functional guidelines for Superfund organic methods data review. USEPA-540-R-2016-002, Contract Laboratory Program. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, DC. September.

USEPA. 2016b. National functional guidelines for inorganic Superfund methods data review. USEPA-540-R-2016-001, Contract Laboratory Program. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, DC. September.

FIGURES

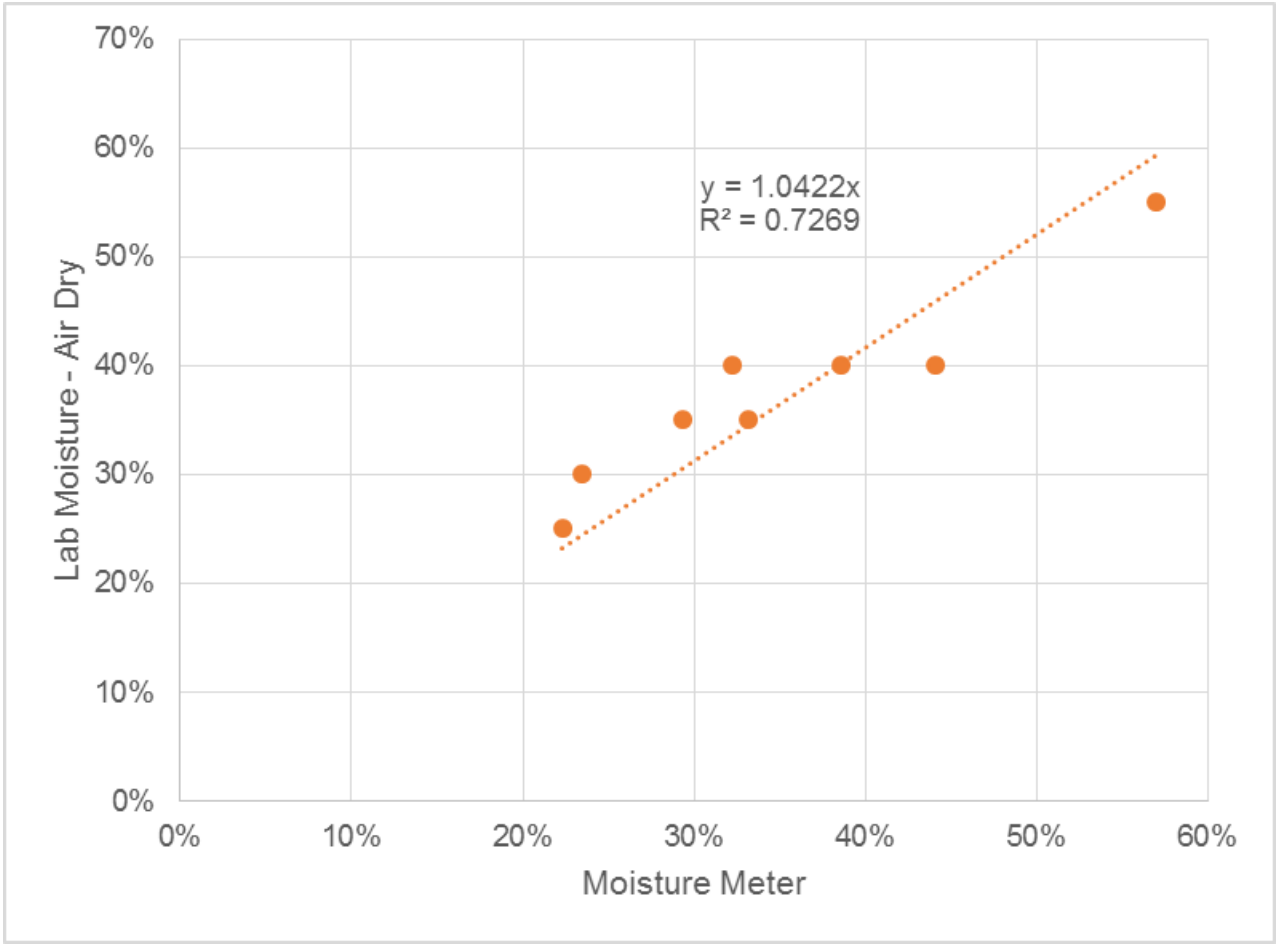

Figure 2-1.
Crossplot of Field to Lab Moisture Measurements

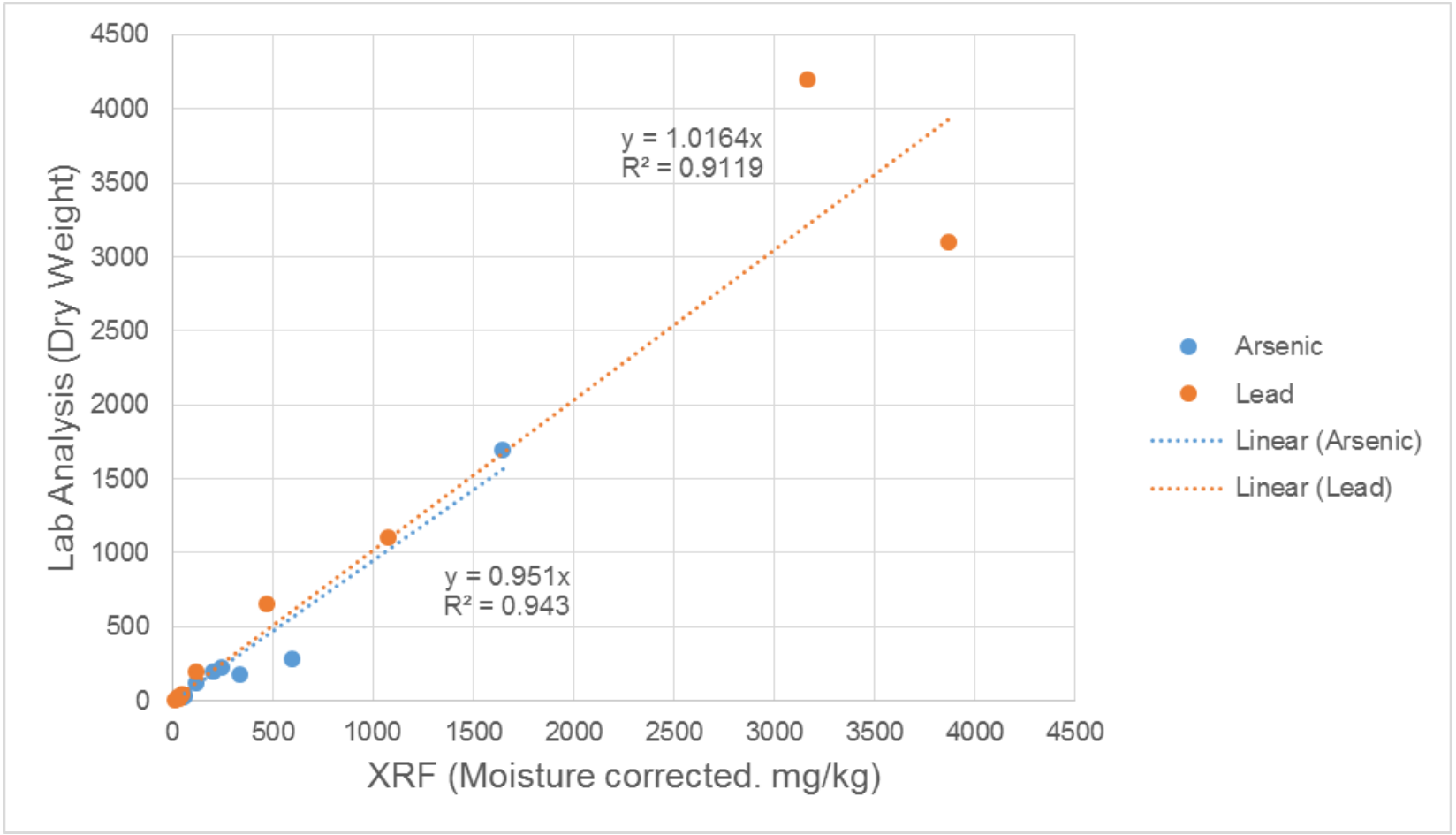

Figure 2-2.
Crossplot of Field XRF to Lab Arsenic and Lead Measurements

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integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-1.
Soil Analysis Results
Hilo High
556 Waianuenue Avenue, Hilo, HI 96720

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-2.
Soil Analysis Results
Hilo Intermediate
587 Waianuenue Avenue, Hilo, HI 96720

DU-S3-01
Arsenic..... **60 J**
Arsenic, bio..... --
Lead..... **600**
Chlordane..... --

DU-S3-02[a]
Arsenic..... **40**
Arsenic, bio..... --
Lead..... **730 J**
Chlordane..... **6.7 J**

DU-S3-03
Arsenic..... **12 J**
Arsenic, bio..... --
Lead..... **270**
Chlordane..... --

DU-S3-04[a]
Arsenic..... **110 J**
Arsenic, bio..... **2.5 J**
Lead..... **77**
Chlordane..... --

DU-S3-05[a]
Arsenic..... **14**
Arsenic, bio..... --
Lead..... **1800 J**
Chlordane..... **15 J**

DU-S3-01
DU-S3-02
DU-S3-03
DU-S3-04
DU-S3-05

1 Arsenic = 14, Lead = 52
2 Arsenic = 52, Lead = 20
3 Arsenic = 16, Lead = 51
4 Arsenic = 200, Lead = 470
5 Arsenic = 83, Lead = 950
6 Arsenic = 24, Lead = 310
7 Arsenic = 17, Lead = 84
8 Arsenic = 280, Lead = 72
9 Arsenic = 33, Lead = 230
10 Arsenic = 26, Lead = 120; Arsenic = <QL, Lead = 130; Arsenic = 37, Lead = 620
11 Arsenic = <QL, Lead = 74
13 Arsenic = <QL, Lead = 72
14 Arsenic = 9, Lead = 67
15 Arsenic = <QL, Lead = 53
16 Arsenic = <QL, Lead = 73
17 Arsenic = <QL, Lead = 32
18 Arsenic = <QL, Lead = 37
19 Arsenic = <QL, Lead = 48
20 Arsenic = <QL, Lead = 66
21 Arsenic = 43, Lead = 53

- Open Space XRF Analysis
- Building Perimeter XRF Analysis
- Open Space Multi-Increment Sample
- Building Perimeter Multi-Increment Sample
- Newer Building Not Shown on Aerial
- School Property Boundary

0 50 100
Feet

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-3.
Soil Analysis Results
Kalanianaole Elementary & Intermediate
27-330 Old Mamalahoa Highway, Papaikou, HI 96781

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DU-S4-01
Arsenic..... 270
Arsenic, bio..... 4.9 J
Lead..... 330
Chlordane..... --

DU-S4-03
Arsenic..... 130
Arsenic, bio..... 3.5 J
Lead..... 39
Chlordane..... --

DU-S4-06
Arsenic..... 550
Arsenic, bio..... 20
Lead..... 120
Chlordane..... --

DU-S4-09[a]
Arsenic..... 257
Arsenic, bio..... 4.9 J
Lead..... 170
Chlordane..... --

DU-S4-10
Arsenic..... 1200
Arsenic, bio..... 89
Lead..... 96
Chlordane..... 0.0009 J

DU-S4-02
Arsenic..... 540
Arsenic, bio..... --
Lead..... 69
Chlordane..... ND

DU-S4-12
Arsenic..... 75
Arsenic, bio..... --
Lead..... 26
Chlordane..... --

DU-S4-04
Arsenic..... 2500
Arsenic, bio..... 180
Lead..... 280
Chlordane..... 0.00695 J

DU-S4-07
Arsenic..... 560
Arsenic, bio..... --
Lead..... 190
Chlordane..... 0.00062 J

DU-S4-05
Arsenic..... 730
Arsenic, bio..... --
Lead..... 59
Chlordane..... 0.0009 J

Arsenic = 28 ● 3
Lead = <QL

Arsenic = 44
Lead = 10 ● 4

Arsenic = 140 ● 5
Lead = 380

Arsenic = 67
Lead = 47 ● 6

Arsenic = 240
Lead = 24 ● 7

Arsenic = 390
Lead = 100 ● 8

Arsenic = 2700
Lead = 100 ● 10

Arsenic = 1600
Lead = 120 ● 9

Arsenic = 220
Lead = 42 ● 11

Arsenic = 23 ● 16
Lead = 11

Arsenic = 280
Lead = 150 ● 13

Arsenic = 150
Lead = 42 ● 12

Arsenic = 630
Lead = 200 ● 14

Arsenic = 260
Lead = 120 ● 17

Arsenic = 1800
Lead = 85 ● 19

Arsenic = 280
Lead = 140 ● 18

Arsenic = 30 ● 22
Lead = 36

Arsenic = 26
Lead = 18 ● 21

Arsenic = 48 ● 23
Lead = 26

Arsenic = 200
Lead = 30 ● 20

Arsenic = 42 ● 24
Lead = 24

Arsenic = 25 ● 1
Lead = 9

Arsenic = 14 ● 2
Lead = 10

26 ●
Arsenic = 52
Lead = <QL

Arsenic = 54 ● 25
Lead = <QL

DU-S4-01
DU-S4-03
DU-S4-06
DU-S4-09
DU-S4-10
DU-S4-02
DU-S4-12
DU-S4-04 (DU-S4-MI)
DU-S4-05
DU-S4-07

● Open Space XRF Analysis
Building Perimeter XRF Analysis
Open Space Multi-Increment Sample
Building Perimeter Multi-Increment Sample
Newer Building Not Shown on Aerial
School Property Boundary

0 40 80
Feet

N

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-4.
Soil Analysis Results
DeSilva Elementary
278 Ainako Avenue, Hilo, HI 96720

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1
Arsenic = 31
Lead = 31

2
Arsenic = 55
Lead = 32

3
Arsenic = 41
Lead = 16

4
Arsenic = 56
Lead = 15

5
Arsenic = 94
Lead = 140

6
Arsenic = 40
Lead = 43

7
Arsenic = 83
Lead = 96

8
Arsenic = <QL
Lead = 16

9
Arsenic = <QL
Lead = 15

10
Arsenic = <QL
Lead = 85

11
Arsenic = <QL
Lead = 88

12
Arsenic = 44
Lead = 640

13
Arsenic = <QL
Lead = 180

14
Arsenic = 16
Lead = 80

15
Arsenic = <QL
Lead = 65

DU-S5-02[a]

Arsenic	**6.5 J**
Arsenic, bio	--
Lead	**1400**
Chlordane	ND

DU-S5-02

DU-S5-01

Arsenic	**25 J**
Arsenic, bio	--
Lead	**17**
Chlordane	--

DU-S5-01

- Open Space XRF Analysis
- Building Perimeter XRF Analysis
- Open Space Multi-Increment Sample
- Building Perimeter Multi-Increment Sample
- Newer Building Not Shown on Aerial
- School Property Boundary

0 30 60
Feet

N

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

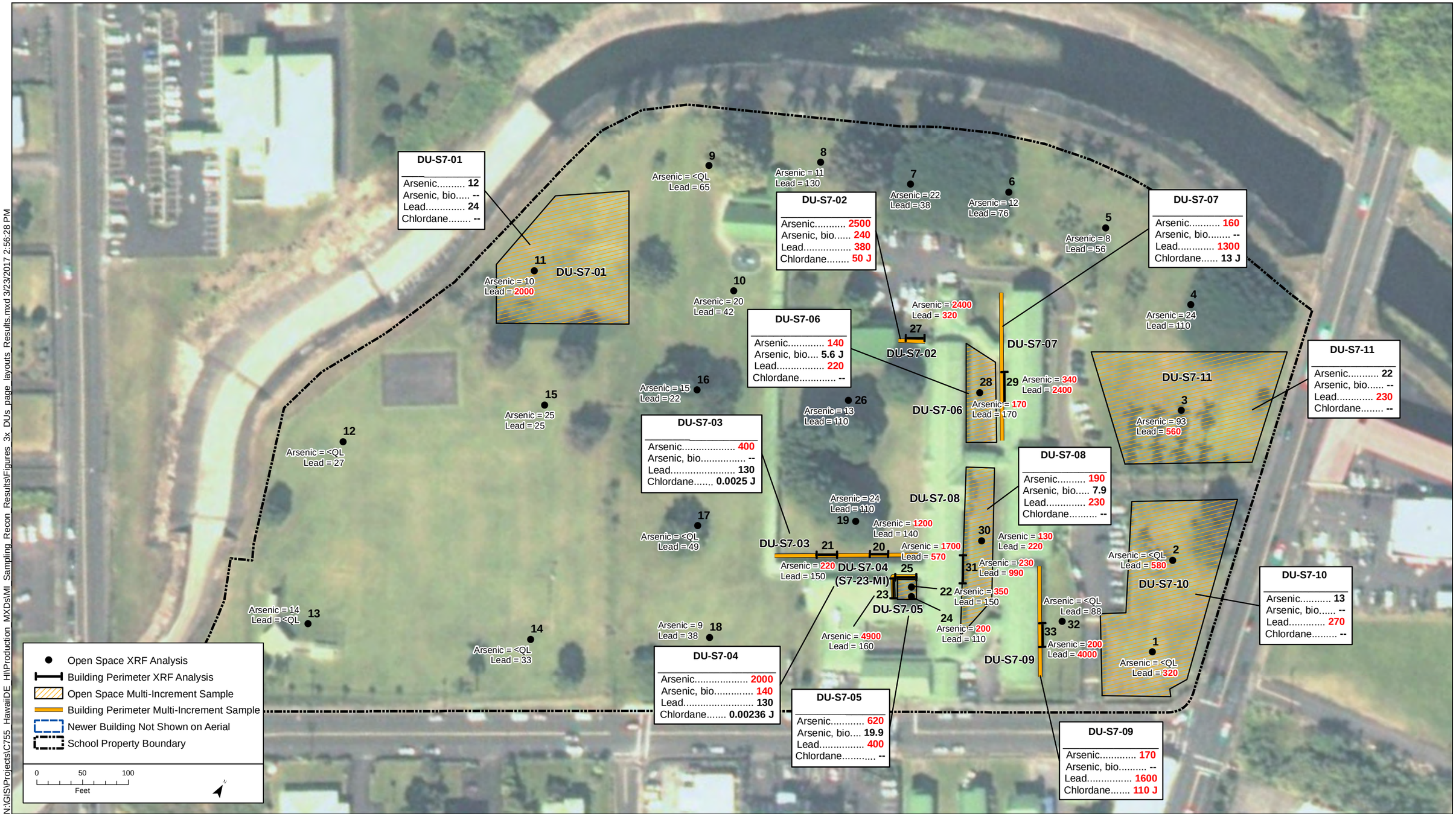
Figure 3-5.
Soil Analysis Results
Haaheo Elementary
121 Haaheo Road, Hilo, HI 96720

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. ^ Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-6.
Soil Analysis Results
Hilo Union Elementary
506 Waianuenue Avenue, Hilo, HI 96720



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integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-7.
Soil Analysis Results
Kapiolani Elementary
966 Kilauea Avenue, Hilo, HI 96720

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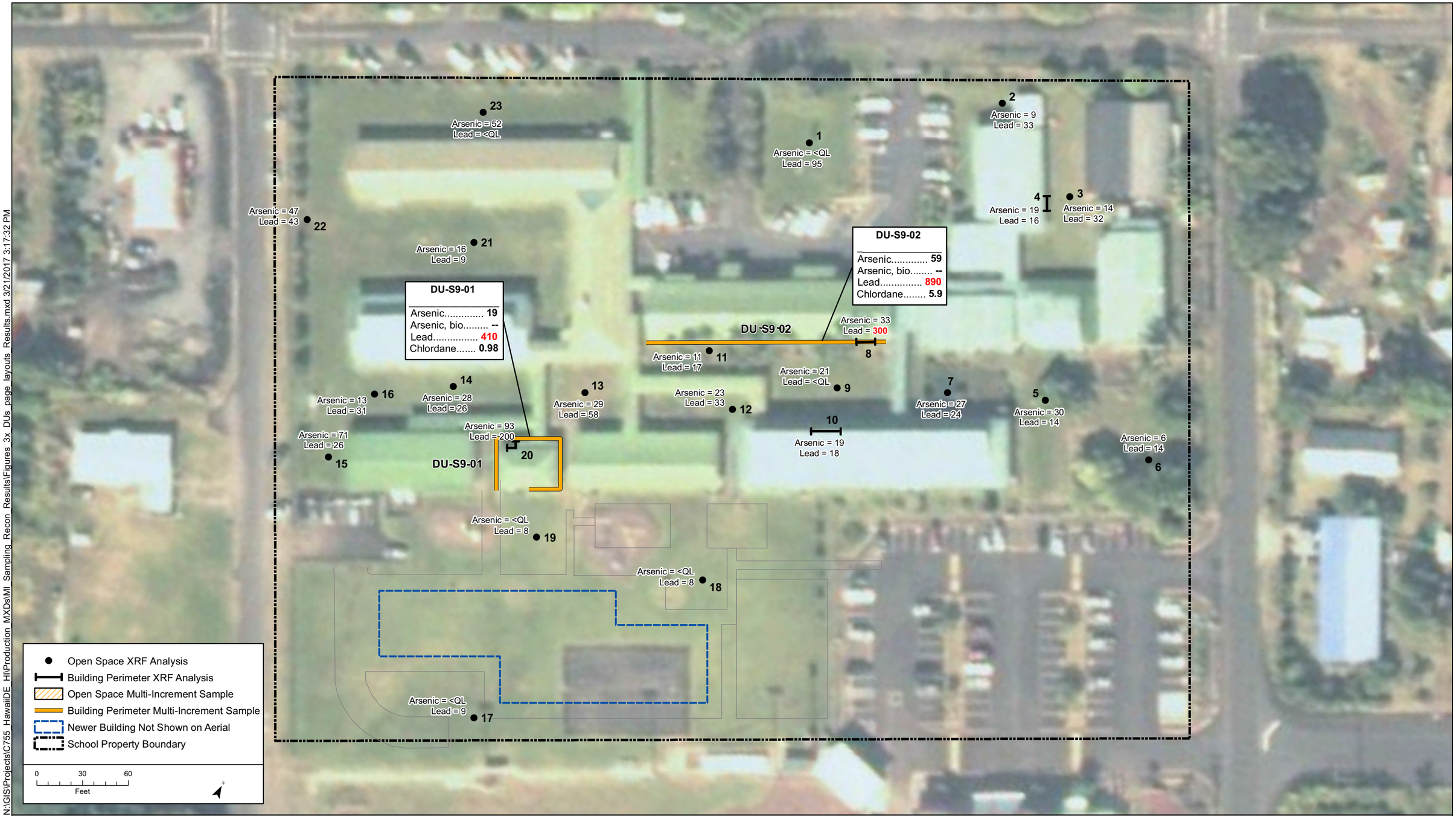
integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-8.
Soil Analysis Results
Kaumana Elementary
1710 Kaumana Drive, Hilo, HI 96720



integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-9.
Soil Analysis Results
Keaukaha Elementary
240 Desha Avenue, Hilo, HI 96720

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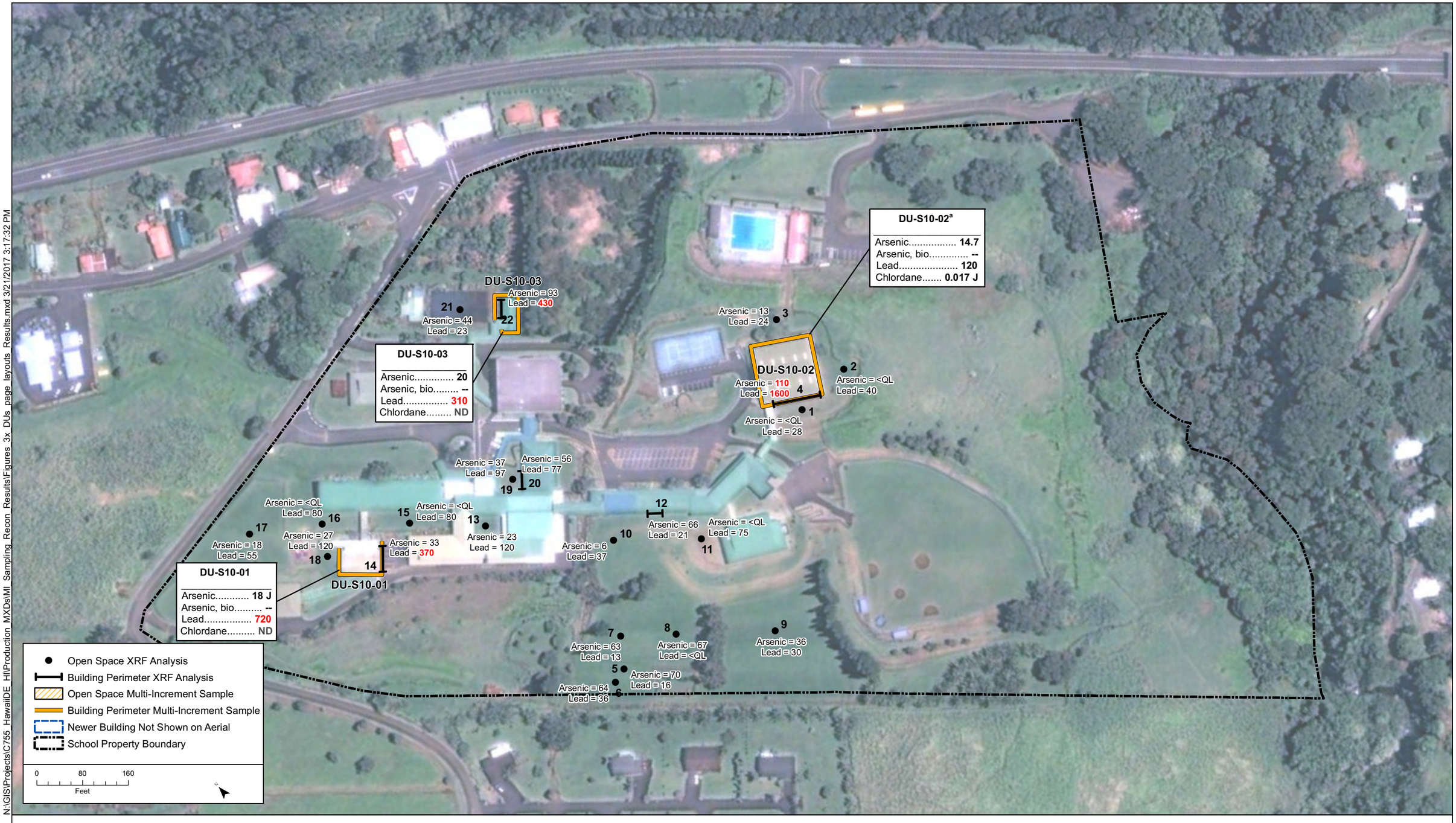

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-10.
Soil Analysis Results
Laupahoehoe High & Elementary
35-2065 Mamalahoa Highway, Laupahoehoe, HI 96764

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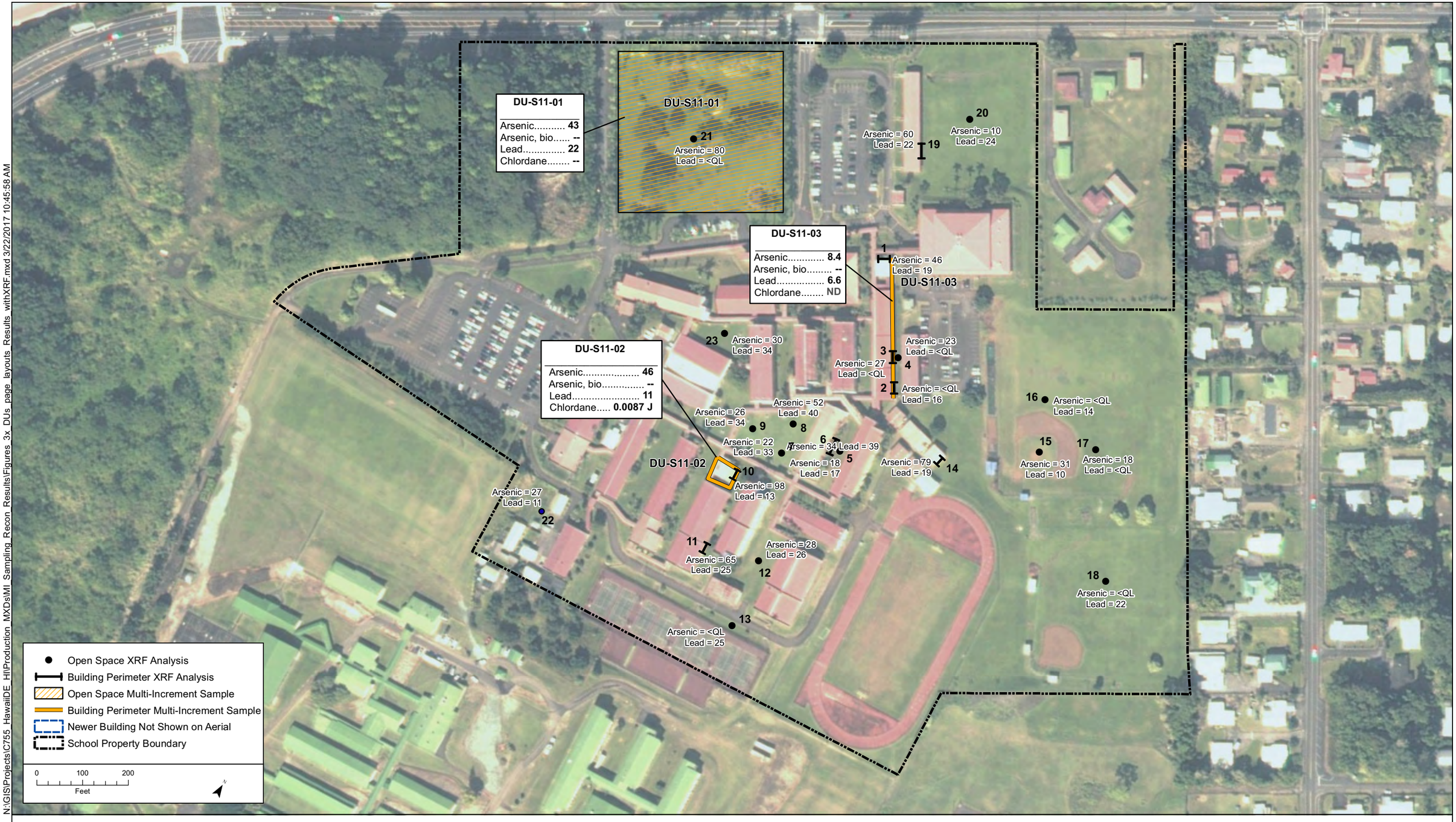

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Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-11.
Soil Analysis Results
Waiakea High
155 West Kawili Street, Hilo, HI 96720

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1
Arsenic = 15
Lead = 25

2
Arsenic = 25
Lead = <QL

3
Arsenic = 9
Lead = 25

4
Arsenic = 11
Lead = 27

5
Arsenic = 47
Lead = 11

6
Arsenic = 14
Lead = 22

7
Arsenic = 26
Lead = 280

8
Arsenic = 18
Lead = 27

9
Arsenic = <QL
Lead = 25

10
Arsenic = <QL
Lead = 33

11
Arsenic = 32
Lead = 27

12
Arsenic = <QL
Lead = <QL

13
Arsenic = <QL
Lead = 22

14
Arsenic = 150
Lead = 150

15
Arsenic = <QL
Lead = <QL

16
Arsenic = 31
Lead = 20

17
Arsenic = 45
Lead = 11

18
Arsenic = 28
Lead = 20

19
Arsenic = 17
Lead = 76

DU-S12-01

DU-S12-01[a]

Arsenic	29.3
Arsenic, bio	--
Lead	190
Chlordane	ND

DU-S12-02

DU-S12-02[a]

Arsenic	780
Arsenic, bio	320
Lead	142
Chlordane	0.003 J

- Open Space XRF Analysis
- Building Perimeter XRF Analysis
- Open Space Multi-Increment Sample
- Building Perimeter Multi-Increment Sample
- Newer Building Not Shown on Aerial
- School Property Boundary

0 100 200
Feet

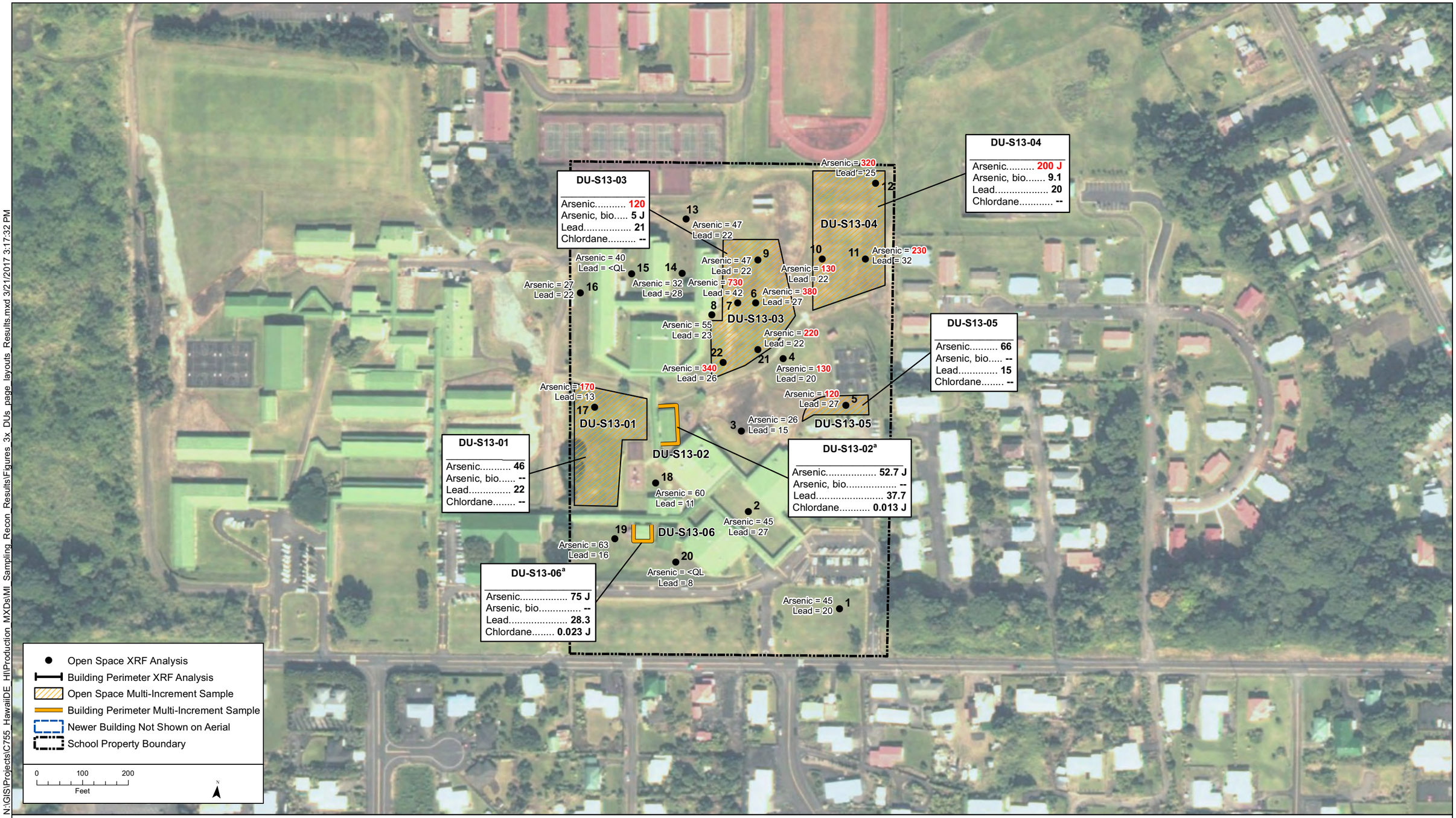
N

integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-12.
Soil Analysis Results
Waiakea Intermediate
180 West Puainako Street, Hilo, HI 96720



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Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-13.
Soil Analysis Results
Waiakea Elementary
200 West Puainako Street, Hilo, HI 96720

