

DAVID Y. IGE
GOVERNOR OF HAWAII




BRUCE S. ANDERSON, Ph.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File: 18-159 IV

June 13, 2018

TO: The Honorable Jade T. Butay
Director of Transportation

FROM: Bruce S. Anderson, Ph.D. 
Director of Health

SUBJECT: **Request for Directing Ownership of Factory Street (a Disputed Road) to
City and County of Honolulu**

The Hawaii Department of Health (HDOH) is reaching out to the Department of Transportation (DOT) to direct ownership of Factory Street, a disputed road that poses potential health risks to the local community if it is not properly maintained to ensure subsurface soils remain capped with intact road and shoulder surfaces. The request is pursuant to Act 208, HB 115 HD1 SD1 CD1 (Attachment A). The soils under the pavement present a potential hazard to the community if the roadway is not paved and properly maintained. While excavations in the roadway or shoulder areas can be managed safely with appropriate precautions, it is essential that this property be owned and managed to ensure the underlying soils remain properly covered. This can be accomplished with routine maintenance and resurfacing.

Factory Street is a busy side street located in Kalihi, City & County of Honolulu (C&C), off of N. King Street in a mixed residential-commercial/industrial use zone (Zoning code BMX-3; Community Business Mixed Use; Attachment B). Today's frequent traffic, cars parking on the shoulder areas, and travel of heavy commercial trucks to businesses lining the road has taken a toll on the road. Considering the location of this street within ½ mile radius of the planned Kalihi rail station, traffic is even more likely to increase in the future. The Kalihi area in general is an underprivileged area and in need of road repairs and upgrades, but the degrading pavement on Factory Street specifically poses a public health concern, because high lead levels have been measured in soil underneath Factory Street and its shoulder (Attachment C and D). The disputed ownership of the street provides an obstacle to HDOH to meet our mandate protecting human health and the environment.

It is documented that children's exposure to lead in soil at Factory Street led to high lead blood concentrations (Attachment C, Page 1). These children lived in an apartment on Factory Street and HDOH wishes to avoid such incidents in the future.

HDOH has spent public funds to assess the extent of the lead contamination in soil underneath Factory Street, repair pavement in the shoulder area during an emergency response in 2017 and prepared an environmental hazard management plan to manage the lead contamination during intrusive subsurface work in the street. HDOH relied on the C&C to continue maintenance of the travel-way of the street. EPA also spent public funds in the 1990s to address the lead contamination.

Road Ownership Dispute and Maintenance

The disputed ownership of the travel way and shoulder area of the street has not been resolved since the dispute became apparent in the 1990s (Appendix C, Page 17). No private individual, entity, company, or the C&C claim ownership of the road.

The C&C lists Factory Street as "private road", but the last listed owner of the street and neighboring lots is Kalihi Taro and Land Company, Limited. The neighboring lots were sold to private owners, but the street was not, and the Kalihi Taro and Land Company was dissolved in 1926 (Attachment E), leaving the road ownerless or as an "abandoned" road. For the longest time the street was listed as privately owned, but the C&C maintained it and was planning on resurfacing it and replacing utilities along Factory Street as part of the larger Kalihi Area (Attachment F). When the contamination under the road became apparent, both efforts were halted. Recently, the C&C has discontinued maintenance of the road due to "No Parking" signs posted on utility poles located on the shoulder areas and fences of private residences. C&C is permitted by Ordinance to provide surface maintenance to privately owned streets as long as all 12 conditions specified in ROH Section 14-32 are complied with. Due to the posting of the signs, C&C stated they are no longer permitted to maintain the road according to ROH Section 14-32.2 (4) "Surface Maintenance" due to restrictive signage (e.g., posting of "No Parking" signs). This also means that C&C will no longer respond to pothole patching requests through the pothole line as they have in the past. If the signs are removed, the residents and owners of buildings lining Factory Street may petition the C&C to resume maintenance. HDOH has reached out to the owners and residents asking to remove the signs, but nobody has claimed ownership of the signs. Without the C&C maintaining the road and shoulder of the road, maintenance falls to residents and owners of buildings lining Factory Street - an effort that seems difficult to coordinate and implement in an underprivileged area.

HDOH has put considerable effort in trying to reconstruct property boundaries based on C&C GIS Maps, site visits to locate property line pins, request for information from property owners, title search record, previous reports, TMK maps, survey maps from the Board of Water Supply, supplied private property owner survey maps, and corresponding features on google earth maps. We are confident that the property lines as drawn on Attachment G are correct and that the travel way of the road is not part of the private properties lining Factory Street. In our opinion, even most of the shoulder areas on Factory Street are not part of the private properties based on our

reconstruction, although one of the residents on Factory Street between Waterhouse and Stanley Street indicated this may be part of their property (Appendix H). Further evidence to make this claim was however not supplied (e.g., survey data). In our opinion, installing "No Parking" signs does not demonstrate a claim of ownership of the road.

Request

HDOH requests that ownership of Factory Street be directed to the C&C for the following reasons:

- 1) The current status as "abandoned", or in C&C-terms "private road", does not ensure continued maintenance of the road needed for the protection of human health and the environment. The street is open to the public and located in a county (C&C of Honolulu) with a population of five hundred thousand and more.
- 2) Our reconstruction of property lines indicates that Factory Street and most of the shoulder area (Appendix G) are not part of the private property parcels.
- 3) Ownership of the street ended with dissolution of the Kalihi Taro and Land Company in 1926 (Appendix E).
- 4) Redevelopment or resurfacing of the road will be necessary in the near future, because of the discontinuous patchwork of pothole patching on the street, the increased traffic or increasing traffic demand and/or load on the road. This is unlikely to be accomplished by different residents and owners in an underprivileged area.
- 5) To our knowledge, nobody claimed to own the road within the last 5 years, only in one instance the shoulder area (Appendix H).
- 6) The C&C Department of Planning & Permitting's enforces a setback of buildings and structures 5 feet from the property line to ensure the possibility of road widening (see example Factory Street 808, Appendix I). C&C acts as in this instance as an owner of the street that can implement road widening at any time.
- 7) Statements and survey maps from property owners indicate the road and/most of the shoulder are not part of their property (Appendix H).
- 8) C&C utility lines (e.g., water, sewer) run underneath the street and shoulder area and need to be accessible to C&C. With subsurface excavation, there is also the need cover these areas after excavation with asphalt/concrete by C&C.

We also request that the shoulder area of Factory Street will be included as part of the street for the ownership direction. If the one statement received by a property owner of a shoulder area part of Factory Street between Waterhouse and Stanley Street or the posting of "No Parking

The Honorable Jade T. Butay
June 13, 2018
Page 4

signs” poses an obstacle to this, we request that the shoulder area be excluded for direction of ownership to C&C, but that an alternate owner for the shoulder area be formally determined.

Should you have any questions regarding this letter, please contact Ms. Iris van der Zander of the HDOH HEER Office at iris.vanderzander@doh.hawaii.gov or (808) 586-4653.

Attachment A: Act 208, HB 115 HD1 SD1 CD1

Attachment B: Factory Street Site Location

Attachment C: Factory Street Site Assessment Report (EPA, 1995)

Attachment D: Results from 2017 HDOH Site Assessment

Attachment E: Dissolution of Kalihi Taro And Land Company, Limited

Attachment F: City and County of Honolulu Letter Regarding Pavement & Maintenance
of Factory Street

Attachment G: Reconstruction of Property Lines at Factory Street

Attachment H: Documents Proving Dispute Over Ownership and Property Lines

Attachment I: Building Permits showing 5-foot setback enforcement by City and County
DPP at Factory Street 808

c: Kathleen Ho, Deputy AG

Attachment A:
Act 208, HB 115 HD1 SD1 CD1



EXECUTIVE CHAMBERS
HONOLULU

DAVID Y. IGE
GOVERNOR

GOV. MSG. NO. 1322

July 12, 2017

The Honorable Ronald D. Kouchi,
President
and Members of the Senate
Twenty-Ninth State Legislature
State Capitol, Room 409
Honolulu, Hawai'i 96813

The Honorable Scott K. Saiki,
Speaker and Members of the
House of Representatives
Twenty-Ninth State Legislature
State Capitol, Room 431
Honolulu, Hawai'i 96813

Dear President Kouchi, Speaker Saiki, and Members of the Legislature:

Re: HB115 HD1 SD1 CD1

HB115 HD1 SD1 CD1, entitled "A BILL FOR AN ACT RELATING TO HIGHWAYS" will become law without my signature, pursuant to Section 16 of Article III of the State Constitution.

The purpose of this bill is to address the roads "in limbo" throughout the State whose ownership has been disputed or called into question. The bill provides that a disputed road may be transferred ownership to a county as directed by the State Department of Transportation.

There is concern that on roads that are privately owned but the private owners cannot be easily determined or are unwilling to accept responsibility for the road will expose the counties to an unknown and unquantified potential liability. This could also be a potential unfunded mandate to the counties.

For the foregoing reasons, HB115 HD1 SD1 CD1 will become law as Act 208, Session Laws of Hawaii 2017, effective July 12, 2017, without my signature.

Sincerely,

DAVID Y. IGE
Governor, State of Hawaii

A BILL FOR AN ACT

RELATING TO HIGHWAYS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

1 SECTION 1. The legislature finds that while federal,
2 state, and county agencies maintain jurisdiction over, and are
3 responsible for, the repair and maintenance of the majority of
4 highways, streets, and roads throughout Hawaii, there are
5 numerous roads throughout the State whose ownership has been
6 disputed or called into question. Because the ownership of
7 these roads is in dispute, these roads often do not receive
8 proper care and maintenance. These disputes create difficulties
9 for members of the public and government agencies when
10 individuals report repair or maintenance issues. The
11 legislature also finds that although counties have policies and
12 procedures to assist owners with the repair and maintenance of
13 private roads, these policies and procedures are only applicable
14 when the county can determine or locate the actual owner of the
15 road.

16 The legislature further finds that Act 221, Session Laws of
17 Hawaii 1965, provided that all public highways not under the
18 jurisdiction of the state department of transportation were



1 declared to be owned by the respective county governments.
2 However, notwithstanding that ownership of these highways was
3 transferred to the counties by law under Act 221, the counties
4 of the State have not acknowledged their ownership and
5 jurisdiction over these public highways, in part because title
6 for many of these roads was not transferred by deed of
7 conveyance or other tangible evidence of ownership.

8 The purpose of this Act is to require each county with a
9 population of five hundred thousand or greater to take ownership
10 and jurisdiction over all roads for which there is a dispute
11 over ownership and jurisdiction between the State or any of its
12 political subdivisions and a county or a private party, or
13 between a county and a private party.

14 SECTION 2. Chapter 264, Hawaii Revised Statutes, is
15 amended by adding a new section to part I to be appropriately
16 designated and to read as follows:

17 "§264- County highways; ownership. (a) As used in this
18 section:

19 "Disputed road" means any highway, road, alley, street,
20 way, lane, bikeway, bridge, or trail that is open to the public
21 and is located in any county with a population of five hundred



1 thousand or more, for which there is a dispute over ownership
2 and jurisdiction, as determined by the department of
3 transportation, between the State or any of its political
4 subdivisions and a county or a private party, or between a
5 county and a private party.

6 (b) If no party has exercised ownership over the disputed
7 road in the five years prior to the effective date of this
8 section, the disputed road shall be deemed to have been
9 surrendered to the county in which the road is situated,
10 pursuant to an administrative order issued by the state director
11 of transportation. The county shall accept without exercise of
12 discretion all surrendered roads and shall record its ownership
13 immediately with the bureau of conveyances.

14 For purposes of this subsection, driving on a disputed road
15 shall not, on its own, constitute an act of ownership."

16 SECTION 3. New statutory material is underscored.

17 SECTION 4. This Act shall take effect on July 1, 2017.

APPROVED this day of , 2017

GOVERNOR OF THE STATE OF HAWAII



HB No. 115, HD 1, SD 1, CD 1

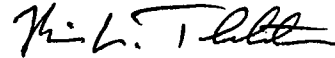
THE HOUSE OF REPRESENTATIVES OF THE STATE OF HAWAII

Date: May 2, 2017
Honolulu, Hawaii

We hereby certify that the above-referenced Bill on this day passed Final Reading in the House of Representatives of the Twenty-Ninth Legislature of the State of Hawaii, Regular Session of 2017.



Joseph M. Souki
Speaker
House of Representatives



Brian L. Takeshita
Chief Clerk
House of Representatives


H.B. No. 115, H.D. 1, S.D. 1 , C.D. 1

THE SENATE OF THE STATE OF HAWAII

Date: May 2, 2017
Honolulu, Hawaii 96813

We hereby certify that the foregoing Bill this day passed Final Reading in the
Senate of the Twenty-ninth Legislature of the State of Hawaii, Regular Session of 2017.