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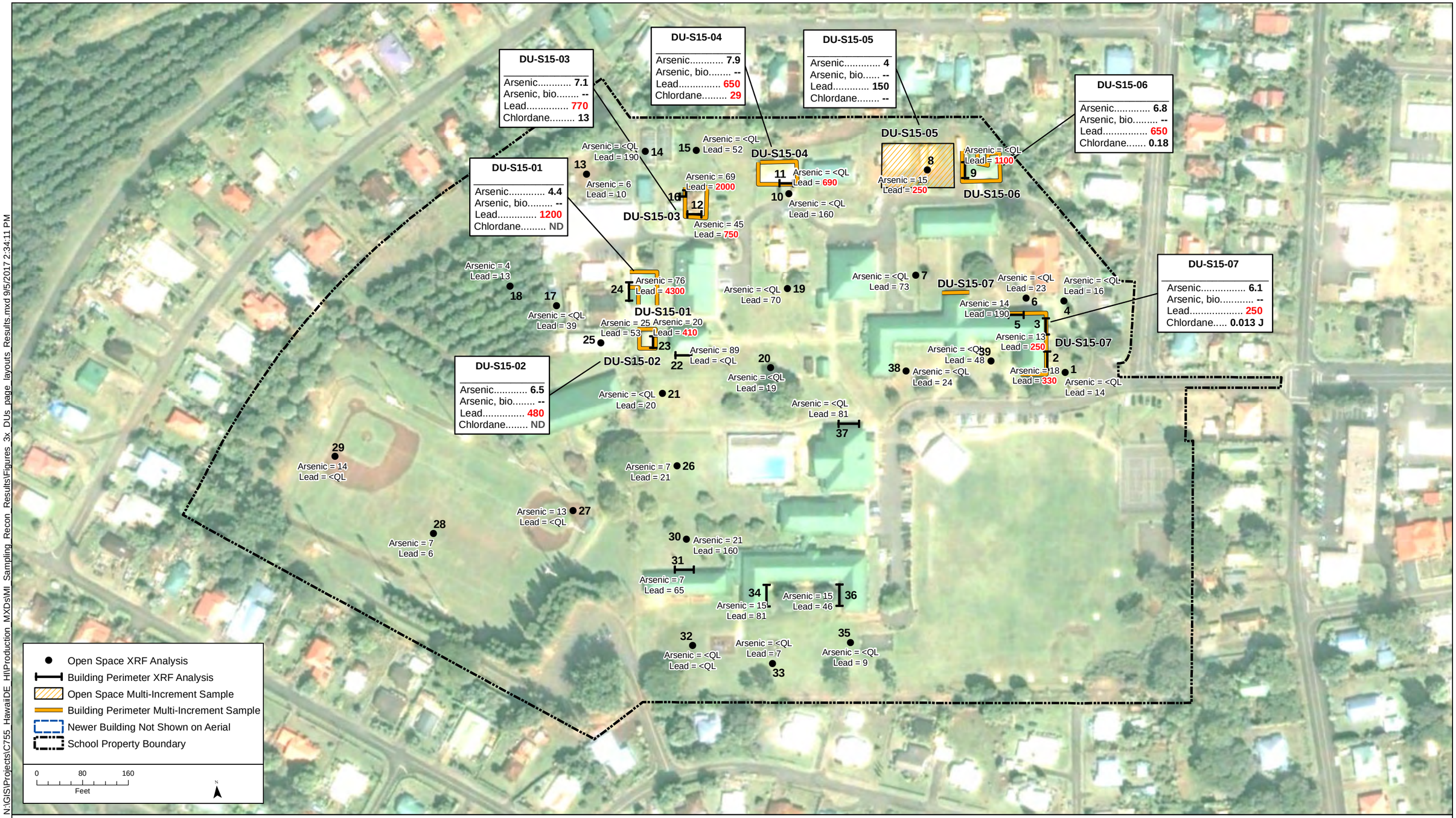
integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-14.
Soil Analysis Results
Waiakeawaena Elementary
2420 Kilauea Avenue, Hilo, HI 96720



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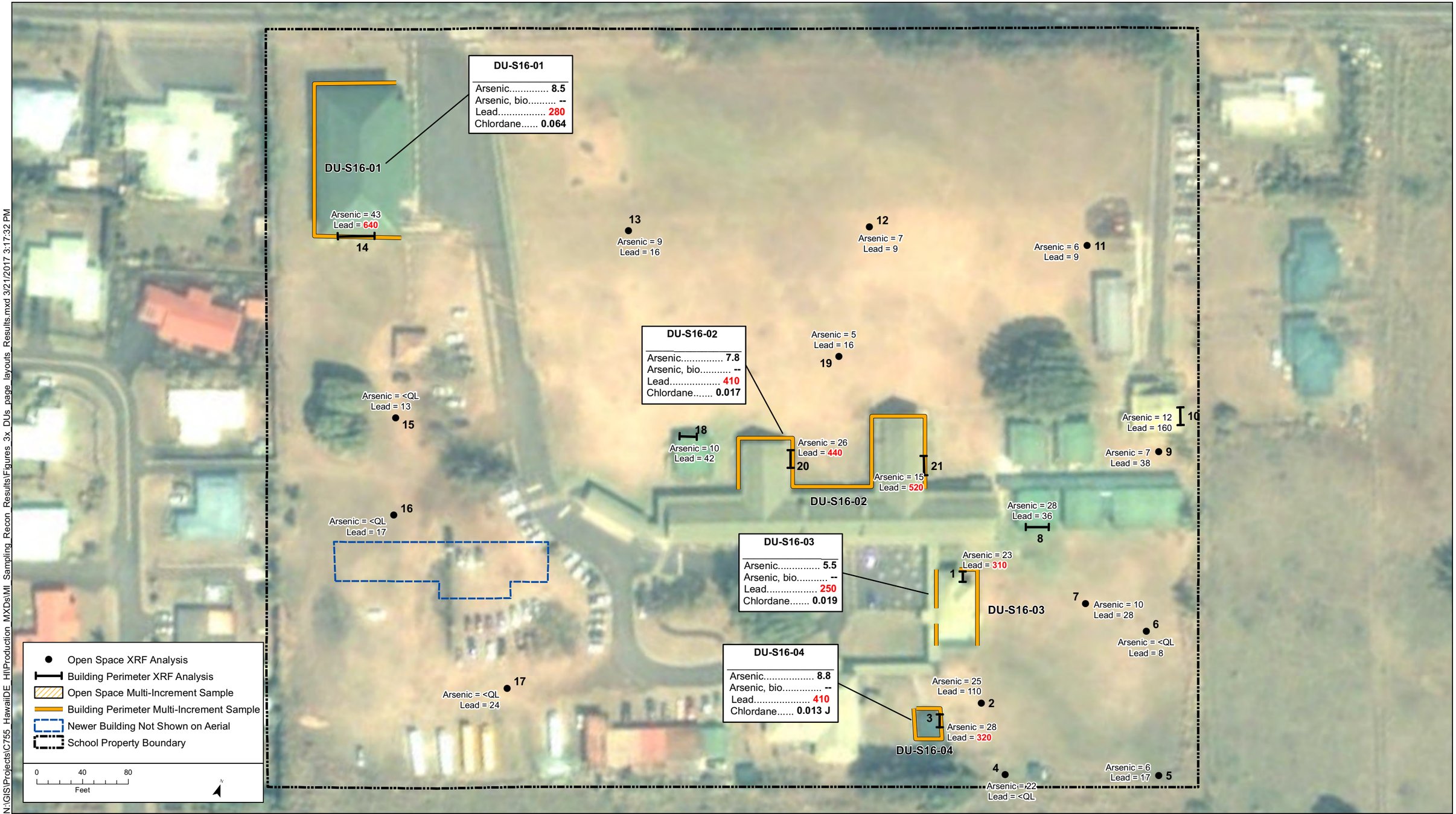
Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-15.
Soil Analysis Results
Kau High & Pahala Elementary
96-3150 Pikake Street, Pahala, HI 96777



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integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. ^ Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-16.
Soil Analysis Results
Naalehu Elementary & Intermediate
95-5545 Mamalahoa Highway, Naalehu, HI 96772

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integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-17.
Soil Analysis Results
Keaau High
16-725 Keaau-Pahoa Road, Keaau, HI 96749

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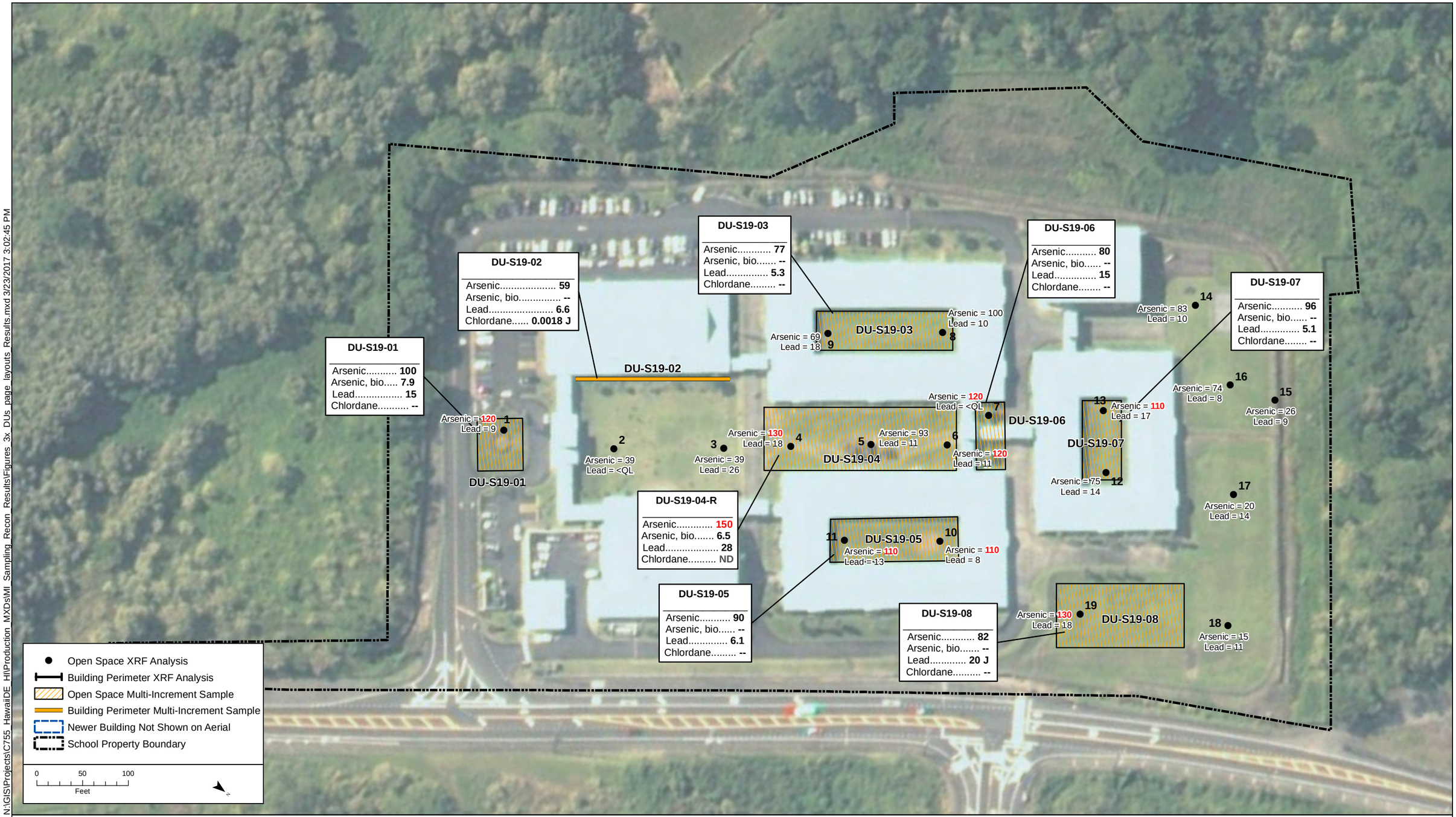
Note:
This facility was not screened and no further sampling is proposed.

Sources:
1. Aerial: NAIP, 2011

Figure 3-18.
Soil Analysis Results
Keaau Middle
16-565 Keaau Pahoa Road, Keaau, HI 96749



integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. ^a Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-19.
Soil Analysis Results
Keaau Elementary
16-680 Keaau-Pahoa Road, Keaau, HI 96749

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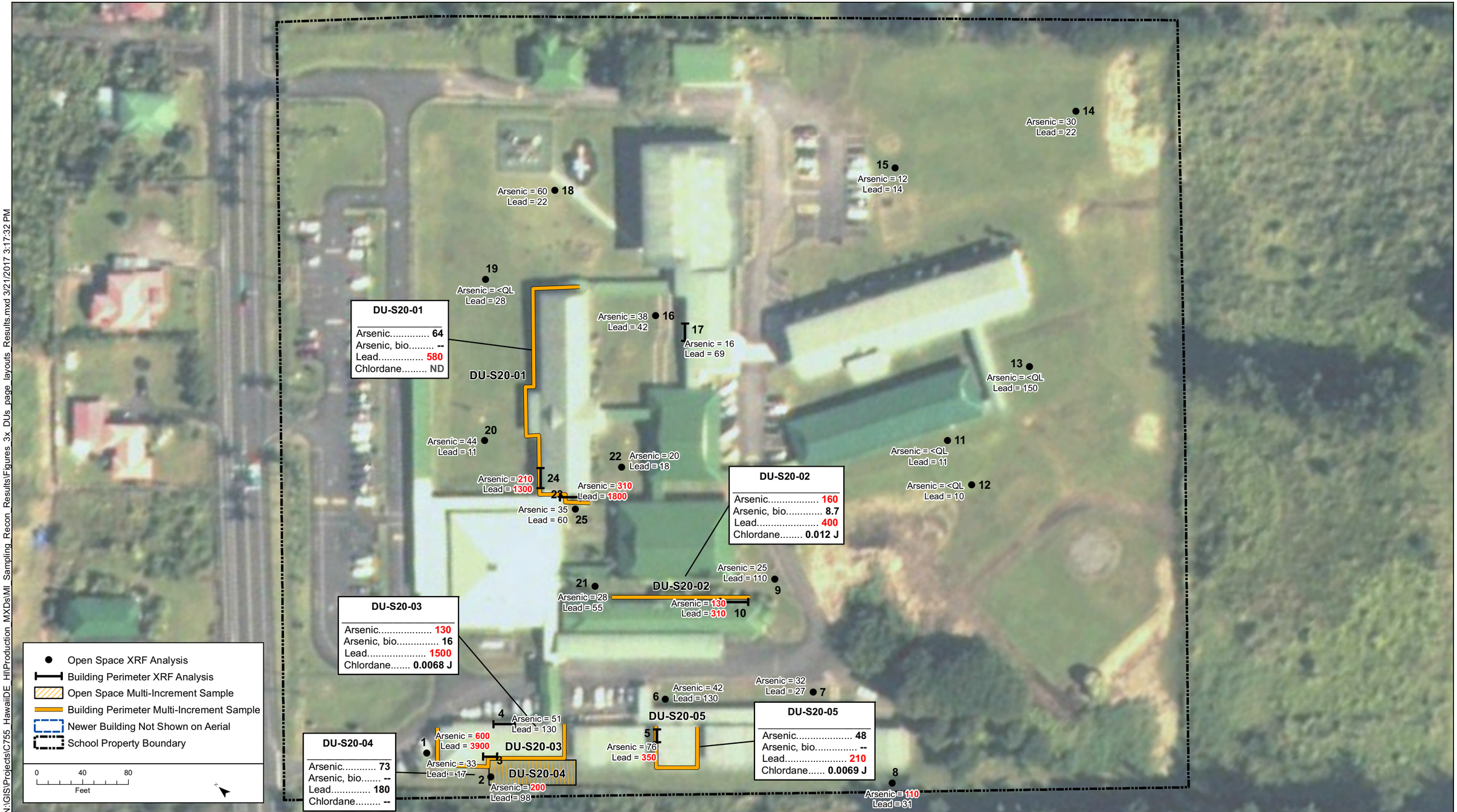
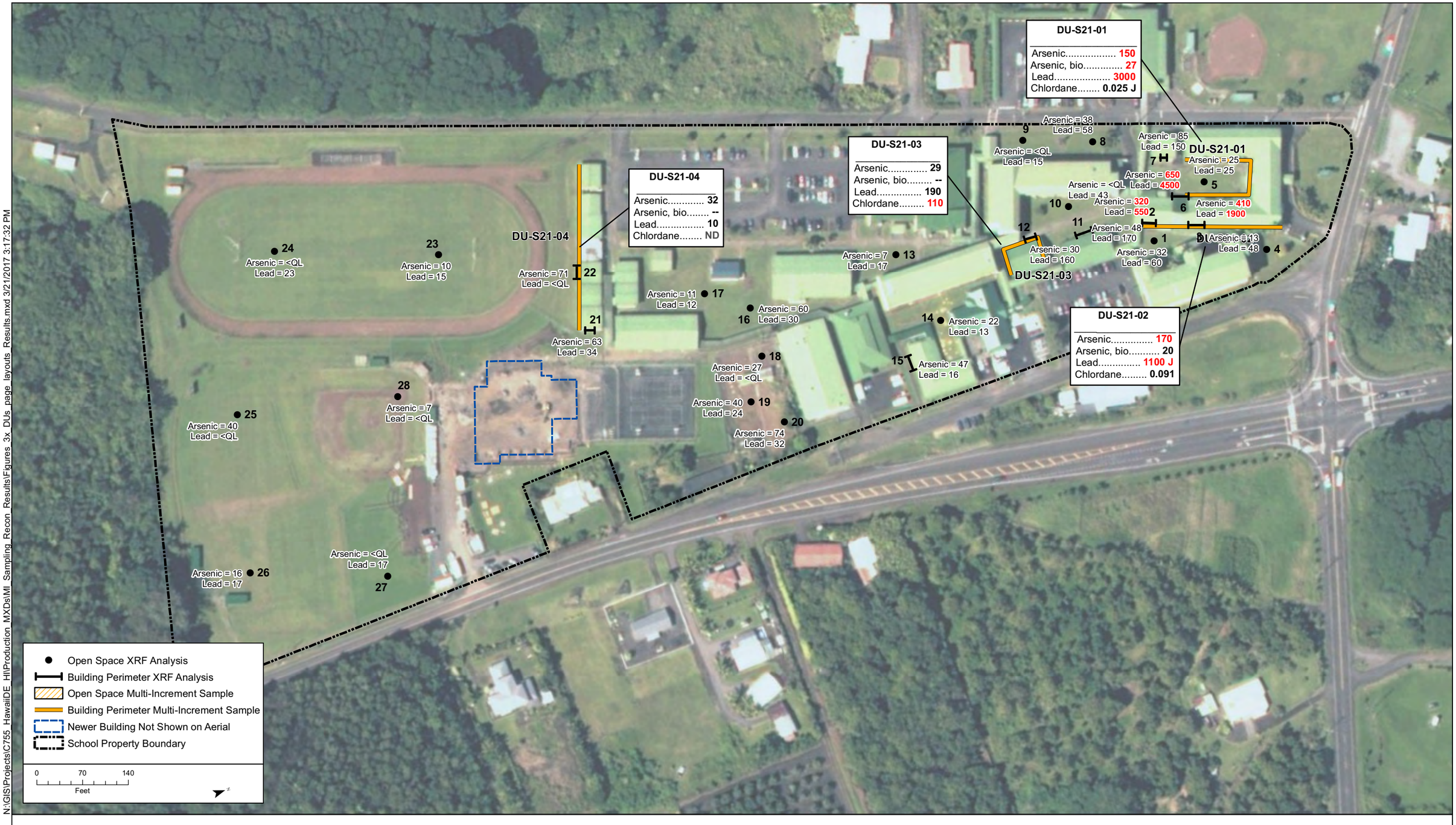


integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-20.
Soil Analysis Results
Mountain View Elementary
18-1235 Volcano Road, Mountain View, HI 96771



integral consulting inc.

Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. [a] Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-21.
Soil Analysis Results
Pahoa High & Intermediate
15-3038 Pahoa Village Road, Pahoa, HI 96778

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Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. # Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-22.
Soil Analysis Results
Keonepoko Elementary
15-890 Kahakai Boulevard, Pahoa, HI 96778

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DU-S23-01

Arsenic..... **46**
Arsenic, bio..... **--**
Lead..... **300 J**
Chlordane..... **ND**

DU-S23-02

Arsenic..... **18**
Arsenic, bio..... **--**
Lead..... **44 J**
Chlordane..... **ND**

DU-S23-03

Arsenic..... **22**
Arsenic, bio..... **--**
Lead..... **230 J**
Chlordane..... **22 J**

- 1: Arsenic = 42, Lead = 85
- 2: Arsenic = 7, Lead = 27
- 3: Arsenic = 11, Lead = <QL
- 4: Arsenic = <QL, Lead = 14
- 5: Arsenic = <QL, Lead = 8
- 6: Arsenic = <QL, Lead = 9
- 7: Arsenic = 8, Lead = 11
- 8: Arsenic = 8, Lead = 20
- 9: Arsenic = 14, Lead = 24
- 10: Arsenic = 17, Lead = 39
- 11: Arsenic = 56, Lead = 25
- 12: Arsenic = 15, Lead = 110
- 13: Arsenic = 35, Lead = 28
- 14: Arsenic = 54, Lead = 19
- 15: Arsenic = 53, Lead = 310
- 16: Arsenic = 22, Lead = 48
- 17: Arsenic = 28, Lead = 170
- 18: Arsenic = 40, Lead = 23
- 19: Arsenic = 10, Lead = 28
- 20: Arsenic = 27, Lead = 190

- Open Space XRF Analysis
- Building Perimeter XRF Analysis
- Open Space Multi-Increment Sample
- Building Perimeter Multi-Increment Sample
- Newer Building Not Shown on Aerial
- School Property Boundary

0 40 80
Feet

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Notes:
1. All results in mg/kg
2. A result in red indicates an exceedance of lowest Action Level
3. Arsenic, bio = bioaccessible arsenic
4. J = Estimated value
5. -- = Not analyzed
6. ND = Not detected
7. <QL = result less than XRF instrument quantification level
8. " Concentrations are average of triplicate sample results

Sources:
1. Aerial: NAIP, 2011

Figure 3-23.
Soil Analysis Results
Pahoa Elementary
15-3030 Pahoa Village Road, Pahoa, HI 96778

TABLES

Table 1-1. Facilities for Environmental Hazard Assessment

HAWAII DISTRICT	
Hilo-Laupahoehoe-Waiakea	
HILO COMPLEX	
1	Hilo High
2	Hilo Intermediate
3	Kalanianaole Elementary & Intermediate
4	DeSilva Elementary
5	Haaheo Elementary
6	Hilo Union Elementary
7	Kapiolani Elementary
8	Kaumana Elementary
9	Keaukaha Elementary
LAUPAHOEHOE COMPLEX	
10	Laupahoehoe High & Elementary
WAIAKEA COMPLEX	
11	Waiakea High
12	Waiakea Intermediate
13	Waiakea Elementary
14	Waiakeawaena Elementary
Kau-Keaau-Pahoa	
KAU COMPLEX	
15	Kau High & Pahala Elementary
16	Naalehu Elementary & Intermediate
KEAAU COMPLEX	
17	Keaau High
18	Keaau Middle
19	Keaau Elementary
20	Mountain View Elementary
PAHOA COMPLEX	
21	Pahoa High & Intermediate
22	Keonepoko Elementary
23	Pahoa Elementary

Table 2-1. Soil Categories for Arsenic

Soil Category	Action Level (mg/kg)[a]	Notes
A (Background)	≤24 (total As)	HDOH natural background action level for arsenic in soil is 24 mg/kg.
B (Low Risk)	>24 (total As) and ≤23 (BA As)b	This category considers soils with arsenic above background levels, but below the 23 mg/kg bioaccessible arsenic soil action level for residences and young children (HDOH 2016, Table I-1).
C (Moderate Risk)	>23 to ≤95 (BA As)	This category considers soils with bioaccessible arsenic above the 23 mg/kg action level, but below the 95 mg/kg soil action level for school workers and contractors (HDOH 2016, Table I-2).
D (High Risk)	>95 (BA As)	Category D soils pose a potential risk to school workers and contractors, even in low activity areas where work may potentially occur.

Notes:

Table applies to surface (0–6 in. depth) soils at school campuses.

As = arsenic

BA = bioaccessible

HDOH = Hawaii Department of Health

mg/kg = milligrams of contaminant per kilogram of (< 2mm particle size) soil.

[a] Action levels are based on natural background concentrations and residential and commercial/industrial direct-exposure levels presented in HDOH (2017a).

b Not all soil samples with total arsenic >24 mg/kg were tested for bioaccessible arsenic. In particular, soils with total arsenic ≤100 mg/kg were anticipated to exhibit bioaccessible arsenic ≤23 mg/kg (see Section 2.1.1, footnote 1) without further bioaccessible arsenic testing, and were assumed to be Category B.

Table 2-2. Soil Categories for Lead

Soil Category	Action Level (mg/kg)[a]	Notes
A (Background)	≤73	HDOH natural background action level for lead is 73 mg/kg.
B (Low Risk)	>73 to ≤200	This category considers soils with lead above background levels, but below the 200 mg/kg soil action level for residences and young children (HDOH 2016, Table I-1).
C (Moderate Risk)	>200 to ≤800	This category considers soils with lead above the 200 mg/kg action level, but below the 800 mg/kg soil action level for school workers and contractors (HDOH 2016, Table I-2).
D (High Risk)	>800	Category D soils pose a potential risk to school workers and contractors, even in low activity areas where work may potentially occur.

Notes:

Table applies to surface (0–6 in. depth) soils at school campuses.

HDOH = Hawaii Department of Health

mg/kg = milligrams of contaminant per kilogram of (< 2mm particle size) soil.

[a] Action levels are based on natural background concentrations and residential and commercial/industrial direct-exposure levels presented in HDOH (2017a).

Table 2-3. Soil Categories and General Actions for Chlordane

Soil Category	Action Level (mg/kg)[a]	Notes
A (Negligible Risk)	≤ 7.0	This category considers soils with Technical Chlordane up to an action level of 7.0 mg/kg, based on a conservative target Hazard Quotient of 0.2 for young children (HDOH 2016, Table I-1).
B (Low Risk)	>7.0 to ≤17	This category considers soils with Technical Chlordane above 7.0 mg/kg but below the 17 mg/kg action level for residences and young children, based on a target Hazard Quotient of 1.0 for young children (HDOH 2016, Table I-1).
C (Moderate Risk)	>17 to ≤77	This category considers soils with chlordane above the 17 mg/kg action level, but below the 77 mg/kg action soil level for school workers and contractors (HDOH 2016, Table I-2).
D (High Risk)	>77	Category D soils pose a potential risk to school workers and contractors, even in low activity areas where work may potentially occur.

Notes:

Table applies to surface (0–6 in. depth) soils at school campuses.

HDOH = Hawaii Department of Health

mg/kg = milligrams of contaminant per kilogram of (< 2mm particle size) soil.

[a] Action levels are based on natural background concentrations and residential and commercial/industrial direct-exposure levels presented in HDOH (2017a).

Table 2-4. Action Levels, Laboratory Methods, and Detection Limits for Arsenic, Lead, and Chlordane

Analyte	Preparation Method[a]	Analytical Method	MDL[b] (mg/kg)	EAL[c] (mg/kg)
Arsenic	EPA 3050B	EPA 6020A	0.18	use bioaccessible
Arsenic (bioaccessible)	SBRC-gastric[d]	EPA 6010C	0.32	23
Lead	EPA 3050B	EPA 6020A	0.048	200
Technical Chlordane	EPA 3546	EPA 8081B	0.00025	17

Notes:

EAL = environmental action level
EPA = U.S. Environmental Protection Agency
MDL = method detection limit
SBRC = Solubility/Bioavailability Research Consortium

[a] Sample digestion or extraction.

[b] Laboratory method detection limits are project specific, and reported by TestAmerica Laboratories, Inc. facility in Tacoma, WA.

[c] Hawaii EALs for unrestricted land use.

[d] SBRC, gastric phase test (Kelley et al. 2002).

Table 3-1a. XRF Soil Screening Results—Hilo High

Reconnaissance XRF Soil Screening
Date: 7/14/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<5.1	48	40	<QL	80
2	Open Space	9.8	33	35	15	51
3	Open Space	26	11	35	40	17
4	Open Space	53	120	40	88	200
5	Open Space	10	56	35	15	86
6	Bldg Perimeter	72	440	10	80	490
7	Open Space	17	230	45	31	420
8	Open Space	12	50	40	20	83
9	Bldg Perimeter	52	27	10	58	30
10	Open Space	14	100	45	25	180
11	Open Space	<6.0	76	40	<QL	130
12	Open Space	12	51	45	22	93
13	Open Space	<4.7	28	40	<QL	47
14	Open Space	15	35	25	20	47

Notes:
Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-1b. Multi-increment Soil Sampling Results—Hilo High

Sample Identification:			S1-01		S1-02		S1-03	
Sample Collection Date:			2016-12-19		2016-12-19		2016-12-16	
Sample Type:			Open Space		Bldg Perimeter		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)								
Arsenic, bioaccessible	23	2	--		18		--	
Arsenic, total	100	1	28	J	**250**	J	16	J
Chromium, hexavalent	30	2	--		--		--	
Chromium, total	1100	3	--		--		--	
Copper, total	630	2	--		--		--	
Lead, total	200	2	99		**860**		180	
Organochlorine Pesticides (mg/kg)								
4,4'-DDD	2.3	2	--		--	ND	--	
4,4'-DDE	2.0	2	--		--	ND	--	
4,4'-DDT	1.9	2	--		1.5	J	--	
Aldrin	3.9	2	--		--	ND	--	
Dieldrin	2.5	2	--		0.51	J	--	
Endosulfans	94	2	--		0.38	J	--	
Endrins	3.8	2	--		0.37	J	--	
gamma-BHC (Lindane)	0.57	2	--		--	ND	--	
Methoxychlor	63	2	--		0.068	J	--	
Technical Chlordane	17	2	--		--	ND	--	
Toxaphene	0.49	2	--		--	ND	--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels.
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-2a. XRF Soil Screening Results—Hilo Intermediate

Reconnaissance XRF Soil Screening
Date: 7/14/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<3.4	16	45	<QL	29
2	Open Space	7.7	65	45	14	120
3	Open Space	34	29	40	57	48
4	Open Space	41	100	45	75	180
5	Open Space	51	100	40	85	170
6	Open Space	27	93	35	42	140
7	Open Space	14	32	40	23	53
8	Open Space	19	41	45	35	75
9	Open Space	<3.6	23	45	<QL	42
10	Garden	26	15	20	33	19
11	Bldg Perimeter	92	2300	10	100	2600
12	Open Space	9.6	64	35	15	98
13	Bldg Perimeter	200	1900	40	330	3200
14	Bldg Perimeter	37	310	20	46	390
15	Open Space	21	130	40	35	220
16	Open Space	10	140	35	15	220
17	Open Space	<4.9	47	45	<QL	85
18	Open Space	<7.0	130	40	<QL	220
19	Open Space	5.4	72	40	9	120

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-2b. Multi-increment Soil Sampling Results—Hilo Intermediate

Sample Identification:			S2-01		S2-02		S2-03		S2-04	
Sample Collection Date:			2016-12-03		2016-12-03		2016-11-25		2016-11-25	
Sample Type:			Bldg Perimeter		Open Space		Open Space		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)										
Arsenic, bioaccessible	23	2	--	ND	--		--		--	
Arsenic, total	100	1	**140**	J	32	J	6.8	J	14	J
Chromium, hexavalent	30	2	1.1	J	--		--		--	
Chromium, total	1100	3	650		--		--			
Copper, total	630	2	270		--		--		--	
Lead, total	200	2	**2100**		**290**		76	J	140	J
Organochlorine Pesticides (mg/kg)										
4,4'-DDD	2.3	2	0.27	J	--		--		--	
4,4'-DDE	2.0	2	0.016	J	--		--		--	
4,4'-DDT	1.9	2	0.016	J	--		--		--	
Aldrin	3.9	2	0.0015	J	--		--		--	
Dieldrin	2.5	2	--	ND	--		--		--	
Endosulfans	94	2	0.012	J	--		--		--	
Endrins	3.8	2	0.085	J	--		--		--	
gamma-BHC (Lindane)	0.57	2	--	ND	--		--		--	
Methoxychlor	63	2	0.00072	J	--		--		--	
Technical Chlordane	17	2	15	J	--		--		--	
Toxaphene	0.49	2	--	ND	--		--		--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-3a. XRF Soil Screening Results—Kalanianaole Elementary & Intermediate

Reconnaissance XRF Soil Screening
Date: 7/13/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Garden	8.4	31	40	14	52
2	Garden	31	12	40	52	20
3	Garden	8.9	28	45	16	51
4	Garden	120	280	40	200	470
5	Bldg Perimeter	50	570	40	83	950
6	Open Space	13	170	45	24	310
7	Open Space	12	59	30	17	84
8	Open Space	140	36	50	280	72
9	Open Space	20	140	40	33	230
10	Open Space	<6.0	84	35	<QL	130
11	Open Space	<4.5	37	50	<QL	74
12A	Bldg Perimeter	17	81	35	26	120
12B	Bldg Perimeter	35	590	5	37	620
13	Open Space	<4.2	43	40	<QL	72
14	Open Space	5.2	40	40	9	67
15	Open Space	<3.6	24	55	<QL	53
16	Open Space	<4.6	44	40	<QL	73
17	Open Space	<4.0	21	35	<QL	32
18	Open Space	<4.5	22	40	<QL	37
19	Open Space	<4.0	29	40	<QL	48
20	Open Space	<4.5	43	35	<QL	66
21	Open Space	26	32	40	43	53

Notes:
Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-3b. Multi-increment Soil Sampling Results—Kalanianaole Elementary & Intermediate

Sample Identification:			S3-01		S3-02A		S3-02B		S3-02C		S3-03		S3-04A		S3-04B		S3-04C		S3-05A		S3-05B		S3-05C	
Sample Collection Date:			2017-01-05		2017-01-02		2017-01-02		2017-01-02		2017-01-05		2017-01-05		2017-01-05		2017-01-05		2017-01-03		2017-01-03		2017-01-03	
Sample Type:			Garden		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Open Space		Open Space		Open Space		Open Space		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																								
Arsenic, bioaccessible	23	2	--		--		--		--		--		--		--	ND	--		--		--		--	
Arsenic, total	100	1	60	J	43		38		38		12	J	**110**	J	**110**	J	**110**	J	12		15		15	
Chromium, hexavalent	30	2	--		--		--		--		--		--		--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--		--		--		--		--		--		--	
Copper, total	630	2	--		--		--		--		--		--		--		--		--		--		--	
Lead, total	200	2	**600**		**710**	J	**760**	J	**710**	J	**270**		75		79		77		**1800**	J	**1900**	J	**1700**	J
Organochlorine Pesticides (mg/kg)																								
4,4'-DDD	2.3	2	--		--		--		--		--		--		--		--		--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	--		0.0087	J	0.0054	J	0.012	J	--		--		--		--		--	ND	0.0080	J	--	ND
4,4'-DDT	1.9	2	--		0.021	J	0.016	J	0.031	J	--		--		--		--		0.030	J	0.022	J	0.018	J
Aldrin	3.9	2	--		--		--		--		--		--		--		--		--	ND	--	ND	--	ND
Dieldrin	2.5	2	--		--	ND	--	ND	--	ND	--		--		--		--		--	ND	--	ND	0.014	J
Endosulfans	94	2	--		--		--		--		--		--		--		--		0.017	J	0.0093	J	0.0088	J
Endrins	3.8	2	--		--		--		--		--		--		--		--		0.020	J	--	ND	0.0075	J
gamma-BHC (Lindane)	0.57	2	--		--	ND	--	ND	--	ND	--		--		--		--		--	ND	--	ND	--	ND
Methoxychlor	63	2	--		--		--		--		--		--		--		--		0.021	J	0.016	J	0.011	J
Technical Chlordane	17	2	--		3.5	J	4.6	J	12	J	--		--		--		--		**17**	J	12	J	16	J
Toxaphene	0.49	2	--		--	ND	--	ND	--	ND	--		--		--		--		--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-4a. XRF Soil Screening Results—DeSilva Elementary

Reconnaissance XRF Soil Screening
Date: 7/15/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	19	7.0	25	25	9
2	Open Space	7.0	5.0	50	14	10
3	Open Space	17	<7	40	28	<QL
4	Open Space	22	5.0	50	44	10
5	Open Space	55	150	60	140	380
6	Open Space	30	21	55	67	47
7	Open Space	110	11	55	240	24
8	Open Space	130	25	40	220	42
9	Bldg Perimeter	1400	100	15	1600	120
10	Bldg Perimeter	2300	89	15	2700	100
11	Bldg Perimeter	330	88	15	390	100
12	Open Space	85	23	45	150	42
13	Open Space	140	77	50	280	150
14	Bldg Perimeter	590	190	6	630	200
16	Open Space	21	10	10	23	11
17	Open Space	130	60	50	260	120
18	Open Space	140	69	50	280	140
19	Bldg Perimeter	1200	55	35	1800	85
20	Open Space	100	15	50	200	30
21	Open Space	17	12	35	26	18
22	Open Space	15	18	50	30	36
23	Open Space	24	13	50	48	26
24	Open Space	21	12	50	42	24
25	Garden	35	<8	35	54	<QL
26	Garden	34	<9	35	52	<QL

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-4b. Multi-increment Soil Sampling Results—DeSilva Elementary

Sample Identification:			S4-01		S4-02		S4-03		S4-9-MI		S4-05		S4-06		S4-07		S4-09A		S4-09B		S4-09C		S4-10		S4-12	
Sample Collection Date:			2016-11-11		2016-11-11		2016-11-11		2016-07-22		2016-11-11		2016-11-11		2016-11-11		2016-11-11		2016-11-11		2016-11-11		2016-11-11		2016-11-11	
Sample Type:			Drainage Ditch		Bldg Perimeter		Open Space		Bldg Perimeter		Bldg Perimeter		Open Space		Bldg Perimeter		Open Space		Open Space		Open Space		Bldg Perimeter		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																										
Arsenic, bioaccessible	23	2	3.7	J	--		--	ND	**180**		--		20		--		--	ND	6.1		--	ND	**89**		--	
Arsenic, total	100	1	**270**		**540**		**130**		**2500**		**730**		**550**		**560**		**260**		**320**		**190**		**1200**		75	
Chromium, hexavalent	30	2	--		--		--		--		--		--		--		--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--		--		--		--		--		--		--		--	
Copper, total	630	2	--		--		--		--		--		--		--		--		--		--		--		--	
Lead, total	200	2	**330**		69		39		**280**		59		120		190		180		**210**		120		96		26	
Organochlorine Pesticides (mg/kg)																										
4,4'-DDD	2.3	2	--		0.00085		--		--	ND	--	ND	--		0.00013	J	--		--		--		0.00048	J	--	
4,4'-DDE	2.0	2	--		--	ND	--		0.00034	J	0.00031	J	--		0.00065	J	--		--		--		0.00014	J	--	
4,4'-DDT	1.9	2	--		0.000059	J	--		--	ND	0.00065	J	--		0.00054	J	--		--		--		0.0029		--	
Aldrin	3.9	2	--		--	ND	--		--	ND	--	ND	--		--	ND	--		--		--		--	ND	--	
Dieldrin	2.5	2	--		0.00056	J	--		--	ND	0.00072	J	--		--	ND	--		--		--		0.0052		--	
Endosulfans	94	2	--		0.0019	J	--		--	ND	0.00084	J	--		0.00072	J	--		--		--		0.00057	J	--	
Endrins	3.8	2	--		0.0058	J	--		0.0071	J	0.17	J	--		0.011	J	--		--		--		0.0041	J	--	
gamma-BHC (Lindane)	0.57	2	--		--	ND	--		--	ND	--	ND	--		--	ND	--		--		--		--	ND	--	
Methoxychlor	63	2	--		--	ND	--		--	ND	--	ND	--		--	ND	--		--		--		--	ND	--	
Technical Chlordane	17	2	--		--	ND	--		0.0070	J	0.00086	J	--		0.00062	J	--		--		--		0.00087	J	--	
Toxaphene	0.49	2	--		--	ND	--		--	ND	--	ND	--		--	ND	--		--		--		--	ND	--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-5a. XRF Soil Screening Results—Haaheo Elementary

Reconnaissance XRF Soil Screening
Date: 7/13/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	20	20	35	31	31
2	Open Space	36	21	35	55	32
3	Garden	33	13	20	41	16
4	Garden	45	12	20	56	15
5	Open Space	61	94	35	94	140
6	Open Space	24	26	40	40	43
7	Bldg Perimeter	58	67	30	83	96
8	Open Space	<3.0	9.5	40	<QL	16
9	Open Space	<4.5	10	35	<QL	15
10	Open Space	<5.5	55	35	<QL	85
11	Open Space	<5.4	44	50	<QL	88
12	Bldg Perimeter	33	480	25	44	640
13	Open Space	<7.0	120	35	<QL	180
14	Open Space	8.7	44	45	16	80
15	Open Space	<4.4	42	35	<QL	65

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-5b. Multi-increment Soil Sampling Results—Haaheo Elementary

Sample Identification:			S5-01		S5-02A		S5-02B		S5-02C	
Sample Collection Date:			2016-12-20		2016-12-20		2016-12-20		2016-12-20	
Sample Type:			Open Space		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)										
Arsenic, bioaccessible	23	2	--		--		--		--	
Arsenic, total	100	1	25	J	7.2	J	6.0	J	6.4	J
Chromium, hexavalent	30	2	--		--		--		--	
Chromium, total	1100	3	--		--		--			
Copper, total	630	2	--		--		--		--	
Lead, total	200	2	17		**1600**		**1300**		**1300**	
Organochlorine Pesticides (mg/kg)										
4,4'-DDD	2.3	2	--		--	ND	--	ND	0.0012	J
4,4'-DDE	2.0	2	--		0.0028		0.0021	J	0.0024	J
4,4'-DDT	1.9	2	--		0.0075	J	0.0077	J	0.0087	J
Aldrin	3.9	2	--		0.00028	J	0.00036	J	--	ND
Dieldrin	2.5	2	--		--	ND	--	ND	--	ND
Endosulfans	94	2	--		0.0023	J	0.0018	J	0.0019	J
Endrins	3.8	2	--		0.014	J	0.011	J	0.019	J
gamma-BHC (Lindane)	0.57	2	--		--	ND	--	ND	--	ND
Methoxychlor	63	2	--		--	ND	0.0070	J	--	ND
Technical Chlordane	17	2	--		--	ND	--	ND	--	ND
Toxaphene	0.49	2	--		--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-6a. XRF Soil Screening Results—Hilo Union Elementary

Reconnaissance XRF Soil Screening
Date: 7/14/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<5.5	75	40	<QL	130
2	Open Space	<5.0	57	40	<QL	95
3	Open Space	5.7	46	35	9	71
4	Bldg Perimeter	28	640	15	33	750
5	Garden	16	420	35	25	650
6	Open Space	5.2	44	35	8	68
7	Open Space	<4.9	53	40	<QL	88
8	Open Space	<7.0	150	40	<QL	250
9	Bldg Perimeter	57	2700	10	63	3000
10	Bldg Perimeter	30	1700	15	35	2000
11	Bldg Perimeter	17	610	15	20	720
12	Open Space	14	100	30	20	140
13	Open Space	<7.0	140	35	<QL	220
14	Open Space	<6.0	96	35	<QL	150
15	Garden	26	57	15	31	67
16	Garden	31	41	15	36	48

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-6b. Multi-increment Soil Sampling Results—Hilo Union Elementary

Sample Identification:			S6-01		S6-02		S6-03		S6-04		S6-05		S6-06		S6-07	
Sample Collection Date:			2016-11-25		2016-12-01		2016-11-25		2016-11-24		2016-11-27		2016-11-27		2016-11-24	
Sample Type:			Bldg Perimeter		Garden		Bldg Perimeter		Open Space		Bldg Perimeter		Bldg Perimeter		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																
Arsenic, bioaccessible	23	2	--		--		--		--		--		--		--	
Arsenic, total	100	1	9.7	J	14	J	21	J	5.3	J	12	J	11	J	8.5	J
Chromium, hexavalent	30	2	--		--		--		--		0.88	J	--		--	
Chromium, total	1100	3	--		--		--				460		--		--	
Copper, total	630	2	--		--		--		--		140	J	--		--	
Lead, total	200	2	**490**	J	**590**		**3800**	J	190	J	**1500**	J	**1400**	J	200	J
Organochlorine Pesticides (mg/kg)																
4,4'-DDD	2.3	2	0.071	J	--		0.17	J	--		0.81	J	**3.4**	J	--	
4,4'-DDE	2.0	2	0.00028	J	--		0.00086	J	--		0.18		0.23		--	
4,4'-DDT	1.9	2	0.0026	J	--		0.0019	J	--		0.039	J	0.15		--	
Aldrin	3.9	2	--	ND	--		--	ND	--		--	ND	0.024	J	--	
Dieldrin	2.5	2	--	ND	--		--	ND	--		--	ND	--	ND	--	
Endosulfans	94	2	--	ND	--		--	ND	--		0.0060	J	0.16	J	--	
Endrins	3.8	2	--	ND	--		0.0084	J	--		--	ND	--	ND	--	
gamma-BHC (Lindane)	0.57	2	--	ND	--		--	ND	--		--	ND	--	ND	--	
Methoxychlor	63	2	--	ND	--		--	ND	--		--	ND	--	ND	--	
Technical Chlordane	17	2	3.8		--		5.3		--		**64**		**110**		--	
Toxaphene	0.49	2	--	ND	--		--	ND	--		--	ND	--	ND	--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-7a. XRF Soil Screening Results—Kapiolani Elementary

Reconnaissance XRF Soil Screening
Date: 7/15/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<7	160	50	<QL	320
2	Open Space	<10	320	45	<QL	580
3	Open Space	51	310	45	93	560
4	Open Space	13	61	45	24	110
5	Open Space	4.5	31	45	8	56
6	Open Space	6.1	38	50	12	76
7	Open Space	12	21	45	22	38
8	Open Space	6.2	74	45	11	130
9	Open Space	<4.6	36	45	<QL	65
10	Open Space	11	23	45	20	42
11	Open Space	5.6	1100	45	10	2000
12	Open Space	<2.9	15	45	<QL	27
13	Open Space	11	<7	20	14	<QL
14	Open Space	<3	18	45	<QL	33
15	Open Space	14	14	45	25	25
16	Open Space	8.5	12	45	15	22
17	Open Space	<4.1	27	45	<QL	49
18	Open Space	4.8	21	45	9	38
19	Open Space	13	60	45	24	110
20	Bldg Perimeter	1100	130	10	1200	140
21	Bldg Perimeter	190	130	15	220	150
22	Garden	160	91	20	200	110
23	Bldg Perimeter	4400	140	10	4900	160
24	Open Space	190	80	45	350	150
25	Bldg Perimeter	1300	430	25	1700	570
26	Open Space	10	83	25	13	110
27	Bldg Perimeter	2200	290	10	2400	320
28	Open Space	130	130	25	170	170
29	Bldg Perimeter	320	2300	5	340	2400
30	Open Space	80	130	40	130	220
31	Bldg Perimeter	210	890	10	230	990
32	Open Space	<4.7	57	35	<QL	88
33	Bldg Perimeter	160	3200	20	200	4000

Notes:
Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.
Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-7b. Multi-increment Soil Sampling Results—Kapiolani Elementary

Sample Identification:			S7-01		S7-02		S7-03		S7-23-MI		S7-05		S7-06		S7-07		S7-08		S7-09		S7-10		S7-11	
Sample Collection Date:			2016-11-14		2016-11-21		2016-11-14		2016-07-22		2016-11-15		2016-11-15		2016-11-15		2016-11-15		2016-11-17		2016-11-17		2016-11-17	
Sample Type:			Open Space		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Garden		Open Space		Bldg Perimeter		Open Space		Bldg Perimeter		Open Space		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																								
Arsenic, bioaccessible	23	2	--		**240**		--		**140**		20		--	ND	--		7.9		--		--		--	
Arsenic, total	100	1	12		**2500**		**400**		**2000**		**620**		**140**		**160**		**190**		**170**		13		22	
Chromium, hexavalent	30	2	--		--		0.86	J	--		--		--		--		--		--		--		--	
Chromium, total	1100	3	--		--		330				--		--		--		--		--		--		--	
Copper, total	630	2	--		--		190		--		--		--		--		--		--		--		--	
Lead, total	200	2	24		**380**		130		130		**400**		**220**		**1300**		**230**		**1600**		**270**		**230**	
Organochlorine Pesticides (mg/kg)																								
4,4'-DDD	2.3	2	--		--	ND	--	ND	0.00030	J	--		--		--	ND	--		--	ND	--		--	
4,4'-DDE	2.0	2	--		--	ND	0.000086	J	0.00032	J	--		--		0.0094	J	--		0.12	J	--		--	
4,4'-DDT	1.9	2	--		0.056	J	0.0014	J	0.00031	J	--		--		0.030	J	--		0.21	J	--		--	
Aldrin	3.9	2	--		--	ND	--	ND	--	ND	--		--		--	ND	--		--	ND	--		--	
Dieldrin	2.5	2	--		--	ND	--	ND	--	ND	--		--		--	ND	--		--	ND	--		--	
Endosulfans	94	2	--		--	ND	--	ND	0.0029	J	--		--		--	ND	--		--	ND	--		--	
Endrins	3.8	2	--		0.037	J	0.015	J	0.0031	J	--		--		0.20	J	--		0.057	J	--		--	
gamma-BHC (Lindane)	0.57	2	--		--	ND	--	ND	--	ND	--		--		--	ND	--		--	ND	--		--	
Methoxychlor	63	2	--		0.015	J	--	ND	--	ND	--		--		--	ND	--		0.031	J	--		--	
Technical Chlordane	17	2	--		**50**	J	0.0025	J	0.0024	J	--		--		13	J	--		**110**	J	--		--	
Toxaphene	0.49	2	--		--	ND	--	ND	--	ND	--		--		--	ND	--		--	ND	--		--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-8a. XRF Soil Screening Results—Kaumana Elementary

Reconnaissance XRF Soil Screening
Date: 7/15/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Bldg Perimeter	18	410	45	33	750
2	Open Space	12	31	50	24	62
3	Open Space	5.4	6.6	70	18	22
4	Open Space	<2.9	8.3	50	<QL	17
5	Open Space	<3.2	11	45	<QL	20
6	Open Space	9.7	12	60	24	30
7	Open Space	<3.6	16	55	<QL	36
8	Open Space	15	13	75	60	52
9	Open Space	<3.3	18	60	<QL	45
10	Bldg Perimeter	13	67	35	20	100

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-8b. Multi-increment Soil Sampling Results—Kaumana Elementary

Sample Identification:			S8-01A		S8-01B		S8-01C	
Sample Collection Date:			2016-12-19		2016-12-19		2016-12-19	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)								
Arsenic, bioaccessible	23	2	--		--		--	
Arsenic, total	100	1	14	J	16	J	13	J
Chromium, hexavalent	30	2	--		--		--	
Chromium, total	1100	3	--		--		--	
Copper, total	630	2	--		--		--	
Lead, total	200	2	**600**		**510**		**610**	
Organochlorine Pesticides (mg/kg)								
4,4'-DDD	2.3	2	0.021	J	0.0072	J	0.011	J
4,4'-DDE	2.0	2	0.13	J	0.091	J	0.12	J
4,4'-DDT	1.9	2	0.76	J	0.34	J	0.39	J
Aldrin	3.9	2	--	ND	--	ND	--	ND
Dieldrin	2.5	2	--	ND	--	ND	--	ND
Endosulfans	94	2	--	ND	--	ND	--	ND
Endrins	3.8	2	0.0053	J	0.0036	J	0.010	J
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND
Technical Chlordane	17	2	0.064	J	0.050	J	0.087	J
Toxaphene	0.49	2	--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels.
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-9a. XRF Soil Screening Results—Keaukaha Elementary

Reconnaissance XRF Soil Screening
Date: 7/16/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<5.1	62	35	<QL	95
2	Open Space	7.0	26	20	9	33
3	Open Space	9.3	21	35	14	32
4	Bldg Perimeter	17	14	10	19	16
5	Open Space	24	11	20	30	14
6	Open Space	4.8	11	20	6	14
7	Garden	20	18	25	27	24
8	Bldg Perimeter	26	240	20	33	300
9	Open Space	16	<7.0	25	21	<QL
10	Bldg Perimeter	18	17	5	19	18
11	Open Space	8.4	13	25	11	17
12	Open Space	17	25	25	23	33
13	Open Space	19	38	35	29	58
14	Open Space	18	17	35	28	26
15	Open Space	46	17	35	71	26
16	Open Space	8.6	20	35	13	31
17	Open Space	<3.1	6.9	20	<QL	9
18	Open Space	<3.2	5.6	30	<QL	8
19	Open Space	<3.4	5.9	30	<QL	8
20	Bldg Perimeter	65	140	30	93	200
21	Open Space	11	6.4	30	16	9
22	Garden	35	32	25	47	43
23	Open Space	34	<21	35	52	<QL

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-9b. Multi-increment Soil Sampling Results—Keaukaha Elementary

Sample Identification:			S9-01		S9-02	
Sample Collection Date:			2017-01-09		2017-01-09	
Sample Type:			Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.
Metals (mg/kg)						
Arsenic, bioaccessible	23	2	--		--	
Arsenic, total	100	1	19		59	
Chromium, hexavalent	30	2	--		--	
Chromium, total	1100	3	--		--	
Copper, total	630	2	--		--	
Lead, total	200	2	**410**		**890**	
Organochlorine Pesticides (mg/kg)						
4,4'-DDD	2.3	2	0.023		--	ND
4,4'-DDE	2.0	2	0.092		0.0091	J
4,4'-DDT	1.9	2	0.23		0.011	J
Aldrin	3.9	2	0.00067	J	0.0012	J
Dieldrin	2.5	2	0.33		0.61	
Endosulfans	94	2	--	ND	--	ND
Endrins	3.8	2	0.0040	J	0.098	
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND
Methoxychlor	63	2	--	ND	0.0011	J
Technical Chlordane	17	2	0.98		5.9	
Toxaphene	0.49	2	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-10a. XRF Soil Screening Results—Laupahoehoe High & Elementary

Reconnaissance XRF Soil Screening
Date: 7/11/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<4.1	22	20	<QL	28
2	Open Space	<4.7	32	20	<QL	40
3	Open Space	10	19	20	13	24
4	Bldg Perimeter	90	1300	20	110	1600
5	Garden	56	13	20	70	16
6	Garden	51	29	20	64	36
7	Open Space	50	10	20	63	13
8	Open Space	50	<10	25	67	<QL
9	Open Space	29	24	20	36	30
10	Open Space	4.3	26	30	6	37
11	Open Space	<4.8	49	35	<QL	75
12	Bldg Perimeter	46	15	30	66	21
13	Open Space	14	72	40	23	120
14	Bldg Perimeter	23	260	30	33	370
15	Open Space	<5.0	40	50	<QL	80
16	Open Space	<5.3	44	45	<QL	80
17	Open Space	11	33	40	18	55
18	Open Space	16	72	40	27	120
19	Open Space	24	63	35	37	97
20	Bldg Perimeter	42	58	25	56	77
21	Garden	31	16	30	44	23
22	Bldg Perimeter	70	320	25	93	430

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-10b. Multi-increment Soil Sampling Results—Laupahoehoe High & Elementary

Sample Identification:			S10-01		S10-02A		S10-02B		S10-02C		S10-03	
Sample Collection Date:			2016-12-19		2016-12-12		2016-12-12		2016-12-12		2016-12-13	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)												
Arsenic, bioaccessible	23	2	--		--		--		--		--	
Arsenic, total	100	1	18	J	19		13		12		20	
Chromium, hexavalent	30	2	--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--	
Copper, total	630	2	--		--		--		--		--	
Lead, total	200	2	**720**		100		150		110		**310**	
Organochlorine Pesticides (mg/kg)												
4,4'-DDD	2.3	2	0.0027	J	--	ND	--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	0.0087	J	0.00024	J	0.000061	J	0.00020	J	0.0042	
4,4'-DDT	1.9	2	0.064	J	0.00069		0.00066		0.0011		0.016	
Aldrin	3.9	2	0.000086	J	--	ND	--	ND	--	ND	0.00047	
Dieldrin	2.5	2	--	ND	--	ND	--	ND	--	ND	--	ND
Endosulfans	94	2	--	ND	0.00052	J	0.00050	J	--	ND	0.00052	J
Endrins	3.8	2	0.0035	J	--	ND	--	ND	--	ND	--	ND
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND	--	ND	--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND	--	ND	--	ND
Technical Chlordane	17	2	--	ND	0.018	J	0.016	J	0.018	J	--	ND
Toxaphene	0.49	2	--	ND	--	ND	--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-11a. XRF Soil Screening Results—Waiakea High

Reconnaissance XRF Soil Screening
Date: 7/12/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Bldg Perimeter	39	16	15	46	19
2	Bldg Perimeter	<6.0	14	10	<QL	16
3	Bldg Perimeter	16	<11	40	27	<QL
4	Open Space	14	<10	40	23	<QL
5	Open Space	11	10	40	18	17
6	Bldg Perimeter	29	33	15	34	39
7	Open Space	13	20	40	22	33
8	Open Space	26	20	50	52	40
9	Open Space	13	17	50	26	34
10	Bldg Perimeter	59	8	40	98	13
11	Bldg Perimeter	42	16	35	65	25
12	Open Space	14	13	50	28	26
13	Open Space	<2.9	9.9	60	<QL	25
14	Bldg Perimeter	55	13	30	79	19
15	Open Space	25	8	20	31	10
16	Open Space	<3.5	7.1	50	<QL	14
17	Open Space	8.8	<7.0	50	18	<QL
18	Open Space	<4.1	11	50	<QL	22
19	Bldg Perimeter	30	11	50	60	22
20	Open Space	5.2	12	50	10	24
21	Open Space	40	<4.7	50	80	<QL
22	Garden	16	6.5	40	27	11
23	Open Space	15	17	50	30	34

Notes:
<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-11b. Multi-increment Soil Sampling Results—Waiakea High

Sample Identification:			S11-01		S11-02		S11-03	
Sample Collection Date:			2016-12-23		2016-12-26		2016-12-26	
Sample Type:			Open Space		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)								
Arsenic, bioaccessible	23	2	--		--		--	
Arsenic, total	100	1	43		46		8.4	
Chromium, hexavalent	30	2	--		--		--	
Chromium, total	1100	3	--		--		--	
Copper, total	630	2	--		--		--	
Lead, total	200	2	22		11		6.6	
Organochlorine Pesticides (mg/kg)								
4,4'-DDD	2.3	2	--		--	ND	--	ND
4,4'-DDE	2.0	2	--		--	ND	--	ND
4,4'-DDT	1.9	2	--		--	ND	--	ND
Aldrin	3.9	2	--		--	ND	--	ND
Dieldrin	2.5	2	--		--	ND	--	ND
Endosulfans	94	2	--		--	ND	--	ND
Endrins	3.8	2	--		--	ND	--	ND
gamma-BHC (Lindane)	0.57	2	--		--	ND	0.00051	J
Methoxychlor	63	2	--		--	ND	--	ND
Technical Chlordane	17	2	--		0.0087	J	--	ND
Toxaphene	0.49	2	--		--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-12a. XRF Soil Screening Results—Waiakea Intermediate

Reconnaissance XRF Soil Screening
Date: 7/12/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	9.1	15	40	15	25
2	Open Space	15	<7.0	40	25	<QL
3	Open Space	5.2	15	40	9	25
4	Open Space	6.4	16	40	11	27
5	Garden	33	8	30	47	11
6	Open Space	8.4	13	40	14	22
7	Bldg Perimeter	23	250	10	26	280
8	Open Space	11	16	40	18	27
9	Open Space	<3.8	15	40	<QL	25
10	Open Space	<3.3	20	40	<QL	33
11	Open Space	19	16	40	32	27
12	Open Space	<3.4	<5.5	40	<QL	<QL
13	Open Space	<3.2	13	40	<QL	22
14	Bldg Perimeter	120	120	20	150	150
15	Open Space	<3.1	<4.8	30	<QL	<QL
16	Open Space	22	14	30	31	20
17	Open Space	27	6.6	40	45	11
18	Open Space	17	12	40	28	20
19	Open Space	9.3	42	45	17	76

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-12b. Multi-increment Soil Sampling Results—Waiakea Intermediate

Sample Identification:			S12-01A		S12-01B		S12-01C		S12-02A		S12-02B		S12-02C	
Sample Collection Date:			2016-12-09		2016-12-09		2016-12-09		2016-12-12		2016-12-12		2016-12-12	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)														
Arsenic, bioaccessible	23	2	--		--		--		**320**		--		--	
Arsenic, total	100	1	38		27		23		**810**		**740**		**790**	
Chromium, hexavalent	30	2	--		--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--		--	
Copper, total	630	2	--		--		--		--		--		--	
Lead, total	200	2	180		180		**210**		**220**		110		96	
Organochlorine Pesticides (mg/kg)														
4,4'-DDD	2.3	2	0.00041	J	0.0016	J	0.0015	J	--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	0.0019		0.0018		0.0015		--	ND	--	ND	--	ND
4,4'-DDT	1.9	2	0.021	J	0.011	J	0.0064	J	0.00016	J	0.00016	J	0.00016	J
Aldrin	3.9	2	--	ND	--	ND	--	ND	--	ND	--	ND	--	ND
Dieldrin	2.5	2	--	ND	--	ND	--	ND	0.00074		0.00045	J	0.00064	
Endosulfans	94	2	--		--		--		--	ND	--	ND	--	ND
Endrins	3.8	2	--	ND	--	ND	--	ND	--	ND	--	ND	--	ND
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND	--	ND	--	ND	--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND	--	ND	--	ND	--	ND
Technical Chlordane	17	2	--	ND	--	ND	--	ND	0.0045	J	0.0016	J	0.0027	J
Toxaphene	0.49	2	--	ND	--	ND	--	ND	--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-13a. XRF Soil Screening Results—Waiakea Elementary

Reconnaissance XRF Soil Screening
Date: 7/12/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	25	11	45	45	20
2	Open Space	27	16	40	45	27
3	Open Space	17	9.6	35	26	15
4	Open Space	77	12	40	130	20
5	Open Space	70	16	40	120	27
6	Open Space	230	16	40	380	27
7	Open Space	440	25	40	730	42
8	Open Space	33	14	40	55	23
9	Open Space	26	12	45	47	22
10	Open Space	79	13	40	130	22
11	Open Space	140	19	40	230	32
12	Open Space	190	15	40	320	25
13	Open Space	28	13	40	47	22
14	Open Space	19	17	40	32	28
15	Open Space	22	<6.0	45	40	<QL
16	Open Space	15	12	45	27	22
17	Open Space	110	8.3	35	170	13
18	Open Space	39	7.2	35	60	11
19	Open Space	38	9.8	40	63	16
20	Open Space	<3.5	5.6	25	<QL	8
21	Open Space	110	11	50	220	22
22	Open Space	220	17	35	340	26

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-13b. Multi-increment Soil Sampling Results—Waiakea Elementary

Sample Identification:			S13-01		S13-02A		S13-02B		S13-02C		S13-03		S13-04		S13-05		S13-06A		S13-06B		S13-06C	
Sample Collection Date:			2016-12-26		2016-12-05		2016-12-05		2016-12-05		2016-12-09		2016-12-06		2016-12-09		2016-12-05		2016-12-05		2016-12-05	
Sample Type:			Open Space		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Open Space		Open Space		Open Space		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																						
Arsenic, bioaccessible	23	2	--		--		--		--		--	ND	9.1		--		--		--		--	
Arsenic, total	100	1	46		52	J	52	J	54	J	**120**		**200**	J	66		74	J	73	J	78	J
Chromium, hexavalent	30	2	--		--		--		--		--		--		--		--		--		--	
Chromium, total	1100	3	--		--		--		--		--		--		--		--		--		--	
Copper, total	630	2	--		--		--		--		--		--		--		--		--		--	
Lead, total	200	2	22		49		32		32		21		20		15		28		28		29	
Organochlorine Pesticides (mg/kg)																						
4,4'-DDD	2.3	2	--		--	ND	--	ND	--	ND	--		--		--		--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	--		--	ND	--	ND	--	ND	--		--		--		--	ND	--	ND	0.00018	J
4,4'-DDT	1.9	2	--		0.00015	J	0.00028	J	0.00014	J	--		--		--		--	ND	--	ND	0.00036	J
Aldrin	3.9	2	--		--	ND	--	ND	--	ND	--		--		--		--	ND	--	ND	--	ND
Dieldrin	2.5	2	--		0.00038	J	--	ND	--	ND	--		--		--		--	ND	--	ND	--	ND
Endosulfans	94	2	--		0.0016	J	0.0021	J	0.0018	J	--		--		--		0.0018	J	0.0018	J	0.0022	J
Endrins	3.8	2	--		--	ND	--	ND	--	ND	--		--		--		--	ND	--	ND	--	ND
gamma-BHC (Lindane)	0.57	2	--		--	ND	--	ND	--	ND	--		--		--		0.000035	J	0.000064	J	0.000081	J
Methoxychlor	63	2	--		--	ND	--	ND	--	ND	--		--		--		0.00038	J	0.00041	J	0.00044	J
Technical Chlordane	17	2	--		0.012	J	0.013	J	0.014	J	--		--		--		0.034	J	0.018	J	0.016	J
Toxaphene	0.49	2	--		--	ND	--	ND	--	ND	--		--		--		--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-14a. XRF Soil Screening Results—Waiakeawaena Elementary

Reconnaissance XRF Soil Screening
Date: 7/18/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	12	150	25	16	200
2	Bldg Perimeter	21	20	20	26	25
3	Open Space	23	44	25	31	59
4	Bldg Perimeter	27	83	10	30	92
5	Bldg Perimeter	76	45	10	84	50
6	Bldg Perimeter	53	46	20	66	58
7	Open Space	5.7	16	35	9	25
8	Bldg Perimeter	24	94	20	30	120
9	Open Space	7.5	<6.0	25	10	<QL
10	Open Space	11	17	35	17	26
11	Open Space	13	9.6	35	20	15
12	Open Space	10	5.2	35	15	8
13	Open Space	10	10	35	15	15
14	Bldg Perimeter	91	610	25	120	810
15	Open Space	18	48	35	28	74
16	Open Space	35	<10	35	54	<QL
17	Bldg Perimeter	59	98	10	66	110
18	Garden	11	68	20	14	85
19	Open Space	27	23	30	39	33
20	Bldg Perimeter	62	96	25	83	130
21	Open Space	62	71	40	100	120
22	Open Space	39	31	25	52	41
23	Bldg Perimeter	30	210	20	38	260
24	Open Space	40	<10	30	57	<QL

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-14b. Multi-increment Soil Sampling Results—Waiakeawaena Elementary

Sample Identification:			S14-01		S14-02		S14-03		S14-04	
Sample Collection Date:			2017-01-05		2017-01-05		2017-01-09		2017-01-09	
Sample Type:			Open Space		Open Space		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)										
Arsenic, bioaccessible	23	2	--		--	ND	--		--	
Arsenic, total	100	1	25	J	**110**	J	60		26	J
Chromium, hexavalent	30	2	--		--		--		--	
Chromium, total	1100	3	--		--		--			
Copper, total	630	2	--		--		--		--	
Lead, total	200	2	40		150		**480**		34	
Organochlorine Pesticides (mg/kg)										
4,4'-DDD	2.3	2	--		--		--	ND	--	ND
4,4'-DDE	2.0	2	--		--		0.0012	J	0.061	J
4,4'-DDT	1.9	2	--		--		0.0074		0.064	
Aldrin	3.9	2	--		--		--	ND	--	ND
Dieldrin	2.5	2	--		--		--	ND	--	ND
Endosulfans	94	2	--		--		0.0056	J	--	ND
Endrins	3.8	2	--		--		--	ND	0.025	J
gamma-BHC (Lindane)	0.57	2	--		--		--	ND	--	ND
Methoxychlor	63	2	--		--		--	ND	--	ND
Technical Chlordane	17	2	--		--		0.14		**33**	
Toxaphene	0.49	2	--		--		--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-15a. XRF Soil Screening Results—Kau High & Pahala Elementary

Reconnaissance XRF Soil Screening
Date: 7/21/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	<3.6	11	20	<QL	14
2	Bldg Perimeter	14	260	20	18	330
3	Bldg Perimeter	11	210	15	13	250
4	Open Space	<3.2	13	20	<QL	16
5	Bldg Perimeter	13	170	10	14	190
6	Open Space	<4.0	18	20	<QL	23
7	Open Space	<5.0	58	20	<QL	73
8	Open Space	12	200	20	15	250
9	Bldg Perimeter	<14	700	35	<QL	1100
10	Open Space	<7.0	130	20	<QL	160
11	Bldg Perimeter	<13	550	20	<QL	690
12	Bldg Perimeter	34	560	25	45	750
13	Garden	4.7	7.6	25	6	10
14	Garden	<7.0	140	25	<QL	190
15	Open Space	<4.4	39	25	<QL	52
16	Bldg Perimeter	52	1500	25	69	2000
17	Open Space	<4.6	33	15	<QL	39
18	Open Space	3.7	12	10	4	13
19	Open Space	<5.2	56	20	<QL	70
20	Open Space	<3.7	15	20	<QL	19
21	Open Space	<4.2	16	20	<QL	20
22	Bldg Perimeter	67	<5.4	25	89	<QL
23	Bldg Perimeter	16	330	20	20	410
24	Bldg Perimeter	61	3400	20	76	4300
25	Garden	20	42	20	25	53
26	Open Space	5.9	17	20	7	21
27	Open Space	11	<7.0	15	13	<QL
28	Open Space	5.7	5.4	15	7	6
29	Open Space	13	<8.0	10	14	<QL
30	Open Space	17	130	20	21	160
31	Bldg Perimeter	5.3	49	25	7	65
32	Open Space	<3.5	<5.8	20	<QL	<QL
33	Open Space	<3.2	5.8	20	<QL	7
34	Bldg Perimeter	12	65	20	15	81
35	Open Space	<3.4	6.8	20	<QL	9
36	Bldg Perimeter	12	37	20	15	46
37	Bldg Perimeter	<5.8	65	20	<QL	81
38	Open Space	<3.9	19	20	<QL	24
39	Open Space	<4.4	38	20	<QL	48

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

Outlined cells exceed 5-times the screening values.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-15b. Multi-increment Soil Sampling Results—Kau High & Pahala Elementary

Sample Identification:			S15-01		S15-02		S15-03		S15-04		S15-05		S15-06		S15-07	
Sample Collection Date:			2017-01-16		2017-01-16		2017-01-16		2017-01-16		2017-01-16		2017-01-16		2017-01-16	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Open Space		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																
Arsenic, bioaccessible	23	2	--		--		--		--		--		--		--	
Arsenic, total	100	1	4.4		6.5		7.1		7.9		4.0		6.8		6.1	
Chromium, hexavalent	30	2	--		--		0.39	J	--		--		--		--	
Chromium, total	1100	3	--		--		180				--		--		--	
Copper, total	630	2	--		--		130		--		--		--		--	
Lead, total	200	2	**1200**		**480**		**770**		**650**		150		**650**		**250**	
Organochlorine Pesticides (mg/kg)																
4,4'-DDD	2.3	2	--	ND	0.00055	J	--	ND	--	ND	--		--	ND	--	ND
4,4'-DDE	2.0	2	0.024		0.00059	J	0.087		0.040		--		0.0021	J	0.00033	J
4,4'-DDT	1.9	2	0.039		0.0034		0.096		0.044		--		0.0042		0.0024	J
Aldrin	3.9	2	--	ND	--	ND	--	ND	--	ND	--		--	ND	0.00018	J
Dieldrin	2.5	2	--	ND	--	ND	--	ND	--	ND	--		--	ND	0.0014	J
Endosulfans	94	2	0.0028	J	--	ND	--	ND	--	ND	--		--	ND	--	ND
Endrins	3.8	2	--	ND	--	ND	0.018		0.0050	J	--		0.0036	J	0.0035	J
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND	--	ND	--		--	ND	--	ND
Methoxychlor	63	2	0.011	J	--	ND	--	ND	--	ND	--		--	ND	--	ND
Technical Chlordane	17	2	--	ND	--	ND	13		**29**		--		0.18		0.013	J
Toxaphene	0.49	2	--	ND	0.011	J	--	ND	--	ND	--		--	ND	--	ND

Notes:
Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:
1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-16a. XRF Soil Screening Results—Naalehu Elementary & Intermediate

Reconnaissance XRF Soil Screening
Date: 7/21/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Bldg Perimeter	21	280	10	23	310
2	Open Space	24.0	100	5	25	110
3	Bldg Perimeter	27	300	5	28	320
4	Garden	20	<7.0	10	22	<QL
5	Garden	4.8	13	25	6	17
6	Garden	<2.4	7	20	<QL	8
7	Open Space	9.7	27	5	10	28
8	Bldg Perimeter	24	31	15	28	36
9	Open Space	6.2	34	10	7	38
10	Bldg Perimeter	10	140	15	12	160
11	Open Space	5.1	8	10	6	9
12	Open Space	5.9	8	10	7	9
13	Open Space	7.9	14	10	9	16
14	Bldg Perimeter	41	610	5	43	640
15	Open Space	<4	12	5	<QL	13
16	Open Space	<4.5	16	5	<QL	17
17	Open Space	<4.5	23	5	<QL	24
18	Bldg Perimeter	8.5	36	15	10	42
19	Open Space	4.7	15	5	5	16
20	Bldg Perimeter	22	370	15	26	440
21	Bldg Perimeter	14	490	5	15	520

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-16b. Multi-increment Soil Sampling Results—Naalehu Elementary & Intermediate

Sample Identification:			S16-01		S16-02		S16-03		S16-04	
Sample Collection Date:			2017-01-17		2017-01-17		2017-01-17		2017-01-17	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)										
Arsenic, bioaccessible	23	2	--		--		--		--	
Arsenic, total	100	1	8.5		7.8		5.5		8.8	
Chromium, hexavalent	30	2	--		--		--		--	
Chromium, total	1100	3	--		--		--			
Copper, total	630	2	--		--		--		--	
Lead, total	200	2	**280**		**410**		**250**		**410**	
Organochlorine Pesticides (mg/kg)										
4,4'-DDD	2.3	2	--	ND	--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	0.00094	J	0.00066	J	0.00069	J	0.0025	J
4,4'-DDT	1.9	2	0.0032	J	0.0041		0.0011	J	0.0022	J
Aldrin	3.9	2	--	ND	--	ND	--	ND	--	ND
Dieldrin	2.5	2	--	ND	--	ND	0.00066	J	--	ND
Endosulfans	94	2	--	ND	--	ND	--	ND	--	ND
Endrins	3.8	2	0.0036	J	0.0037	J	--	ND	--	ND
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	0.0030		--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND	--	ND
Technical Chlordane	17	2	0.064		0.017		0.019		0.013	J
Toxaphene	0.49	2	--	ND	--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-17a. XRF Soil Screening Results—Keaau High

Reconnaissance XRF Soil Screening
Date: 7/19/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	17	16	40	28	27
2	Open Space	15	16	30	21	23
3	Open Space	12	16	35	18	25
4	Open Space	15	15	40	25	25
5	Open Space	<2.0	<3.3	35	<QL	<QL
6	Open Space	<2.2	<3.4	40	<QL	<QL
7	Open Space	<2.2	<3.6	50	<QL	<QL
8	Open Space	<2.4	<3.7	45	<QL	<QL
9	Open Space	5.6	5.7	45	10	10
10	Open Space	<2.4	3.9	40	<QL	7
11	Open Space	<2.8	<4.2	30	<QL	<QL
12	Open Space	<2.3	<3.7	25	<QL	<QL
13	Open Space	<2.5	<3.9	40	<QL	<QL
14	Open Space	<2.5	<4.0	40	<QL	<QL
15	Open Space	27	<7.0	35	42	<QL
16	Garden	23	21	25	31	28
17	Garden	25	10	25	33	13
18	Garden	33	<8.0	25	44	<QL
19	Open Space	16	<5.4	35	25	<QL
20	Open Space	12	<7.0	25	16	<QL
21	Open Space	21	8	25	28	11
22	Open Space	9.8	<6.0	25	13	<QL
23	Open Space	<2.0	<3.2	50	<QL	<QL
24	Open Space	<2.1	<3.2	50	<QL	<QL
25	Open Space	<2.3	3.7	35	<QL	6
26	Open Space	16	6.2	50	32	12
27	Open Space	17	10	30	24	14
28	Open Space	14	10	30	20	14
29	Open Space	8.9	<5.7	30	13	<QL
30	Open Space	8.3	8.3	50	17	17
31	Open Space	12	6.9	50	24	14

Notes:
<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-17b. Multi-increment Soil Sampling Results—Keaau High

Sample Identification:			S17-01	
Sample Collection Date:			2017-01-09	
Sample Type:			Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.
Metals (mg/kg)				
Arsenic, bioaccessible	23	2	--	
Arsenic, total	100	1	6.6	
Chromium, hexavalent	30	2	--	
Chromium, total	1100	3	--	
Copper, total	630	2	--	
Lead, total	200	2	3.7	
Organochlorine Pesticides (mg/kg)				
4,4'-DDD	2.3	2	--	ND
4,4'-DDE	2.0	2	--	ND
4,4'-DDT	1.9	2	--	ND
Aldrin	3.9	2	--	ND
Dieldrin	2.5	2	--	ND
Endosulfans	94	2	--	ND
Endrins	3.8	2	--	ND
gamma-BHC (Lindane)	0.57	2	--	ND
Methoxychlor	63	2	--	ND
Technical Chlordane	17	2	--	ND
Toxaphene	0.49	2	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-18a. XRF Soil Screening Results—Keaau Middle

Reconnaissance XRF Soil Screening
Date: N/A

	Field Measurements			Moisture Corrected	
Sample ID	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
N/A					

Note:
This facility was not screened.