President of the Senate


Clerk of the Senate

Attachment B:
Factory Street Site Location

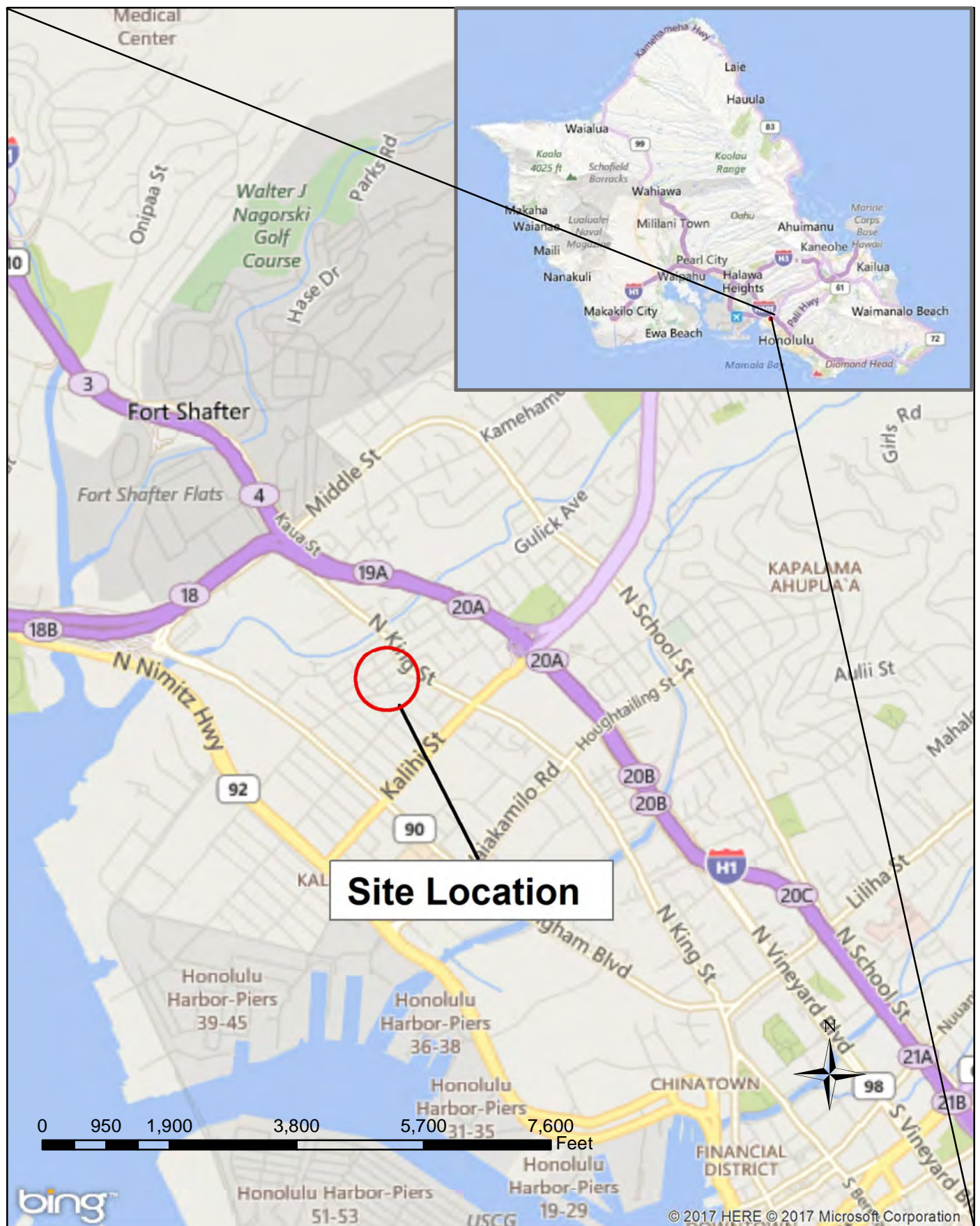


Figure 1: Site Location

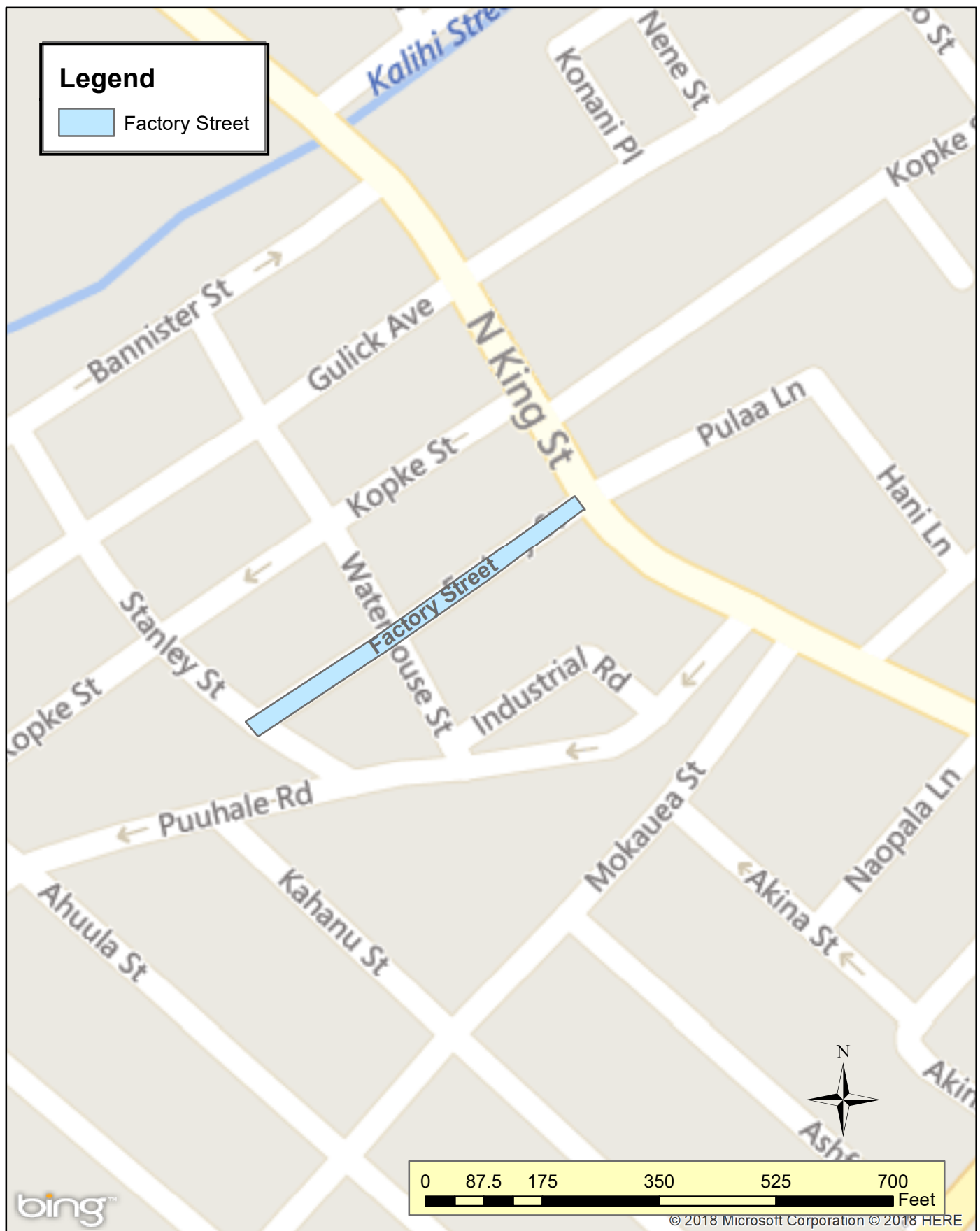


Figure 2: Factory Street Location

Attachment C:
Factory Street Site Assessment Report (EPA, 1995)

TECHNICAL ASSISTANCE TEAM

**Factory Street Lead Site
Assessment Report**

Honolulu, Hawaii

TAT No: 099505-T-001
TDD No: T09-9410-011
PAN No: EHI-0073-SBA

Submitted To:

**William E. Lewis
Deputy Project Officer
U.S. Environmental Protection Agency
Region IX Emergency Response Section (H-8-3)
75 Hawthorne Street
San Francisco, CA 94105**

Contract No. 68-WO-0037

Prepared By:

John H. Whitaker, R.G.

**Technical Assistance Team
Ecology and Environment, Inc.**

September 30, 1995



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

75 Hawthorne Street
San Francisco, CA 94105-3901

July 28, 1995

Michael C. Cripps
State On-Scene Coordinator
Office of Hazardous Evaluation
and Emergency Response
919 Ala Moana Blvd, Room 206
Honolulu, Hawaii 96814-4912

Dear Mike:

I want to express my appreciation to you and your colleagues for the your help during my recent Factory Street Site visit. I enjoyed working with you, exploring and evaluating the various information systems the State has to offer, and meeting the many promising sleuths and archival scholars residing on you staff. My only regret is tht I will sorely miss searching for and discovering those remote and aromatic parking spaces that only your office has to offer.

Since my visit, I have organized and analyzed the information and archival documents that we collected over the week. Also I have received the final report and associated documents from Title Guarantee of Hawaii, the contractor who we met on our first day of the PRP Search. I have enclosed these documents in summary form, along with my conclusions regarding ownership of Factory Street, the identifcation of the PRPs, the sourse of lead contamination, and my recommendations with respect to enacting a Safety and Health Plan for any future construction at the Site.

Thanks again and I hope we get a chance to work together in the future. If you have any questions, please don't hesitate to call me. My phone number was recently changed to (415) 744-2338.

Sincerely;

A handwritten signature in black ink, which appears to read "William J. Weis III". The signature is written in a cursive, flowing style.

William J. Weis III
Investigations and Enforcement

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1.0 INTRODUCTION

On July 11, 1994 the U.S. Environmental Protection Agency (EPA) Emergency Response Section (ERS) directed the Zone II Region IX Technical Assistance Team (TAT) to conduct a site assessment at the Factory Street Lead Site in Honolulu, Hawaii. Of concern was the presence of lead contamination in soils at an apartment complex and in the surrounding neighborhood. The contamination was the result of poor housekeeping practices during the manufacture of fishing weights at a small fishing supply shop formerly located at the site. Investigations conducted by the State of Hawaii Department of Health (DOH) Human Services Branch and Hazard Evaluation and Emergency Response (HEER) Branch revealed that residents at the site had been exposed to lead. In addition, HEER officials felt that contamination was a potential threat to surface water and groundwater. The HEER was concerned that removal activities conducted by the current property owner were incomplete.

The TAT collected soil samples from the surface and at depth at the site and at the surface in the surrounding neighborhood. The samples were analyzed in the field with a Spectrace 9000 x-ray fluorescence spectrometer (XRF). Results indicated that lead contamination in soils was confined primarily to areas near the source at depths of three feet or less. The EPA Investigation and Enforcement Section determined that ownership of land near the apartment complex found to be contaminated was under dispute. Moderate lead levels were also found in surface soils away from the apartment complex site. This contamination could not be directly attributed to a source on the site.

2.0 BACKGROUND AND SITE DESCRIPTION

The HEER has defined the Factory Street Lead Site as a four block area centered on the intersection of Factory and King Streets in the Kalihi Subdivision, City and County of Honolulu, Island of Oahu, Hawaii (Figure 1). For the purposes of this report the site is defined as the parcel encompassing the suspected source area for lead contamination located at 2003 North King Street and 922 Factory Street, and curbside portions of parcels on the other side of Factory Street where contamination was reportedly found and removed by the landowner (Figure 2). The parcels are occupied by several shops, a small apartment complex, and a parking lot.

In April of 1993, two children living in the apartments were found to have blood lead levels of 33 micrograms per deciliter ($\mu\text{g}/\text{dl}$) in samples taken by their physician. These values exceeded the

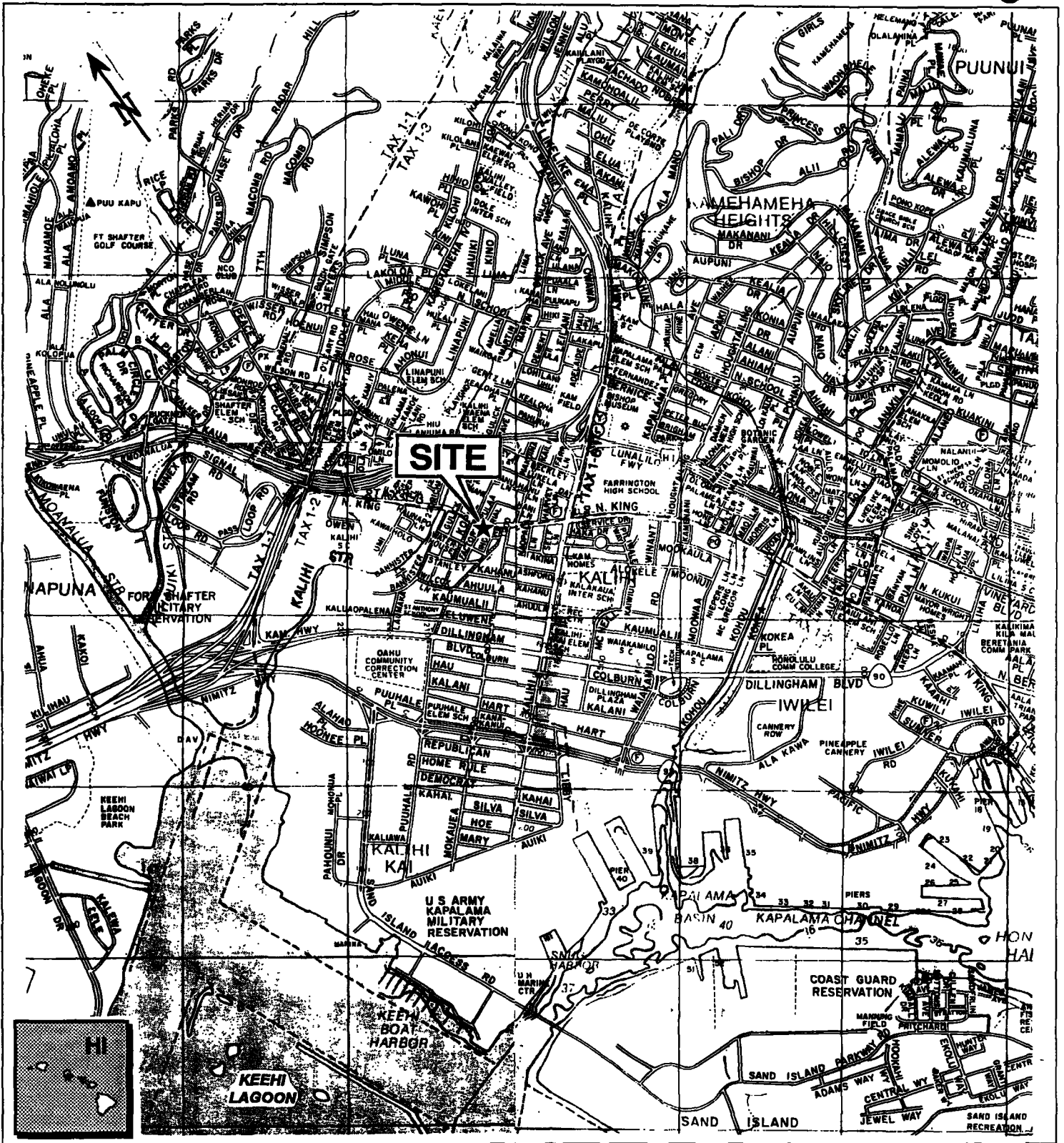
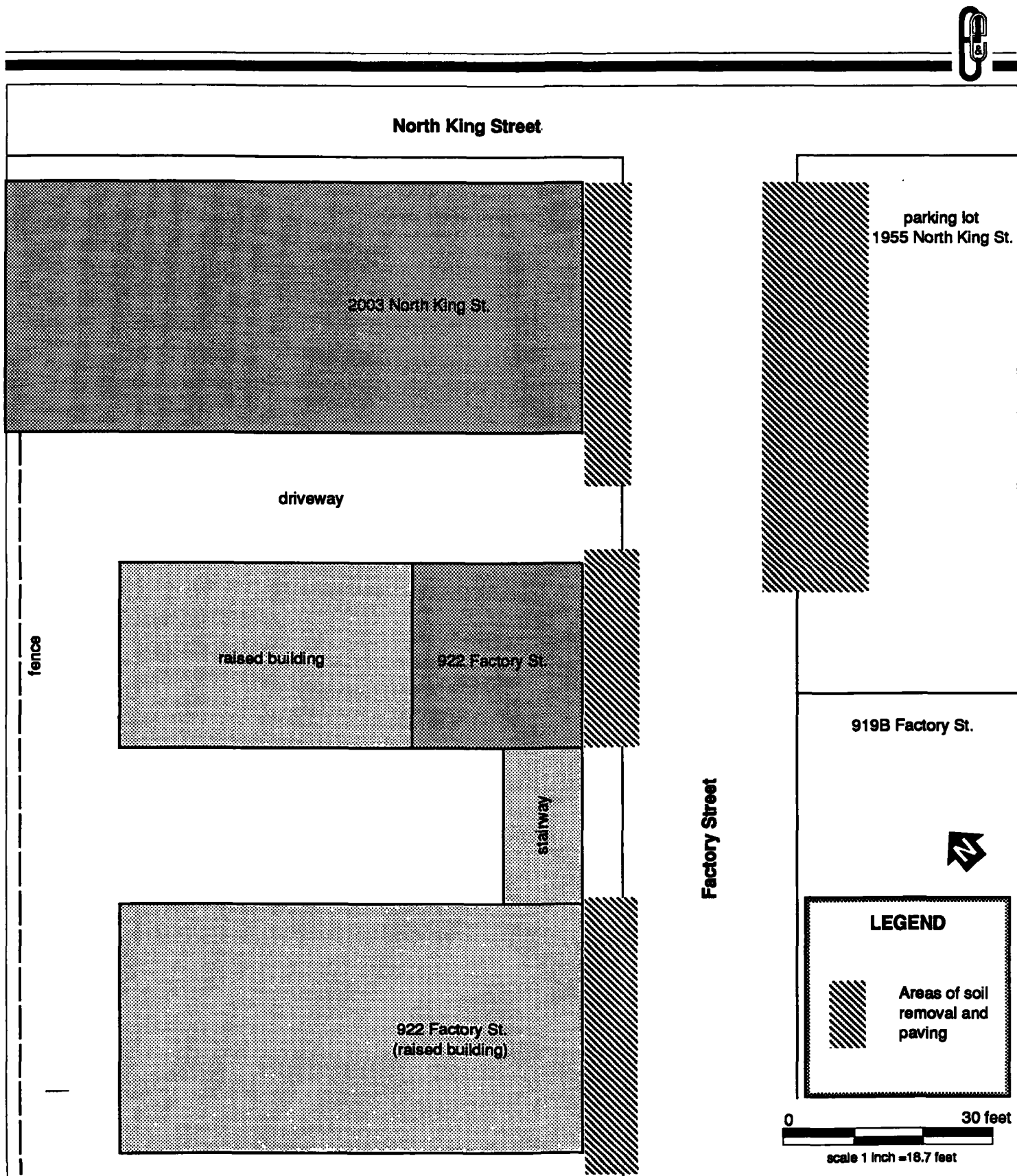


Figure 1
SITE LOCATION MAP
Factory Street Lead Site
Honolulu, Hawaii



ecology and environment, inc.

Figure 2
**APPROXIMATE EXTENT OF SOIL REMOVAL AND PAVING
COMPLETED BY LANDOWNER**
Factory Street Lead Site
Honolulu, Hawaii

Center for Disease Control's blood lead level of concern of 10 µg/dl. The State of Hawaii DOH and HEER conducted a follow-up study to determine the source of the lead exposure in the Fernandez household (Apartment H) on April 28, 1993. The family was interviewed and samples were collected of wall paint, vacuum cleaner bag dust, and drinking water. In addition, soil samples were collected from four areas of exposed soil around the apartment complex where the children played (Figure 3). The results indicated high lead levels in the soils and vacuum cleaner bag dust. Lead in soil samples ranged from 41,000 mg/kg to 342,000 mg/kg. The vacuum cleaner bag dust contained 6,400 mg/kg of lead. On June 1, 1993 the family was relocated. Sampling continued through August 1993 and on August 24, 1993 the HEER issued an Emergency Response Order to the landowner, Mr. Merton Lau, who complied with the order by paving the "hot spots" after removing contaminated soils to a depth of approximately 6 to 12 inches.

On August 26, 1993 a citizen who grew up in the affected area called the HEER and identified the "Kalihi Pawn Shop," currently located at 2003 N. King St., as having once been the site of a fishing supply store. Mr. Ronald Ahina reported that "Kalihi Fishing Supply" dumped lead ash from the manufacture of sinkers on the ground behind the store from at least 1955 through 1966. Mr. Ahina indicated that the lead may have been derived from discarded automobile batteries. Other former commercial tenants of the site include a dental office and a sign printing shop. They were identified by the HEER as having stored chemicals on site.

The HEER collected six soil samples in a two block radius around the site on June 6, 1993 (Figure 3). Analytical results revealed lead levels that ranged from 168 mg/kg to 1,170 mg/kg. Based on these findings, the HEER suspected that lead contamination from the Factory Street site had migrated off site potentially impacting the surrounding residential neighborhood and surface water in the Kalihi Stream located approximately 2000 feet to the south of the site. The Kalihi Stream lies approximately 1.5 miles to the west of the site and flows southwest into Keehi Lagoon. Storm water runoff from the Factory Street neighborhood flows on the surface to collection drains which empty directly into the stream. Residents utilize Keehi Lagoon for fishing and recreational activities.