N/A = not applicable
XRF = X-ray fluorescence

Table 3-18b. Multi-increment Soil Sampling Results—Keaau Middle

Sample Identification:				N/A
Sample Collection Date:				N/A
Sample Type:				N/A
Analyte	Action Level	Basis	Result	Qual.
Metals (mg/kg)				
Arsenic, bioaccessible	23	2		
Arsenic, total	100	1		
Chromium, hexavalent	30	2		
Chromium, total	1100	3		
Copper, total	630	2		
Lead, total	200	2		
Organochlorine Pesticides (mg/kg)				
4,4'-DDD	2.3	2		
4,4'-DDE	2.0	2		
4,4'-DDT	1.9	2		
Aldrin	3.9	2		
Dieldrin	2.5	2		
Endosulfans	94	2		
Endrins	3.8	2		
gamma-BHC (Lindane)	0.57	2		
Methoxychlor	63	2		
Technical Chlordane	17	2		
Toxaphene	0.49	2		

Notes:

This facility was not sampled as part of this program.

N/A = not applicable

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-19a. XRF Soil Screening Results—Keaau Elementary

Reconnaissance XRF Soil Screening
Date: 7/18/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	84	6	30	120	9
2	Open Space	27	<8.0	30	39	<QL
3	Open Space	27	18	30	39	26
4	Open Space	65	9	50	130	18
5	Open Space	51	6	45	93	11
6	Open Space	81	8	30	120	11
7	Garden	77	<5.4	35	120	<QL
8	Open Space	55	6	45	100	10
9	Open Space	38	10	45	69	18
10	Open Space	88	6	20	110	8
11	Open Space	77	9.1	30	110	13
12	Open Space	49	9.4	35	75	14
13	Open Space	70	11	35	110	17
14	Open Space	54	6.4	35	83	10
15	Open Space	23	8	10	26	9
16	Open Space	52	5.6	30	74	8
17	Open Space	13	9.1	35	20	14
18	Open Space	7.3	5.3	50	15	11
19	Open Space	70	10	45	130	18

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level

XRF = X-ray fluorescence

Table 3-19b. Multi-increment Soil Sampling Results—Keaau Elementary

Sample Identification:			S19-01		S19-02		S19-03		S19-04-R		S19-05		S19-06		S19-07		S19-08	
Sample Collection Date:			2017-01-11		2017-01-09		2017-01-10		2017-08-01		2017-01-11		2017-01-11		2017-01-11		2016-12-29	
Sample Type:			Open Space		Bldg Perimeter		Open Space		Open Space		Open Space		Garden		Open Space		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)																		
Arsenic, bioaccessible	23	2	7.9		--		--		6.5		--		--		--		--	
Arsenic, total	100	1	100		59		77		**150**		90		80		96		82	
Chromium, hexavalent	30	2	--		--		--		--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--		--		--		--	
Copper, total	630	2	--		--		--		--		--		--		--		--	
Lead, total	200	2	15		6.6		5.3		28		6.1		15		5.1		20	J
Organochlorine Pesticides (mg/kg)																		
4,4'-DDD	2.3	2	--		--	ND	--		0.0011	J	--		--		--		--	
4,4'-DDE	2.0	2	--		--	ND	--		--	ND	--		--		--		--	
4,4'-DDT	1.9	2	--		--	ND	--		--	ND	--		--		--		--	
Aldrin	3.9	2	--		--	ND	--		--	ND	--		--		--		--	
Dieldrin	2.5	2	--		--	ND	--		--	ND	--		--		--		--	
Endosulfans	94	2	--		--	ND	--		--	ND	--		--		--		--	
Endrins	3.8	2	--		--	ND	--		--	ND	--		--		--		--	
gamma-BHC (Lindane)	0.57	2	--		--	ND	--		--	ND	--		--		--		--	
Methoxychlor	63	2	--		--	ND	--		--	ND	--		--		--		--	
Technical Chlordane	17	2	--		0.0018	J	--		--	ND	--		--		--		--	
Toxaphene	0.49	2	--		--	ND	--		--	ND	--		--		--		--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-20a. XRF Soil Screening Results—Mountain View Elementary

Reconnaissance XRF Soil Screening
Date: 7/18/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	23	12	30	33	17
2	Open Space	160	78	20	200	98
3	Bldg Perimeter	450	2900	25	600	3900
4	Bldg Perimeter	38	100	25	51	130
5	Bldg Perimeter	42	190	45	76	350
6	Open Space	23	71	45	42	130
7	Open Space	19	16	40	32	27
8	Open Space	72	20	35	110	31
9	Open Space	15	66	40	25	110
10	Bldg Perimeter	84	200	35	130	310
11	Open Space	<2.7	6.1	45	<QL	11
12	Open Space	<2.3	3.5	65	<QL	10
13	Garden	<8.0	100	35	<QL	150
14	Open Space	15	11	50	30	22
15	Open Space	6.6	7.5	45	12	14
16	Open Space	25	27	35	38	42
17	Bldg Perimeter	12	52	25	16	69
18	Open Space	27	9.9	55	60	22
19	Open Space	<2.4	4.2	85	<QL	28
20	Open Space	24	5.9	45	44	11
21	Open Space	18	36	35	28	55
22	Open Space	16	14	20	20	18
23	Bldg Perimeter	250	1400	20	310	1800
24	Bldg Perimeter	170	1000	20	210	1300
25	Open Space	23	39	35	35	60

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.
Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-20b. Multi-increment Soil Sampling Results—Mountain View Elementary

Sample Identification:			S20-01		S20-02		S20-03		S20-04		S20-05	
Sample Collection Date:			2016-11-18		2016-11-18		2016-11-18		2016-11-18		2016-11-18	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Open Space		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)												
Arsenic, bioaccessible	23	2	--		8.7		16		--		--	
Arsenic, total	100	1	64		**160**		**130**		73		48	
Chromium, hexavalent	30	2	--		--		--		--		--	
Chromium, total	1100	3	--		--		--				--	
Copper, total	630	2	--		--		--		--		--	
Lead, total	200	2	**580**		**400**		**1500**		180		**210**	
Organochlorine Pesticides (mg/kg)												
4,4'-DDD	2.3	2	--	ND	0.00017	J	0.00018	J	--		0.00017	J
4,4'-DDE	2.0	2	--	ND	--	ND	--	ND	--		0.00019	J
4,4'-DDT	1.9	2	--	ND	0.00051	J	0.0012	J	--		0.00034	J
Aldrin	3.9	2	--	ND	--	ND	--	ND	--		--	ND
Dieldrin	2.5	2	--	ND	--	ND	--	ND	--		0.0012	J
Endosulfans	94	2	0.0024	J	0.0019	J	0.0015	J	--		0.0021	J
Endrins	3.8	2	0.0068	J	0.0051	J	0.0086	J	--		0.045	J
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND	--		--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND	--		--	ND
Technical Chlordane	17	2	--	ND	0.012	J	0.0068	J	--		0.0069	J
Toxaphene	0.49	2	--	ND	--	ND	--	ND	--		--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-21a. XRF Soil Screening Results—Pahoa High & Intermediate

Reconnaissance XRF Soil Screening
Date: 7/20/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	16	30	50	32	60
2	Bldg Perimeter	210	360	35	320	550
3	Bldg Perimeter	370	1700	10	410	1900
4	Open Space	5.2	19	60	13	48
5	Open Space	9.9	10	60	25	25
6	Bldg Perimeter	490	3400	25	650	4500
7	Bldg Perimeter	68	120	20	85	150
8	Open Space	15	23	60	38	58
9	Open Space	<2.4	5.8	60	<QL	15
10	Open Space	<3.0	17	60	<QL	43
11	Bldg Perimeter	43	150	10	48	170
12	Bldg Perimeter	15	82	50	30	160
13	Open Space	2.6	6.9	60	7	17
14	Open Space	8.7	5.3	60	22	13
15	Bldg Perimeter	42	14	10	47	16
16	Open Space	24	12	60	60	30
17	Open Space	4.3	4.8	60	11	12
18	Garden	15	<5.6	45	27	<QL
19	Garden	22	13	45	40	24
20	Garden	48	21	35	74	32
21	Bldg Perimeter	41	22	35	63	34
22	Bldg Perimeter	46	<9.0	35	71	<QL
23	Open Space	4	6	60	10	15
24	Open Space	<2.9	9.1	60	<QL	23
25	Open Space	16	<7.0	60	40	<QL
26	Open Space	6.5	6.9	60	16	17
27	Open Space	<2.4	6.8	60	<QL	17
28	Open Space	3.4	<5.3	50	7	<QL

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.
Outlined cells exceed 5 times the screening values.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-21b. Multi-increment Soil Sampling Results—Pahoa High & Intermediate

Sample Identification:			S21-01		S21-02		S21-03		S21-04	
Sample Collection Date:			2016-12-27		2016-12-27		2016-12-27		2016-12-27	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)										
Arsenic, bioaccessible	23	2	**27**		20		--		--	
Arsenic, total	100	1	**150**		**170**		29		32	
Chromium, hexavalent	30	2	--		0.64	J	--		--	
Chromium, total	1100	3	--		96		--			
Copper, total	630	2	--		170		--		--	
Lead, total	200	2	**3000**		**1100**	J	190		10	
Organochlorine Pesticides (mg/kg)										
4,4'-DDD	2.3	2	0.010		0.019	J	--	ND	--	ND
4,4'-DDE	2.0	2	0.037		0.082		0.066	J	--	ND
4,4'-DDT	1.9	2	0.18		0.17		0.19	J	--	ND
Aldrin	3.9	2	--	ND	--	ND	0.022	J	--	ND
Dieldrin	2.5	2	--	ND	--	ND	0.12	J	--	ND
Endosulfans	94	2	0.0030	J	0.0016	J	0.24	J	0.0022	J
Endrins	3.8	2	0.31	J	--	ND	0.015	J	--	ND
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND	--	ND
Methoxychlor	63	2	--	ND	--	ND	--	ND	--	ND
Technical Chlordane	17	2	0.025	J	0.091		**110**		--	ND
Toxaphene	0.49	2	0.15	J	0.059	J	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-22a. XRF Soil Screening Results—Keonepoko Elementary

Reconnaissance XRF Soil Screening
Date: 7/19/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	7.2	6.8	70	24	23
2	Open Space	9.0	8.4	60	23	21
3	Open Space	14	14	45	25	25
4	Open Space	9.4	6.9	70	31	23
5	Open Space	6.9	7.0	35	11	11
6	Garden	6.0	5.8	25	8	8
7	Open Space	<2.0	<3.3	50	<QL	<QL
8	Open Space	7.0	8.1	50	14	16
9	Open Space	12	8.5	50	24	17
10	Open Space	11	8.3	40	18	14
11	Open Space	8.1	8.5	30	12	12
12	Open Space	13	11	30	19	16
13	Open Space	9.1	10	45	17	18
14	Open Space	9.1	8.7	55	20	19
15	Open Space	12	12	35	18	18
16	Open Space	9.5	13	35	15	20
17	Open Space	6.9	83	35	11	130
18	Bldg Perimeter	41	53	25	55	71
19	Open Space	65	25	15	76	29
20	Open Space	19	10	25	25	13
21	Open Space	33	11	30	47	16

Notes:
<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-22b. Multi-increment Soil Sampling Results—Keonepoko Elementary

Sample Identification:			S22-01		S22-02	
Sample Collection Date:			2017-01-10		2016-12-29	
Sample Type:			Bldg Perimeter		Open Space	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.
Metals (mg/kg)						
Arsenic, bioaccessible	23	2	--		--	
Arsenic, total	100	1	26		57	
Chromium, hexavalent	30	2	--		--	
Chromium, total	1100	3	--		--	
Copper, total	630	2	--		--	
Lead, total	200	2	31		15	J
Organochlorine Pesticides (mg/kg)						
4,4'-DDD	2.3	2	--	ND	--	
4,4'-DDE	2.0	2	--	ND	--	
4,4'-DDT	1.9	2	--	ND	--	
Aldrin	3.9	2	--	ND	--	
Dieldrin	2.5	2	--	ND	--	
Endosulfans	94	2	0.0041	J	--	
Endrins	3.8	2	--	ND	--	
gamma-BHC (Lindane)	0.57	2	--	ND	--	
Methoxychlor	63	2	--	ND	--	
Technical Chlordane	17	2	--	ND	--	
Toxaphene	0.49	2	--	ND	--	

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels

Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg

Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed

-- ND = compound not detected

J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic

2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)

3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-23a. XRF Soil Screening Results—Pahoa Elementary

Reconnaissance XRF Soil Screening
Date: 7/20/2016

		Field Measurements			Moisture Corrected	
Sample ID	Sample Type	Arsenic (mg/kg)	Lead (mg/kg)	Soil Moisture (% volume)	Arsenic (mg/kg)	Lead (mg/kg)
1	Open Space	23	47	45	42	85
2	Open Space	3.6	15	45	7	27
3	Open Space	5.8	<5.9	45	11	<QL
4	Open Space	<2.6	7.9	45	<QL	14
5	Open Space	<2.3	4.6	45	<QL	8
6	Open Space	<2.5	5.1	45	<QL	9
7	Open Space	4.1	6.1	45	8	11
8	Open Space	4.3	11	45	8	20
9	Bldg Perimeter	12	20	15	14	24
10	Bldg Perimeter	13	29	25	17	39
11	Bldg Perimeter	42	19	25	56	25
12	Bldg Perimeter	11	85	25	15	110
13	Garden	28	22	20	35	28
14	Garden	43	15	20	54	19
15	Bldg Perimeter	42	250	20	53	310
16	Open Space	13	29	40	22	48
17	Garden	17	100	40	28	170
18	Open Space	24	14	40	40	23
19	Open Space	5.8	17	40	10	28
20	Bldg Perimeter	20	140	25	27	190

Notes:

Shaded cells exceed screening values: 100 mg/kg arsenic and 200 mg/kg lead in moisture-corrected XRF readings.

<QL = result less than XRF instrument quantification level
XRF = X-ray fluorescence

Table 3-23b. Multi-increment Soil Sampling Results—Pahoa Elementary

Sample Identification:			S23-01		S23-02		S23-03	
Sample Collection Date:			2017-01-02		2017-01-02		2017-01-02	
Sample Type:			Bldg Perimeter		Bldg Perimeter		Bldg Perimeter	
Analyte	Action Level	Basis	Result	Qual.	Result	Qual.	Result	Qual.
Metals (mg/kg)								
Arsenic, bioaccessible	23	2	--		--		--	
Arsenic, total	100	1	46		18		22	
Chromium, hexavalent	30	2	--		--		--	
Chromium, total	1100	3	--		--		--	
Copper, total	630	2	--		--		--	
Lead, total	200	2	**300**	J	44	J	**230**	J
Organochlorine Pesticides (mg/kg)								
4,4'-DDD	2.3	2	--	ND	--	ND	--	ND
4,4'-DDE	2.0	2	--	ND	--	ND	0.17	J
4,4'-DDT	1.9	2	0.0020		--	ND	0.36	
Aldrin	3.9	2	--	ND	--	ND	--	ND
Dieldrin	2.5	2	--	ND	--	ND	--	ND
Endosulfans	94	2	0.0014	J	--	ND	0.012	J
Endrins	3.8	2	0.0021	J	--	ND	0.066	J
gamma-BHC (Lindane)	0.57	2	--	ND	--	ND	--	ND
Methoxychlor	63	2	0.00072	J	--	ND	--	ND
Technical Chlordane	17	2	--	ND	--	ND	**22**	J
Toxaphene	0.49	2	--	ND	--	ND	--	ND

Notes:

Bold values exceed Action Level; shaded cells exceed Category C levels; shaded and bold outlined cells exceed Category D levels
Category C thresholds: Bioaccessible arsenic: 23 mg/kg, Lead: 200 mg/kg, Technical Chlordane: 17 mg/kg
Category D thresholds: Bioaccessible arsenic: 95 mg/kg, Lead: 800 mg/kg, Technical Chlordane: 77 mg/kg

-- = not analyzed
-- ND = compound not detected
J = result is an estimated quantity

Basis:

1 - Project-specific total arsenic value for iron-rich soils where bioaccessible arsenic expected to be <20% total arsenic
2 - Direct exposure action level, unrestricted land use (HDOH 2016, Table I-1)
3 - Hawaii soil background concentration (HDOH 2016, Table K)

Table 3-24a. XRF Soil Screening—Summary of Findings

		Percentage of Samples Exceeding Screening Levels				
No.	School Name	Lead or Arsenic >1X	Lead >1X	Lead >5X	Arsenic >1X	Arsenic >5X
18	Keaau Middle	NS	NS	NS	NS	NS
4	DeSilva Elementary	50%	8%	0%	50%	15%
19	Keaau Elementary	47%	0%	0%	47%	0%
13	Waiakea Elementary	45%	0%	0%	45%	5%
6	Hilo Union Elementary	44%	44%	13%	0%	0%
2	Hilo Intermediate	32%	32%	11%	11%	0%
7	Kapiolani Elementary	30%	30%	9%	36%	12%
3	Kalanianaole Elementary & Intermediate	29%	23%	0%	9%	0%
20	Mountain View Elementary	28%	20%	12%	24%	4%
16	Naalehu Elementary & Intermediate	24%	24%	0%	0%	0%
15	Kau High & Pahala Elementary	23%	23%	8%	0%	0%
1	Hilo High	21%	21%	0%	0%	0%
14	Waiakeawaena Elementary	17%	13%	0%	8%	0%
10	Laupahoehoe High & Elementary	14%	14%	5%	5%	0%
21	Pahoa High & Intermediate	11%	11%	7%	11%	4%
12	Waiakea Intermediate	11%	5%	0%	5%	0%
8	Kaumana Elementary	10%	10%	0%	0%	0%
9	Keaukaha Elementary	9%	9%	0%	0%	0%
5	Haaheo Elementary	7%	7%	0%	0%	0%
23	Pahoa Elementary	5%	5%	0%	0%	0%
11	Waiakea High	0%	0%	0%	0%	0%
17	Keaau High	0%	0%	0%	0%	0%
22	Keonepoko Elementary	0%	0%	0%	0%	0%

Notes:

Sorted highest to lowest based on percentage of samples exceeding the arsenic and lead screening levels.

NS = not sampled
XRF = X-ray fluorescence

Table 3-24b. Multi-increment Soil Sampling Results—Summary of Findings and Recommendations

		Open Space Areas			Building Perimeters			Garden Plots			Recommendations	
No.	School Name	Arsenic	Lead	OCPs[a]	Arsenic	Lead	OCPs[a]	Arsenic	Lead	OCPs[a]	No Further Action	Further Study
1	Hilo High	OK	OK	- -	OK	>AL	OK		No Garden Plots			X
2	Hilo Intermediate	OK	>AL	- -	OK	>AL	OK	OK	OK	- -		X
3	Kalanianaole Elementary & Intermediate	OK	>AL	- -	OK	>AL	OK	OK	>AL	- -		X
4	DeSilva Elementary	OK	OK	- -	>AL	>AL	OK	OK	OK	- -		X
5	Haaheo Elementary	OK	OK	- -	OK	>AL	OK	OK	OK	- -		X
6	Hilo Union Elementary	OK	OK	- -	OK	>AL	>AL	OK	>AL	- -		X
7	Kapiolani Elementary	OK	>AL	- -	>AL	>AL	>AL	OK	>AL	- -		X
8	Kaumana Elementary	- -	- -	- -	OK	>AL	OK		No Garden Plots			X
9	Keaukaha Elementary	- -	- -	- -	OK	>AL	OK	OK	OK	- -		X
10	Laupahoehoe High & Elementary	OK	OK	- -	OK	>AL	OK	OK	OK	- -		X
11	Waiakea High	OK	OK	- -	OK	OK	OK	OK	OK	- -		X
12	Waiakea Intermediate	- -	- -	- -	>AL	OK	OK	OK	OK	- -		X
13	Waiakea Elementary	OK	OK	- -	OK	OK	OK		No Garden Plots			X
14	Waiakeawaena Elementary	OK	OK	- -	OK	>AL	>AL	OK	OK	- -		X
15	Kau High & Pahala Elementary	OK	OK	- -	OK	>AL	>AL	OK	OK	- -		X
16	Naalehu Elementary & Intermediate	- -	- -	- -	OK	>AL	OK	OK	OK	- -		X
17	Keaau High	- -	- -	- -	OK	OK	OK	OK	OK	- -	X	
18	Keaau Middle[b]	>AL	>AL	OK	>AL	>AL	OK	>Al[c]	OK	OK		X
19	Keaau Elementary	OK	OK	- -	OK	OK	OK	OK	OK	- -	X	
20	Mountain View Elementary	OK	OK	- -	OK	>AL	OK	OK	OK	- -		X
21	Pahoa High & Intermediate	- -	- -	- -	>AL	>AL	>AL	OK	OK	- -		X
22	Keonepoko Elementary	OK	OK	- -	OK	OK	OK	OK	OK	- -	X	
23	Pahoa Elementary	- -	- -	- -	OK	>AL	>AL	OK	OK	- -		X

Notes:
Results are for Decision Units with highest observed concentrations.

- - = not analyzed
>AL = concentrations above action levels
HDOH = Hawaii Department of Health
OCP = organochlorine pesticide
OK = concentrations below action levels

Shaded cells corresponds to Category C soils
Outlined cells corresponds to Category D soils

[a] All OCP exceedances of action levels were for technical chlordane, except for one sample with 4,4'-DDD reported at slightly over the action level.
[b] Based on previous investigations at Keaau Middle School conducted by HDOH and AMEC (2007), ERM (2008), and Kennedy/Jenks Consultants (2014).
[c] Former garden plot at Keaau Middle School was taken out of service in 2005, based on HDOH advice to school. Currently in highly vegetated state with no bare soils.

Table 3-25. Summary of Areas with Category D Soils and Recommended Interim Actions

No.	School Name	Decision Unit	Result	Building Construction Date	Type of Construction	Ground Conditions	Recommended Interim Actions
1	Hilo High	S1-02	Lead = 860 mg/kg	1937	Wood	Bare soil, significant amount of visible paint chips	Cover bare soil with garden fabric and place landscape cover on top.
2	Hilo Intermediate	S2-01	Lead = 2100 mg/kg	1929	Wood	Some bare soil	Cover bare soil with garden fabric and place landscape cover on top.
3	Kalanianaole Elementary & Intermediate	S3-01	Lead = 600 mg/kg	--	--	Grass cover	Restrict access to this area of garden.
		S3-05	Lead = 1800 mg/kg	1921	Concrete and hollow tile	Sparsely vegetated, mostly bare soil along building's edge	Cover bare soil with garden fabric and place landscape cover on top.
4	DeSilva Elementary	S4-04	Total arsenic = 2500 mg/kg Bioaccessible arsenic = 180 mg/kg	1959	Wood	Shrubs with bare soil under plantings	Cover bare soil with garden fabric and place landscape cover on top.
		S4-10	Total arsenic = 1200 mg/kg Bioaccessible arsenic = 89 mg/kg	1962	Wood	Shrubs with bare soil under plantings	Category C soils, however close to Category D soils. Cover bare soil with garden fabric and place landscape cover on top.
5	Haaheo Elementary	S5-02	Lead = 1400 mg/kg	1931	Wood	Shrubs with bare soil under plantings	Cover bare soil with garden fabric and place landscape cover on top.
6	Hilo Union Elementary	S6-02 and S6-03	Lead = 590 and 3800 mg/kg, respectively	1930	Wood	Grass, bare soil along Building B	Restrict access to entire garden area and in the back of Building B.
		S6-05 and S6-06	Lead = 1500 and 1400 mg/kg, respectively Chlordane = 64 and 110 mg/kg, respectively	1912	Wood	Mostly grass, limited bare soil right against building walls	Request that maintenance personnel do not spray herbicide along edge of building in order to maintain grass cover.
7	Kapiolani Elementary	S7-02	Total arsenic = 2500 mg/kg Bioaccessible arsenic = 240 mg/kg	1920 (Bldg D) - 1956 (Bldg G)	Wood	Half covered with cinder, half bare soil	Reinforce existing ground cover.
		S7-04	Total arsenic = 2000 mg/kg Bioaccessible arsenic = 140 mg/kg	1956	Wood	Bare soil	Cover bare soil with garden fabric and place landscape cover on top.
		S7-05	Lead = 400 mg/kg	--	--	Grassed with two garden beds growing vegetable crops	Restric access to garden beds. Relocate gardening activites.
		S7-07	Lead = 1300 mg/kg	1921	Wood	Bare soil	Cover bare soil with garden fabric and place landscape cover on top.
		S7-09	Lead = 1600 mg/kg Chlordane = 110 mg/kg	1921	Wood	Mostly vegetated and mulched, some limited bare soil at plant's base	Reinforce existing mulch cover.
8	Kaumana Elementary					No Category D Soils	
9	Keaukaha Elementary	S9-02	Lead = 890 mg/kg	1930	Wood	Mostly well vegetated, area of bare soil with school's bike racks and visible paint chips	Remove bike racks from and relocate elsewhere. Cover bare soil with garden fabric and place landscape cover on top.
10	Laupahoehoe High & Elementary					No Category D Soils	
11	Waiakea High					No Category D Soils	
12	Waiakea Intermediate	S12-02	Total arsenic = 780 mg/kg Bioaccessible arsenic = 320 mg/kg	1962	Wood	Mostly bare soil	Cover bare soil with garden fabric and place landscape cover on top. Consider rerouting foot traffic away from building as much as possible.
13	Waiakea Elementary					No Category D Soils	
14	Waiakeawaena Elementary					No Category D Soils	
15	Kau High & Pahala Elementary	S15-01	Lead = 1200 mg/kg	1890	Wood	Sparse grass on 2 sides of building. Mulch on 1 side. Bare soil on 1 side.	
		S15-03	Lead = 770 mg/kg	unknown but appears pre-1950s	Wood	Bare soil, spare grass	
16	Naalehu Elementary & Intermediate					No Category D Soils	
17	Keaau High					No Category D Soils	
18	Keaau Middle					No Category D Soils	
19	Keaau Elementary					No Category D Soils	
20	Mountain View Elementary	S20-03	Lead = 1500 mg/kg	1946	Wood	Mostly vegetated except for roof drip-line (no gutters in place)	Cover bare soil with garden fabric and place landscape cover on top. Consider installing gutters to prevent erosion.
21	Pahoa High & Intermediate	S21-01	Lead = 3000 mg/kg	1912	Wood	Half of perimeter has cinder/gravel cover, half is bare soil. Bare soil under plantings.	Cover bare soil with garden fabric and place landscape cover on top.
		S21-02	Lead = 1100 mg/kg	1912	Wood	Some grass, mostly bare soil	Cover bare soil with garden fabric and place landscape cover on top.
		S21-03	Chlordane = 110 mg/kg	1970	Wood	Mostly grassed, some sparse grass, some patches of bare soil	Cover bare soil with garden fabric and place landscape cover on top.
22	Keonepoko Elementary					No Category D Soils	
23	Pahoa Elementary					No Category D Soils	

Table 4-1. Relative Standard Deviation Evaluation

	Arsenic		Lead		Chlordane	
Set of Triplicate Samples	Average (mg/kg)	RSD (%)	Average (mg/kg)	RSD (%)	Average (mg/kg)	RSD (%)
S3-02 A, B, C	40	7	727	4	7	69
S3-04 A, B, C	110	0	77	3	--	--
S3-05 A, B, C	14	12	1800	6	15	18
S4-09 A, B, C	257	25	170	27	--	--
S5-02 A, B, C	7	9	1400	12	--	--
S8-01 A, B, C	14	11	573	10	0.07	28
S10-02 A, B, C	15	26	120	22	0.02	7
S12-01 A, B, C	29	26	190	9	--	--
S12-02 A, B, C	780	5	142	48	0.0029	50
S13-02 A, B, C	53	2	38	26	0.013	8
S13-06 A, B, C	75	4	28	2	0.023	44

Notes:
-- = not analyzed
RSD = relative standard deviation

Table 4-2. Effectiveness of XRF Screening to Identify EAL Exceedances

			MIS Results			XRF Results		Arsenic Test Criteria 100 mg/kg		Lead Test Criteria 200 mg/kg		Using XRF>"X" to test MIS >200
MI Sample ID	Location Identification	Location Type	Total Arsenic (mg/kg)	Total Lead (mg/kg)	XRF Sample ID	Total Arsenic (mg/kg)	Total Lead (mg/kg)	False Pos If: XRF≥100, MIS<100	False Neg If: XRF<100, MIS≥100	False Pos If: XRF≥200, MIS<200	False Neg If: XRF<200, MIS≥200	False Neg If: XRF<150, MIS≥200
S1-01	DU-S1-01	Open Space	28 J	99	4	88	200	OK	OK	FALSE POS	OK	OK
S1-02	DU-S1-02	Bldg Perimeter	250 J	860	6	80	490	OK	FALSE NEG	OK	OK	OK
S1-03	DU-S1-03	Open Space	16 J	180	7	31	420	OK	OK	FALSE POS	OK	OK
S2-02	DU-S2-02	Bldg Perimeter	141 J	2101	11,13	215	2900	OK	OK	OK	OK	OK
S2-02	DU-S2-02	Open Space	32 J	290	15	35	220	OK	OK	OK	OK	OK
S2-03	DU-S2-03	Open Space	6.8 J	76 J	17,18	0	152.5	OK	OK	OK	OK	OK
S2-04	DU-S2-04	Open Space	14 J	140 J	16	15	220	OK	OK	FALSE POS	OK	OK
S3-01	DU-S3-01	Garden	60 J	600	4	200	470	FALSE POS	OK	OK	OK	OK
S3-02ave	DU-S3-02	Bldg Perimeter	40	727	5	83	950	OK	OK	OK	OK	OK
S3-03	DU-S3-03	Open Space	12 J	270	6	24	310	OK	OK	OK	OK	OK
S3-04ave	DU-S3-04	Open Space	110 J	77	8,9	156.5	151	OK	OK	OK	OK	OK
S3-05ave	DU-S3-05	Bldg Perimeter	14	1800 J	12B	37	620	OK	OK	OK	OK	OK
S4-02	DU-S4-02	Bldg Perimeter	540	69	11	390	100	OK	OK	OK	OK	OK
S4-03	DU-S4-03	Open Space	130	39	6,7,8	176	38	OK	OK	OK	OK	OK
S4-06	DU-S4-06	Open Space	550	120	12,23	215	96	OK	OK	OK	OK	OK
S4-07	DU-S4-07	Bldg Perimeter	560	190	14	630	200	OK	OK	FALSE POS	OK	OK
S4-09ave	DU-S4-09	Open Space	257	170	17,18	270	130	OK	OK	OK	OK	OK
S4-10	DU-S4-10	Bldg Perimeter	1200	96	19	1800	85	OK	OK	OK	OK	OK
S4-12	DU-S4-12	Open Space	75	26	20	200	30	FALSE POS	OK	OK	OK	OK
S4-9-MI	DU-S4-04	Bldg Perimeter	2500	280	9,10	2150	110	OK	OK	OK	FALSE NEG	FALSE NEG
S5-01	DU-S5-01	Open Space	25 J	17	5	94	140	OK	OK	OK	OK	OK
S5-02ave	DU-S5-02	Bldg Perimeter	7 J	1400	12	44	640	OK	OK	OK	OK	OK
S6-01	DU-S6-01	Bldg Perimeter	9.7 J	490 J	4	33	750	OK	OK	OK	OK	OK
S6-02	DU-S6-02	Garden	14 J	590	5	25	650	OK	OK	OK	OK	OK
S6-04	DU-S6-04	Open Space	5.3 J	190 J	8	0	250	OK	OK	FALSE POS	OK	OK
S6-05	DU-S6-05	Bldg Perimeter	12 J	1500 J	9	63	3000	OK	OK	OK	OK	OK
S6-06	DU-S6-06	Bldg Perimeter	11 J	1400 J	10,11	27.5	1375	OK	OK	OK	OK	OK
S6-07	DU-S6-07	Open Space	8.5 J	200 J	12,13,14	7	170	OK	OK	OK	FALSE NEG	OK
S7-01	DU-S7-01	Open Space	12	24	11	10	2000	OK	OK	FALSE POS	OK	OK
S7-02	DU-S7-02	Bldg Perimeter	2500	380	27	2400	320	OK	OK	OK	OK	OK
S7-03	DU-S7-03	Bldg Perimeter	400	130	20,21	710	145	OK	OK	OK	OK	OK
S7-04	DU-S7-04	Bldg Perimeter	2000	130	23	4900	160	OK	OK	OK	OK	OK
S7-04	DU-S7-04	Bldg Perimeter	2000	130	25	1700	570	OK	OK	FALSE POS	OK	OK
S7-04	DU-S7-04	Bldg Perimeter	2000	130	23,25	3300	365	OK	OK	FALSE POS	OK	OK
S7-05	DU-S7-05	Garden	620	400	22	350	150	OK	OK	OK	FALSE NEG	OK
S7-06	DU-S7-06	Open Space	140	220	28	170	170	OK	OK	OK	FALSE NEG	OK
S7-07	DU-S7-07	Bldg Perimeter	160	1300	29	340	2400	OK	OK	OK	OK	OK
S7-08	DU-S7-08	Open Space	190	230	30	130	220	OK	OK	OK	OK	OK
S7-09	DU-S7-09	Bldg Perimeter	170	1600	33	200	4000	OK	OK	OK	OK	OK
S7-10	DU-S7-10	Open Space	13	270	1	0	320	OK	OK	OK	OK	OK
S7-11	DU-S7-11	Open Space	22	230	2	0	580	OK	OK	OK	OK	OK
S8-01A	DU-S8-01	Bldg Perimeter	14 J	600	1	33	750	OK	OK	OK	OK	OK
S9-01	DU-S9-01	Bldg Perimeter	19	410	20	93	200	OK	OK	OK	OK	OK
S9-02	DU-S9-02	Bldg Perimeter	59	890	8	33	300	OK	OK	OK	OK	OK
S10-01	DU-S10-01	Bldg Perimeter	18 J	720	14	33	370	OK	OK	OK	OK	OK
S10-02ave	DU-S10-02	Bldg Perimeter	15	120	4	110	1600	FALSE POS	OK	FALSE POS	OK	OK
S10-03	DU-S10-03	Bldg Perimeter	20	310	22	93	430	OK	OK	OK	OK	OK
S11-01	DU-S11-01	Open Space	43	22	21	80	0	OK	OK	OK	OK	OK
S11-02	DU-S11-02	Bldg Perimeter	46	11	10	98	13	OK	OK	OK	OK	OK
S11-03	DU-S11-03	Bldg Perimeter	8.4	6.6	2,3	13.5	8	OK	OK	OK	OK	OK
S12-01ave	DU-S12-01	Bldg Perimeter	29	190	7	26	280	OK	OK	FALSE POS	OK	OK