The HEER also expressed concern that lead contamination might be impacting groundwater beneath the site. According to HEER estimates, the upper Kalihi aquifer lies at a depth of approximately nine feet beneath the site. It is not currently used for drinking water purposes. The basal lower Kalihi aquifer begins at approximately 128 feet below ground surface (bgs). There are three drinking water wells in this aquifer located between 0.5 and 1.0 miles from the site. These wells are upslope to the east and at a similar elevation to the southeast. The direction of shallow groundwater

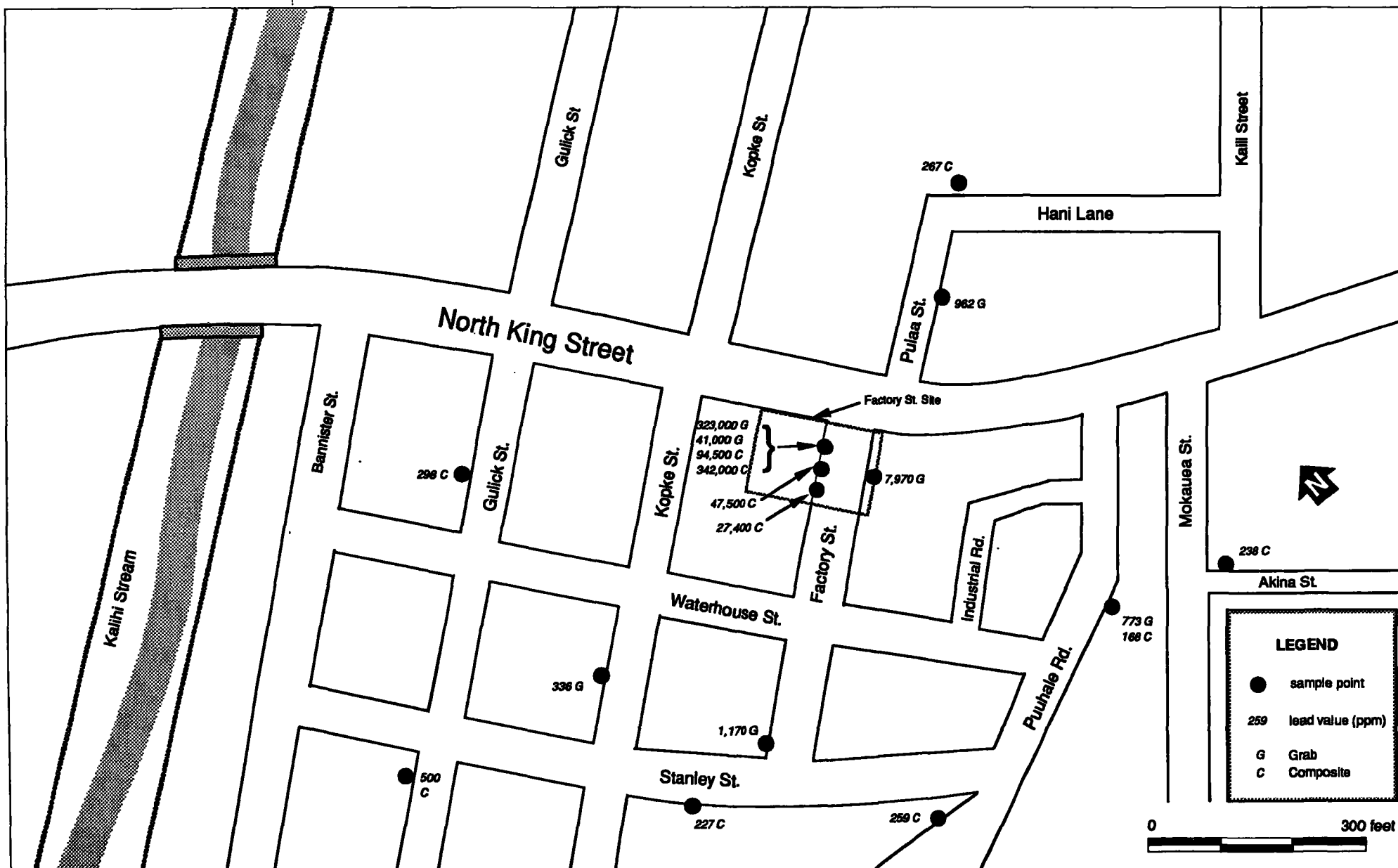


Figure 3
HEER SAMPLE LOCATION MAP
 Factory Street Lead Site
 Honolulu, Hawaii

flow at the site is not known but is suspected to be to the southwest (downslope towards the ocean). There are no known monitoring wells within the area previously sampled by the HEER.

A Preliminary Assessment (PA) was submitted to the EPA by the HEER on February 11, 1994. In it, the HEER recommended further CERCLA evaluations of the site based on the above information.

3.0 SITE ASSESSMENT ACTIVITIES

3.1 SITE RECONNAISSANCE

In April 1994, the TAT met with HEER officials at Hawaii Department of Health offices in Honolulu to review site files and determine whether EPA ERS involvement was warranted. The TAT also conducted a site reconnaissance visit with the HEER. The TAT made the following observations at the conclusion of the visit:

- The landowner, Mr. Lau, did not submit documentation of the soil volume removed from the site nor did he submit post-removal confirmation sample results to the HEER.
- All formerly exposed areas of the site, where contaminated soils were reportedly removed, were paved.
- It could not be determined from the available data whether relatively high lead values in soils away from the site (Figure 3) were due to off-site migration or represented local background levels.

The TAT concluded that the original or current extent of contamination was unknown, both laterally and at depth. Also, it could not be determined whether contamination originating at the site was threatening or impacting groundwater or had travelled off site to neighborhood households or to Kalihi Stream. It did appear that pavement capping on-site soils identified as source areas was preventing exposure to residents and surface migration from the site. The EPA ERS subsequently determined that a site assessment would be required to determine the extent of contamination and the necessity of a removal action or subsequent EPA Remedial action.

3.2 AERIAL PHOTOGRAPH SEARCH

At the request of the EPA ERS, a historical aerial photograph search was conducted by the EPA Environmental Monitoring Systems Laboratory (EMSL) in Las Vegas, Nevada during April and May 1994. The objective of the search was to locate photographs which showed the site during the time period when fishing weights were being manufactured. This might pinpoint the location of source areas and identify surface migration pathways that existed at that time. Photographs might also reveal other potential sources of lead contamination.

The search identified aerial photographs taken between 1951 and 1992. Photographs from 1952 and 1988 were selected for retrieval and enlargement. The two photographs revealed that buildings at the site itself had changed between 1952 and 1988 and that some changes had occurred in the surrounding neighborhood, such as construction of the H-1 freeway approximately one quarter mile north of the site. The photographs also showed that the neighborhood has been primarily residential since 1952. There was not enough detail or resolution to see small-scale manufacturing operations or waste piles as might be expected at the site. Other potential sources were also not apparent.

3.3 SOIL SAMPLING

The soil sampling phase of the site assessment took place in February and March 1995. The TAT utilized sampling trowels, hand augers, and power augers to collect a total of 86 soil samples at the Factory Street site, in surrounding neighborhoods, and in Kalihi Stream. Subsurface soil grab samples were collected with soil augers and surface soil composite samples were collected with sampling trowels. All samples were analyzed with the XRF. Due to a lack of laboratory space at the site, XRF analysis took place at the U.S. Coast Guard (USCG) Marine Safety Office (MSO) in Honolulu. Eleven samples were sent to the Region IX laboratory in Richmond, California for confirmation analysis. Sampling and field analytical procedures are described in the attached Quality Assurance Sampling Plan (Appendix III). XRF and confirmation sample results are listed in Table 1.

3.3.1 On-Site Soil Samples

The TAT completed a total of 20 soil borings on site. From these soil borings, the TAT collected 57 soil grab samples. Sampling encompassed the parking lot behind the shops at 2003 North King

Table 1
Factory Street Lead Site
Analytical Results

SAMPLE ID	SAMPLE NUMBER	STREET ADDRESS	SAMPLE TYPE	SAMPLE DEPTH	SAMPLE COLLECTION DATE	XRF RESULT	LAB RESULT
						Pb - mg/kg ND = < 60 ⁽¹⁾	Pb - mg/kg ND = < 7.1 ⁽²⁾
PU-1032-1-0'	1	1032 Pu'aa Street	Grab	0' - 6"	2/22/95	150	
PU-1032-2-1'	2	1032 Pu'aa Street	Grab	1' - 1' 6"	2/22/95	ND	
PU-1032-3-2'	3	1032 Pu'aa Street	Grab	2' - 2' 6"	2/22/95	ND	
KSAK-4	4	Kalihi Stream	Stream sediment	surface	2/22/95	ND	
KSBK-5	5	Kalihi Stream	Stream sediment	surface	2/22/95	75	
KSBK-6	6	Kalihi Stream	Stream sediment	surface	2/22/95	115	207
KSBK-7	7	Kalihi Stream	Stream sediment	surface	2/22/95	126	
FS-915-8-0'	8	915 Factory Street	Grab	0' - 6"	2/22/95	188	
FS-915-9-1'	9	915 Factory Street	Grab	1' - 1' 6"	2/22/95	124	
FS-915-10-2'	10	915 Factory Street	Grab	2' - 2' 6"	2/22/95	106	
WA-2003-11-0'	11	2003 Waterhouse St	Grab	0' - 6"	2/22/95	ND	
WA-2003-12-1'	12	2003 Waterhouse St	Grab	1' - 1' 6"	2/22/95	ND	
WA-2003-13-2'	13	2003 Waterhouse St	Grab	2' - 2' 6"	2/22/95	ND	ND
FS-806-14-0'	14	806 Factory St	Grab	0' - 4"	2/22/95	320	
FS-806-15-4"	15	806 Factory St	Grab	4" - 10"	2/22/95	369	
FS-919B-16-3"	16	919B Factory St	Grab	0' - 6"	2/23/95	679	
FS-919B-17-1'	17	919B Factory St	Grab	1' - 1' 6"	2/23/95	ND	
FS-919B-18-2'	18	919B Factory St	Grab	2' - 2' 6"	2/23/95	ND	
NK-2003-19-3"	19	2003 North King St	Grab	3" - 6"	2/23/95	269	
NK-2003-20-1'	20	2003 North King St	Grab	1' - 1' 6"	2/23/95	ND	
NK-2003-21-4"	21	2003 North King St	Grab	0' - 6"	2/23/95	ND	
NK-2003-22-1'	22	2003 North King St	Grab	1' - 1' 6"	2/23/95	ND	
NK-2003-23-2'	23	2003 North King St	Grab	2' - 2' 6"	2/23/95	ND	
FS-910-24-0'	24	910 Factory St	Grab	0' - 1' 6"	2/23/95	289	
FS-910-25-2'	25	910 Factory St	Grab	2' - 2' 6"	2/23/95	ND	
FS-904-26-0'	26	904 Factory St	Grab	0' - 6"	2/23/95	449	
FS-904-27-1'	27	904 Factory St	Grab	1' - 1' 6"	2/23/95	ND	
FS-904-28-2'	28	904 Factory St	Grab	2' - 2' 6"	2/23/95	ND	
FS-922-29-3"	29	922 Factory St	Grab	3" - 6"	2/23/95	74	
FS-922-30-1'	30	922 Factory St	Grab	1' - 1' 6"	2/23/95	ND	172
FS-922-31-2'	31	922 Factory St	Grab	2' - 2' 6"	2/23/95	ND	
FS-922-32-3"	32	922 Factory St	Grab	3" - 3' 6"	2/23/95	ND	
NK-2003-33-3"	33	2003 North King St	Grab	3" - 6"	2/24/95	16,570	
NK-2003-34-1'	34	2003 North King St	Grab	1' - 1' 6"	2/24/95	12,850	37,400
NK-2003-35-2'	35	2003 North King St	Grab	2' - 2' 6"	2/24/95	72	
NK-2003-36-3"	36	2003 North King St	Grab	3" - 3' 6"	2/24/95	200	
NK-2003-37-4"	37	2003 North King St	Grab	4' - 4' 6"	2/24/95	ND	308
NK-2003-38-5"	38	2003 North King St	Grab	5' - 5' 6"	2/24/95	ND	
NK-2003-39-3"	39	2003 North King St	Grab	3" - 6"	2/24/95	90	
FS-922-40-4"	40	922 Factory St	Grab	4" - 6"	2/24/95	ND	27
FS-922-41-1'	41	922 Factory St	Grab	1' - 1' 6"	2/24/95	619	
FS-922-42-2'	42	922 Factory St	Grab	2' - 2' 6"	2/24/95	111	
FS-922-43-3"	43	922 Factory St	Grab	3" - 3' 5"	2/24/95	ND	

Table 1
Factory Street Lead Site
Analytical Results

SAMPLE ID	SAMPLE NUMBER	STREET ADDRESS	SAMPLE TYPE	SAMPLE DEPTH	SAMPLE COLLECTION DATE	XRF RESULT Pb - mg/kg ND = < 60 ⁽¹⁾	LAB RESULT Pb - mg/kg ND = < 7.1 ⁽²⁾
FS-922-44-3"	44	922 Factory St	Grab	3" - 6"	2/25/95	ND	
FS-922-45-1'	45	922 Factory St	Grab	1' - 1' 6"	2/25/95	ND	
FS-922-46-2'	46	922 Factory St	Grab	2' - 2' 6"	2/25/95	ND	
FS-922-47-3'	47	922 Factory St	Grab	3' - 3' 6"	2/25/95	ND	
FS-922-48-4'	48	922 Factory St	Grab	4' - 4' 6"	2/25/95	ND	
FS-922-49-3"	49	922 Factory St	Grab	3" - 6"	2/25/95	96	
FS-922-50-1'	50	922 Factory St	Grab	1' - 1' 6"	2/27/95	ND	
FS-922-51-2'	51	922 Factory St	Grab	2' - 2' 6"	2/27/95	ND	
FS-922-52-3'	52	922 Factory St	Grab	3' - 3' 6"	2/27/95	ND	
HA-1927-53-SC	53	1927 Hani Lane	surface composite	surface	2/27/95	351	
HA-1020-54-SC	54	1020 Hani Lane	surface composite	surface	2/27/95	ND	
NK-1955-55-SC	55	1955 North King St	surface composite	surface	2/27/95	663	
FS-915-56-SC	56	915 Factory St	surface composite	surface	2/27/95	554	
FS-902-57-SC	57	902 Factory St	surface composite	surface	2/27/95	902	
IN-902-58-SC	58	902 Industrial Road	surface composite	surface	2/27/95	325	
WA-2016-59-SC	59	2016 Waterhouse St	surface composite	surface	2/27/95	338	
KO-757-60-SC	60	757 Kopke St	surface composite	surface	2/27/95	511	
PA-774-61-SC	61	774 Puuhale Road	surface composite	surface	2/27/95	951	
NK-1955-62-3"	62	1955 North King St	Grab	3" - 6"	2/27/95	23,780	117,000
NK-1955-63-1'	63	1955 North King St	Grab	1' - 1' 6"	2/27/95	521	
NK-1955-64-2'	64	1955 North King St	Grab	2' - 2' 6"	2/27/95	216	
NK-2003-65-3"	65	2003 North King St	Grab	3" - 6"	2/27/95	565	
NK-2003-66-2'	66	2003 North King St	Grab	2' - 6"	2/27/95	13,850	
NK-2003-67-1'	67	2003 North King St	Grab	1' - 1' 6"	2/27/95	223	
NK-2003-68-2'	68	2003 North King St	Grab	2' - 2' 6"	2/27/95	361	
FS-922-69-3"	69	922 Factory St	Grab	3" - 6"	2/27/95	6,980	
FS-922-70-1'	70	922 Factory St	Grab	1' - 1' 6"	2/27/95	3,130	4,710
FS-922-71-2"	71	922 Factory St	Grab	2" - 6"	2/28/95	1,231	14,800
FS-922-72-1'	72	922 Factory St	Grab	1' - 1' 6"	2/28/95	263	
FS-922-73-2'	73	922 Factory St	Grab	2' - 2' 6"	2/28/95	ND	
FS-922-74-3"	74	922 Factory St	Grab	3" - 6"	2/28/95	175	
FS-922-75-1'	75	922 Factory St	Grab	1' - 1' 6"	2/28/95	263	
FS-922-76-2'	76	922 Factory St	Grab	2' - 2' 6"	2/28/95	ND	
FS-GTR-77-3"	77	Center of Factory St	Grab	3" - 6"	2/28/95	10,690	
FS-GTR-78-1'	78	Center of Factory St	Grab	1' - 1' 6"	2/28/95	421	1,520
FS-GTR-79-2'	79	Center of Factory St	Grab	2' - 2' 6"	2/28/95	93	
FS-CTR-80-3"	80	Center of Factory St	Grab	3" - 6"	2/28/95	1,281	
FS-CTR-81-1'	81	Center of Factory St	Grab	1' - 1' 3"	2/28/95	ND	
FS-922-82-2'	82	922 Factory St	Grab	2" - 6"	2/28/95	1,120	
FS-922-83-1'	83	922 Factory St	Grab	1' - 1' 6"	2/28/95	60	
FS-CTR-84-4"	84	Center of Factory St	Grab	4" - 6"	2/28/95		
NK-1955-85-2'	85	1955 North King St	Grab	2" - 6"	2/28/95	1,115	
NK-1955-86-1'	86	1955 North King St	Grab	1' - 1' 6"	2/28/95	ND	
Notes: Shading indicates samples grouped by borehole or street address						Pb = Lead	
(1) Detection limit for XRF samples = 60 mg/kg						ND = Non-detect (value below detection limit)	
(2) Detection limit for laboratory samples = 7.1 mg/kg						mg/kg = milligrams per kilogram	

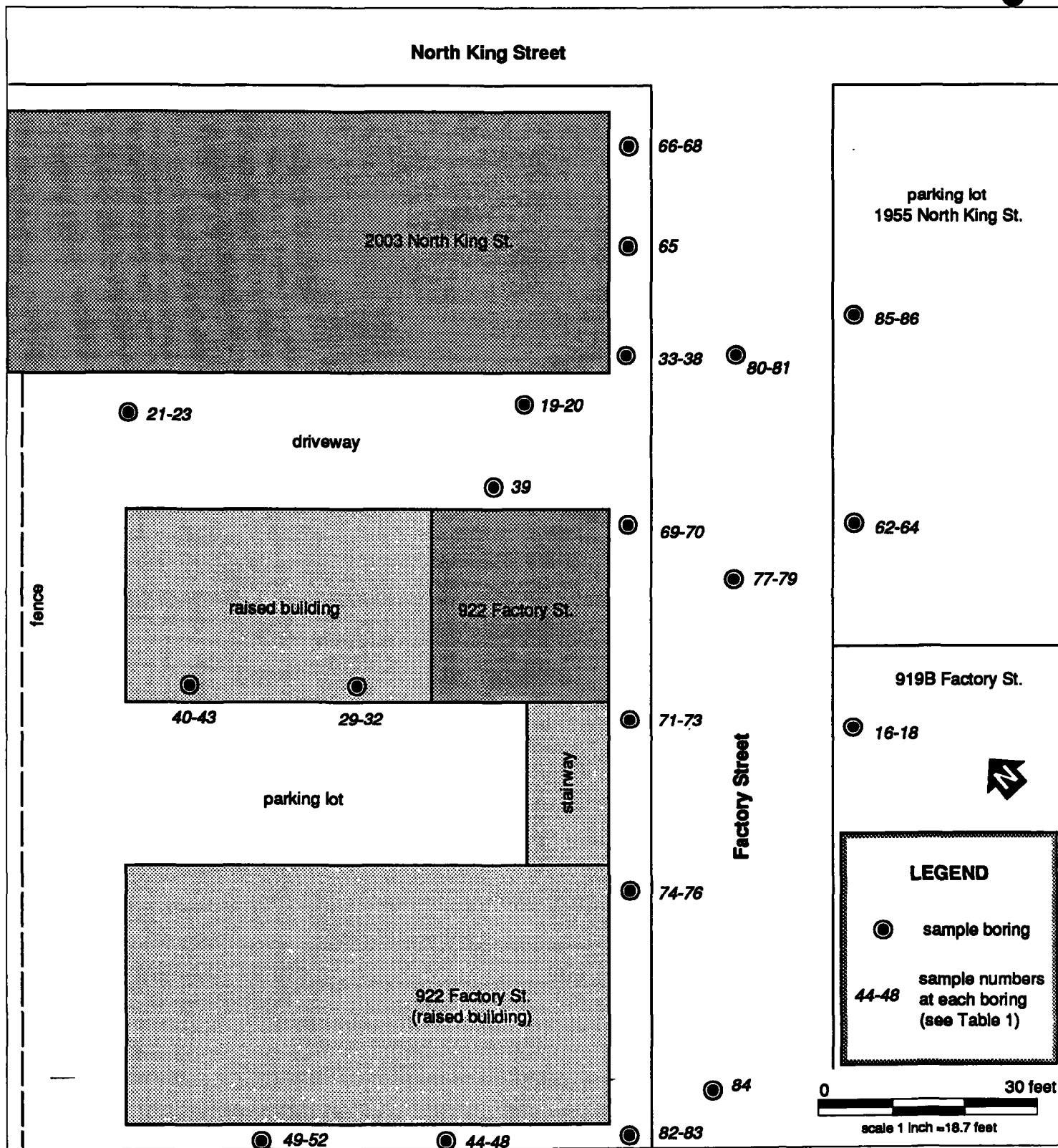
Street and surrounding the apartment complex at 915 Factory Street as well as curb side areas along both sides of Factory Street adjacent to the above addresses (Figure 4). Samples were also collected in the center of Factory Street beneath the asphalt. Most borings were completed to a depth of two to three feet using hand augers and power augers. All soil borings were advanced to refusal in an effort to reach groundwater. The deepest sample was collected at five feet. Soil augers encountered an extremely hard layer at two to five feet. Refusal at these depths was probably due to the presence of bedrock. The TAT observed a construction excavation approximately three blocks to the northwest on North King Street which revealed shallow, coarsely fractured basaltic bedrock.

Lead contamination, as determined by XRF analysis, was generally confined to near-surface soils. In borings which reached a depth of three feet bgs or greater, only one sample at the three-foot interval contained lead above the XRF detection limit. The TAT therefore concludes that lead contamination is not impacting or threatening groundwater. Also, the soils beneath surface fill were very rich in clay, which would inhibit downward migration of surface water containing lead. The contaminated soils are not likely to migrate in surface water or in the air because of the pavement cover. Exposure during excavation is possible but volumes of contaminated soil are low.

Areas which had the highest near-surface contamination were located adjacent to Factory Street on the shoulder or in narrow areas between buildings and the street (Figure 5). The highest lead levels were found in the narrow strip between the building at 2003 North King Street and Factory Street, and across the street at the edge of the parking lot at 1955 North King Street (Figure 5). These are both locations where Mr. Lau reportedly had soil removed. Three soil samples contained lead at greater than 10,000 mg/kg and one sample contained greater than 20,000 mg/kg lead. All were within one foot of the surface. One sample just beneath the asphalt in the center of Factory Street also contained greater than 10,000 mg/kg lead.

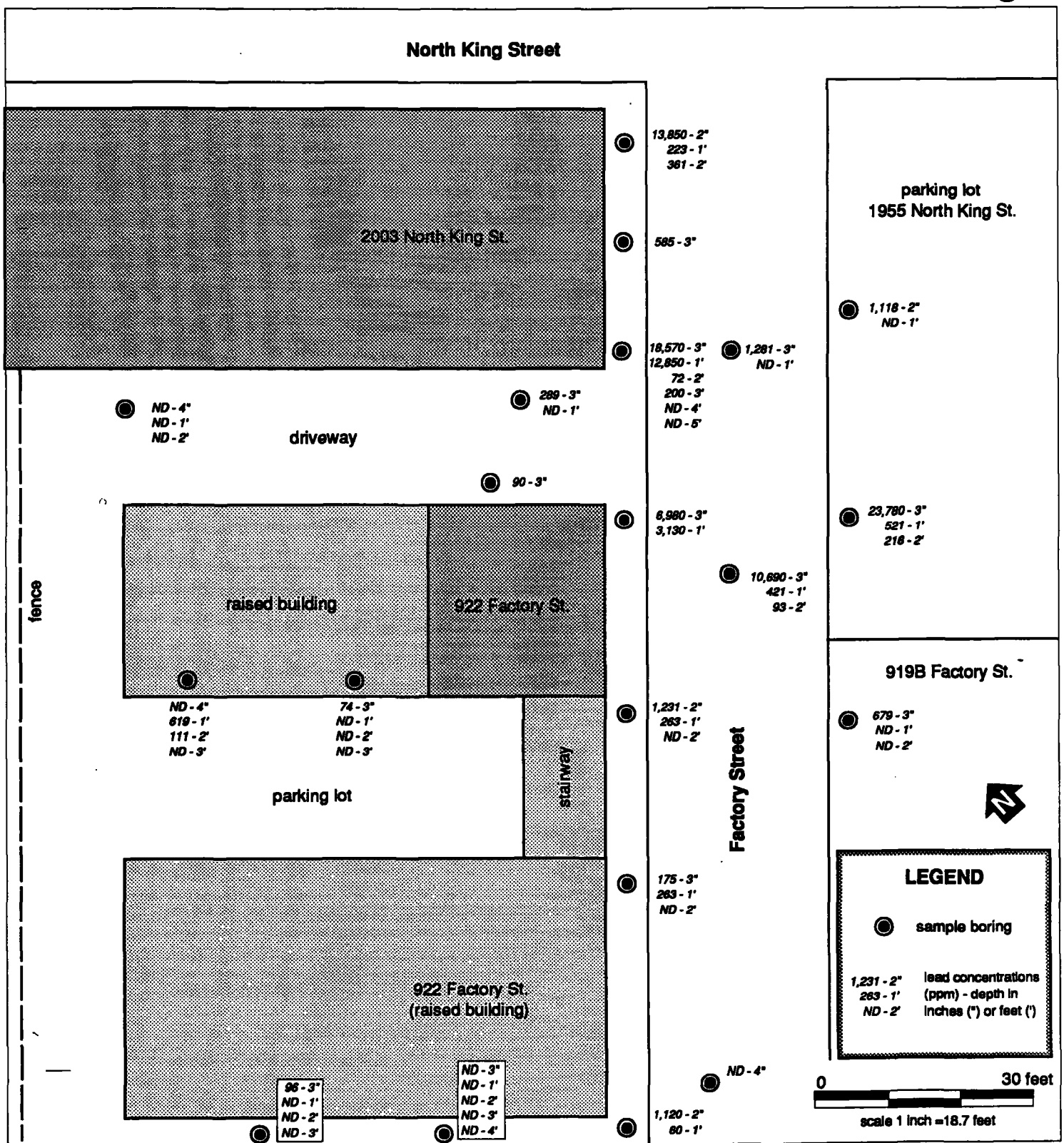
3.3.2 Off-Site Soil Samples

The TAT collected nine surface composite soil samples and drilled six soil borings within a three block radius of the site (Figure 6). The TAT concentrated sampling efforts in areas to the southwest of the site, which is the downslope or downgradient direction for surface water-born contamination migration. Background samples were collected to the northeast on Pulaa Street and Hani Lane. Most off-site samples were collected from roadside areas of exposed soil or gravel. Two borings were drilled in garden plots on parcels adjacent to the site (904 and 910 Factory Street). There were three objectives of off-site sample collection:



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Figure 4
TAT ON-SITE SOIL BORING LOCATIONS AND
SAMPLE NUMBERS
Factory Street Lead Site
Honolulu, Hawaii



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Figure 5
TAT ON-SITE SOIL SAMPLE LEAD CONCENTRATIONS
Factory Street Lead Site
Honolulu, Hawaii

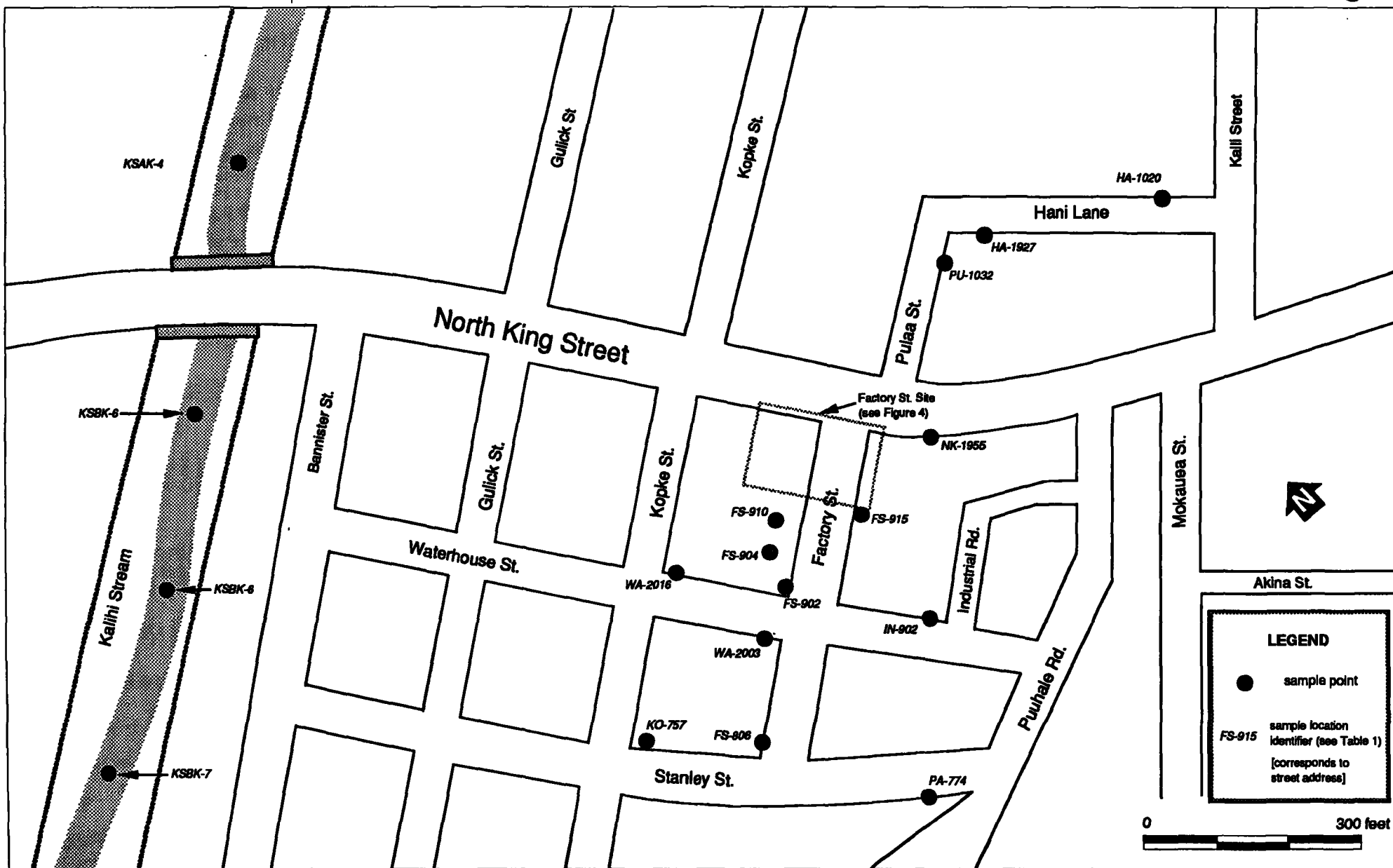


Figure 6
TAT OFF-SITE SAMPLE LOCATION MAP
 Factory Street Lead Site
 Honolulu, Hawaii

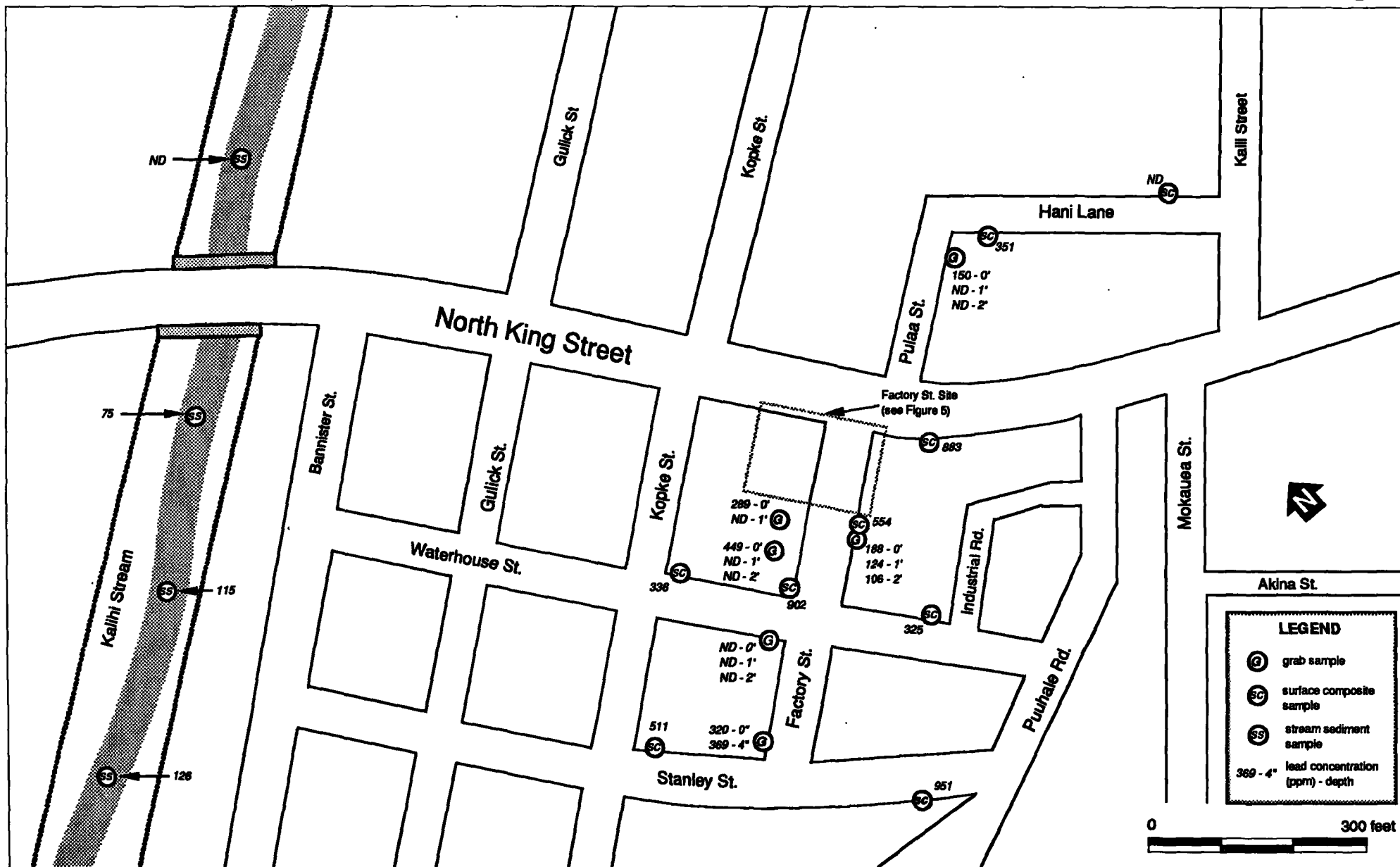


Figure 7
TAT OFF-SITE SOIL SAMPLE XRF LEAD CONCENTRATIONS
 Factory Street Lead Site
 Honolulu, Hawaii

- To determine if lead contamination originating at the site had migrated off site
- To determine whether any other lead contamination sources exist locally
- To establish background levels of lead concentrations in soil

XRF sample results indicate shallow lead contamination ranging from non-detect (ND) to 951 mg/kg (Figure 7). While some of the higher values were located adjacent to the site, there did not appear to be any consistent distribution pattern such as might be expected in a downgradient surface migration plume. The off-site sample with the highest value was collected at 774 Puuhale Street. That sample contained 951 mg/kg lead. The TAT noted a pile of three discarded automobile batteries located on the 774 Puuhale Street property within 20 feet of the sample location (Appendix A, Photo 5). Eight more discarded automobile batteries were noted approximately 100 feet to the northwest at 2003 Stanley Street. Other discarded batteries were noted scattered throughout the neighborhood.