Table 4-2. Effectiveness of XRF Screening to Identify EAL Exceedances

			MIS Results			XRF Results		Arsenic Test Criteria 100 mg/kg		Lead Test Criteria 200 mg/kg		Using XRF>"X" to test MIS >200
MI Sample ID	Location Identification	Location Type	Total Arsenic (mg/kg)	Total Lead (mg/kg)	XRF Sample ID	Total Arsenic (mg/kg)	Total Lead (mg/kg)	False Pos If: XRF≥100, MIS<100	False Neg If: XRF<100, MIS≥100	False Pos If: XRF≥200, MIS<200	False Neg If: XRF<200, MIS≥200	False Neg If: XRF<150, MIS≥200
S12-02ave	DU-S12-02	Bldg Perimeter	780	142	14	150	150	OK	OK	OK	OK	OK
S13-01	DU-S13-01	Open Space	46	22	17	170	13	FALSE POS	OK	OK	OK	OK
S13-03	DU-S13-03	Open Space	120	21	6,7,9,21,22	343	28	OK	OK	OK	OK	OK
S13-04	DU-S13-04	Open Space	200 J	20	10,11,12	227	26	OK	OK	OK	OK	OK
S13-05	DU-S13-05	Open Space	66	15	5	120	27	FALSE POS	OK	OK	OK	OK
S14-01	DU-S14-01	Open Space	25 J	40	1	16	200	OK	OK	FALSE POS	OK	OK
S14-02	DU-S14-02	Open Space	110 J	150	21	100	120	OK	OK	OK	OK	OK
S14-03	DU-S14-03	Bldg Perimeter	60	480	14	120	810	FALSE POS	OK	OK	OK	OK
S14-04	DU-S14-04	Bldg Perimeter	26 J	34	23	38	260	OK	OK	FALSE POS	OK	OK
S15-01	DU-S15-01	Bldg Perimeter	4.4	1200	24	76	4300	OK	OK	OK	OK	OK
S15-02	DU-S15-02	Bldg Perimeter	6.5	480	23	20	410	OK	OK	OK	OK	OK
S15-03	DU-S15-03	Bldg Perimeter	7.1	770	12	45	750	OK	OK	OK	OK	OK
S15-04	DU-S15-04	Bldg Perimeter	7.9	650	11	0	690	OK	OK	OK	OK	OK
S15-05	DU-S15-05	Open Space	4	150	8	15	250	OK	OK	FALSE POS	OK	OK
S15-06	DU-S15-06	Bldg Perimeter	6.8	650	9	0	1100	OK	OK	OK	OK	OK
S15-07	DU-S15-07	Bldg Perimeter	6.1	250	2,3,5	15	257	OK	OK	OK	OK	OK
S16-01	DU-S16-01	Bldg Perimeter	8.5	280	14	43	640	OK	OK	OK	OK	OK
S16-02	DU-S16-02	Bldg Perimeter	7.8	410	20,21	20.5	480	OK	OK	OK	OK	OK
S16-03	DU-S16-03	Bldg Perimeter	5.5	250	1	23	310	OK	OK	OK	OK	OK
S16-04	DU-S16-04	Bldg Perimeter	8.8	410	3	28	320	OK	OK	OK	OK	OK
S19-01	DU-S19-01	Open Space	100	15	1	120	9	OK	OK	OK	OK	OK
S19-03	DU-S19-05	Open Space	77	5.3	8,9	85	14	OK	OK	OK	OK	OK
S19-04-R	DU-S19-04	Open Space	150	28	4,5,6	114	13	OK	OK	OK	OK	OK
S19-05	DU-S19-05	Open Space	90	6.1	10,11	110	10.5	FALSE POS	OK	OK	OK	OK
S19-06	DU-S19-06	Garden	80	15	7	120	0	FALSE POS	OK	OK	OK	OK
S19-07	DU-S19-07	Open Space	96	5.1	12,13	92.5	15.5	OK	OK	OK	OK	OK
S19-08	DU-S19-08	Open Space	82	20 J	19	130	18	FALSE POS	OK	OK	OK	OK
S20-01	DU-S20-01	Bldg Perimeter	64	580	23,24	260	1550	FALSE POS	OK	OK	OK	OK
S20-02	DU-S20-02	Bldg Perimeter	160	400	10	130	310	OK	OK	OK	OK	OK
S20-03	DU-S20-03	Bldg Perimeter	130	1500	3,4	325.5	2015	OK	OK	OK	OK	OK
S20-04	DU-S20-04	Open Space	73	180	2	200	98	FALSE POS	OK	OK	OK	OK
S20-05	DU-S20-05	Bldg Perimeter	48	210	5	76	350	OK	OK	OK	OK	OK
S21-01	DU-S21-01	Bldg Perimeter	150	3000	6	650	4500	OK	OK	OK	OK	OK
S21-02	DU-S21-02	Bldg Perimeter	170	1100	2,3	365	1225	OK	OK	OK	OK	OK
S21-03	DU-S21-03	Bldg Perimeter	29	190	12	30	160	OK	OK	OK	OK	OK
S21-04	DU-S21-04	Bldg Perimeter	32	10	21,22	67	17	OK	OK	OK	OK	OK
S22-01	DU-S22-01	Bldg Perimeter	26	31	18	55	71	OK	OK	OK	OK	OK
S22-02	DU-S22-02	Open Space	57	15 J	19,20,21	49	19	OK	OK	OK	OK	OK
S23-01	DU-S23-01	Bldg Perimeter	46	300 J	15	53	310	OK	OK	OK	OK	OK
S23-02	DU-S23-02	Bldg Perimeter	18	44 J	11,12	35.5	67.5	OK	OK	OK	OK	OK
S23-03	DU-S23-03	Bldg Perimeter	22	230 J	20	27	190	OK	OK	OK	FALSE NEG	OK

Notes:
EAL = environmental action level
MI = multi-increment
MIS = multi-increment sample
XRF = X-ray fluorescence

J = result is an estimated quantity

Table 4-3. Total and Bioaccessible Arsenic Results

School	Sample Identification	Sample Type	Total Arsenic <2mm Fraction (mg/kg)	Total Arsenic <0.25mm Fraction (mg/kg)	Arsenic Concentration Factor (<0.25mm/<2mm)	Bioaccessible Arsenic <0.25mm Fraction (mg/kg)	Bioaccessible Arsenic (%)
Hilo High	S1-02	Bldg Perimeter	250 J	410	1.64	18	4.4%
Waiakea Intermediate	S12-02A	Bldg Perimeter	810	950	1.17	320	33.7%
Waiakea Elementary	S13-03	Open Space	120	130	1.08	ND	NA
Waiakea Elementary	S13-04	Open Space	200 J	210	1.05	9.1	4.3%
Waiakeawaena Elementary	S14-02	Open Space	110 J	150	1.36	ND	NA
Keaau Elementary	S19-01	Open Space	100	120	1.20	7.9	6.6%
Keaau Elementary	S19-04	Open Space	150	120	0.80	6.5	5.4%
Mountain View Elementary	S20-02	Bldg Perimeter	160	160	1.00	8.7	5.4%
Mountain View Elementary	S20-03	Bldg Perimeter	130	180	1.38	16	8.9%
Hilo Intermediate	S2-01	Bldg Perimeter	140 J	200	1.43	ND	NA
Pahoa High & Intermediate	S21-01	Bldg Perimeter	150	210	1.40	27	12.9%
Pahoa High & Intermediate	S21-02	Bldg Perimeter	170	200	1.18	20	10.0%
Kalanianaole Elementary & Intermediate	S3-04B	Open Space	110 J	170	1.55	ND	NA
DeSilva Elementary	S4-01	Drainage Ditch	270	352	1.30	3.7 J	1.1%
DeSilva Elementary	S4-03	Open Space	130	170	1.31	ND	NA
DeSilva Elementary	S4-06	Open Space	550	720	1.31	20	2.8%
DeSilva Elementary	S4-09A	Open Space	260	250	0.96	ND	NA
DeSilva Elementary	S4-09B	Open Space	320	360	1.13	6.1	1.7%
DeSilva Elementary	S4-09C	Open Space	190	190	1.00	ND	NA
DeSilva Elementary	S4-10	Bldg Perimeter	1200	1600	1.33	89	5.6%
DeSilva Elementary	S4-9-MI	Bldg Perimeter	2500	--	--	180	NA
Kapiolani Elementary	S7-02	Bldg Perimeter	2500	2600	1.04	240	9.2%
Kapiolani Elementary	S7-05	Garden	620	740	1.19	20	2.7%
Kapiolani Elementary	S7-06	Open Space	140	160	1.14	ND	NA
Kapiolani Elementary	S7-08	Open Space	190	210	1.11	7.9	3.8%
Kapiolani Elementary	S7-23-MI	Bldg Perimeter	2000	--	--	140	NA
		Minimum	100	120	0.8	3.7	1.1%
		Maximum	2500	2600	1.64	320	34%
		Average	518	440	1.2	63	7.4%

Notes:
-- = not analyzed
ND = compound not detected
NA = not applicable as bioaccessible arsenic was not detected

J = result is an estimated quantity

APPENDIX A

INFRASTRUCTURE INVENTORY

APPENDIX A: INFRASTRUCTURE INVENTORY

School No.	1
School Name	Hilo High
Address	556 Waianuenue Ave, Hilo, HI 96720
TMK	2-3-015-001 and 2-3-015-026
Acres	24.2
School Garden	No

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1922	CON & HWL TILE
AA	Classroom	1980	CON & HWL TILE
C	Classroom	1980	CON & HWL TILE
B	Administration	1928	CON & HWL TILE
BB	Classroom	1995	CON & HWL TILE
D	Administration	1960	WOOD
E	Library	1964	CON & HWL TILE
F	Administration	1931	WOOD
G	Classroom	1994	WOOD
H	Classroom	1963	STEEL
I	Classroom	1973	CON & HWL TILE
J	Gymnasium	1937	WOOD
K	Classroom	1941	WOOD
L	Classroom	1974	CON & HWL TILE
T	Classroom	1974	CON & HWL TILE
U	Lath House	1974	WOOD
V	Pavillion	1974	--
W	Pavillion	1974	--
M	Classroom	1945	WOOD
N	Classroom	1945	WOOD
O	PE locker/shower	1957	CON & HWL TILE
P1	Portable Classroom	1993	WOOD
P2	Portable Classroom	1993	WOOD
P4	Portable Classroom	1993	WOOD
PT1	Portable Classroom	1993	WOOD
P3	Portable Classroom	1968	WOOD
Q	Convention Kitchen	1967	CON & HWL TILE
R	Classroom	1970	CON & HWL TILE
S	Classroom	1970	CON & HWL TILE
TB1	Portable Classroom	1997	WOOD
X	PE locker/shower	1985	CON & HWL TILE
YY	Swimming Pool	1962	CON & HWL TILE
	New Gymnasium		
1	Parking	1905	
2	Parking	1905	
3	Parking	1905	

School No.	2
School Name	Hilo Intermediate
Address	587 Waianuenue Ave, Hilo, HI 96720
TMK	2-3-015-001 and 2-3-015-026
Acres	12.132
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1929	WOOD
B	Classroom	1940	WOOD
C	Classroom	1941	WOOD
D	Classroom	1993	CON & HWL TILE
F	PE locker/shower	1964	STEEL
G	Equipment Shed	1960	WOOD
H	Gymnasium	1931	WOOD
I	Classroom	1969	CON & HWL TILE
K	Convention Kitchen	1971	CON & HWL TILE
L	Classroom	1976	CON & HWL TILE
1	Parking	1929	
2	Parking	1929	

School No.	3
School Name	Kalanianaole Elementary & Intermediate
Address	27-330 Old Mamalahoa Hwy, Papaikou, HI 96781
TMK	2-7-025-004, 2-7-025-004 and 2-7-022-002
Acres	10.778
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1921	CON & HWL TILE
B	Classroom	1926	WOOD
D	Classroom	1945	WOOD
E	Classroom	1965	STEEL
F	Toilet	1960	WOOD
G	Maintenance Room	1960	WOOD
H	Classroom	1971	CON & HWL TILE
I	Cafeteria	1975	CON & HWL TILE
J	Classroom	1980	CON & HWL TILE
QQ	PE Field-Boys,Girls	1884	
1	Parking	1884	
2	Paved Court	1884	
3	Parking	1884	

School No.	4
School Name	DeSilva Elementary
Address	278 Ainako Ave, Hilo, HI 96720
TMK	2-5-008-013
Acres	8.479
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1959	WOOD
B	Classroom	1959	WOOD
C	Administration	1959	WOOD
D	Classroom	1959	WOOD
E	Classroom	1962	WOOD
F	Convention Kitchen	1959	WOOD
G	Classroom	1969	WOOD
H	Library	1969	WOOD
I	Covered Playcourt	1970	STEEL
J	Equipment Shed	1963	STEEL
TB1	Portable Classroom	1996	WOOD
TB2	Portable Classroom		
1	Parking	1959	

School No.	5
School Name	Haaheo Elementary
Address	121 Haaheo Rd, Hilo, HI 96720
TMK	2-6-020-038
Acres	3.391
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1931	WOOD
B	Serving Kitchen	1931	WOOD
C	Toilet	1973	CON & HWL TILE
E	Maintenance Room	1960	STEEL
P1	Portable Classroom	1971	WOOD
P2	Portable Classroom	1968	WOOD
P3	Portable Classroom	1991	WOOD
P4	Portable Classroom	1995	WOOD
P5	Portable Classroom	1996	WOOD
QQ	PE Field-Boys,Girls	1900	
1	Parking	–	
2	Paved Court	1900	

School No.	6
School Name	Hilo Union Elementary
Address	506 Waianuenue Ave, Hilo, HI 96720
TMK	2-3-016-037
Acres	5.778
School Garden	No

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1912	WOOD
B	Classroom	1930	WOOD
D	Toilet	1916	CON & HWL TILE
E	Toilet	1938	CON & HWL TILE
F	Maintenance Room	1960	WOOD
G	Convention Kitchen	1969	CON & HWL TILE
H	Classroom	1972	CON & HWL TILE
I	Administration	1976	CON & HWL TILE
P01	Portable Classroom	1989	WOOD
P02	Portable Classroom	1991	WOOD
QQ	PE Field-Boys,Girls	1912	
1	Paved Court	1912	
2	Parking	1912	

School No.	7
School Name	Kapiolani Elementary
Address	966 Kilauea Ave, Hilo, HI 96720
TMK	2-2-020-001
Acres	14.316
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1956	WOOD
B	Classroom	1921	WOOD
C	Classroom	1921	WOOD
D	Classroom	1920	WOOD
E	Convention Kitchen	1956	WOOD
F	Classroom	1957	WOOD
G	Classroom	1956	WOOD
H	Classroom	1946	WOOD
I	Toilet	1960	WOOD
J	Equipment Shed	1963	STEEL
K	Equipment Shed	1920	WOOD
QQ	PE Field-Boys,Girls	1922	GRAD W/ GRASS CVR
1	Parking	1922	
2	Paved Court	1922	
3	Parking	1922	
4	Parking	1922	

School No.	8
School Name	Kaumana Elementary
Address	1710 Kaumana Dr, Hilo, HI 96720
TMK	2-5-005-084
Acres	7.142
School Garden	No

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1938	WOOD
B	Classroom	1952	WOOD
C	Serving Kitchen	1992	CON & HWL TILE
E	Classroom	1974	CON & HWL TILE
F	Classroom	1985	CON & HWL TILE
P1	Portable Classroom	1992	WOOD
P2	Portable Classroom	1991	WOOD
P3	Portable Classroom	1965	WOOD
P4	Portable Classroom	1966	WOOD
P5	Portable Classroom	1990	WOOD
QQ	PE Field-Boys,Girls	1906	
1	Parking	1906	
2	Parking	1992	
3	Sewage Treat Plant	1992	
D	Covered Playcourt	1998	

School No.	9
School Name	Keaukaha Elementary
Address	240 Desha Ave, Hilo, HI 96720
TMK	2-1-020-001
Acres	6
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1930	WOOD
B	Classroom	1951	WOOD
C	Classroom	1956	WOOD
D	Classroom	1954	WOOD
E	Classroom	1963	WOOD
F	Library	1972	WOOD
G	Classroom	1982	CON & HWL TILE
H	Equipment Shed	1961	STEEL
P01	Portable Classroom	1990	WOOD
P02	Portable Classroom	1991	WOOD
P03	Portable Classroom	1992	WOOD
P04	Portable Classroom	1992	WOOD
P05	Portable Classroom	1994	WOOD
QQ	PE Field-Boys,Girls	1930	GRAD W/ GRASS CVR
TB1	Portable Classroom	1996	WOOD
TB2	Portable Classroom	1997	WOOD
TB3	Portable Classroom	1998	WOOD
	Cafeteria	2015	
1	Parking	1930	
2	Parking	1930	
3	Paved Court	1992	

School No.	10
School Name	Laupahoehoe High & Elementary
Address	35-2065 Old Mamalahoa Hwy, Waimea, HI 96743
TMK	3-5-005-001, 3-5-004-059 and 3-5-004-026
Acres	34.939
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1952	CON & HWL TILE
B	Classroom	1952	STEEL
C	Classroom	1952	STEEL
D	Gymnasium	1962	WOOD
E	Cottage	1948	WOOD
F	Community/Sch Lib	1972	CON & HWL TILE
P01	Classroom	1962	WOOD
QQ	PE Field-Boys, Girls	1904	GRAD W/GRASS CVR
3	Baseball Field	1904	
4	Paved Court	1904	
7	Parking	1904	
8	Parking	1904	

School No.	11
School Name	Waiakea High
Address	155 W Kawili St, Hilo, HI 96720
TMK	2-4-001-015
Acres	46.904
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1998	unknown
B	Classroom	1979	CON & HWL TILE
C	Classroom	1978	CON & HWL TILE
D	Classroom	1978	CON & HWL TILE
D1	mechanical room	1991	REINF CONCRETE
E	Classroom	1977	CON & HWL TILE
F	Classroom	1977	CON & HWL TILE
G	Prep Kitchen	1978	CON & HWL TILE
G1	garage	1978	CON & HWL TILE
H	Classroom	1979	CON & HWL TILE
I	Classroom	1977	CON & HWL TILE
J	Classroom	1978	CON & HWL TILE
K	Classroom	1980	CON & HWL TILE
L	PE locker/shower	1978	CON & HWL TILE
M	Classroom	1978	CON & HWL TILE
N	gymnasium	1987	CON & HWL TILE
O	library	1981	CON & HWL TILE
P1-P4, P10	portable classroom	1976	WOOD
P5, P9	portable classroom	1967	WOOD
P11, P12, P14	portable classroom	1985-1986	WOOD
P13	portable classroom	1968	WOOD
P15, P16	portable classroom	1991	WOOD
P17-P32	portable classroom	1992-1996	WOOD
Q	Classroom	1980	CON & HWL TILE
QQ	PE field-boys, girls	1976	
R	Classroom	1983	CON & HWL TILE
S	garage	1983	CON & HWL TILE
TB1-TB4	portable classroom	1997	WOOD
U	Classroom	1988	CON & HWL TILE
XX	baseball field	1976	
ZZ	paved court	1976	
1-4	parking	1976	
5	parking	1998	

School No.	12
School Name	Waiakea Intermediate
Address	200 W Puainako St, Hilo, HI 96720
TMK	2-4-001-015
Acres	26.354
School Garden	No

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1961	WOOD
B	Classroom	1961	WOOD
C	Classroom	1966	CON & HWL TILE
D	Classroom	1962	WOOD
E	Classroom	1962	WOOD
F	Classroom	1970	CON & HWL TILE
G	Classroom	1962	CON & HWL TILE
H	Classroom	1963	WOOD
I	Classroom	1939	WOOD
J	Administration	1968	CON & HWL TILE
K	Classroom	1969	CON & HWL TILE
L	Prep Kitchen	1962	CON & HWL TILE
M	Classroom	1970	CON & HWL TILE
N	Equipment shed	1966	--
O	maintenance room	1963	WOOD
P1	portable classroom	1964	WOOD
P2	portable classroom	1966	WOOD
P3	portable classroom	1965	WOOD
P4	portable classroom	1965	WOOD
P5	portable classroom	1965	WOOD
P6	portable classroom	1966	WOOD
P7	portable classroom	1968	WOOD
P8	portable classroom	1988	WOOD
Q	Classroom	1988	CON & HWL TILE
QQ	PE field-boys, girls	1961	
R	Classroom	1991	CON & HWL TILE
S	covered playcourt	1999	
1	parking	1961	
2	parking	1961	
3	paved court	1961	
4	parking	1991	
5	sewage treat plant	1991	
6	parking	1961	

School No.	13
School Name	Waiakea Elementary
Address	180 W Puainako St, Hilo, HI 96720
TMK	2-4-001-015
Acres	16.465
School Garden	No

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	classroom	1963	CON & HWL TILE
B	classroom	1963	CON & HWL TILE
C	admin	1963	CON & HWL TILE
D	classroom	1969	CON & HWL TILE
E	classroom	1985	CON & HWL TILE
F	classroom	1986	CON & HWL TILE
G	classroom	1993	CON & HWL TILE
M	equip shed	1965	WOOD
P01	portable classroom	1971	WOOD
P02	portable classroom	1970	WOOD
P03	portable classroom	1964	WOOD
P04	portable classroom	1989	WOOD
P05	portable classroom	1989	WOOD
P07	portable classroom	1968	WOOD
1	parking	1963	
2	roadway	1963	
3	paved court	1998	

School No.	14
School Name	Waiakeawaena Elementary
Address	2420 Kilauea Ave, Hilo, HI 96720
TMK	and 2-2-042-007
Acres	9
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1956	WOOD
B	Cafeteria	1955	WOOD
C	Classroom	1952	WOOD
D	Classroom	1952	WOOD
E	Classroom	1975	CON & HWL TILE
F	Classroom	1972	CON & HWL TILE
G	Classroom	1966	WOOD
H	Classroom	1970	CON & HWL TILE
P1	portable classroom	1964	WOOD
P2	portable classroom	1964	WOOD
P3	portable classroom	–	WOOD
P4	portable classroom	1909	–
QQ	PE field-boys, girls	1909	
1	parking	1909	
4	parking	1995	

School No.	15
School Name	Kau High & Pahala Elementary
Address	96-3150 Pikake St, Pahala, HI 96777
TMK	9-6-005-008 and 9-6-005-039
Acres	47.918
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1947	WOOD
B	Classroom	1939	WOOD
C	Convention Kitchen	1956	WOOD
D	Gymnasium	1936	WOOD
E	Administration	1936	WOOD
F	Classroom	1993	CON & HWL TILE
G	Classroom	1890	WOOD
H	Classroom	1939	WOOD
I	Classroom	1971	CON & HWL TILE
J	Toilet	1936	CON & HWL TILE
K	Toilet	1936	CON & HWL TILE
L	Maintenance Room	1966	WOOD
M	Classroom	1975	CON & HWL TILE
N	Classroom	1978	CON & HWL TILE
O	Community/Sch Lib	1963	CON & HWL TILE
P01	Portable Classroom	1997	WOOD
Q	Classroom	1987	CON & HWL TILE
QQ	PE Field-boys, girls	1881	GRAD W/ GRASS CVR
R	Green house	1967	
S	Green house	1967	
T	Weight train	1985	WOOD
XX	Baseball field	1881	
YY	Swimming pool	--	
	New Gymnasium	--	
2	parking	1881	
3	parking	1881	
5	mechanical room	--	

School No.	16
School Name	Naalehu Elementary & Intermediate
Address	95-5545 Mamalahoa Highway
TMK	9-5-009-015 and 9-5-009-006
Acres	12.27
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1928	WOOD
AA	Classroom		
B	Classroom	1941	WOOD
C	Classroom	1937	WOOD
D	Convention Kitchen	1939	WOOD
E	Gymnasium	1940	WOOD
L	Classroom	1939	WOOD
M	Equipment Shed	1939	WOOD
N	Equipment Shed	1953	WOOD
P01	Portable Classroom	1977	WOOD
P02	Portable Classroom	1989	WOOD
P03	Portable Classroom	1990	WOOD
P04	Portable Classroom	1990	WOOD
P05	Portable Classroom	1991	WOOD
P06	Portable Classroom	1992	WOOD
P07	Portable Classroom	1993	WOOD
QQ	PE Field-boys, girls	1928	GRAD W/GRASS CVR
1	parking	1928	
2	cottage	1947	WOOD
3	cottage	1947	WOOD

School No.	17
School Name	Keaau High
Address	16-725 Keaau-Pahoa Rd, Keaau, HI 96749
TMK	1-6-003-003, 1-6-003-015 and 1-6-003-068
Acres	52.417
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1999	CON & HWL TILE
B	Library	1999	CON & HWL TILE
C	Cafeteria	1999	CON & HWL TILE
D	PE locker/showers	1999	CON & HWL TILE
E	Classroom	1999	CON & HWL TILE
F	Classroom	1999	CON & HWL TILE
G	Classroom	1999	CON & HWL TILE
H	Classroom	1999	CON & HWL TILE
I	gymnasium	1999	CON & HWL TILE
J	Classroom	1999	CON & HWL TILE
P	broadcast booth	1999	CON & HWL TILE
Q	PE locker/showers	1999	CON & HWL TILE
R	PE locker/showers	1999	CON & HWL TILE
S	Toilet	1999	CON & HWL TILE
T	Toilet	1999	CON & HWL TILE
U	storage	1999	CON & HWL TILE
V	storage	1999	CON & HWL TILE
X	storage	1999	CON & HWL TILE
Y	storage	1999	CON & HWL TILE
1	covered playcourt	1999	STEEL
2	bleacher	1999	CON & HWL TILE

School No.	18
School Name	Keaau Middle
Address	16-565 Keaau Pahoa Rd, Keaau, HI 96749
TMK	1-6-002-001, 1-6-003-059 and 1-6-003-014
Acres	16.566
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1947	WOOD
B	Classroom	1939	WOOD
C	Convention Kitchen	1956	WOOD
D	Gymnasium	1936	WOOD
E	Administration	1936	WOOD
F	Classroom	1993	CON & HWL TILE
G	Classroom	1890	WOOD
H	Classroom	1939	WOOD
I	Classroom	1971	CON & HWL TILE
J	Toilet	1936	CON & HWL TILE
K	Toilet	1936	CON & HWL TILE
L	Maintenance Room	1966	WOOD
M	Classroom	1975	CON & HWL TILE
N	Classroom	1978	CON & HWL TILE
O	Community/Sch Lib	1963	CON & HWL TILE
P01	Portable Classroom	1997	WOOD
Q	Classroom	1987	CON & HWL TILE
QQ	PE Field-boys, girls	1881	GRAD W/ GRASS CVR
R	green house	1967	
S	green house	1967	
T	weight train	1985	WOOD
XX	baseball field	1881	
YY	swimming pool	–	
2	parking	1881	
3	parking	1881	
5	mechanical room	–	

School No.	19
School Name	Keaau Elementary
Address	16-680 Keaau-Pahoa Rd, Keaau, HI 96749
TMK	Info missing from inventory
Acres	Info missing from inventory
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1997	CON & HWL TILE
B	Convention Kitchen	1997	CON & HWL TILE
C	Classroom	1997	CON & HWL TILE
D	Classroom	1997	CON & HWL TILE
E	Classroom	1997	CON & HWL TILE
F	Classroom	1997	CON & HWL TILE
G	Classroom	1997	CON & HWL TILE
H	Classroom	1997	CON & HWL TILE
QQ	PE field-boys, girls		
1	parking		
4	parking	1995	

Note: DOE database showed buildings dates from Keaau Middle School

School No.	20
School Name	Mountain View Elementary
Address	18-1235 Volcano Rd, Mountain View, HI 96771
TMK	1-8-001-007
Acres	12.363
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Administration	1931	WOOD
B	Classroom	1946	WOOD
C	Classroom	1946	WOOD
CT1	Classroom	1961	WOOD
D	Classroom	1973	CON & HWL TILE
F	covered playcourt	1968	–
G	Classroom	1994	CON & HWL TILE
H	Community/Sch/Lib	1976	CON & HWL TILE
I	Classroom	1986	CON & HWL TILE
J	kitchen	1999	CON & HWL TILE
P02	Portable Classroom	1902	WOOD
P03	Portable Classroom	1902	WOOD
P04	Portable Classroom	1966	WOOD
P05	Portable Classroom	1991	WOOD
P06	Portable Classroom	1988	WOOD
P07	Portable Classroom	1989	WOOD
P08	Portable Classroom	1992	WOOD
P09	Portable Classroom	1993	WOOD
P1	Portable Classroom	1963	WOOD
P10	Portable Classroom	1993	WOOD
P11	Portable Classroom	1993	WOOD
QQ	PE Field-Boys, Girls	1902	
1	paved court	1902	
2	sewage treat plant	1994	
7	parking	1902	
8	parking	1902	
9	parking	1990	

School No.	21
School Name	Pahoa High & Intermediate
Address	15-3038 Pahoa Village Rd, Pahoa, HI 96778
TMK	1-5-003-038, 1-5-003-039, 1-5-003-045 and 1-5-114-026
Acres	22.644
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
E	Gymnasium	1940	WOOD
B	New Gymnasium	2016	
F	Classroom	1912	WOOD
G	Classroom	1960	WOOD
H	Classroom	1996	CON & HWL TILE
I	Community/Sch/Lib	1966	CON & HWL TILE
J	Toilet	1960	CON & HWL TILE
K	Toilet	1960	WOOD
L	Equipment Shed	1960	STEEL
M	Classroom	1970	WOOD
N	Classroom	1971	WOOD
O	Classroom	1973	CON & HWL TILE
P1	Portable Classroom	1968	WOOD
P14	Portable Classroom	1976	WOOD
P15	Portable Classroom	1976	WOOD
P16	Portable Classroom	1976	WOOD
P2	Portable Classroom	1966	WOOD
P21	Portable Classroom	1968	WOOD
P29	Portable Classroom	1910	WOOD
P3	Portable Classroom	1966	WOOD
P30	Portable Classroom	1910	WOOD
P33	Portable Classroom	1994	WOOD
Q	convention kitchen	1979	CON & HWL TILE
QQ	PE Field (Boys)	1984	GRAD W/GRASS CVR
R	PE locker/shower	1984	CON & HWL TILE
S	Classroom	1985	CON & HWL TILE
T	Classroom	1986	CON & HWL TILE
TB1	Portable Classroom	1998	WOOD
TP1	Portable Classroom	2005	--
U	Classroom	1988	CON & HWL TILE
V	football/track field	1992	REINF CONCRETE
VV	football/track field	1984	
XX	baseball field.	1984	
ZZ	paved court	1984	
4	parking	1910	
5	parking	1996	
6	parking	1910	
7	parking	1992	

School No.	22
School Name	Keonepoko Elementary
Address	15-890 Kahakai Blvd, Pahoa, HI 96778
TMK	1-5-009-009
Acres	11.194
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
C	Cafeteria	1998	--
C1	maintenance room	1998	--
E	Classroom	1992	CON & HWL TILE
F	Classroom	1991	CON & HWL TILE
G	Classroom	1991	CON & HWL TILE
H	Classroom	1991	CON & HWL TILE
K	Mechanical Room	1991	REINF CONCRETE
L	maintenance room	1991	WOOD
M	covered playcourt	1992	CON & HWL TILE
P01	Portable Classroom	1964	WOOD
P02	Portable Classroom	1966	WOOD
P03	Portable Classroom	1965	WOOD
P04	Portable Classroom	1966	WOOD
P05	Portable Classroom	1993	WOOD
P06	Portable Classroom	1993	WOOD
P07	Portable Classroom	1994	--
P08	Portable Classroom	1994	--
P09	Portable Classroom	1994	--
P10	Portable Classroom	1994	--
P11	Portable Classroom	1994	--
1	parking	1991	
2	sewage treat plant	1991	

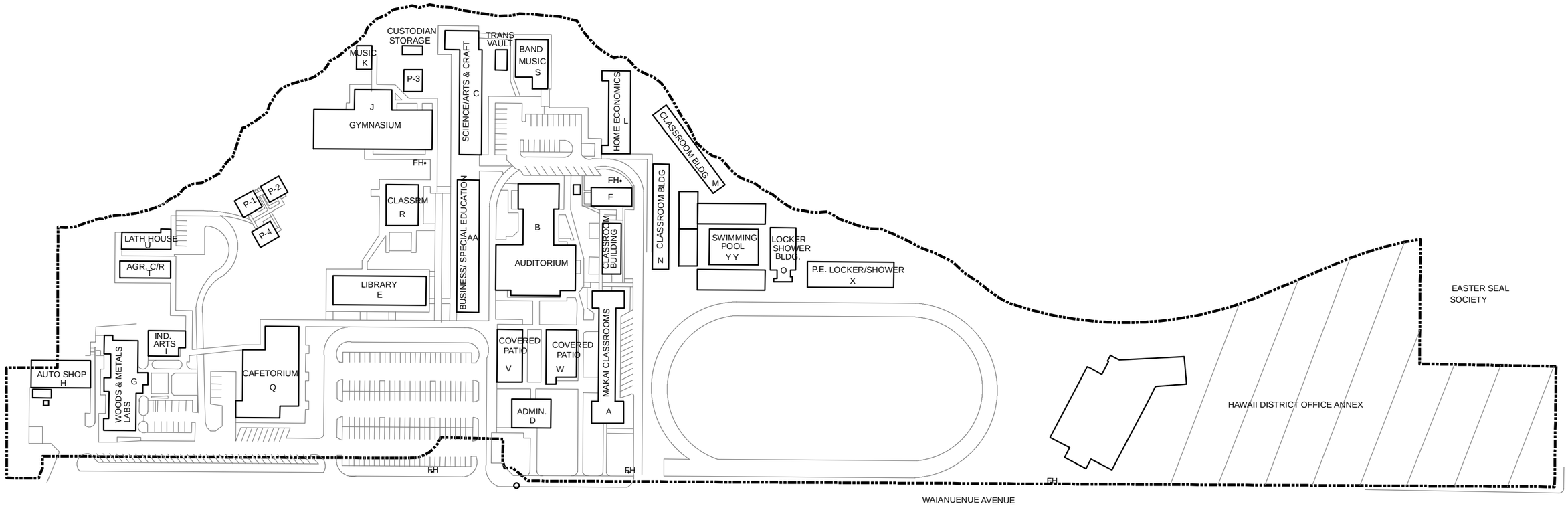
School No.	23
School Name	Pahoa Elementary
Address	15-3038 Pahoa Village Rd, Pahoa, HI 96778
TMK	1-5-114-025 and 1-5-114-002
Acres	2.942
School Garden	Yes