The TAT believes that off-site lead contamination cannot be attributed to contamination originating at the Factory Street site. Based on XRF results, background lead levels in soil appear to range from ND to 500 mg/kg with anomalous values attributed to proximity to household battery disposal areas or major streets. The TAT considers these background lead levels to be normal for an urban environment based on experience at other sites.

3.3.3 Stream Sediment Samples:

During the TAT sampling event, the HEER collected four composite stream sediment samples in the Kalihi Stream bed (Figure 6). The Kalihi Stream is channeled by man-made walls at least 10 feet in height on both sides. There are no storm sewers in the site neighborhood; however, rain water runoff from the site flows into the stream through drain pipes in the wall of the stream channel.

The HEER collected one sample upstream from North King Street and three samples downstream. Results do indicate higher levels downstream (Figure 7); however, the values are lower than local background levels as determined in this sampling event. Lead contamination in Kalihi Stream could easily come from sources other than the site, such as runoff from North King Street related to historical use of leaded gasoline, lead paint, or from street corner automotive battery disposal.

3.3.4 pH Testing

The TAT conducted pH tests on 10 soil samples from the Factory Street site. The objective of these tests was to determine whether soil acidity might contribute to lead mobility. Extremely acidic or basic soil conditions are known to increase the mobility of lead in soil. Soil pH results are listed in Table 2. All samples tested were within one pH unit of 7.00 indicating neutral conditions. Acidity was therefore not a factor in lead mobility in soils at the site.

3.3.5 Confirmation Samples:

Confirmation sample results are explained fully in Appendix II. In general, confirmation sample results revealed higher lead levels in Factory Street site soils than did XRF sample results. The TAT believes that this is due primarily to the clay matrix of the soils. High density clay-rich soils, such as those found at the site, tend to reduce the response sensitivity of the XRF to metals in soil. As a result there may have been some false negatives. The TAT believes that confirmation sample data should not alter our conclusions or recommendations.

TABLE 3
pH Values of Selected Factory Street Soil Samples

Sample Identification Number	Soil pH
NK-2003-33-3"	7.20
NK-2003-34-1'	7.25
NK-2003-35-2'	6.90
NK-2003-36-3'	6.75
NK-1955-62-3"	7.53
NK-1955-63-1'	7.65
NK-1955-64-2'	7.41
NK-2003-66-2"	7.05
FS-922-69-3"	7.54
FS-922-70-1'	7.67

4.0 CONCLUSIONS

The analytical results of the assessment at the Factory Street Lead Site indicate that lead is present in shallow soils at above background levels. Sampling indicated limited areas of such contamination located in curbside strips along either side of Factory Street adjacent to 2003 North King Street, 922 Factory Street, and 1955 North King Street. These were areas where the landowner, Mr. Lau had reportedly removed contaminated soil and paved over exposed soil.

During a meeting with the EPA ERS, the EPA Investigation and Enforcement Section, the HEER, and the TAT, it was determined that, since all soils contaminated with lead were capped with asphalt, that there was no immediate threat to public health and no further federal involvement was warranted. Also, through a land title search conducted by the EPA Investigation and Enforcement Section, it was determined that no one officially claimed ownership to the contaminated land. Originally, the land had been owned by the Kalihi Taro and Land Company. The land was subsequently subdivided and sold and the Kalihi Taro and Land Company no longer exists. This means that the land which the street occupies has been abandoned. Currently, no local or state agency has laid claim to or accepted responsibility for Factory Street. The HEER considered ordering further cleanup, or placement of a deed restriction disallowing excavation on the property. However, Mr. Lau claimed that his property ends at the edge of his building or one inch into the curbside area, outside the area with lead values above background. Without further surveying or legal action, enforcement of additional cleanup by the HEER or other state agency would be difficult.

APPENDIX A
PHOTODOCUMENTATION

ECOLOGY AND ENVIRONMENT, INC.
Technical Assistance Team

Factory Street Lead Site - Honolulu, Hawaii

PAN: EHI0073-SB
Photographer: J. Whitaker

TDD: T099410-011
Date: 02-22-95

Photo 1: TAT collecting
soil sample with hand auger at
915 Factory Street



ECOLOGY AND ENVIRONMENT, INC.
Technical Assistance Team

Factory Street Lead Site - Honolulu, Hawaii

PAN: EHI0073-SB
Photographer: J. Whitaker

TDD: T099410-011
Date: 02-23-95



Photo 2: TAT and HEER drilling to sampling depth with power auger
in parking lot at 922 Factory Street

ECOLOGY AND ENVIRONMENT, INC.

Technical Assistance Team

Factory Street Lead Site - Honolulu, Hawaii

PAN: EHI0073-SB

Photographer: J. Whitaker

TDD: T099410-011

Date: 02-24-95

Photo 3: Parking lot at
2003 North King Street showing
patched sample borings.



ECOLOGY AND ENVIRONMENT, INC.

Technical Assistance Team

Factory Street Lead Site - Honolulu, Hawaii

PAN: EHI0073-SB
Photographer: J. Whitaker

TDD: T099410-011
Date: 02-28-95



Photo 4: The TAT collecting soil samples beneath the asphalt
in the center of Factory Street

ECOLOGY AND ENVIRONMENT, INC.
Technical Assistance Team

Factory Street Lead Site - Honolulu, Hawaii

PAN: EHI0073-SB
Photographer: J. Whitaker

TDD: T099410-011
Date: 02-28-95



Photo 5: Discarded batteries curbside on Stanley Street
adjacent to 774 Puuhale Street.

APPENDIX B
XRF DATA REVIEW

Memorandum

To: *John Whitaker*

From: *Keith Kuerzel*

Date: *9/28/95*

Subject: *XRF Data Review for Factory Street Lead Site*

PAN: EHI0073SBA

At the Factory Street Lead Site in Honolulu, HI the Spectrace 9000 field portable X-Ray Fluorescence (XRF) instrument was utilized between 2/22/95 and 3/1/95 to screen 86 soil samples for lead (Table 1). Over ten percent of the samples screened with the XRF were submitted for confirmatory analysis to the EPA Region IX laboratory in Richmond, California following all Contract Laboratory Program (CLP) protocols for sample handling and documentation. The samples were analyzed by Inductively Coupled Plasma (ICP), EPA method 6010 for lead only (report attached).

All XRF instrument performance criteria were checked daily and met the established performance requirements. Blanks, low-level standards, action level standards, and performance standards were all run daily. Action level check standards were analyzed after every ten samples and met the instrument performance requirements. All blanks, low level standards, and performance standards were within the plus or minus 50% expected concentrations.

The XRF data meet the TAT requirements for screening data. This data set correlated favorably with the CLP definitive data generated by the EPA lab with an r-value of .97 and thus meets Screening Plus 10% Definitive Data criteria. The instrument detection limit established for the site, based on a soil matrix blank, was 60mg/kg (ppm). Two false negative XRF results were exposed by the CLP data; SYE951 and SYE953. A blind field duplicate sample was submitted to test sample homogeneity and the two results were 14,900 and 19,000 a 28% difference which indicates a potential for matrix related error.

In Table 2 and in Chart 1 it is apparent that the XRF response was considerably lower than the ICP response to lead in the samples. The slope of the linear regression plot is 4.51, outside of the recommended slope value of >0.5 to <2.0. The TAT believes that this is related to matrix interferences of the soils collected. The samples were dense, saturated clays which made homogenization difficult if not impossible and high moisture content is a documented interference for XRF analysis. When the samples were dried in an oven and reanalyzed there was no appreciable increase in instrument response but this could be related to a number of interrelated matrix, sample handling, and analyte factors. The data is accepted by the TAT because of the high r-value (.97) which shows that the XRF and CLP data are directly related and can be converted using the linear equation of the line expressed as:

$$\text{ICP Result} = (4.51) \text{XRF Result} + (-1176).$$

Table 1
Factory Street Lead Site
Analytical Results

SAMPLE ID	XRF RESULT	CLP ID	CLP RESULT
	Pb - ppm		Pb - ppm
	ND = < 60		ND = < 7.1
PU-1032-1-0'	150		
PU-1032-2-1'	ND		
PU-1032-3-2'	ND		
KSAK-4	ND		
KSBK-5	75		
KSBK-6	115	SYE949	207
KSBK-7	126		
FS-915-8-0'	188		
FS-915-9-1'	124		
FS-915-10-2'	106		
WA-2003-11-0'	ND		
WA-2003-12-1'	ND		
WA-2003-13-2'	ND	SYE950	ND
FS-806-14-0'	320		
FS-806-15-4"	369		
FS-919B-16-3"	679		
FS-919B-17-1'	ND		
FS-919B-18-2'	ND		
NK-2003-19-3"	289		
NK-2003-20-1'	ND		
NK-2003-21-4"	ND		
NK-2003-22-1'	ND		
NK-2003-23-2'	ND		
FS-910-24-0'	289		
FS-910-25-2'	ND		
FS-904-26-0'	449		
FS-904-27-1'	ND		
FS-904-28-2'	ND		
FS-922-29-3"	74		
FS-922-30-1'	ND	SYE951	172
FS-922-31-2'	ND		
FS-922-32-3'	ND		
NK-2003-33-3"	18570		
NK-2003-34-1'	12850	SYE952	37400
NK-2003-35-2'	72		
NK-2003-36-3'	200		
NK-2003-37-4'	ND	SYE953	308
NK-2003-38-5'	ND		
NK-2003-39-3"	90		
FS-922-40-4"	ND	SYE954	27
FS-922-41-1'	619		
FS-922-42-2'	111		
FS-922-43-3'	ND		
FS-922-44-3"	ND		

Table 1
Factory Street Lead Site
Analytical Results

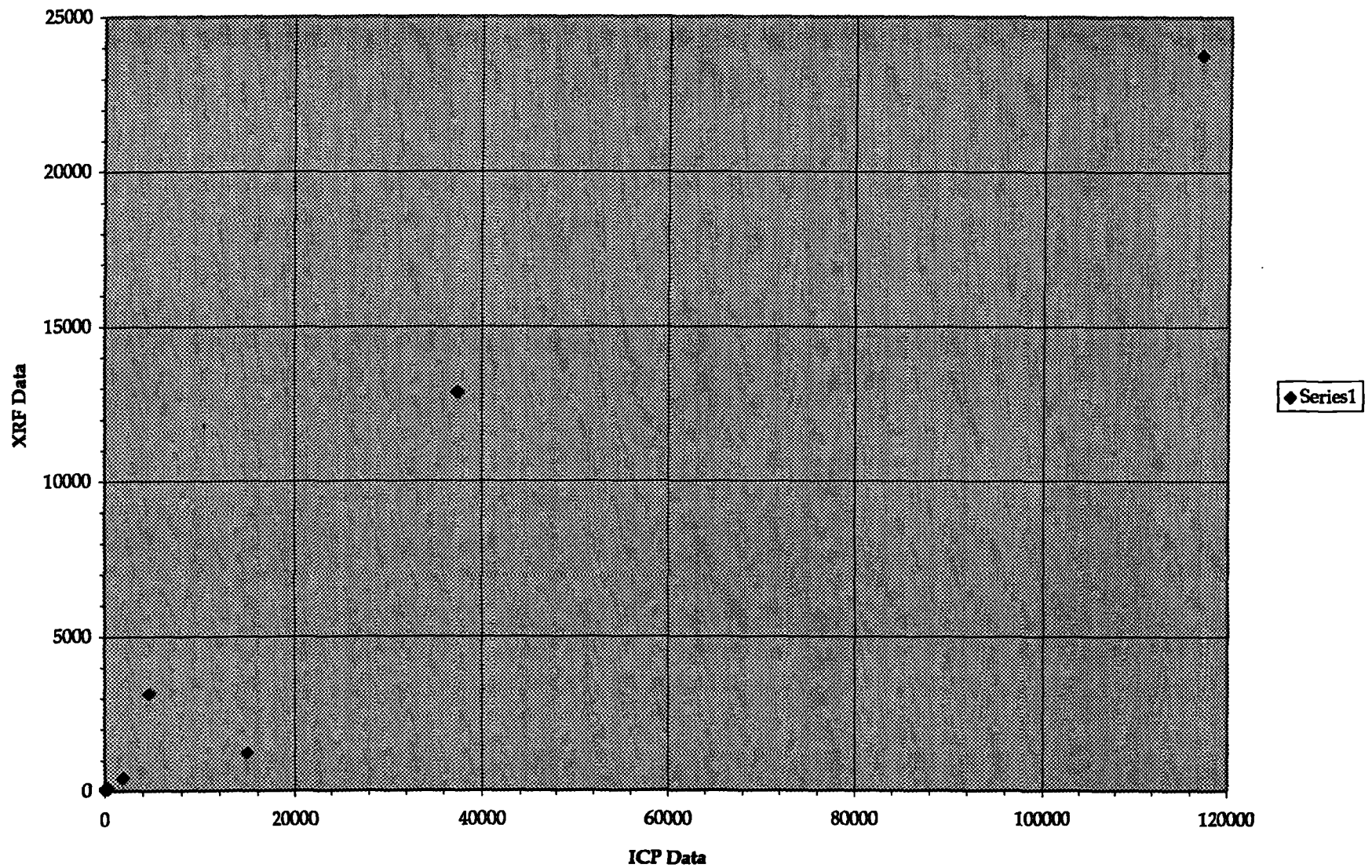
SAMPLE ID	XRF RESULT	CLP ID	CLP RESULT
	Pb - ppm		Pb - ppm
	ND = < 60		ND = < 7.1
FS-922-45-1'	ND		
FS-922-46-2'	ND		
FS-922-47-3'	ND		
FS-922-48-4'	ND		
FS-922-49-3"	96		
FS-922-50-1'	ND		
FS-922-51-2'	ND		
FS-922-52-3'	ND		
HA-1927-53-SC	351		
HA-1020-54-SC	ND		
NK-1955-55-SC	883		
FS-915-56-SC	554		
FS-902-57-SC	902		
IN-902-58-SC	325		
WA-2016-59-SC	336		
KO-757-60-SC	511		
PA-774-61-SC	951		
NK-1955-62-3"	23780	SYE955	117000
NK-1955-63-1'	521		
NK-1955-64-2'	216		
NK-2003-65-3"	585		
NK-2003-66-2"	13850		
NK-2003-67-1'	223		
NK-2003-68-2'	361		
FS-922-69-3"	6980		
FS-922-70-1'	3130	SYE956	4710
FS-922-71-2"	1231	SYE957	14900
FS-922-72-1'	263		
FS-922-73-2'	ND		
FS-922-74-3"	175		
FS-922-75-1'	263		
FS-922-76-2'	ND		
FS-CTR-77-3"	10690		
FS-CTR-78-1'	421	SYE958	1820
FS-CTR-79-2'	93		
FS-CTR-80-3"	1281		
FS-CTR-81-1'	ND		
FS-922-82-2"	1120		
FS-922-83-1'	60		
FS-CTR-84-4"	ND		
NK-1955-85-2"	1118		
NK-1955-86-1'	ND		

Table 2
Factory Street Lead Site
CLP and XRF Data Sets
Statistical Data

SAMPLE ID	CLP ID	ICP RESULT	XRF RESULT
		Pb - ppm	Pb - ppm
KSBK-6	SYE949	207	115
WA-2003-013-2'	SYE950	<7.1	<60
FS-922-030-1'	SYE951	172	<60
NK-2003-034-1'	SYE952	37400	12854
NK-2003-037-4'	SYE953	308	<60
FS-922-040-4"	SYE954	27	<60
NK-1955-062-3"	SYE955	117000	23784
FS-CTR-078-1'	SYE958	1820	421
FS-922-070-1'	SYE956	4710	3134
FS-922-090-2"	SYE959	14900	1231
FS-922-071-2"	SYE957	19000	1231

SUMMARY OUTPUT						
<i>Regression Statistics</i>						
Multiple R	0.97176243					
R Square	0.94432222					
Adjusted R Square	0.9373625					
Standard Error	9221.53488					
Observations	10					
<i>ANOVA</i>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	11538111841	1.1538E+10	135.6839	2.6884E-06	
Residual	8	680293644.5	85036705.6			
Total	9	12218405485				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-1176.6265	3334.269124	-0.3528889	0.733289	-8865.469877	6512.21684
X Variable 1	4.50746464	0.386961867	11.6483432	2.69E-06	3.615128397	5.39980088

Chart 1
Factory Street Lead Site
Linear Regression Plot



APPENDIX C

**WORK PLAN AND
QUALITY ASSURANCE SAMPLING PLAN**

Technical Assistance Team

**Work Plan and
Quality Assurance Sampling Plan**

**Factory Street Lead Site Assessment
Honolulu, Hawaii**

TAT No.: 099409-T-001
TDD No.: T09-9410-011
PAN No.: EHI-0073-SBA

U.S. Environmental Protection Agency
Contract No.: 68-WO-0037

Prepared By:

Keith Kuerzel
Ecology & Environment, Inc.