Facilities

Building Letter ID or number	Description	Construction Date	TYPE OF CONSTRUCTION
A	Classroom	1980	CON & HWL TILE
B	Classroom	1947	WOOD
C	Classroom	1960	WOOD
D	Classroom	1956	WOOD
P10	Portable Classroom	1967	WOOD
P11	Portable Classroom	1976	WOOD
P12	Portable Classroom	1976	WOOD
P13	Portable Classroom	1976	WOOD
P17	Portable Classroom	1977	WOOD
P18	Portable Classroom	1977	WOOD
P22	Portable Classroom	1910	WOOD
P23	Portable Classroom	1910	WOOD
P24	Portable Classroom	1910	WOOD
P25	Portable Classroom	1910	WOOD
P26	Portable Classroom	1910	WOOD
P27	Portable Classroom	1910	WOOD
P28	Portable Classroom	1910	WOOD
P31	Portable Classroom	1986	WOOD
P32	Portable Classroom	1986	WOOD
P6	Portable Classroom	1965	WOOD
P7	Portable Classroom	1965	WOOD
PT1	Portable Classroom	1910	WOOD
TB1	Portable Classroom	1996	WOOD
TB2	Portable Classroom	1996	WOOD
TB3	Portable Classroom	1995	WOOD
5	parking	1910	

APPENDIX B

FACILITY PLANS



School Property Boundary

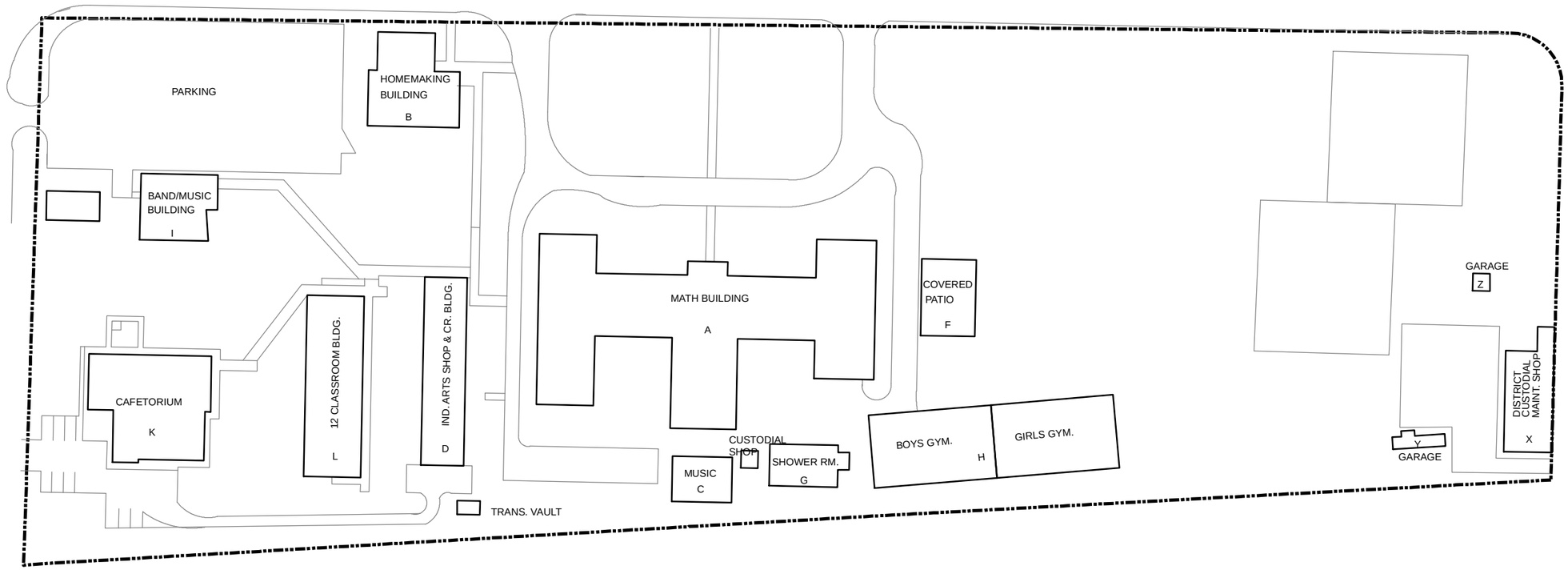
0 80 160
Feet

N

integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-1.
Facility Plan
Hilo High
556 Waianuenue Avenue, Hilo, HI 96720



School Property Boundary

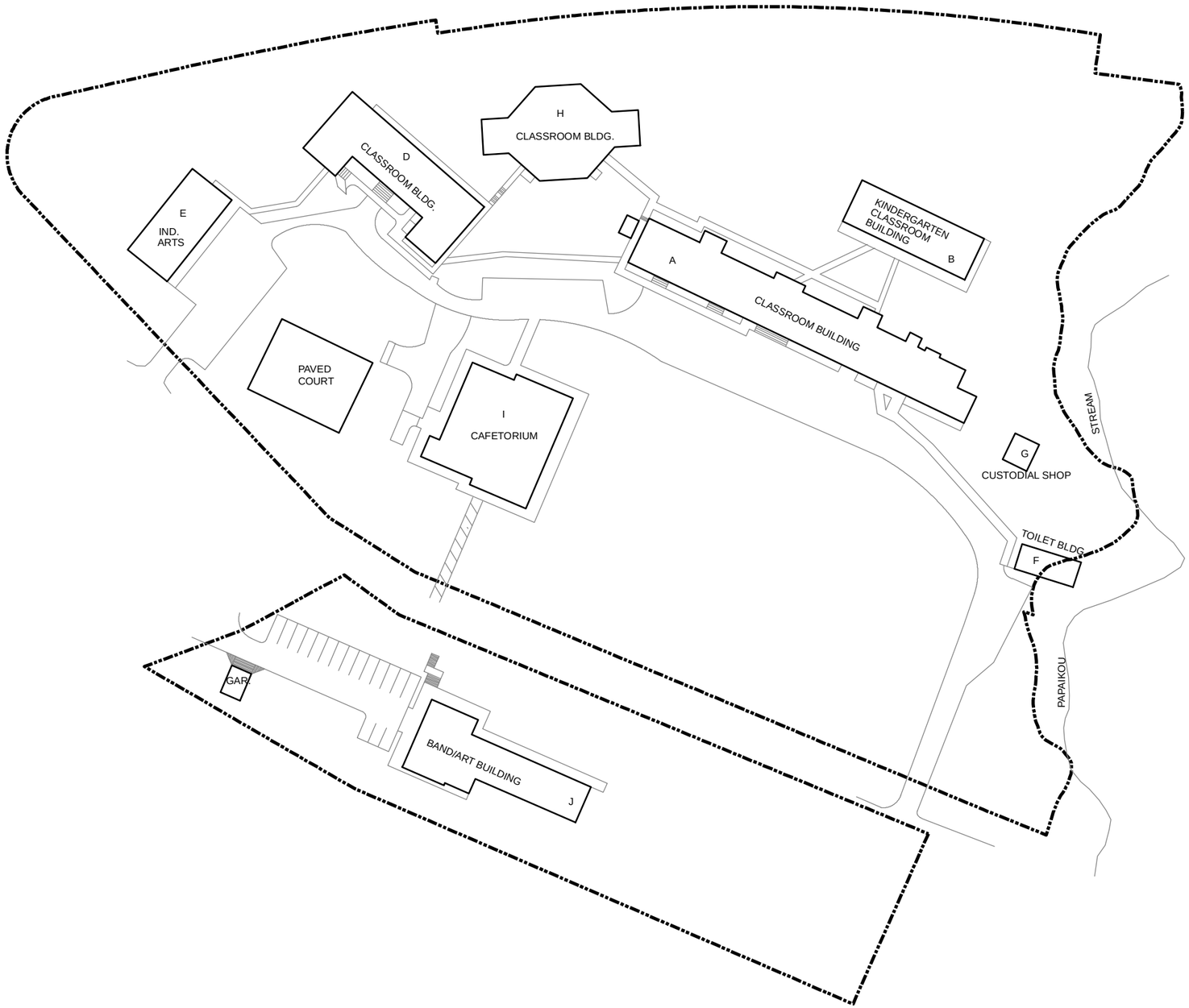
0 50 100
Feet

N

integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-2.
Facility Plan
Hilo Intermediate
587 Waianuenue Avenue, Hilo, HI 96720



integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-3.
Facility Plan
Kalanianaole Elementary & Intermediate
27-330 Old Mamalahoa Highway, Papaikou, HI 96781

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HILO SUGAR CO.

CLASSROOM
G

STOREROOM J

COVERED PLAY AREA I

E

B

D

CLASSROOMS

CLASSROOMS

CLASSROOMS

A

KINDERGARTEN

LIBRARY
H

ADMINISTRATION
C

CAFETERIA F

PARKING AREA

AINAKO AVENUE

School Property Boundary

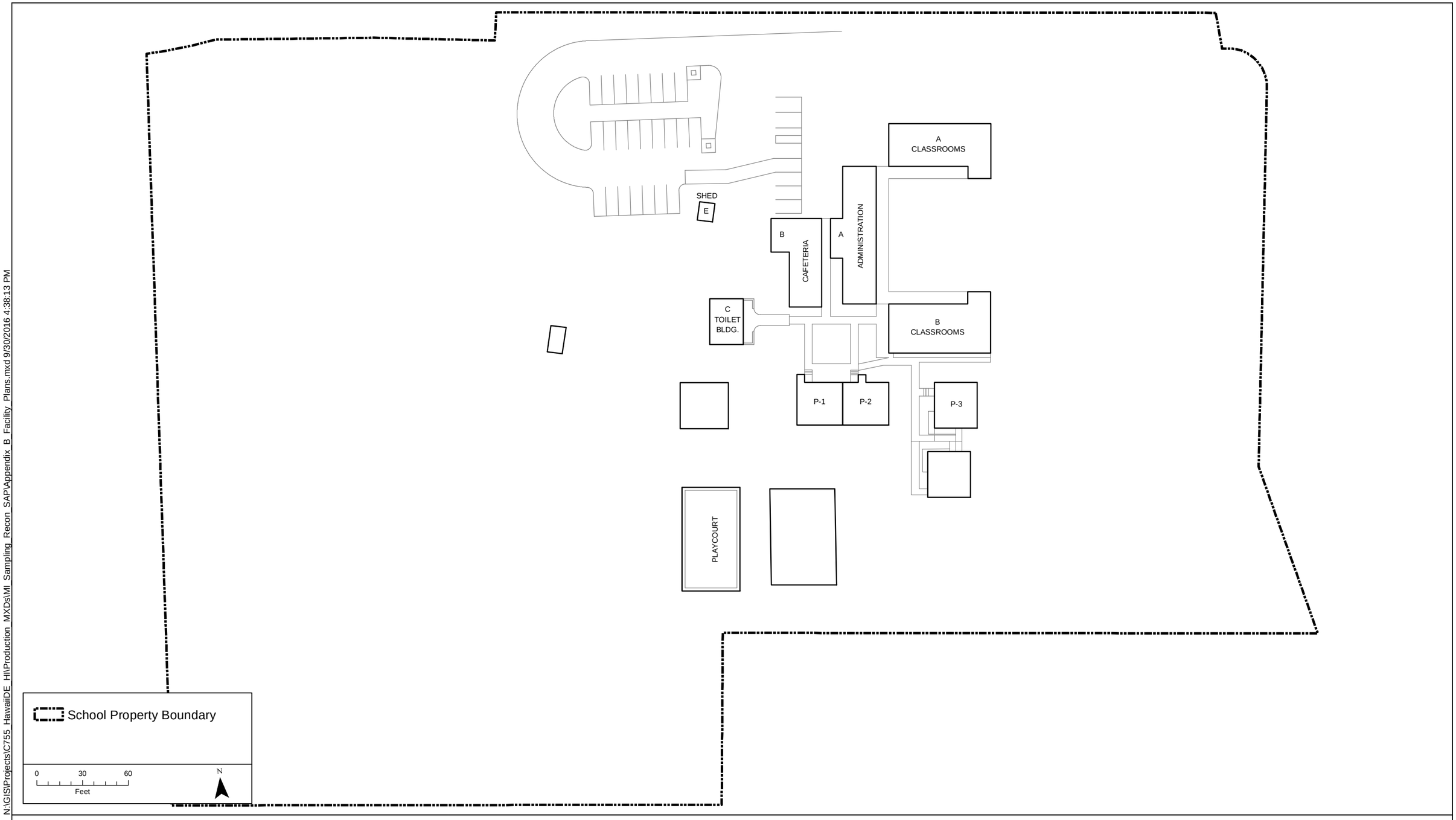
0 40 80
Feet

N

integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Department of Education Plot Plan

Figure B-4.
Facility Plan
DeSilva Elementary
278 Ainako Avenue, Hilo, HI 96720



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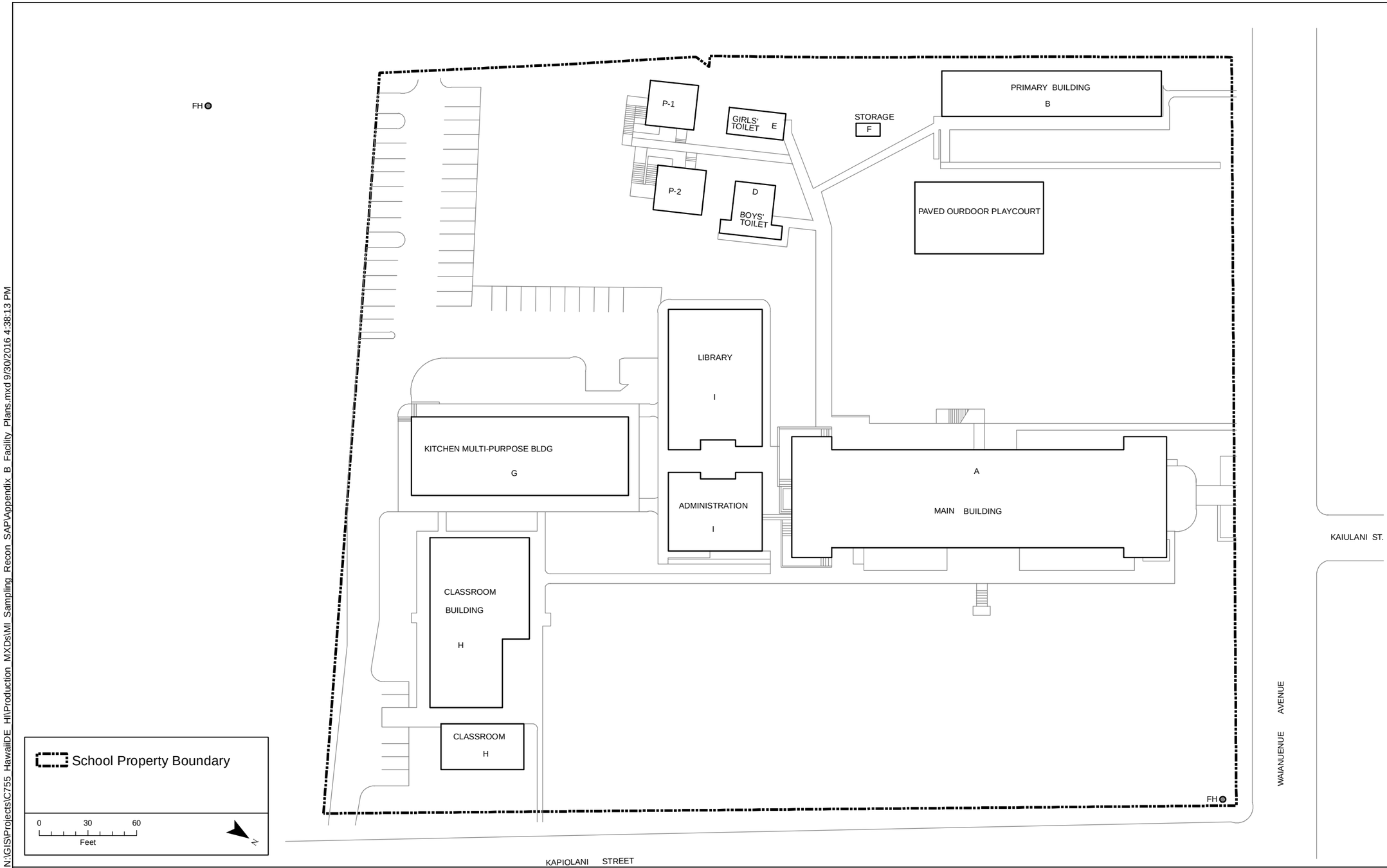
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-5.
Facility Plan
Haaheo Elementary
121 Haaheo Road, Hilo, HI 96720



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integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-6.
Facility Plan
Hilo Union Elementary
506 Waianuenue Avenue, Hilo, HI 96720

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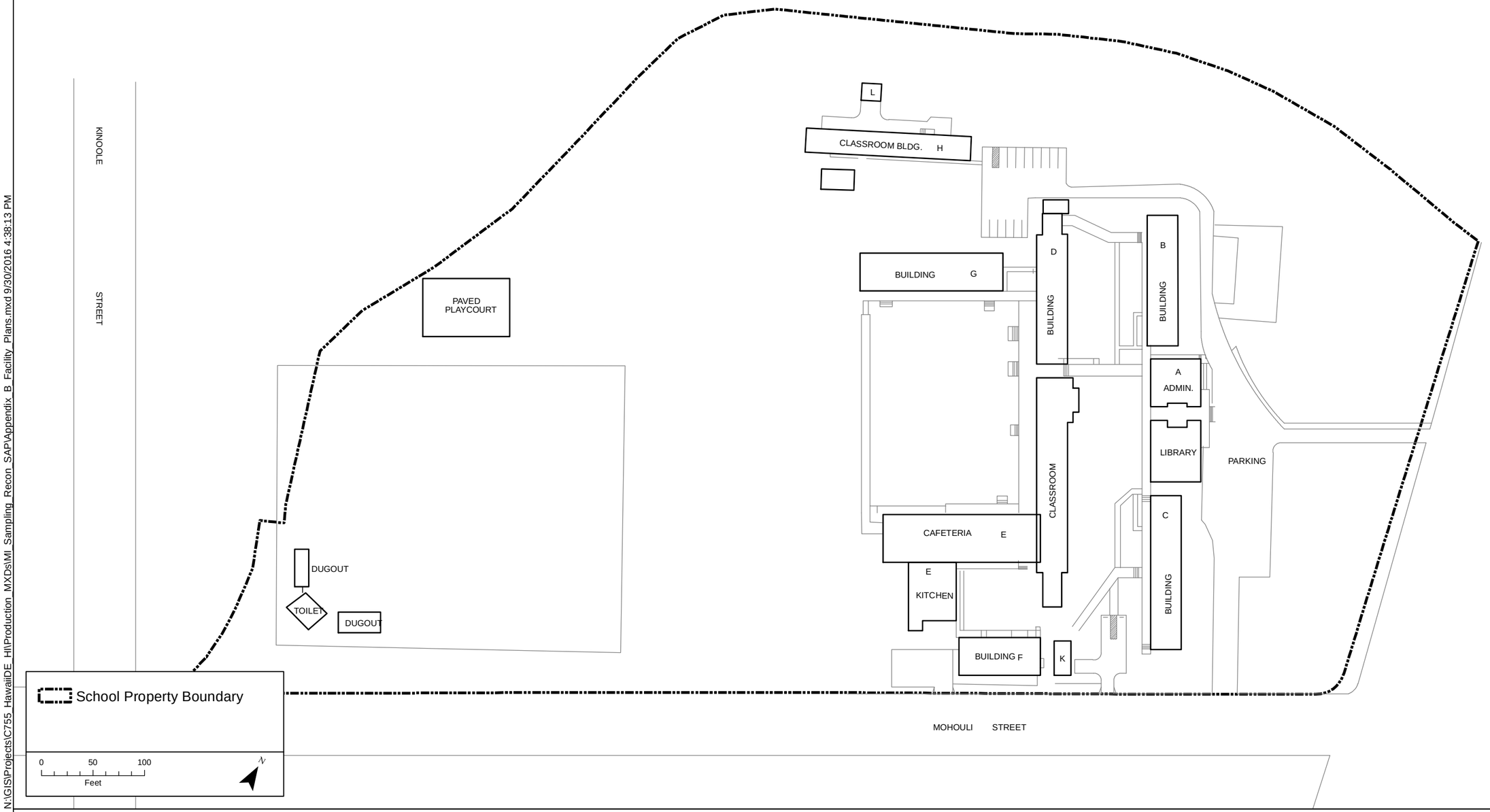

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-7.
Facility Plan
Kapiolani Elementary
966 Kilauea Avenue, Hilo, HI 96720

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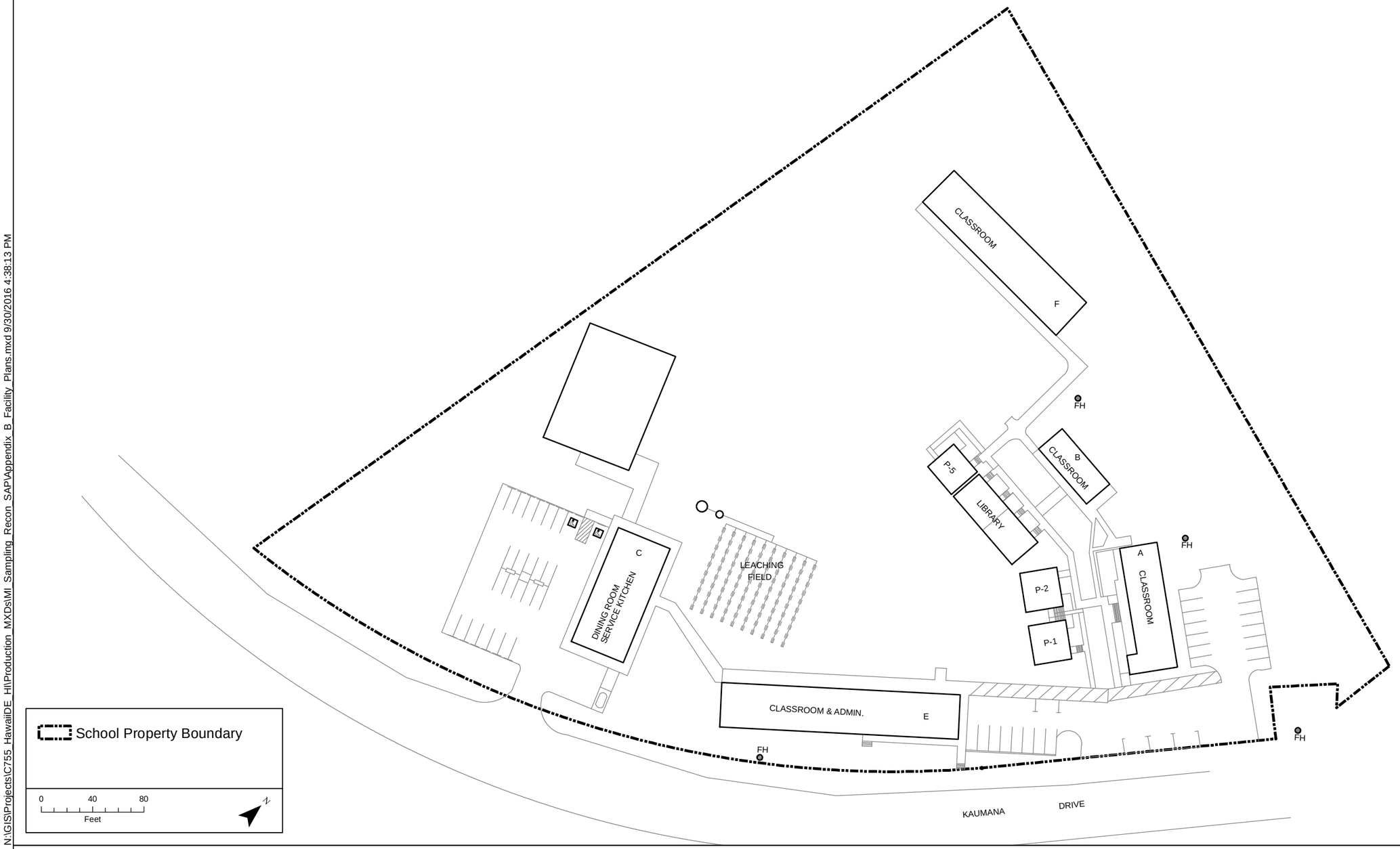
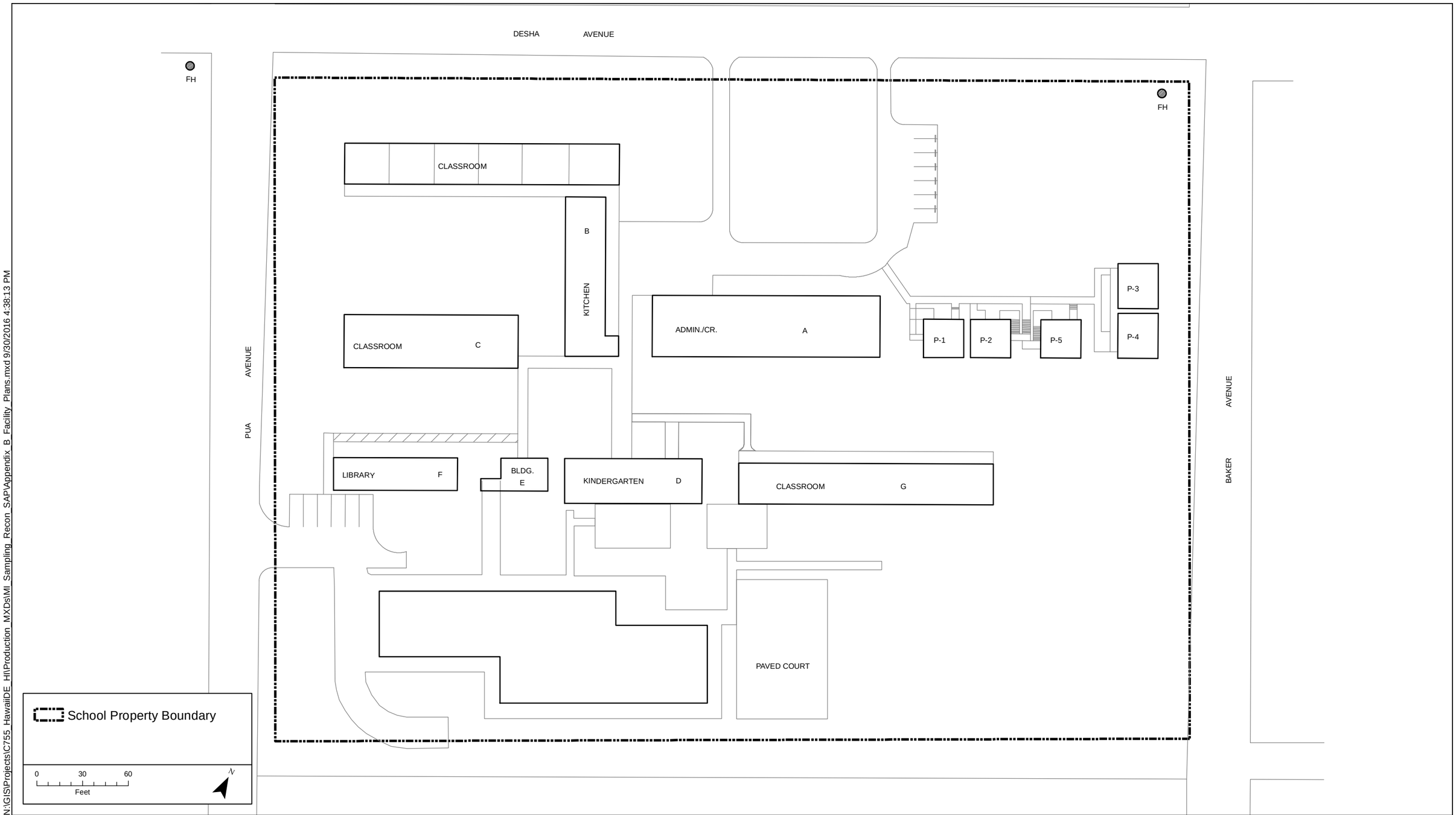


integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Department of Education Plot Plan

Figure B-8.
Facility Plan
Kaumana Elementary
1710 Kaumana Drive, Hilo, HI 96720



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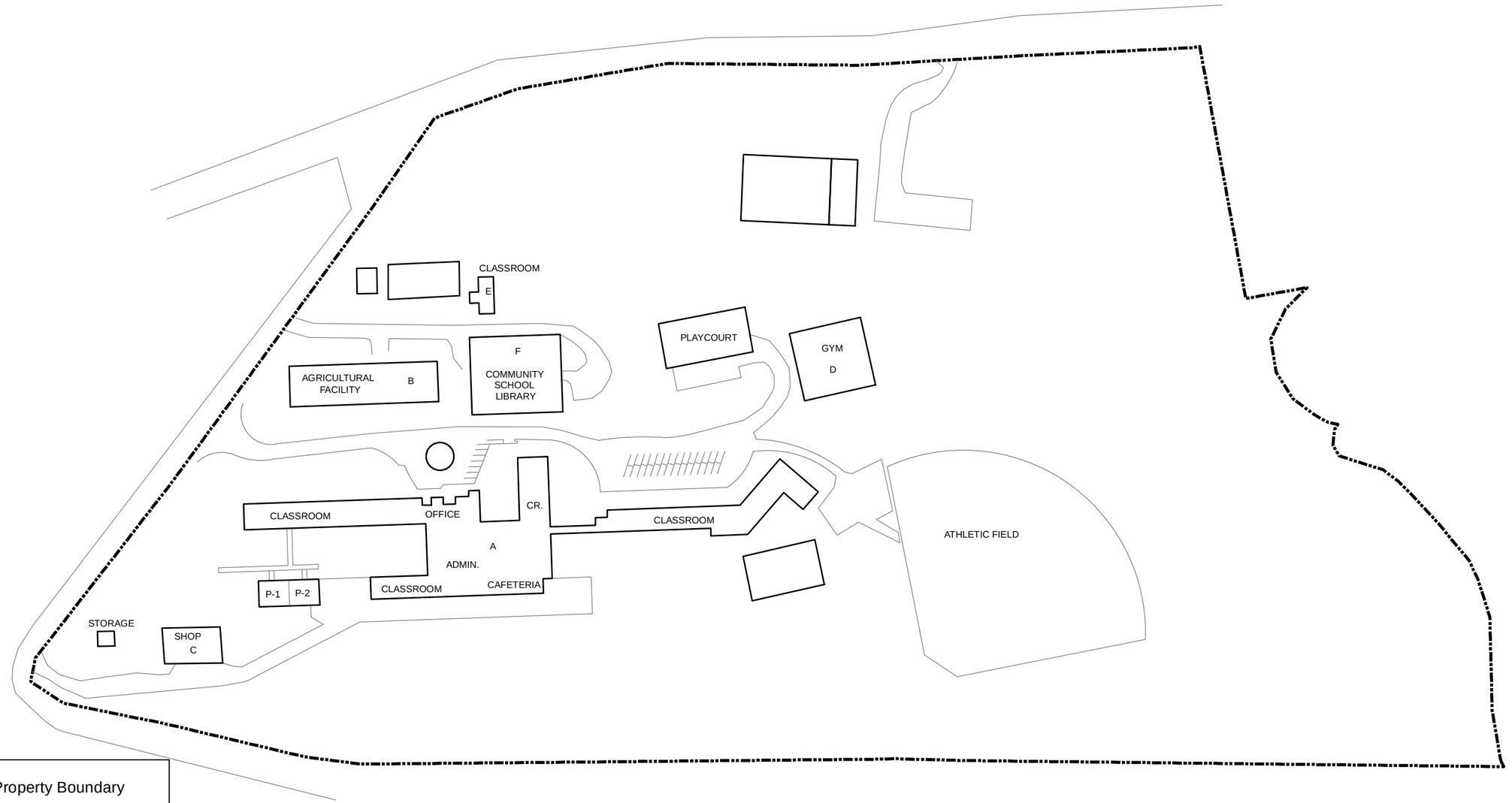
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-9.
Facility Plan
Keaukaha Elementary
240 Desha Avenue, Hilo, HI 96720



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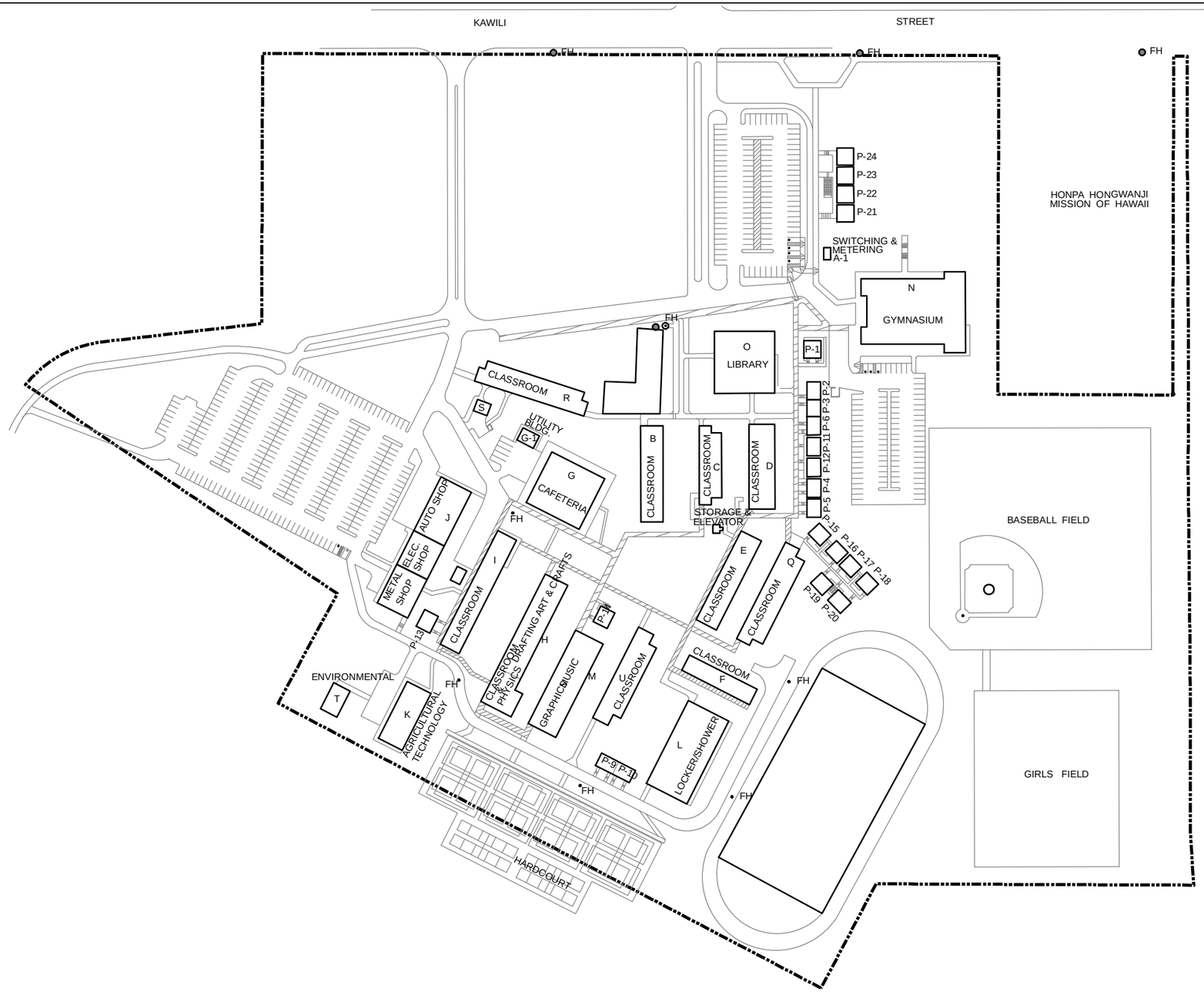
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-10.
Facility Plan
Laupahoehoe High & Elementary
35-2065 Mamalahoa Highway, Laupahoehoe, HI 96764