November 16, 1994

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1.0 INTRODUCTION

On July 11, 1994 the Environmental Protection Agency (EPA) Emergency Response Section (ERS) tasked the Zone II, Region IX Technical Assistance Team (TAT) to conduct a site assessment at the Factory Street Lead Site in Honolulu, Hawaii. Of concern was the presence of lead in soils at an apartment complex and the surrounding neighborhood. Investigations conducted by the State of Hawaii Department of Health (DOH) Human Services Branch and Hazard Evaluation and Emergency Response (HEER) Branch determined that residents at the site had been exposed and contamination was a potential threat to groundwater.

In accordance with the EPA directive, the TAT has developed this Work Plan and Quality Assurance Sampling Plan to assess the extent and magnitude of lead contamination at the site. The TAT will collect soil samples from the surface and at depth in the vadose zone using hand augers and hand operated power augers. The HEER has agreed to be responsible for property access and cuttings disposal.

The samples will be analyzed for lead on site with a portable X-ray fluorescence spectrometer (XRF). Confirmation of these results will be obtained by submitting 10 percent of the samples to an approved laboratory. Soil samples will also be tested for pH to assist in determining if conditions exist that will effect mobility of lead ions.

2.0 BACKGROUND AND SITE DESCRIPTION

The Factory Street Site is located in the general area of 2003 North King Street at the corner of Factory and King Streets in the Kalihi Subdivision, City and County of Honolulu, Island of Oahu, Hawaii (Figure 1). The site is now occupied by a small apartment complex and several small shops. In April of 1993 two children living in the apartments were found to have lead levels of 33 micrograms per deciliter ($\mu\text{g}/\text{dl}$) in blood samples taken by their physician. These values exceeded the Center for Disease Control's blood lead level of concern of 10 $\mu\text{g}/\text{dl}$. The State of Hawaii DOH and HEER conducted a follow-up study to determine the source of the lead exposure in the Fernandez household (Apartment H) on April 28, 1993. The family was interviewed and samples were collected of wall paint, vacuum cleaner bag dust, and drinking water. Soil samples were collected from four areas of exposed soil around the apartment complex where the children played (Figure 2). The results indicated high lead levels in the soils and vacuum cleaner bag dust. Lead in soil samples ranged from 41,000 mg/kg to 342,000 mg/kg. The vacuum cleaner bag dust contained 6,400 mg/kg of lead. On June 1, 1993 the family was relocated. Sampling continued through August 1993 and on August 24, 1993 an Emergency Response

Order was issued to the landowner, Mr. Merton S. C. Lau, who complied with the order by paving the "hotspots" after removing contaminated soils to a depth of approximately 6 to 12 inches.

On August 26, 1993 a citizen who grew up in the affected area called the HEER and identified the "Kalihi Pawn Shop," currently located at 2003 N. King St., as having once been the site of a fishing supply store. Mr. Ronald Ahina reported that "Kalihi Fishing Supply" dumped lead ash from the manufacture of sinkers from at least 1955 through 1966. It is believed that the lead was derived from discarded automobile batteries in the form of elemental lead and lead sulfate.

The TAT has also learned, through investigations conducted by the HEER, that an automobile battery rebuilding shop existed at a gas station at 919 B Factory Street across the street from the fishing supply shop (Figure 2). Battery rebuilding operations took place between approximately 1962 and 1970. According to the HEER, soil samples were collected during removal of an underground storage tank (UST) at the site. Analytical results confirmed the presence of lead in subsurface soils adjacent to the UST.

The HEER collected six soil samples in a two block radius around the site on June 6, 1993, which revealed high lead levels (Figure 2). Values ranged from 168 mg/kg to 1,170 mg/kg. Typical background lead levels for soils in this area are not known; they will be determined during the upcoming sampling event. The lateral limits of contamination may have not been found at the Factory Street site. It is also possible that other sources for lead contamination exist in the area. The TAT observed curbside abandonment of automobile batteries during a reconnaissance visit in April 1994. No other industrial sources in the immediate area are known.

The HEER has expressed concern that lead contamination may be impacting groundwater beneath the site and surface water in the Kalihi Stream located approximately 2000 feet to the south of the site. According to HEER estimates, the upper Kalihi aquifer lies at a depth of approximately 9 feet beneath the site. It is not currently used for drinking water. The basal lower Kalihi aquifer begins at approximately 128 feet below ground surface (bgs). There are three drinking water wells in this aquifer located between 0.5 and 1.0 miles from the site. These wells are upslope to the east and at a similar elevation to the southeast. The direction of shallow groundwater flow at the site is not known but is suspected to be to the southwest (downslope towards the ocean). There are no known monitoring wells within the area previously sampled by the HEER.

The Kalihi Stream lies approximately 1.5 miles to the west of the site and flows southwest into Keehi Lagoon. Storm runoff from the Factory Street neighborhood flows on the surface to collection

drains which empty directly into the stream. Residents utilize Keehi Lagoon for fishing and recreational activities.

3.0 DATA USE OBJECTIVES

The TAT will collect soil samples beneath the parking lots at 2003 King Street and in the neighborhood surrounding the site. For this phase of the investigation, samples will be collected in soils above groundwater only. The sample data will be used to determine:

- The presence, magnitude, and vertical extent of lead contamination in soils above groundwater at 2003 N King St.
- The lateral extent of lead contamination in shallow soils in the Factory Street neighborhood.
- Background lead concentrations in the area.

Analysis of samples collected beneath the parking lots at 2003 N. King Street will help determine the effectiveness of cleanup activities completed by Mr. Lau. Also, samples will be collected at various depths down to the water table. This strategy will help determine whether lead contamination is threatening or has entered the saturated soils of the upper Kalihi aquifer. At other locations in the surrounding neighborhoods soil samples will be collected at the surface and at shallow depths. This data will help determine the lateral extent of contamination originating at the Factory Street site. This data may also indicate whether other sources exist. Background samples will be collected from locations in the neighborhood but away from direct surface water and prevailing wind pathways. Prevailing winds blow from the north and surface water flows down Factory Street southwest to Stanley Street, then northwest to Kalihi Stream (Figure 2). Please see section 5.0 for sample collection details.

Results of TAT sampling and analysis will be used to determine whether further action by the EPA ERS will be necessary. Such actions could include removal and disposal of lead-contaminated soil and investigation of potential groundwater contamination. Levels and quantities of contaminated soil at which these actions will be implemented will be determined by the EPA ERS after analytical results are confirmed, reviewed, and compared to background levels found in the area.

4.0 QUALITY ASSURANCE OBJECTIVES

The quality assurance objectives for this assessment were determined following the requirements stated in "Data Quality

Objectives Process for Superfund" Interim Final Guidance, September, 1993, EPA/540/G-93/071, Publication No. 9355.9-01. They are outlined below in Table 1.

Table 1
Quality Assurance Objectives

Parameter	Matrix	Data Use	QA Objective
Total Lead XRF	Soil	Site Characterization	Screening +10%
Total Lead 6010 (CLPAS-ICP)	Soil	Site Characterization and Screening Data Confirmation	Definitive

5.0 APPROACH AND SAMPLING METHODOLOGIES

5.1 SAMPLING RATIONALE

Due to anticipated difficulties of accessing sample locations throughout residential areas the sampling design is non-probabilistic. The EPA Region IX Preliminary Remediation Goal (PRG) for lead is 400 ppm (August 1994) and this will function as a cleanup level in the absence of site specific guidance. Sampling locations will be determined by the EPA OSC and TAT project manager in the field and will extend beyond the two block radius of the previous HEER efforts. Sampling efforts will focus on the residential neighborhood surrounding 2003 North King Street and the area between the Factory Street site and Kalihi Stream with the goal of determining if lead contamination may have been carried off site by surface water or wind. Samples collected at 2003 North King Street will have the primary goal of determining whether the property owner removed all soil contaminated by lead at levels above 400 ppm (the stated goal) and the depth of lead contamination and whether groundwater may have been impacted or is threatened.

XRF field screening results will be the primary criteria for directing sampling efforts. For example, when areas of concentrations above the PRG for lead of 400 ppm are bounded by samples below the PRG, sampling activities will be concluded for that location. A higher concentration decision level may be assigned if it is determined that background levels samples

Other criteria for determining sampling locations will include access issues, augering equipment limitations, time restrictions, and historical information provided by individuals and agencies

previously involved in this site. For these reasons statistical analysis of the results will not be necessary.

5.2 SAMPLE COLLECTION

Six soil grab samples (0,2,4,6,8,10 feet bgs) will be collected at up to ten locations at 2003 N. King street. Surface composite samples will be collected at approximately 30 locations in surrounding neighborhoods. Approximately 90 to 100 samples will be collected for screening. Of these, approximately 10 samples will be submitted for confirmation analysis. Sampling locations will consist of areas of "likely human exposure" such as schoolyards, parks, exposed soil on streetcorners, residential yards, and drainage channels. Additional samples may be collected as requested by the OSC, the HEER, or the TAT project manager.

5.3 SAMPLING EQUIPMENT AND CONTAINERS

Surface samples will be collected with clean trowels. Any sample compositing will be done in dedicated paper buckets. A stainless steel soil auger will be used to collect soil samples at two, four, six, eight, and ten feet bgs. Where hardened soil exists, a hand operated power auger will be used to advance the sample boring to the top of the desired sample depth. The samples to be shipped for laboratory analysis will be transferred to eight ounce jars and handled as described in section 5.5.

Table 2
Sampling Equipment

Parameter	Sampling Equipment	Fabrication	Dedicated
Total Lead by XRF;	Hand Auger	Stainless Steel	No
	Slam Bar	Stainless Steel	No
	Trowel	Steel	No
Lead by EPA Method 6010, (CLPAS-ICP)	Composite Bucket	Paper	Yes
	#10 Sieve	Stainless Steel	No

5.4 FIELD QA SAMPLES

The project manager (PM) will select at least 10 percent of the total number of screening samples for confirmatory analysis by the EPA Region IX laboratory. The PM will select at a minimum the three highest concentration samples, three non-detect samples, and

two samples with lead concentrations near the XRF instrument quantitation limit of approximately 90 mg/kg. Confirmatory analyses will be by Inductively Coupled Plasma (ICP), EPA Method 6010, for total lead. The field duplicate samples will be randomly picked from the samples sent to the lab. The background sample will be collected at a location outside of the contaminant plume as delineated by field screening results. Matrix spike/matrix spike duplicate sample(s) will be designated by the PM in the field and will be confirmed as medium level samples with the XRF. Equipment blank samples will be collected as deionized water rinsate after the last decontamination rinse of augering equipment at the frequency of one per piece of sampling equipment per day.

5.5 SAMPLE HANDLING AND SHIPMENT

TAT personnel will prepare samples for XRF screening by passing each sample through a number 10 sieve and returning the sample to the collection bag. If the sample is wet, the sample will be mixed as best as possible and a subsample collected by compositing from at least three different locations within the bag. One duplicate per day will be prepared using this method to check for sample homogeneity and subsample collection precision. The subsample will then be dried in an oven, sieved, and then placed in a small poly bag. The TAT will thoroughly mix all samples in their poly bags by shaking prior to analysis. Field samples will be stored in a cooler while awaiting XRF screening. Samples selected for laboratory confirmation will be sealed in 8 oz. jars and labeled according to the following protocol. Bottle labels will contain all required information including site name and sample number, time and date of collection, analysis requested, and preservative used. Caps will be secured with custody seals. Sealed bottles will be placed in large metal or plastic coolers along with double-bagged ice, and padded with cushioning materials such as bubble wrap, or popcorn.

A chain of custody form will be completed as described in Section 5.7 and affixed to the underside of each cooler lid. The lid will be sealed and affixed on three sides with custody seals so that any sign of tampering will be easily visible. Containers and preservatives are listed in Table 3.

Table 3
Containers & Preservation

Matrix	Analysis	Container	Preservative	Holding Time
Soil	Total Lead Screening	32-oz poly bag	4°C, cool	6 months
Soil	Total Lead	8-oz widemouth jar	4°C, cool	6 months
Water (Rinsate Blanks)	Total Lead	1-Liter poly bottle	4°C, cool	6 months

5.6 SAMPLING EQUIPMENT DECONTAMINATION

The decontamination procedure for sampling equipment will be as follows:

- 1) Detergent wash and scrub
- 2) Potable water rinse
- 3) Distilled water rinse
- 4) Air dry

5.7 SAMPLE DOCUMENTATION

All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialling the error.

5.7.1 Field Logbook

The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. All entries will be dated and signed by the individuals making the entries, and should include the following:

1. Site name and project number.
2. Names of personnel on-site.
3. Dates and times of all entries (military time preferred).
4. Descriptions of all site activities, including site entry and exit times.
5. Noteworthy events and discussions.

6. Weather conditions.
7. Site observations.
8. Identification and description of samples and locations.
9. Subcontractor information and names of on-site personnel.
10. Date and time of sample collections, along with chain of custody information.
11. Record of photographs.
12. Site sketches.

5.7.2 Sample Labels

Sample labels will include the following:

1. Site name and number.
2. Time and date sample was taken.
3. Sample preservation.
4. Analysis requested.
5. Sample ID Number
6. Sample Location

Sample labels will be securely affixed to the sample container. Tie-on labels can be used if properly secured.

5.7.3 Chain of Custody Form

A Chain of Custody Form will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a Custody Seal.

The Chain of Custody Form should include the following:

1. Sample identification number.
2. Sample matrix.
3. Sample location.
4. Sample date.
5. Name(s) and signature(s) of sampler(s).
6. Signature(s) of any individual(s) with custody of samples.
7. Project Number.
8. Deliverables requirements.
9. Type of analysis required.
10. Sample type (composite or grab).
11. Name, address, and phone number of individual(s) to receive results, raw data package, and billing correspondence.

5.7.4 Custody Seals

Custody Seals demonstrate that a sample container has not been tampered with or opened.

The individual in possession of the samples will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

5.8 SAMPLE NUMBERING

Each sample will be labeled with a two-letter street name designator followed by an address number, a sequential number, and the sample depth. Where street addresses are not available or inappropriate, another descriptive designator will be added such as the abbreviated name of a park or school. The sequential number will start from the number one with each sample given a unique number. The depth for each sample will be indicated by the top of the sample interval. For example, the first sample collected during the assessment at 2003 North King Street from a depth of 0 to 6 inches will be numbered as follows:

NK-2003-001-0"

The exact location of the sample will be logged in the log book and marked on a field map. Measurements to permanent structures will be taken when possible. Field duplicate samples will be labeled F-100 and the background sample will be labeled B-1.

6.0 SCHEDULE OF SAMPLING ACTIVITIES

The proposed work schedule is presented in Table 4.

Table 4
Proposed Schedule of Work

Activity	Start Date	End Date
Pre-Mobilization Planning Sampling Plan Preparation	11-01-95	02-20-95
Field sampling and Spectrace analysis for field screening	02-21-95	03-10-95
Soil sampling for laboratory confirmation	02-21-95	03-10-95
Lab Analysis - Verbal - Written	TBD	TBD

TBD - To Be Determined

7.0 ANALYTICAL METHODS AND PROCEDURES

7.1 FIELD SCREENING: X-RAY FLUORESCENCE SPECTROMETER (XRF)

All collected samples will be submitted to a TAT member who will use the Spectrace 9000 field-portable XRF instrument to analyze the soil to determine the lead concentration. The TAT will follow the U.S. EPA Environmental Response Team (ERT) Response Engineering and Analytical Contract (REAC) SOPs as presented in Appendix A.

The sample analyses will be performed after instrument performance procedures and quality control checks have been completed and documented in the instrument logbook. An instrument duplicate, sand blank and lead standard will be analyzed after every 10 samples. The QC samples will be used to determine method detection limits, variance of standard analysis, and relative accuracy. The TAT will analyze a single sample ten times to determine the matrix related precision.

The TAT will be primarily concerned with the lead concentration of the soil samples, however the TAT will monitor and document elevated concentrations of other metallic elements present in soil.

After analyses of soil in poly bags, the bags will be sealed and stored at or below 4 degrees Celsius for potential use as confirmatory samples.

7.2 SOIL PH TESTING

Each sampling location will be tested for pH of soils to assist in determining the potential leachability/mobility of lead ions. American Society of Testing Methods (ASTM) method D-4972-89 "Standard Test Method for pH of Soils" (Appendix B) will be used in determining soil pH. This method utilizes a pH probe to test soils in a suspension of deionized water and calcium chloride solution.

8.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The EPA On-Scene Coordinator William Lewis will provide overall direction to Ecology and Environment staff concerning project sampling needs, objectives and schedule.

The Ecology & Environment Project Manager John Whitaker is the primary point of contact with the EPA On-Scene Coordinator. The project manager is responsible for the development and completion of the Sampling QA/QC Plan, project team organization, and supervision of all project tasks, including reporting and deliverables.

The Ecology And Environment Site QC Coordinator Keith Kuerzel is responsible for ensuring field adherence to the Sampling QA/QC Plan and recording any deviations. The Site QC Coordinator is also the primary project team contact with the lab.

The following personnel will work on this project:

<u>Personnel</u>	<u>Responsibility</u>
William Lewis	EPA On-Scene Coordinator
John Whitaker	Project Manager
Keith Kuerzel	QA/QC Officer, Site Safety Officer
Eric Hamrick	XRF Operator, sampling support

9.0 QUALITY ASSURANCE REQUIREMENTS

— The following requirements apply to the respective QA Objectives and parameters identified in Section 3.0 and apply to analyses performed by TAT and contracted laboratories:

9.1 SCREENING DATA

The following QA Protocols for screening data are applicable to all sample matrices and include:

1. Provide sample documentation in the form of field logbooks and appropriate field data sheets. Chain-of-custody records are optional for field screening locations.
2. All instrument calibration and/or performance check procedures/methods will be summarized and documented in the instrument logbook.
3. The detection limit will be determined and recorded, along with all data generated, in the instrument logbook.
4. Analytical error determination in the form of replicate samples must be performed on at least one sample per batch.

9.2 SCREENING PLUS 10% DEFINITIVE DATA

The following QA Protocols for this QA level data are applicable to all sample matrices and include:

1. Provide sample documentation in the form of field logbooks and appropriate field data sheets. Chain-of-custody records are optional for field screening locations.
2. All instrument calibration and/or performance check procedures/methods will be summarized and documented in the instrument logbook.
3. The detection limit will be determined and recorded, along with all data generated, in the instrument logbook.
4. Analytical error determination in the form of replicate samples will be performed on 10 percent of the samples.
5. Ten percent of the samples must be confirmed with definitive data. All confirmatory measurements must be within the range of 50% - 200% of the field measurement to be considered confirmatory.

9.3 DEFINITIVE DATA

The following QA Protocols for Definitive data are applicable to all sample matrices and include:

1. Provide sample documentation in the form of field logbooks, appropriate field data sheets and chain-of-custody forms.

2. Initial and continuing calibrations will be documented.
3. The detection limit will be determined and recorded, along with the data, where appropriate.
4. Analytes will be identified and quantified.
5. QC blanks will be analyzed.
6. Matrix spike recoveries will be documented.
7. Analytical error determination in the form of replicate samples must be performed on 10 percent of the samples.
8. Total measurement error documenting the precision of the measurement system from sample acquisition through analysis will be determined

10.0 DELIVERABLES

The Ecology And Environment Project Manger John Whitaker will maintain contact with the EPA On-Scene Coordinator William Lewis to keep him informed about the technical and financial progress of this project. This communication will commence with the issuance of the work assignment and project scoping meeting. Activities under this project will be reported in status and trip reports and other deliverables (e.g., analytical reports, final reports) described herein. Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

The following deliverables will be provided under this project:

10.1 QUALITY ASSURANCE SAMPLING PLAN AND WORK PLAN

This report is meant to fulfill the requirement for this report. It is due in final form by December, 31 1994 so as to be used as a field document.

10.2 DATA VALIDATION REPORT

All data generated under this plan will be validated with the criteria contained in the Removal Program Validation Procedures which accompany OSWER Directive #9360.4-1. The assessment of data acceptability or useability will be provided separately, or as part of the analytical report.

The data validation report will be prepared for samples analyzed under this plan. Information regarding the analytical methods or

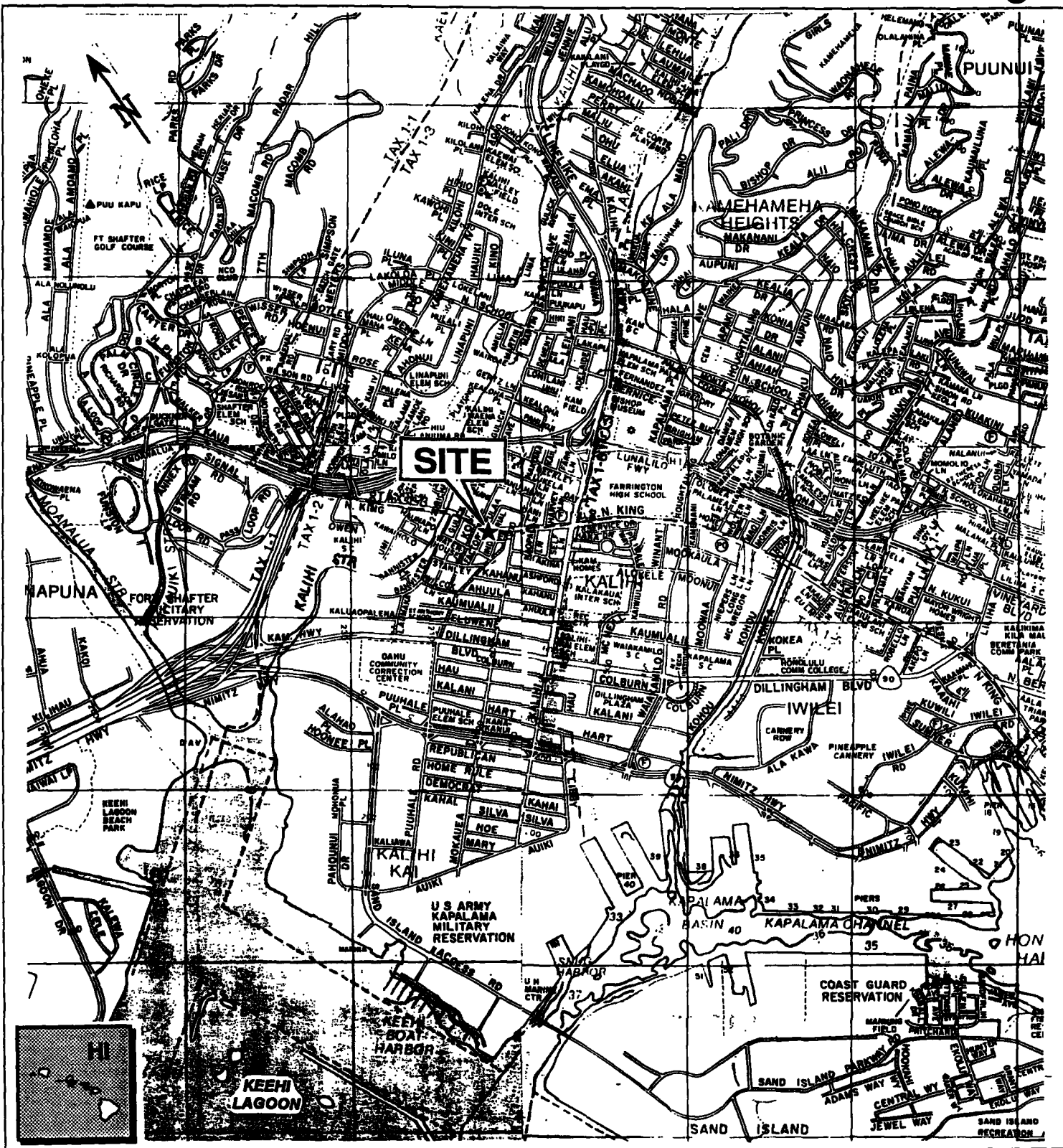
procedures employed, sample results, QA/QC results, chain of custody documentation, laboratory correspondence, and raw data will be provided within this deliverable.

10.3 FINAL REPORT

A final report will be prepared to correlate available background information with data generated under this sampling event and identify supportable conclusions and recommendations which satisfy the objectives of this sampling QA/QC plan. A draft report will be submitted before the final report if so requested by the OSC.

11.0 SITE ASSESSMENT OBJECTIVES

- OBJECTIVE 1: Prepare QASP; prepare work plan.
- OBJECTIVE 2: Mobilize to site; recon. site; stage equipment.
- OBJECTIVE 3: Sample collection and field analysis with XRF. Selection and containerization of soil samples for laboratory confirmation.
- OBJECTIVE 4: Search out and document sources of potential lead contamination.
- OBJECTIVE 5: Demobilization and shipment of samples to EPA Region IX Laboratory.
- OBJECTIVE 6: Evaluation of verbal data and field test data. Offer observations and recommendations to OSC on validity of samples and possible actions.
- OBJECTIVE 7: Data Validation report. Final site assessment report.



ecology and environment, inc.

source: Bryans sectional maps, 1988
scale: 1:24,000

Figure 1
SITE LOCATION MAP
Factory Street Lead Site
Honolulu, Hawaii

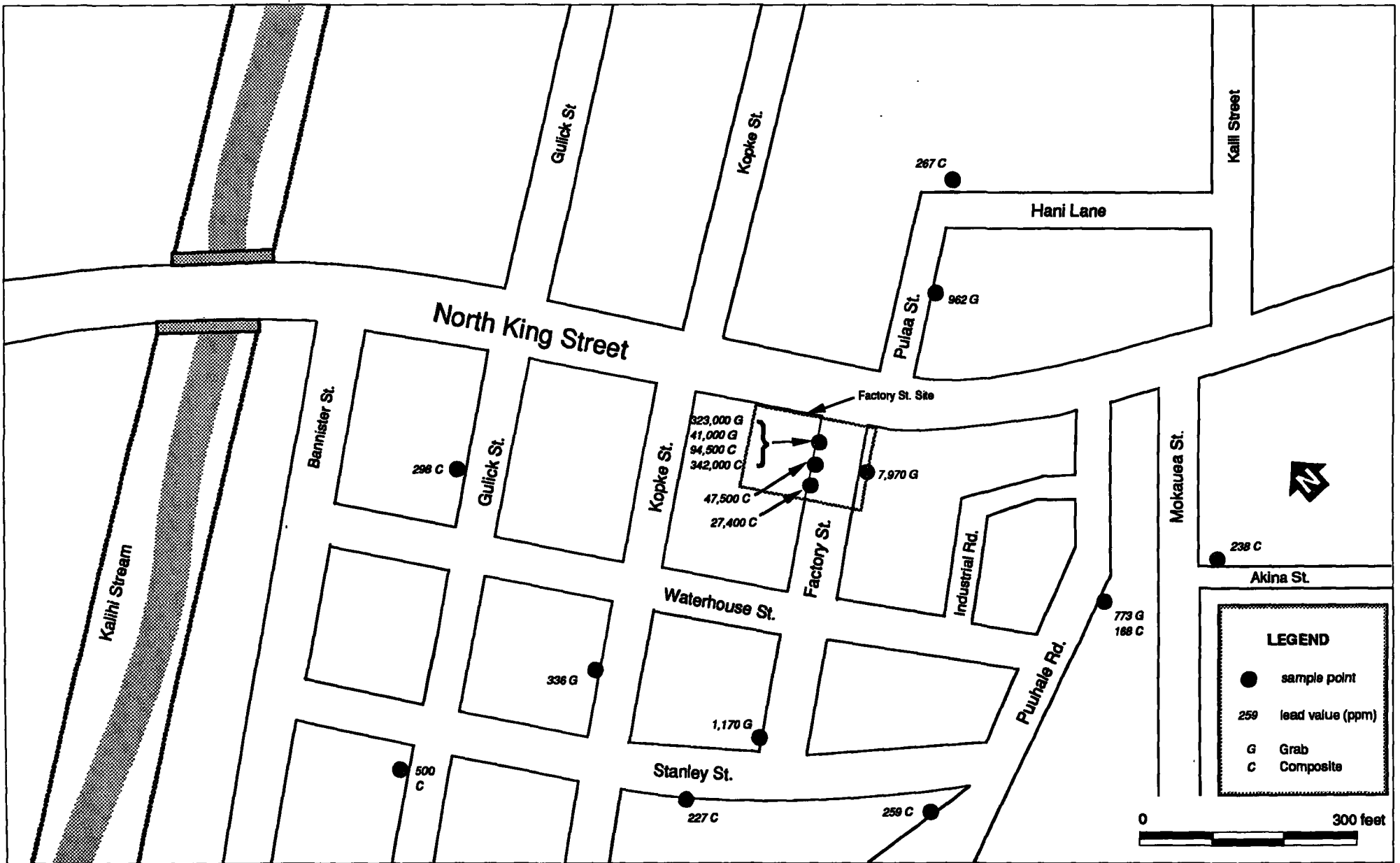


Figure 2
HEER SAMPLE LOCATION MAP
Factory Street Lead Site
Honolulu, Hawaii

APPENDIX A

XRF SOP

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

STANDARD OPERATING PROCEDURES

SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE OPERATING PROCEDURE

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SUPERCEDES: SOP #1713, REVISION 0, 8/31/92

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

STANDARD OPERATING PROCEDURES

SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE OPERATING PROCEDURE

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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to serve as a guide to the start-up, check out, operation, calibration, and routine use of the Spectrace 9000 field portable x-ray fluorescence instrument for field use in screening hazardous or potentially hazardous inorganic materials. It is not intended to replace or diminish the use of the Spectrace 9000 Operating Instructions. The Operating Instructions contain additional information for optimizing instrument performance and for utilizing different applications.

The procedures contained herein are general operating guidelines which may be changed as required, depending on site conditions, equipment limitations, limitations imposed by Quality Assurance/Quality Control (QA/QC) procedure or other protocol limitations. In all instances, the procedures finally employed should be documented and included in any or all final reports. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.1 Principles of Operation

X-ray Fluorescence (XRF) spectroscopy is a non destructive qualitative and quantitative analytical technique used to determine the chemical composition of samples. In a source excited XRF analysis, primary X-rays emitted from a sealed radioisotope source are utilized to irradiate samples. During interaction with samples, source X-rays may either undergo scattering (dominating process) or absorption by sample atoms in a process known as the photoelectric effect (absorption coefficient). This phenomenon originates when incident radiation knocks out an electron from the innermost shell of an atom creating a vacancy. The atom is excited and releases its surplus energy almost instantly by filling the vacancy with an electron from one of the higher energy shells. This rearrangement of electrons is associated with the emission of X-rays characteristic (in terms of energy) of the given atom. This process is referred to as emission of fluorescent X-rays (fluorescent yield). The overall efficiency of the fluorescence process is referred to as excitation efficiency and is proportional to the product of the absorption coefficient and the fluorescent yield.

1.1.1 Characteristic X-rays

The Spectrace 9000 utilizes characteristic X-ray lines originating from the innermost shells of the atoms: K, L, and occasionally M. The characteristic X-ray lines of the K series are the most energetic lines for any element and, therefore, are the preferred analytical lines. The K lines are always accompanied by the L and M lines of the same element. However, with energies much lower than those of the K lines, they can usually be neglected for those elements for which the K lines are analytically useful. For heavy elements such as cerium (Ce) (atomic number [Z]=58), to uranium (U, Z=92), the L lines are the preferred lines for analysis. The L_{α} and L_{β} lines have almost equal intensities, and the choice of one or the other depends on what interfering lines might be present. A source just energetic enough to excite the L lines will not excite the K lines of the same element. The M lines will appear together with the L lines.

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The Spectrace 9000 Operating Instructions contain a table that identifies the X-rays (K or L) and elements measured for each excitation source.

An X-ray source can excite characteristic X-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element (e.g., K absorption edge, L absorption edge, M absorption edge). The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies, and the L absorption edge energy is approximately the sum of the L and M line energies of the particular element.

Energies of the characteristic fluorescent X-rays are converted (within the detector) into a train of electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic multichannel analyzer (electronic unit) measures the pulse amplitudes, which is the basis of a qualitative X-ray analysis. The number of counts at a given energy is representative of element concentration in a sample and is the basis for quantitative analysis.