School Property Boundary

0 100 200
Feet

N

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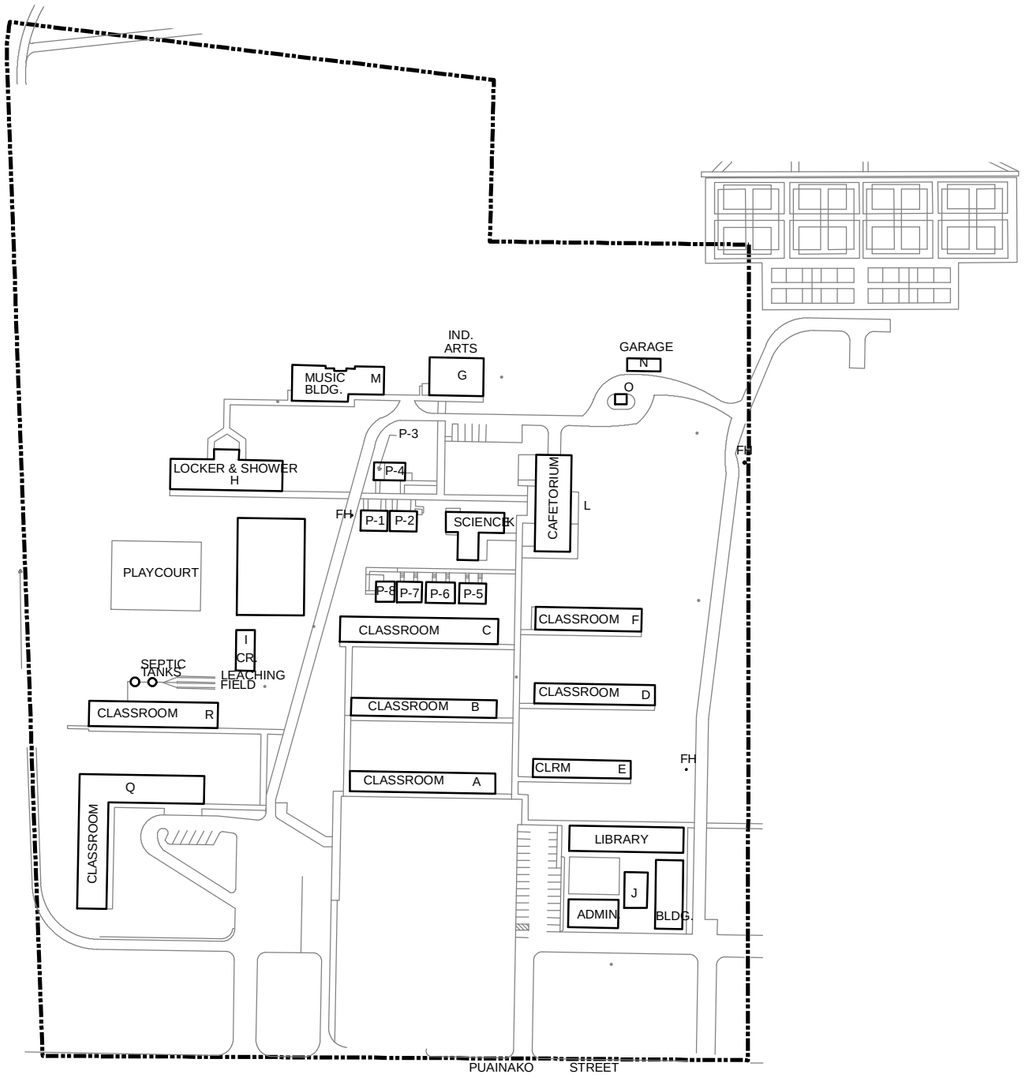
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-11.
Facility Plan
Waiakea High
155 West Kawili Street, Hilo, HI 96720



School Property Boundary

0 100 200
Feet

N

FH

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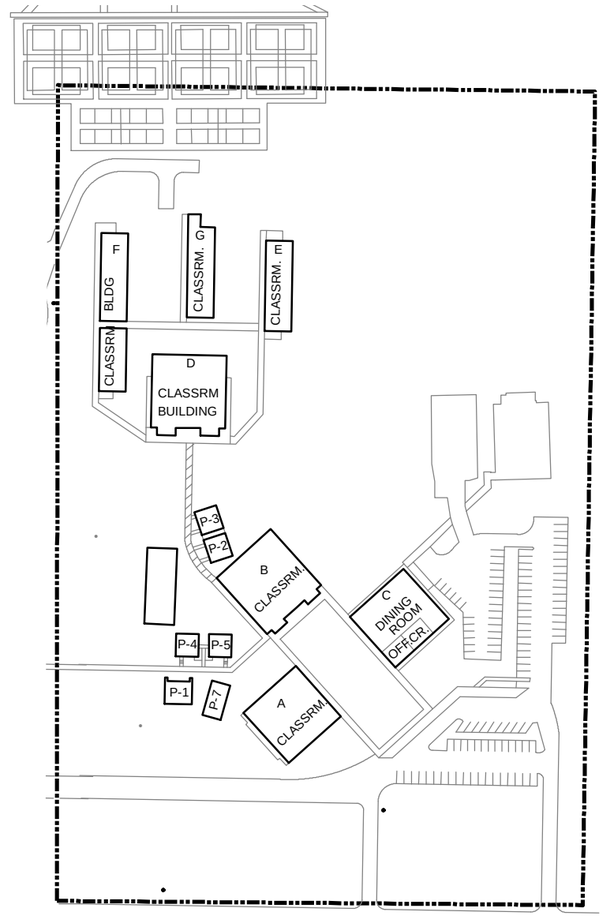
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-12.
Facility Plan
Waiakea Intermediate
180 West Puainako Street, Hilo, HI 96720



School Property Boundary

0 100 200
Feet

N

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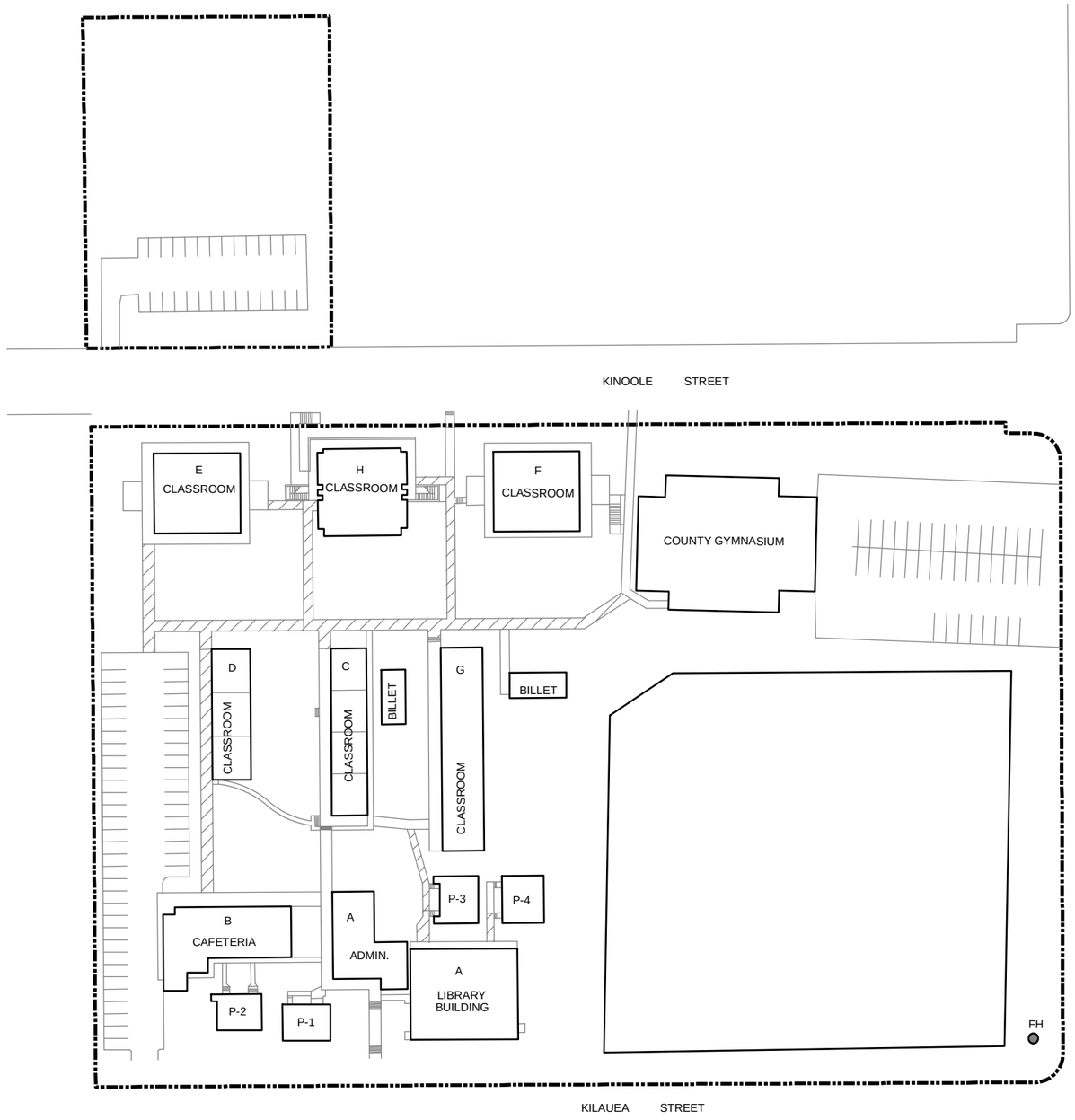
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-13.
Facility Plan
Waiakea Elementary
200 West Puainako Street, Hilo, HI 96720



School Property Boundary

0 50 100
Feet

N

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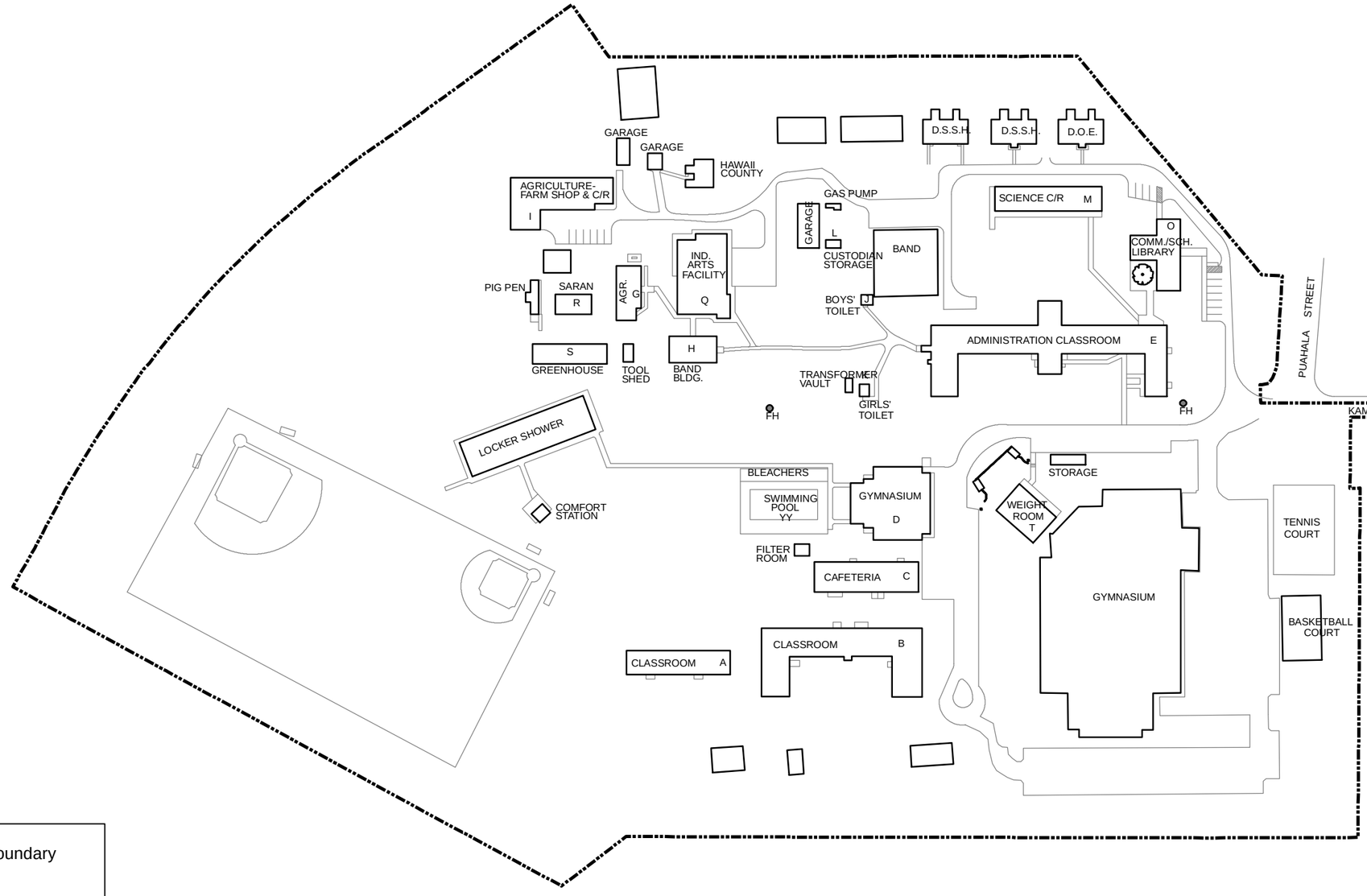
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Department of Education Plot Plan

Figure B-14.
Facility Plan
Waiakeawaena Elementary
2420 Kilauea Avenue, Hilo, HI 96720



School Property Boundary

0 80 160
Feet

N

integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-15.
Facility Plan
Kau High & Pahala Elementary
96-3150 Pikake Street, Pahala, HI 96777

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E
LILY K. AULD GYMNASIUM
MISC. STOR.
P-7
A
A
B
KINDERGARTEN
P-5
P-6
A CLASSROOMS
OFFICE/CLASSROOMS A
P-1
P-2
P-3
P-4
SEISMOGRAPH & ART
F
D
CAFETERIA
BUS GARAGE
O
D.A.G.S. GARAGE
K
CUSTODIAN SHED
L
M
MISC. STOR.
PIGGERY
S

School Property Boundary

0 40 80
Feet

N

integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-16.
Facility Plan
Naalehu Elementary & Intermediate
95-5545 Mamalahoa Highway, Naalehu, HI 96772

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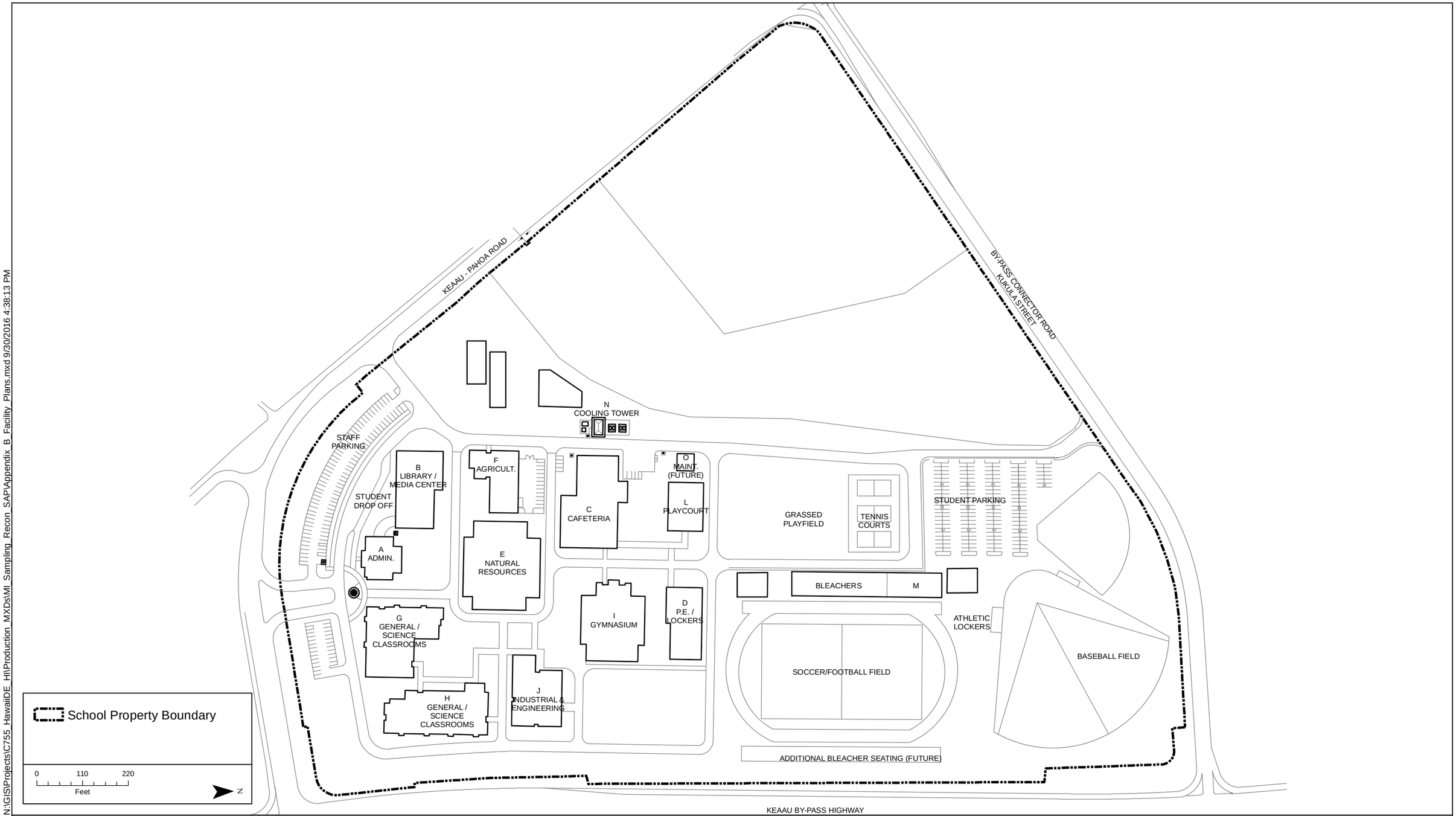
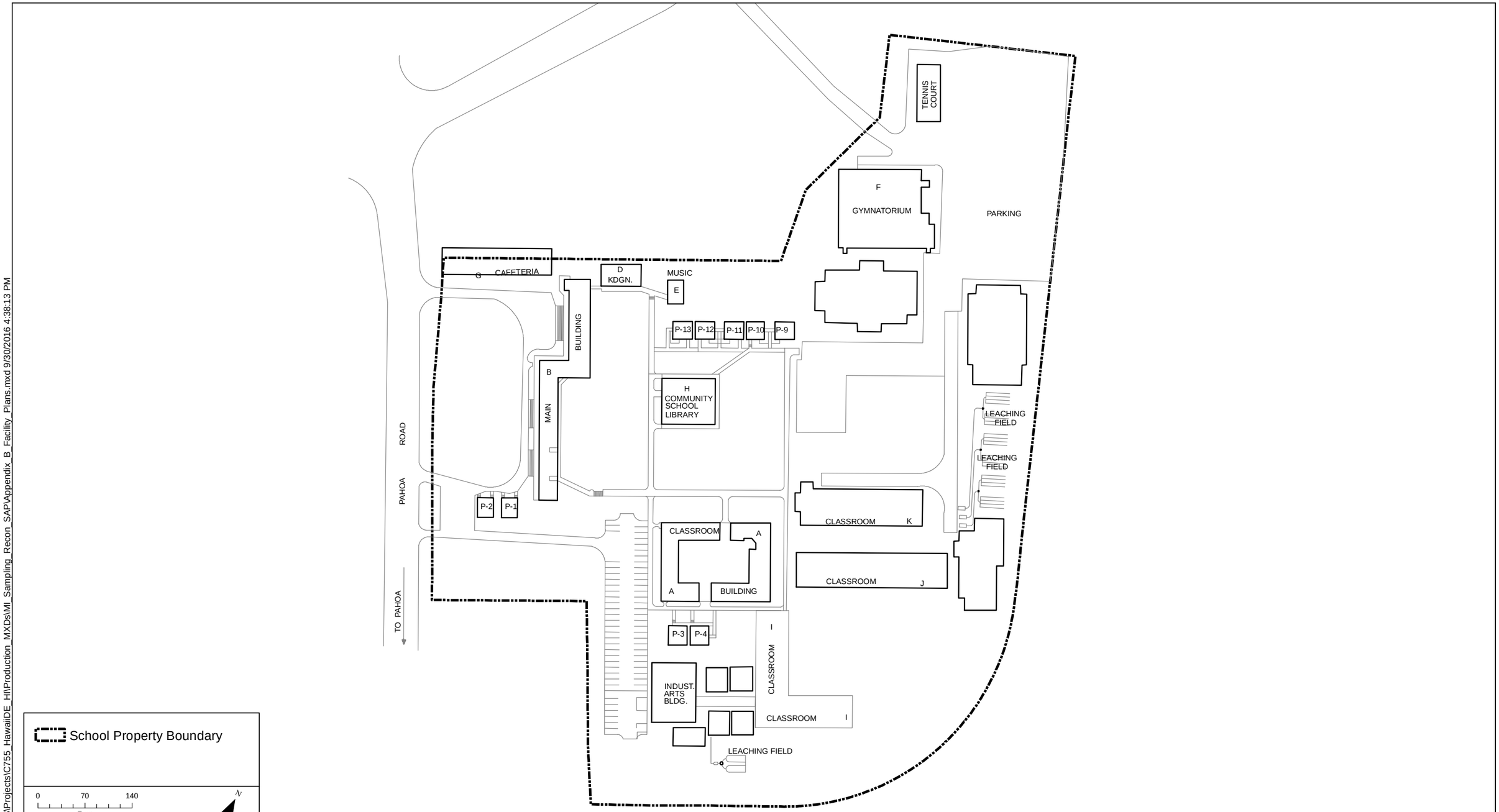


integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-17.
Facility Plan
Keaau High
16-725 Keaau-Pahoa Road, Keaau, HI 96749



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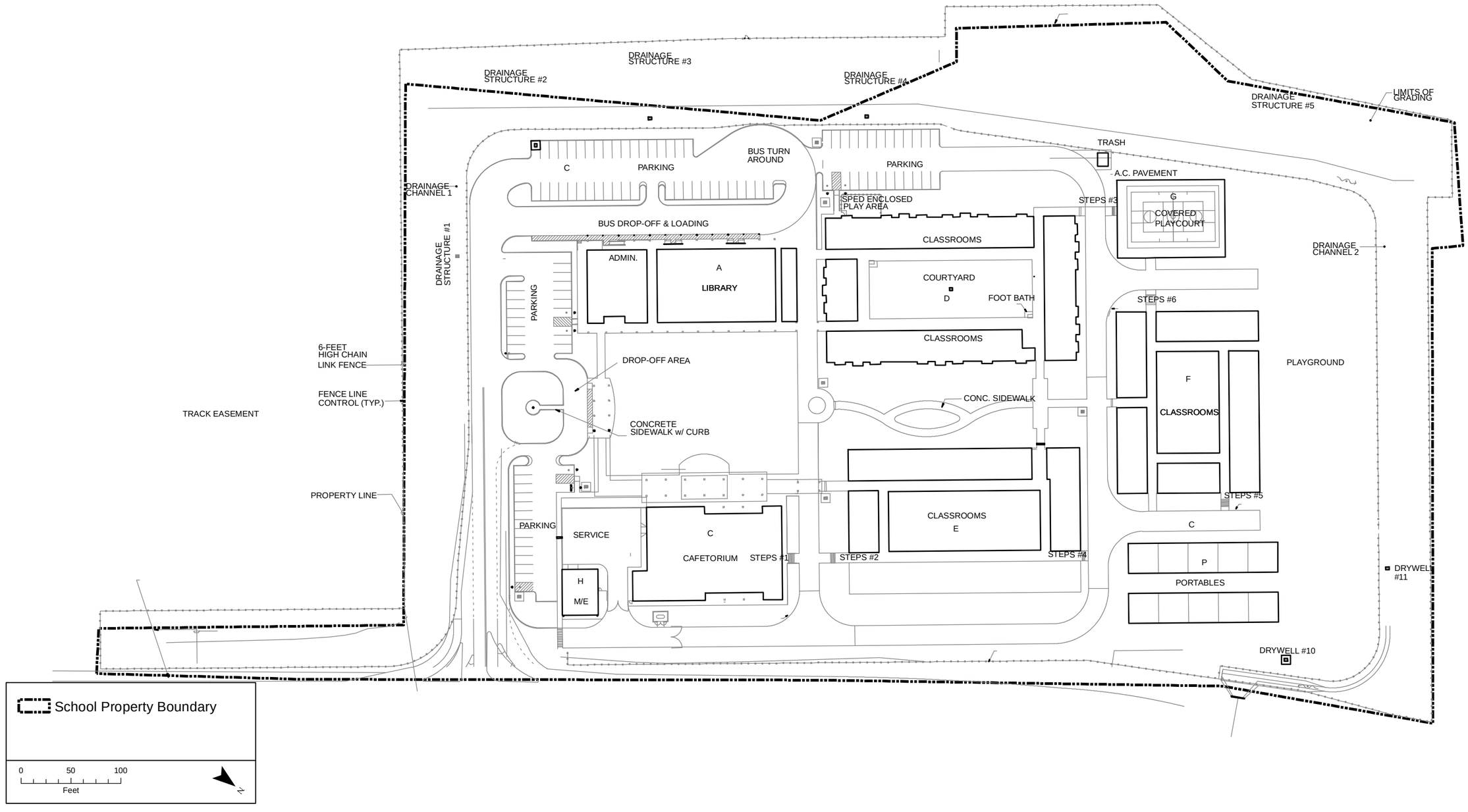
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-18.
Facility Plan
Keaau Middle
16-565 Keaau Pahoa Road, Keaau, HI 96749



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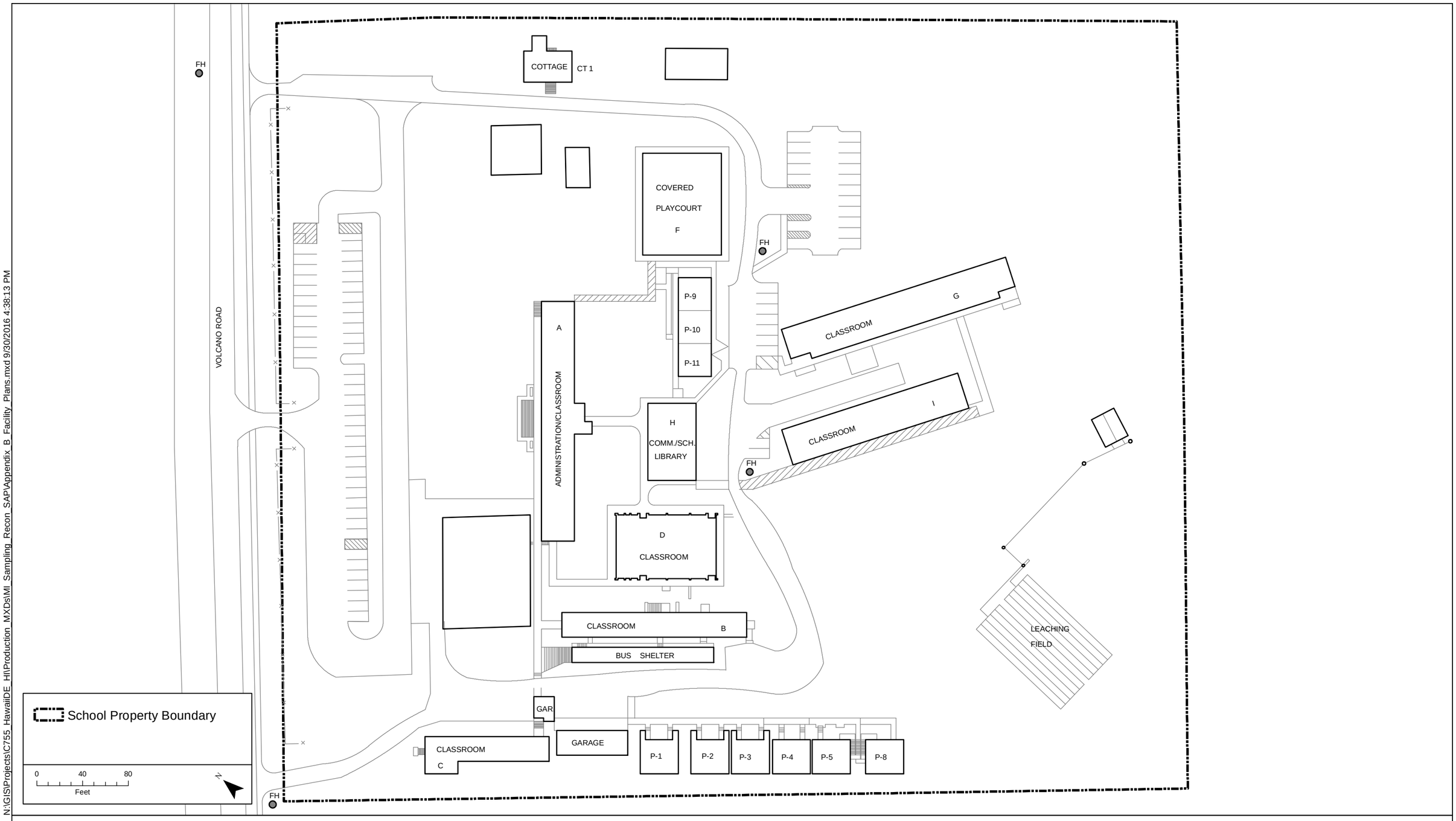
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-19.
Facility Plan
Keaau Elementary
16-680 Keaau-Pahoa Road, Keaau, HI 96749



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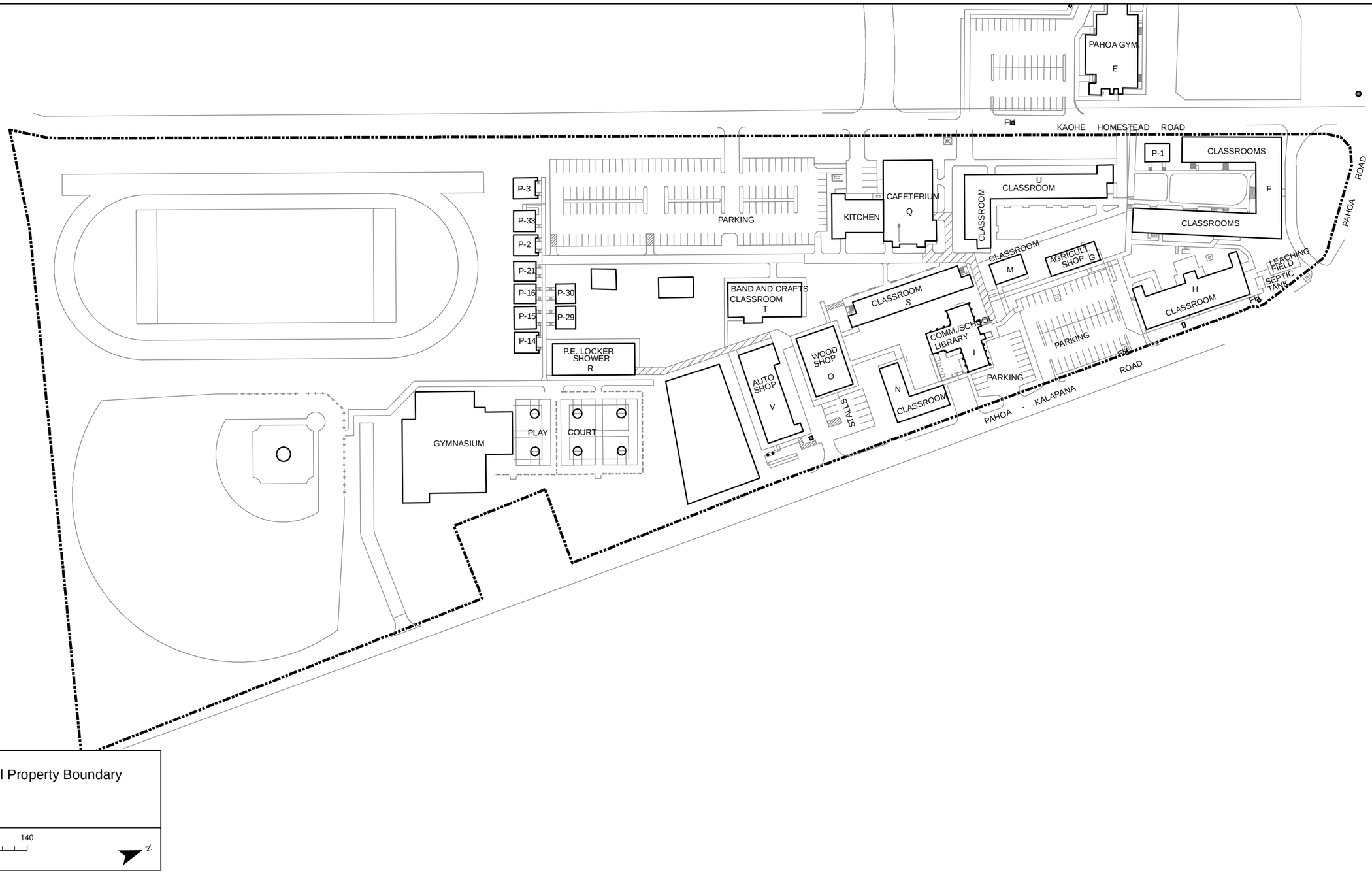
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-20.
Facility Plan
Mountain View Elementary
18-1235 Volcano Road, Mountain View, HI 96771



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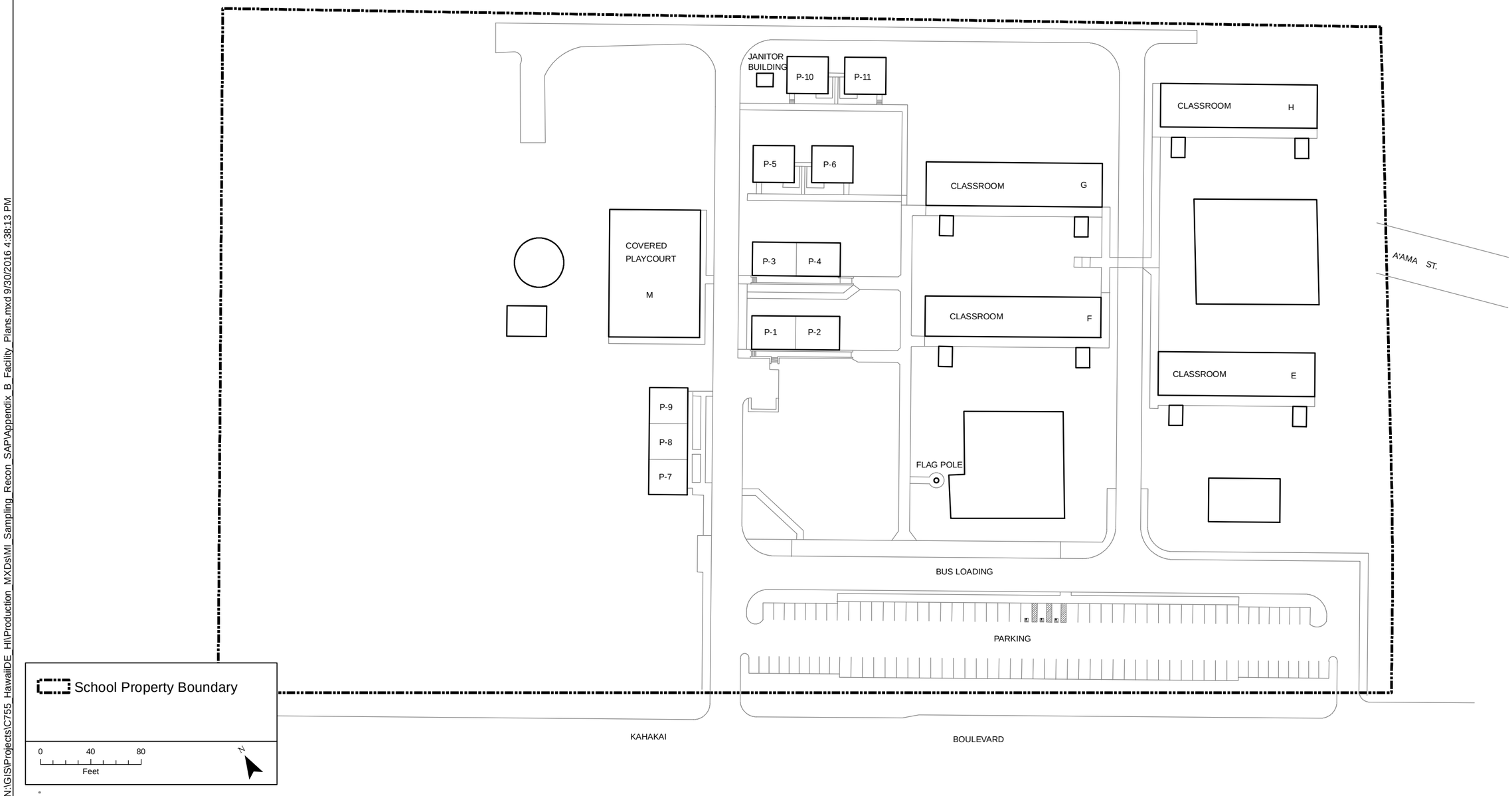
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-21.
Facility Plan
Pahoa High & Intermediate
15-3038 Pahoa Village Road, Pahoa, HI 96778



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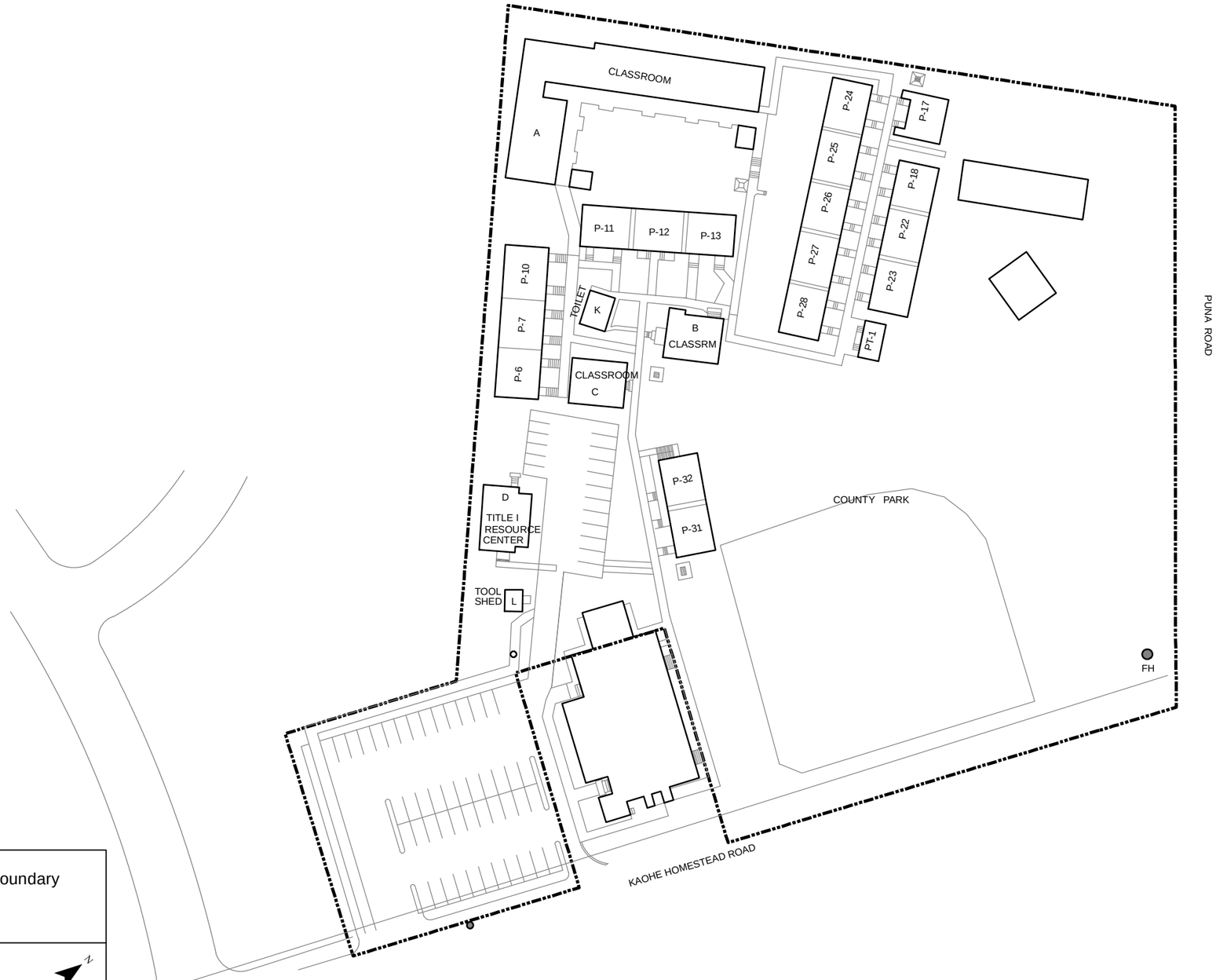
integral consulting inc.

Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-22.
Facility Plan
Keonepoko Elementary
15-890 Kahakai Boulevard, Pahoa, HI 96778



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Sources:
Basemap: Hawaii Department of Education Plot Plan
Property Boundary: HI Office of Planning digital TMK parcels

Figure B-23.
Facility Plan
Pahoa Elementary
15-3030 Pahoa Village Road, Pahoa, HI 96778

APPENDIX C

PHOTOGRAPHIC LOG

- APPENDIX C1. FIELD RECONNAISSANCE AND XRF SCREENING PHOTOGRAPHIC LOG
- APPENDIX C2. MULTI-INCREMENT SAMPLING PHOTOGRAPHIC LOG

APPENDIX C1

FIELD RECONNAISSANCE AND XRF SCREENING PHOTOGRAPHIC LOG

Hazardous Materials Reconnaissance
Job No: Q61001-11
Site Photographs from July 2016

Photograph 1. XRF Screening of Soils in Open Space Area, Kalanianaole Elementary and Intermediate School (July 13, 2016)

Photograph 2. XRF Analysis of Surface Soil, Performed in Triplicate, Soil Moisture Measured for XRF Value Correction (July 13, 2016)

Hazardous Materials Reconnaissance
Job No: Q61001-11
Site Photographs from July 2016

Photograph 3. XRF Screening of Soils in School Garden, Keauakaha Elementary School (July 16, 2016)

Photograph 4. XRF Analysis of Surface Soil along Building Perimeter, Keauakaha Elementary School (July 16, 2016)

Hazardous Materials Reconnaissance
Job No: Q61001-11
Site Photographs from July 2016

Photograph 5. Soils Analyzed Adjacent to Playground Equipment Areas, Haaheo Elementary School (July 13, 2016)

Photograph 6. Soils Analyzed in Bare Dirt along Building Perimeter, Pahoa High and Intermediate School (July 20, 2016)

APPENDIX C2

MULTI-INCREMENT SAMPLING PHOTOGRAPHIC LOG

Hazardous Materials Reconnaissance
Job No: Q61001-11
Site Photographs from November 2016–January 2017

Photograph 1. Measuring a Building Perimeter Decision Unit, Hilo High (December 19, 2016)

Photograph 2. Multi-increment Soil Sampling in Garden Area, Hilo Union Elementary (December 12, 2016)

Photograph 3. Multi-increment Soil Sampling in Open Area, Keaau Elementary (January 11, 2017)

Photograph 4. Multi-increment Soil Sampling in Open Area, Kalanianaole Elementary & Intermediate (January 5, 2017)

Hazardous Materials Reconnaissance
Job No: Q61001-11
Site Photographs from November 2016–January 2017

Photograph 5. Multi-increment Soil Sampling in Open Area, DeSilva Elementary (November 11, 2016)

Photograph 6. Measuring a Building Perimeter Decision Unit, Pahoa Elementary (January 2, 2017)

APPENDIX D

LABORATORY REPORTS

- APPENDIX D1. LABORATORY ANALYTICAL REPORT—XRF CALIBRATION SAMPLES
- APPENDIX D2. ANALYTICAL SAMPLE AND LABORATORY TRACKING—MULTI-INCREMENT SAMPLES
- APPENDIX D3. LABORATORY ANALYTICAL REPORTS—MULTI-INCREMENT SAMPLES (ON CD-ROM)

APPENDIX D1

LABORATORY ANALYTICAL REPORT—XRF CALIBRATION SAMPLES

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-61687-1
Client Project/Site: C755.0101 - XRF Calibration Samples

For:
Integral Consulting Inc
285 Century Place
Suite 190
Louisville, Colorado 80027

Attn: William Cutler

Authorized for release by:
8/24/2016 3:33:01 PM

Robert Greer, Project Manager II
(253)922-2310
robert.greer@testamericainc.com

Table of Contents

Job ID: 580-61687-1

Laboratory: TestAmerica Seattle

Narrative

CASE NARRATIVE
Client: Integral Consulting Inc.
Project: C755.0101 - XRF Calibration Samples
Report Number: 580-61687-1

This case narrative is in the form of an exception report, where only the anomalies related to this report, method specific performance and/or QA/QC issues are discussed. If there are no issues to report, this narrative will include a statement that documents that there are no relevant data issues.

It should be noted that samples with elevated Reporting Limits (RLs) resulting from a dilution may not be able to satisfy customer reporting limits in some cases. Such increases in the RLs are an unavoidable but acceptable consequence of sample dilution that enables quantification of target analytes within the calibration range of the instrument or that reduces the interferences thereby enabling the quantification of target analytes.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT
The samples were received on 08/11/2016; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 23.3 C.

Receipt Exceptions

The following samples were received at the laboratory without a sample collection time documented on the chain of custody or sample container.: S2-3 (580-61687-1), S2-13 (580-61687-2), S3-4 (580-61687-3), S4-7 (580-61687-4), S4-9 (580-61687-5), S15-9 (580-61687-6), S19-6 (580-61687-7), S20-3 (580-61687-8), S21-21 (580-61687-9), SHP-29 (580-61687-10), SHP-52 (580-61687-11) and SHP-54 (580-61687-12).

The following samples were received with insufficient time remaining to perform the analysis within holding time: SHP-29 (580-61687-10), SHP-52 (580-61687-11) and SHP-54 (580-61687-12).

Note: All samples which require thermal preservation are considered acceptable if the arrival temperature is within 2C of the required temperature or method specified range. For samples with a specified temperature of 4C, samples with a temperature ranging from just above freezing temperature of water to 6C shall be acceptable. Samples that are hand delivered immediately following collection may not meet these criteria, however they will be deemed acceptable according to NELAC standards, if there is evidence that the chilling process has begun, such as arrival on ice, etc.

METALS (ICPMS)
Samples S2-3 (580-61687-1), S2-13 (580-61687-2), S3-4 (580-61687-3), S4-7 (580-61687-4), S4-9 (580-61687-5), S15-9 (580-61687-6), S19-6 (580-61687-7), S20-3 (580-61687-8), S21-21 (580-61687-9), SHP-29 (580-61687-10), SHP-52 (580-61687-11) and SHP-54 (580-61687-12) were analyzed for metals (ICPMS) in accordance with SW846 6020A. The samples were prepared on 08/15/2016 and analyzed on 08/16/2016.

Arsenic failed the recovery criteria low for the MS and MSD of sample S2-3MS (580-61687-1) in batch 580-225112. Spike recovery for the LCS and LCSD met acceptance criteria.

The following samples were received past hold time per method: SHP-29 (580-61687-10), SHP-52 (580-61687-11) and SHP-54 (580-61687-12). Samples results have been qualified and reported.

Samples S2-13 (580-61687-2)[50X], S3-4 (580-61687-3)[50X], S4-7 (580-61687-4)[50X], S4-9 (580-61687-5)[50X], S15-9 (580-61687-6)[50X], S19-6 (580-61687-7)[50X], S20-3 (580-61687-8)[50X], S21-21 (580-61687-9)[50X], SHP-29 (580-61687-10)[50X], SHP-52

Job ID: 580-61687-1 (Continued)

Laboratory: TestAmerica Seattle (Continued)

(580-61687-11)[50X] and SHP-54 (580-61687-12)[50X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS

Samples S2-3 (580-61687-1), S2-13 (580-61687-2), S3-4 (580-61687-3), S4-7 (580-61687-4), S4-9 (580-61687-5), S15-9 (580-61687-6), S19-6 (580-61687-7), S20-3 (580-61687-8), S21-21 (580-61687-9), SHP-29 (580-61687-10), SHP-52 (580-61687-11) and SHP-54 (580-61687-12) were analyzed for percent solids in accordance with ASTM D2216. The samples were analyzed on 08/17/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Definitions/Glossary

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Qualifiers

Metals

Qualifier	Qualifier Description
F1	MS and/or MSD Recovery is outside acceptance limits.
H	Sample was prepped or analyzed beyond the specified holding time

General Chemistry

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S2-3
Date Collected: 07/14/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-1
Matrix: Solid
Percent Solids: 84.6

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	30		0.29	0.11	mg/Kg	☼	08/15/16 16:57	08/16/16 16:21	10
Lead	46		0.29	0.028	mg/Kg	☼	08/15/16 16:57	08/16/16 16:21	10

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	84.6		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	15.4		0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S2-13
Date Collected: 07/14/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-2
Matrix: Solid
Percent Solids: 88.7

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	180		1.4	0.49	mg/Kg	☼	08/15/16 16:57	08/16/16 17:09	50
Lead	4200		1.4	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 17:09	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	88.7		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	11.3		0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S3-4
Date Collected: 07/13/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-3
Matrix: Solid
Percent Solids: 87.2

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	200		1.4	0.49	mg/Kg	☼	08/15/16 16:57	08/16/16 17:13	50
Lead	660		1.4	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 17:13	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	87.2		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	12.8		0.1	0.1	%			08/17/16 14:17	1

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S4-7
Date Collected: 07/15/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-4
Matrix: Solid
Percent Solids: 84.6

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	230		1.4	0.52	mg/Kg	☼	08/15/16 16:57	08/16/16 17:18	50
Lead	23		1.4	0.14	mg/Kg	☼	08/15/16 16:57	08/16/16 17:18	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	84.6		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	15.4		0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S4-9
Date Collected: 07/15/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-5
Matrix: Solid
Percent Solids: 91.5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	1700		1.3	0.48	mg/Kg	☼	08/15/16 16:57	08/16/16 17:22	50
Lead	200		1.3	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 17:22	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	91.5		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	8.5		0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S15-9
Date Collected: 07/21/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-6
Matrix: Solid
Percent Solids: 92.6

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	5.3		1.3	0.46	mg/Kg	☼	08/15/16 16:57	08/16/16 17:26	50
Lead	1100		1.3	0.12	mg/Kg	☼	08/15/16 16:57	08/16/16 17:26	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	92.7		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	7.3		0.1	0.1	%			08/17/16 14:17	1

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S19-6
Date Collected: 07/18/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-7
Matrix: Solid
Percent Solids: 96.2

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	120		1.2	0.44	mg/Kg	☼	08/15/16 16:57	08/16/16 17:31	50
Lead	5.8		1.2	0.12	mg/Kg	☼	08/15/16 16:57	08/16/16 17:31	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	96.2		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	3.8		0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S20-3
Date Collected: 07/18/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-8
Matrix: Solid
Percent Solids: 93.1

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	280		1.3	0.46	mg/Kg	☼	08/15/16 16:57	08/16/16 17:35	50
Lead	3100		1.3	0.12	mg/Kg	☼	08/15/16 16:57	08/16/16 17:35	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	93.1		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	6.9		0.1	0.1	%			08/17/16 14:17	1

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S21-21
Date Collected: 07/20/16 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-9
Matrix: Solid
Percent Solids: 90.2

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	40		1.4	0.50	mg/Kg	☼	08/15/16 16:57	08/16/16 17:40	50
Lead	17		1.4	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 17:40	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	90.2		0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	9.8		0.1	0.1	%			08/17/16 14:17	1

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: SHP-29
Date Collected: 04/16/08 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-10
Matrix: Solid
Percent Solids: 92.4

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	59	H	1.3	0.48	mg/Kg	☼	08/15/16 16:57	08/16/16 17:44	50
Lead	3.4	H	1.3	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 17:44	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	92.4	H	0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	7.6	H	0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: SHP-52
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-11
Matrix: Solid
Percent Solids: 88.3

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	190	H	1.4	0.49	mg/Kg	☼	08/15/16 16:57	08/16/16 18:06	50
Lead	19	H	1.4	0.13	mg/Kg	☼	08/15/16 16:57	08/16/16 18:06	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	88.3	H	0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	11.7	H	0.1	0.1	%			08/17/16 14:17	1

Client Sample Results

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: SHP-54
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-12
Matrix: Solid
Percent Solids: 97.6

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	3.3	H	1.2	0.45	mg/Kg	☼	08/15/16 16:57	08/16/16 18:11	50
Lead	12	H	1.2	0.12	mg/Kg	☼	08/15/16 16:57	08/16/16 18:11	50

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	97.6	H	0.1	0.1	%			08/17/16 14:17	1
Percent Moisture	2.4	H	0.1	0.1	%			08/17/16 14:17	1

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 580-224976/15-A
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 224976

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.50	0.18	mg/Kg		08/15/16 16:57	08/16/16 16:12	10
Lead	ND		0.50	0.048	mg/Kg		08/15/16 16:57	08/16/16 16:12	10

Lab Sample ID: LCS 580-224976/16-A
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 224976

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic			200	225		mg/Kg		112	80 - 120		
Lead			50.0	55.3		mg/Kg		111	80 - 120		

Lab Sample ID: LCSD 580-224976/17-A
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 224976

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic			200	212		mg/Kg		106	80 - 120	6	20
Lead			50.0	51.3		mg/Kg		103	80 - 120	8	20

Lab Sample ID: LCSSRM 580-224976/18-A
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 224976

Analyte			Spike Added	LCSSRM Result	LCSSRM Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic			139	157		mg/Kg		112.6	70.4 - 140.3		
Lead			133	156		mg/Kg		117.1	72.9 - 127.8		

Lab Sample ID: 580-61687-1 MS
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: S2-3
Prep Type: Total/NA
Prep Batch: 224976

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic	29	F1	112	97.3	F1	mg/Kg	☼	61	80 - 120		
Lead	45		28.1	77.2		mg/Kg	☼	114	80 - 120		

Lab Sample ID: 580-61687-1 MSD
Matrix: Solid
Analysis Batch: 225112

Client Sample ID: S2-3
Prep Type: Total/NA
Prep Batch: 224976

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	29	F1	117	103	F1	mg/Kg	☼	63	80 - 120	6	20
Lead	45		29.3	75.6		mg/Kg	☼	104	80 - 120	2	20

Lab Chronicle

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S2-3 — **Lab Sample ID: 580-61687-1**
Date Collected: 07/14/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S2-3 — **Lab Sample ID: 580-61687-1**
Date Collected: 07/14/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55 — **Percent Solids: 84.6**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		10	225112	08/16/16 16:21	HJM	TAL SEA

Client Sample ID: S2-13 — **Lab Sample ID: 580-61687-2**
Date Collected: 07/14/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S2-13 — **Lab Sample ID: 580-61687-2**
Date Collected: 07/14/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55 — **Percent Solids: 88.7**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:09	HJM	TAL SEA

Client Sample ID: S3-4 — **Lab Sample ID: 580-61687-3**
Date Collected: 07/13/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S3-4 — **Lab Sample ID: 580-61687-3**
Date Collected: 07/13/16 00:01 — **Matrix: Solid**
Date Received: 08/11/16 09:55 — **Percent Solids: 87.2**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:13	HJM	TAL SEA

Lab Chronicle

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S4-7
Lab Sample ID: 580-61687-4
Date Collected: 07/15/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S4-7
Lab Sample ID: 580-61687-4
Date Collected: 07/15/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 84.6

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:18	HJM	TAL SEA

Client Sample ID: S4-9
Lab Sample ID: 580-61687-5
Date Collected: 07/15/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S4-9
Lab Sample ID: 580-61687-5
Date Collected: 07/15/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 91.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:22	HJM	TAL SEA

Client Sample ID: S15-9
Lab Sample ID: 580-61687-6
Date Collected: 07/21/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S15-9
Lab Sample ID: 580-61687-6
Date Collected: 07/21/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 92.6

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:26	HJM	TAL SEA

Lab Chronicle

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: S19-6
Lab Sample ID: 580-61687-7
Date Collected: 07/18/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S19-6
Lab Sample ID: 580-61687-7
Date Collected: 07/18/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 96.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:31	HJM	TAL SEA

Client Sample ID: S20-3
Lab Sample ID: 580-61687-8
Date Collected: 07/18/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S20-3
Lab Sample ID: 580-61687-8
Date Collected: 07/18/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 93.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:35	HJM	TAL SEA

Client Sample ID: S21-21
Lab Sample ID: 580-61687-9
Date Collected: 07/20/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: S21-21
Lab Sample ID: 580-61687-9
Date Collected: 07/20/16 00:01
Matrix: Solid
Date Received: 08/11/16 09:55
Percent Solids: 90.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:40	HJM	TAL SEA

Lab Chronicle

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Client Sample ID: SHP-29
Date Collected: 04/16/08 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-10
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: SHP-29
Date Collected: 04/16/08 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-10
Matrix: Solid
Percent Solids: 92.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 17:44	HJM	TAL SEA

Client Sample ID: SHP-52
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-11
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: SHP-52
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-11
Matrix: Solid
Percent Solids: 88.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 18:06	HJM	TAL SEA

Client Sample ID: SHP-54
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-12
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	D 2216		1	225214	08/17/16 14:17	CBS	TAL SEA

Client Sample ID: SHP-54
Date Collected: 01/02/10 00:01
Date Received: 08/11/16 09:55

Lab Sample ID: 580-61687-12
Matrix: Solid
Percent Solids: 97.6

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			224976	08/15/16 16:57	PAB	TAL SEA
Total/NA	Analysis	6020A		50	225112	08/16/16 18:11	HJM	TAL SEA

Laboratory References:

TAL SEA = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Certification Summary

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Laboratory: TestAmerica Seattle

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska (UST)	State Program	10	UST-022	03-02-17
California	State Program	9	2901	01-31-18
L-A-B	DoD ELAP		L2236	01-19-19
L-A-B	ISO/IEC 17025		L2236	01-19-19
Montana (UST)	State Program	8	N/A	04-30-20
Oregon	NELAP	10	WA100007	11-06-16
US Fish & Wildlife	Federal		LE058448-0	10-31-16
USDA	Federal		P330-14-00126	04-08-17
Washington	State Program	10	C553	02-17-17

Sample Summary

Client: Integral Consulting Inc
Project/Site: C755.0101 - XRF Calibration Samples

TestAmerica Job ID: 580-61687-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
580-61687-1	S2-3	Solid	07/14/16 00:01	08/11/16 09:55
580-61687-2	S2-13	Solid	07/14/16 00:01	08/11/16 09:55
580-61687-3	S3-4	Solid	07/13/16 00:01	08/11/16 09:55
580-61687-4	S4-7	Solid	07/15/16 00:01	08/11/16 09:55
580-61687-5	S4-9	Solid	07/15/16 00:01	08/11/16 09:55
580-61687-6	S15-9	Solid	07/21/16 00:01	08/11/16 09:55
580-61687-7	S19-6	Solid	07/18/16 00:01	08/11/16 09:55
580-61687-8	S20-3	Solid	07/18/16 00:01	08/11/16 09:55
580-61687-9	S21-21	Solid	07/20/16 00:01	08/11/16 09:55
580-61687-10	SHP-29	Solid	04/16/08 00:01	08/11/16 09:55
580-61687-11	SHP-52	Solid	01/02/10 00:01	08/11/16 09:55
580-61687-12	SHP-54	Solid	01/02/10 00:01	08/11/16 09:55

Loc: 580
61687

CHAIN OF CUSTODY FORM

integral consulting inc.

Project: C755.0101 - XRF Calibration Samples

Samplers: W. Cutler

Integral Contact: W. Cutler (wcutler@integral-corp.com)
Phone 720-465-3342

Ship to:
Lab Name TEST AMERICA
Address 5755 8TH STREET EAST
TACOMA, WA 98424

Contact ROBERT GREER
Phone 253-248-4971

Sample No.	Tag #	Date	Time	Matrix	ANALYSES REQUESTED: TOTAL ARSENIC & LEAD 3050B/6020								Extra Container	Archive	Comments
S2-3		7/14/2016		SL	X									X	Return to Client
S2-13		7/14/2016		SL	X									X	Return to Client
S3-4		7/13/2016		SL	X									X	Return to Client
S4-7		7/15/2016		SL	X									X	Return to Client
S4-9		7/15/2016		SL	X									X	Return to Client
S15-9		7/21/2016		SL	X									X	Return to Client
S19-6		7/18/2016		SL	X									X	Return to Client
S20-3		7/18/2016		SL	X									X	Return to Client
S21-21		7/20/2016		SL	X									X	Return to Client
SHP-29		4/16/2008		SL	X									X	Return to Client
SHP-52		1/2/2010		SL	X									X	Return to Client
SHP-54		1/2/2010		SL	X									X	Return to Client

580-61687 Chain of Custody

TB ___ Cooler IR2 Cor 23.3 °C Unc 23.4
Cooler Dsc Med Red/grey @ Lab
Wet/Packs None Packing bub
Fed Ex

Analysis Turn Time: (Normal) Rush **Rush Results Needed By:**

Shipped by: FedEx **Shipping Tracking No.** 7769 6532 0040

Condition of Samples Upon Receipt: **Custody Seal Intact?**

Matrix Code: GW - Groundwater; SL - Soil; SW - Surface water; SD -Sediment; Other:

Relinquished by: William Cutler (signature) **Date/Time:** 8/10/16 1000h **Received by:** Tom Blankenship (signature) **Date/Time:** 8/11/16 0955

Relinquished by: _____ (signature) **Date/Time:** _____ **Received by:** _____ (signature) **Date/Time:** _____

Special Instructions: Use 5g or 10g soil aliquots for 3050B digestion, after confirmation discussion with Glenn Esler (Integral) at 503.284.5545, Ext. 617.
Return all samples to: William Cutler, Integral Consulting, 285 Century Place, Suite 190, Louisville, CO 80027

Login Sample Receipt Checklist

Client: Integral Consulting Inc

Job Number: 580-61687-1

Login Number: 61687
List Number: 1
Creator: Gall, Brandon A

List Source: TestAmerica Seattle

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	Lab does not accept radioactive samples.
The cooler's custody seal, if present, is intact.	N/A	Not present
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	Thermal preservation not required.
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	False	No time on COC or containers.
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	False	No time on COC or sample containers
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

APPENDIX D2

ANALYTICAL SAMPLE AND LABORATORY TRACKING — MULTI-INCREMENT SAMPLES

Appendix D2. Analytical Sample and Laboratory Tracking—Multi-increment Soil Samples

Sample ID	Sample Date	Laboratory Report Number	Analysis
S1-01	12/19/2016	580-65066-1	MI, As, Pb, Moisture
S1-02	12/19/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S1-02	12/19/2016	580-65066-2	Bioaccessible As and Pb
S1-03	12/16/2016	580-65066-1	MI, As, Pb, Moisture
S2-01	12/3/2016	580-64682-1	MI, As, Pb, Cr, Cu, Pesticides, Moisture
S2-01	12/3/2016	580-64682-2	Bioaccessible As and Pb
S2-01	12/3/2016	580-64682-3	Hexavalent Cr
S2-02	12/3/2016	580-64682-1	MI, As, Pb, Moisture
S2-03	11/25/2016	580-64458-1	MI, As, Pb, Moisture
S2-04	11/25/2016	580-64458-1	MI, As, Pb, Moisture
S3-01	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S3-02A	1/2/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S3-02B	1/2/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S3-02C	1/2/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S3-03	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S3-04A	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S3-04B	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S3-04B	1/5/2017	580-65360-2	Bioaccessible As
S3-04C	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S3-05A	1/3/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S3-05B	1/3/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S3-05C	1/3/2017	580-65254-1	MI,As, Pb, Pesticides, Moisture
S4-01	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S4-01	11/11/2016	580-64233-2	Bioaccessible As and Pb
S4-02	11/11/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S4-03	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S4-03	11/11/2016	580-64233-2	Bioaccessible As
S4-05	11/11/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S4-06	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S4-06	11/11/2016	580-64233-2	Bioaccessible As
S4-07	11/11/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S4-9-MI	7/22/2016	580-61364-1	MI, As, Pb, Pesticides, Bioaccessible As

Appendix D2. Analytical Sample and Laboratory Tracking—Multi-increment Soil Samples

Sample ID	Sample Date	Laboratory Report Number	Analysis
S4-09A	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S4-09A	11/11/2016	580-64233-2	Bioaccessible As
S4-09B	11/11/2016	580-64233-1	MI,As, Pb, Moisture
S4-09B	11/11/2016	580-64233-2	Bioaccessible As and Pb
S4-09C	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S4-09C	11/11/2016	580-64233-2	Bioaccessible As
S4-10	11/11/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S4-10	11/11/2016	580-64233-2	Bioaccessible As
S4-12	11/11/2016	580-64233-1	MI, As, Pb, Moisture
S5-01	12/20/2016	580-65066-1	MI, As, Pb, Moisture
S5-02A	12/20/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S5-02B	12/20/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S5-02C	12/20/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S6-01	11/25/2016	580-64458-1	MI, As, Pb, Pesticides, Moisture
S6-02	12/1/2016	580-64682-1	MI, As, Pb, Moisture
S6-03	11/25/2016	580-64458-1	MI, As, Pb, Pesticides, Moisture
S6-04	11/24/2016	580-64458-1	MI, As, Pb, Moisture
S6-05	11/27/2016	580-64458-1	MI, As, Pb, Cr, Cu, Pesticides, Moisture
S6-05	11/27/2016	580-64458-2	Hexavalent Cr
S6-06	11/27/2016	580-64458-1	MI, As, Pb, Pesticides, Moisture
S6-07	11/24/2016	580-64458-1	MI, As, Pb, Moisture
S7-01	11/14/2016	580-64233-1	MI, As, Pb, Moisture
S7-02	11/21/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S7-02	11/21/2016	580-64346-2	Bioaccessible As and Pb
S7-03	11/14/2016	580-64233-1	MI, As, Pb, Cr, Cu, Pesticides, Moisture
S7-03	11/14/2016	580-64346-3	Hexavalent Cr
S7-05	11/15/2016	580-64233-1	MI, As, Pb, Moisture
S7-05	11/15/2016	580-64346-2	Bioaccessible As
S7-06	11/15/2016	580-64233-1	MI, As, Pb, Moisture
S7-06	11/15/2016	580-64346-2	Bioaccessible As
S7-07	11/15/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S7-08	11/15/2016	580-64233-1	MI, As, Pb, Moisture

Appendix D2. Analytical Sample and Laboratory Tracking—Multi-increment Soil Samples

Sample ID	Sample Date	Laboratory Report Number	Analysis
S7-08	11/15/2016	580-64346-2	Bioaccessible As and Pb
S7-09	11/17/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S7-10	11/17/2016	580-64233-1	MI, As, Pb, Moisture
S7-11	11/17/2016	580-64233-1	MI, As, Pb, Moisture
S7-23-MI	7/22/2016	580-61364-1	MI, As, Pb, Pesticides, Bioaccessible As
S8-01A	12/16/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S8-01B	12/19/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S8-01C	12/19/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S9-01	1/9/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S9-02	1/9/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S10-01	12/19/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S10-02A	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S10-02B	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S10-02C	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S10-03	12/13/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S11-01	12/23/2016	580-65066-1	MI, As, Pb, Moisture
S11-02	12/26/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S11-03	12/26/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S12-01A	12/9/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S12-01B	12/9/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S12-01C	12/9/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S12-02A	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S12-02A	12/12/2016	580-64838-2	Bioaccessible As and Pb
S12-02B	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S12-02C	12/12/2016	580-64838-1	MI, As, Pb, Pesticides, Moisture
S13-01	12/26/2016	580-65066-1	MI, As, Pb, Moisture
S13-02A	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S13-02B	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S13-02C	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S13-03	12/9/2016	580-64838-1	MI, As, Pb, Moisture
S13-03	12/9/2016	580-64838-2	Bioaccessible As
S13-04	12/6/2016	580-64682-1	MI, As, Pb, Moisture

Appendix D2. Analytical Sample and Laboratory Tracking—Multi-increment Soil Samples

Sample ID	Sample Date	Laboratory Report Number	Analysis
S13-04	12/6/2016	580-64759-2	Bioaccessible As
S13-05	12/9/2016	580-64838-1	MI, As, Pb, Moisture
S13-06A	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S13-06B	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S13-06C	12/5/2016	580-64682-1	MI, As, Pb, Pesticides, Moisture
S14-01	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S14-02	1/5/2017	580-65360-1	MI, As, Pb, Moisture
S14-02	1/5/2017	580-65360-2	Bioaccessible As
S14-03	1/9/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S14-04	1/9/2017	580-65360-1	MI, As, Pb, Pesticides, Moisture
S15-01	1/16/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S15-02	1/16/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S15-03	1/16/2017	580-65516-1	MI, As, Pb, Cu, Cr, Pesticides, Moisture
S15-03	1/16/2017	580-65516-2	Hexavalent Cr
S15-04	1/16/2017	580-65519-1	MI, As, Pb, Pesticides, Moisture
S15-05	1/16/2017	580-65519-1	MI, As, Pb, Moisture
S15-06	1/16/2017	580-65519-1	MI, As, Pb, Pesticides, Moisture
S15-07	1/16/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S16-01	1/17/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S16-02	1/17/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S16-03	1/17/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S16-04	1/17/2017	580-65516-1	MI, As, Pb, Pesticides, Moisture
S17-01	1/9/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S19-01	1/11/2017	580-65519-1	MI, As, Pb, Moisture
S19-01	1/11/2017	580-65367-2	Bioaccessible As
S19-02	1/9/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S19-03	1/10/2017	580-65367-1	MI, As, Pb, Moisture
S19-04	1/10/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S19-04	1/10/2017; 8/01/2017	580-65367-2; 580-70443-1	Bioaccessible As and Pb
S19-05	1/11/2017	580-65519-1	MI, As, Pb, Moisture
S19-06	1/11/2017	580-65519-1	MI, As, Pb, Moisture
S19-07	1/11/2017	580-65519-1	MI, As, Pb, Moisture

Appendix D2. Analytical Sample and Laboratory Tracking—Multi-increment Soil Samples

Sample ID	Sample Date	Laboratory Report Number	Analysis
S19-08	12/29/2016	580-65254-1	MI, As, Pb, Moisture
S20-01	11/18/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S20-02	11/18/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S20-02	11/18/2016	580-64346-2	Bioaccessible As and Pb
S20-03	11/18/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S20-03	11/18/2016	580-64346-2	Bioaccessible As and Pb
S20-04	11/18/2016	580-64233-1	MI, As, Pb, Moisture
S20-05	11/18/2016	580-64233-1	MI, As, Pb, Pesticides, Moisture
S21-01	12/27/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S21-01	12/27/2016	580-65134-2	Bioaccessible As and Pb
S21-02	12/27/2016	580-65066-1	MI, As, Pb, Cu, Cr, Pesticides, Moisture
S21-02	12/27/2016	580-65134-2	Bioaccessible As and Pb
S21-02	12/27/2016	580-65134-3	Hexavalent Cr
S21-03	12/27/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S21-04	12/27/2016	580-65066-1	MI, As, Pb, Pesticides, Moisture
S22-01	1/10/2017	580-65367-1	MI, As, Pb, Pesticides, Moisture
S22-02	12/29/2016	580-65254-1	MI, As, Pb, Moisture
S23-01	1/2/2017	580-65254-1	MI, As, Pb, Pesticides, Moisture
S23-02	1/2/2017	580-65254-1	MI, As, Pb, Pesticides, Moisture
S23-03	1/2/2017	580-65254-1	MI, As, Pb, Pesticides, Moisture
KHSF-1	7/22/2016	580-61324-2	Bioaccessible As
KHSF-2	7/22/2016	580-61324-2	Bioaccessible As
900	11/11/2016	580-64233-1	Pesticides
901	1/5/2017	580-65360-1	As, Pb

Notes:
As = arsenic
Cr = chromium
Cu = copper
Pb = lead
MI = multi-increment sample preparation
Pesticides = organochlorine pesticides

APPENDIX D3

LABORATORY ANALYTICAL REPORTS—MULTI-INCREMENT SAMPLES (ON CD-ROM)