1.1.2 Scattered X-rays

The source radiation is scattered from the sample by two physical processes: coherent or elastic scattering (no energy loss), and Compton or inelastic scattering (small energy loss). Thus, source backscatter (background signal) actually consists of two components with X-ray lines close together. The higher energy line is equal to the source energy. Since the whole sample takes part in scattering, the scattered X-rays usually yield the most intense lines in the spectrum. Furthermore, the scattered X-rays have the highest energies in the spectrum and, therefore, contribute most of the total measured intensity signal.

1.2 Sample Types

Solid and liquid samples can be analyzed for elements aluminum (Al) through uranium (U) with proper X-ray source selection and instrument calibration. Typical environmental applications are:

- Heavy metals in soil (in-situ or samples collected from the surface or from bore hole drillings, etc.), sludges, and liquids (e.g., lead (Pb) in gasoline)
- Light elements in liquids (e.g., phosphorus [P], sulphur [S], and chlorine [Cl] in organic solutions)
- Heavy metals in industrial waste stream effluents

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- PCB in transformer oil by Cl analysis
- Heavy metal air particulates collected on membrane filters, either from personnel samplers or from high volume samplers.
- Lead (Pb) in paint

2.0 METHOD SUMMARY

The Spectrace 9000 Portable XRF Analyzer employs three radioactive isotope sources: iron-55 (Fe-55), cadmium-109 (Cd-109), and americium-241 (Am-241) for the production of primary X-rays. Each source emits a specific set of primary X-rays which excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the appropriate source is selected according to its excitation efficiency for the element of interest. See page 1-2 of the Spectrace 9000 Operating Instructions for a chart of source type versus element range.

The sample is positioned in front of the source-detector window and sample measurement is initiated which exposes the sample to primary radiation from the source. Fluorescent and backscattered X-rays from the sample enter through the beryllium (Be) detector window and are counted in the high resolution mercuric iodide (HgI₂) detector.

Elemental concentrations are computed using a Fundamental Parameter (FP) algorithm of the form:

$$\text{Concentration} = R \times S \times (1 + \text{SUM}\{A_n \times C_n\})$$

"R" is the measured analyte X-ray intensity relative to the pure element; "S" is a calculated sensitivity coefficient. The quantity SUM{} is a summation of "n"-element absorption-enhancement terms containing calculated alpha-coefficients and iteratively computed element concentrations. The Spectrace 9000 utilizes FP XRF calibrations derived from theoretical considerations (as opposed to empirical data). The menu-driven software in the Spectrace 9000 supports multiple XRF calibrations called "applications." Each application is a complete analysis configuration including elements to be measured, interfering elements in the sample, and a set of FP calibration coefficients.

The measurement time of each source is user-selectable. The shorter source measurement times (15 - 30s) are generally used for initial screening and hot spot delineation, while longer measurement times (30 - 500s) are typically used for higher precision and accuracy requirements.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This SOP specifically describes equipment operating procedures for the Spectrace 9000; hence, this section is not applicable to this SOP.

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4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The total method error for XRF analysis is defined as the square root of the sum of squares of both instrument precision and user or application related error. Generally, the instrument precision is the least significant source of error in XRF analysis. User- or application-related error is generally more significant and will vary with each site and method used. The components of the user or application related error are the following.

4.1 Sample Placement

This is a potential source of error because the X-ray signal decreases as the distance from the radioactive source is increased. However, this error is minimized by maintaining the same distance for each sample.

4.2 Sample Representivity

In order to accurately characterize site conditions, samples collected must be representative of the site or area under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentration of the contaminant(s) of concern at a given time and location. Analytical results from representative samples reflect the variation in pollutant presence and concentration range throughout a site. Variables affecting sample representativeness include: (1) geologic variability, (2) contaminant concentration variability, (3) collection and preparation variability, and (4) analytical variability. Attempts should be made to minimize these sources of variability. For additional information on representative sampling, refer to the "Removal Program Representative Sampling Guidance, Volume 1 - Soil."⁽¹⁾

4.3 Reference Analysis

Soil chemical and physical matrix effects may be corrected by using site-specific soil samples which have been analyzed by Inductively-Coupled Plasma (ICP) or Atomic Absorption (AA) spectroscopy as calibration samples. A major source of error can result if these samples are not representative of the site and/or if the analytical error is large. Additionally, when comparing XRF results with reference analyses results, the efficiency of the sample digestion reference analysis should be considered. Some digestion methods may breakdown different sample matrices more efficiently than others.

4.4 Chemical Matrix Effects (Due to the Chemical Composition of the Sample)

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, iron (Fe) tends to absorb copper (Cu) X-rays, reducing the intensity of Cu measured by the detector. This effect can be corrected mathematically through the use of FP coefficients.

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4.5 Physical Matrix Effects (Due to Sample Morphology)

Physical matrix effects are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, consider a sample in which the analyte exists in the form of very fine particles within a matrix composed of much coarser material. If two separate aliquots of the sample are prepared in such a way that the matrix particles in one are much larger than in the other, then the relative volume of analyte occupied by the analyte-containing particles will be different in each. When measured, a larger amount of the analyte will be exposed to the source X-rays in the sample containing finer matrix particles; this results in a higher intensity reading for that sample and, consequently, an apparently higher measured concentration for that element.

4.6 Application Error

Generally, the error in the application calibration model is insignificant (relative to the other sources of error) PROVIDED the instrument's operating instructions are followed correctly. However, if the sample matrix varies significantly from the design of the application, the error may become significant (e.g., using the soils application to analyze a 50 percent iron mine tailing sample).

4.7 Moisture Content

Sample moisture content will affect the analytical accuracy of soils or sludges. The overall error may be secondary when the moisture range is small (5-20 percent), or it may be a major source of error when measuring the surface of soils that are saturated with water.

4.8 Cases of Severe X-ray Spectrum Overlaps

When present in the sample, certain X-ray lines from different elements can be very close in energy and, therefore, can interfere by producing a severely overlapped spectrum.

The typical spectral overlaps are caused by the K_{α} line of element Z-1 (or as with heavier elements, Z-2 or Z-3) overlapping with the K_{α} line of element Z. This is the so-called K_{α}/K_{α} interference. Since the $K_{\alpha}:K_{\beta}$ intensity ratio for the given element usually varies from 5:1 to 7:1, the interfering element, Z-1, must be present in large concentrations in order to disturb the measurement of analyte Z. The presence of large concentrations of vanadium (V) could disturb the measurement of chromium (Cr). The V K_{α} and K_{β} energies are 4.951 and 5.427 Kev, respectively. The Cr K_{α} energy is 5.41 Kev. The resolution of the detector is approximately 270 eV. Therefore, large amounts of V in a sample will result in spectral overlap of the V K_{β} with the Cr K_{α} peak (see Figure 1, Appendix A) and the measured X-ray spectrum will include TOTAL counts for Cr plus V lines.

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Other interferences arise from K/L, K/M, and L/M line overlaps. While these are less common, the following are examples of severe overlap:

As $K_{\alpha}/Pb L_{\alpha}$, S $K_{\alpha}/Pb M_{\alpha}$

In the arsenic (As)/lead case, Pb can be measured from the Pb L_{α} line, and arsenic from either the As K_{α} or the As K_{β} line; this way the unwanted interference can be corrected. However, due to the limits of mathematical corrections, measurement sensitivity is reduced. Generally, arsenic concentrations can not be efficiently calculated in samples with Pb:As ratios of 10:1 or more. This may result in zero arsenic being reported regardless of what the actual concentration is.

The Spectrace 9000 uses overlap factors to correct for X-ray spectral overlaps for the elements of interest for a given application.

5.0 EQUIPMENT / APPARATUS

5.1 Description of the Spectrace 9000 System

The analyzer utilizes the method of Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometry to determine the elemental composition of soils, sludges, aqueous solutions, oils, and other waste materials.

The Spectrace 9000 analyzer includes three compact, sealed radiation sources contained in a measuring probe: Fe-55, Cd-109, and Am-241. The analyzer software automatically selects which sources to use as well as measurement time for each source based on stored information for each application. The probe is equipped with a high resolution HgI₂ detector, which is connected by cable to an environmentally sealed electronic module.

The electronic unit provides internal non volatile memory for storage of 120 spectra and 300 multi-element analysis reports. An RS-232 serial port is provided for downloading data and spectra to a peripheral device. The multi-element analysis reports and the 2000-channel spectra can be displayed on the instrument's LCD panel. The replaceable and rechargeable internal battery provides for field-portable operation.

The Spectrace 9000 is supplied with three factory-installed FP-based applications (calibrations). The "Soil Samples" application is for analysis of soils where the balance of the sample (that portion not directly measured by the instrument) is silica (SiO₂). The "Thin Film" application is for analysis of thin films such as air monitoring filters or wipes. Finally, the "PbK in Paint" application is for analyzing Pb in paint films and is reasonably independent of the type of substrate. Spectrace Instruments will also develop calibrations to meet new user application requirements (e.g., adding elements to the present "Soil Samples" application).

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The Spectrace 9000 can be powered from a 115-volt (or 220-volt) wall outlet or from its 4-hour capacity battery. It can be operated in temperatures ranging from 32 to 120° Fahrenheit (F). Furthermore, the probe and electronic unit may be exposed to a light rain. However, additional protection is provided when the system (electronic unit and probe) is contained in the optional water repellant carrying case.

5.2 Equipment and Apparatus List

5.2.1 Spectrace 9000 Analyzer System

The complete Spectrace 9000 Analyzer System includes:

- Analyzer unit for data acquisition, processing, and display
- Hand-held probe including:
 - High-resolution HgI₂ detector
 - Three excitation sources (⁵⁵Fe, ¹⁰⁹Cd, ²⁴¹Am)
 - Safety cover
- Probe laboratory stand with the following:
 - Base for table top use
 - Safety shield over sample
 - Positioning fixtures for standard 30-mm and 40-mm X-ray sample cups
- Interconnecting cable
- RS-232C Serial I/O Interface cable
- Two blank check samples
- Pure element check samples
- Battery charger
- Battery pack
- System carrying/shipping case
- Spectrace 9000 Operating Instructions, application software, and utilities software. The application software is specific to each unit and cannot be interchanged between different units. The software is identified by the serial number of the unit.

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5.2.2 Optional Items

- 31-mm diameter sample cups
- XRF polypropylene film, 0.2 mil thick
- Field carrying case
- Peripheral devices such as a printer and IBM compatible Personal Computer (PC)
- Spare probe window assembly
- Spare battery pack, charger, and charger adaptor (required to charge spare battery outside of electronic unit)

See the Spectrace 9000 Accessories Price List for additional options.

For mobile lab or laboratory X-ray sample preparation accessories (such as drying ovens, grinders, sieves, etc.), consult general laboratory equipment suppliers.

5.2.3 Limits and Precautions

The probes should be handled in accordance with the following radiological control practices.

1. The probe should always be in contact with the surface of the material being analyzed, and that material should completely cover the probe opening (aperture) when the sources are exposed. Do not remove a sample or move the probe while the indicators show SOURCE ON.

SOURCE ON indicators are:

- the message on the screen "SOURCE ON"
 - the flashing light at the base of the probe.
2. When the sources are exposed, under no circumstances should the probe be pointed at the operator or surrounding personnel.
 3. Do not place any part of the operator's or co-worker's bodies in line of exposure when the sources are exposed or partially covered.
 4. The probe must be covered with the safety cover or laboratory safety shield when not in use.

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5. Spectrace Instruments must be notified immediately of any condition or concern relative to the probe's structural integrity, source shielding, source switching condition, or operability.
6. The appropriate state agency or the Nuclear Regulatory Commission (NRC) office must be notified immediately of any damage to the radioactive source, or any loss or theft of the device (see factory supplied data on radiological safety).
7. Labels or instructions on the probe(s) must not be altered or removed.
8. The user must not attempt to open the probe.
9. The source(s) in the probe must be leak-tested every 6 months as described in the Spectrace 9000 Operating Instructions. The leak test certificates must be kept on file, and a copy must accompany the instrument at all times.
10. The probe laboratory safety shield assembly must be used when the probe is inverted for measuring samples contained in cups.
11. During operation, the probe must be kept at least 10 feet from computer monitors and any other source of radio frequency (RF). Some monitors have very poor RF shielding and will affect measurement results.
12. The Spectrace 9000 should not be dropped or exposed to conditions of excessive shock or vibration.
13. The electronic unit should be left on whenever the battery charger is connected to it. If the electronic unit is shut off with the battery charger plugged in, the battery may be damaged due to overcharging.

Additional precautions include:

1. The probe cable must never be pulled while unplugging the probe. The probe plug should be grasped at the ribbed metal connector and squeezed and pulled gently while the connector is unplugged. The connector must never be forced when plugging in the connector.
2. The handle of the electronic unit must not be rotated unless the release buttons on each side of the handle are depressed.
3. The Spectrace 9000 should not be stored at an ambient temperature below -4°F or above 110°F.
4. The battery charging unit should only be used indoors in dry conditions.

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5. Battery packs should be changed only in dry conditions.

5.3 Peripheral Devices

The Spectrace 9000 may be used with a wide range of peripheral devices for electronic data capture or printed readout as long as they are compatible with the RS-232 serial I/O protocol. Such devices include terminals, printers, electronic data loggers, personal computers, etc.

5.3.1 Communication Cable Connection

Plug the 25-pin connector of the RS-232 Serial I/O cable into the Spectrace 9000 25-pin connector (the connection just below the display screen on the electronic unit) and the 9-pin connector of the cable into the serial port of the receiving device.

5.3.2 Communication Port Setup

To communicate with an external device, the Spectrace 9000 MUST be set at the same baud rate, word length, and parity as the receiving device. The Spectrace 9000 allows you to select various configurations for these parameters in the communication (Comm.) port setup portion of the More submenu (which can be accessed from the main menu). The default COM setup for application and utilities software is 9600,N,8,1.

5.3.3 User Software

Refer to your PC software manual for details on additional settings that may be required for proper interfacing between the Spectrace 9000 and your particular software.

5.4 Instrument Maintenance

5.4.1 Probe Window

Should the probe window become damaged or punctured, it should be replaced as soon as possible to prevent dust and moisture from entering the probe. Replacement window assemblies can be ordered from Spectrace Instruments. Note the location of the window aperture; it is closer to one end of the window plate. Simply unscrew the old window plate, press any corner of it, and remove it. Stretch the O-ring for 10 seconds, and lay it back in the groove. The O-ring must lie flat in the groove in order for the new window plate to be installed. Install the new window assembly in the same manner as the old. If the surface of the window plate is not flush with the face of the probe, the O-ring has probably come out of the groove. Remove the assembly, and try the same procedure again.

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5.4.2 Further Information and Troubleshooting

Refer to the Spectrace 9000 Operating Instructions for additional detailed operational and/or maintenance and troubleshooting instructions. If no solution is found in the manual, contact Spectrace Instruments for assistance.

An instrument log should be maintained to document specific corrective actions taken to alleviate any instrumental problems, or for recording any service that has been performed.

6.0 REAGENTS

Generally, calibration standards are not necessary for site screening and extent of contamination analyses with the Spectrace 9000. Optionally, an application (only the Soil Sample application will be discussed here) can be optimized or verified to be 1:1 proportional to another analytical (reference) method (see Section 9.3 and 10.1). This can be done by analyzing a set of Site-Specific Calibration Standards (SSCS) and performing a regression analysis on the reference (dependent) and the Spectrace 9000 results (independent) for each element of concern. In an application, any element's calibration can be adjusted by entering the desired slope and offset (intercept) in the Adjust Calibration menu. If any element's calibration has been adjusted in an application, "adj" will appear on the results screen. An adjusted element calibration can always be changed back to the initial slope and offset values of 1 and 0, respectively.

6.1 Site-Specific Calibration Standards (SSCS)

SSCS must be representative of the matrix to be analyzed by XRF. The concentration of the target elements in the SSCS should be determined by independent AA or ICP analyses that meet acceptable quality levels for referee data.

6.1.1 SSCS Sampling

See Section 4.2 on sample representivity. The SSCS samples must be representative of the matrix to be analyzed by XRF. It is senseless to collect SSCS samples in the site containment area if you are interested in investigating off-site contaminant migration. The matrices may be different and could affect the accuracy of the XRF results. If there are two different matrices on site, collect two sets of SSCS samples.

A full range of target element concentrations is needed to provide a representative calibration curve. Mixing high and low concentration soils to provide a full range of target element concentrations is not recommended due to heterogeneity problems. Unlike liquid samples, solid samples cannot be diluted and re-analyzed.

Additionally, collect several SSCS samples in the concentration range of interest. If the action level of the site is 500 mg/kg, use of several SSCS samples will tend to improve the XRF analytical accuracy in this concentration range.

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Generally, a minimum of seven appropriate SSCS samples should be taken. A minimum sample size of 4 oz. is recommended. A larger size sample should be taken to compensate for sites with greater content of nonrepresentative material such as rocks and/or organic debris. Standard glass sampling jars should be used.

6.1.2 SSCS Preparation

The SSCS samples should be either air dried overnight, or oven dried at less than 105° C. Oven drying invalidates mercury analysis. Aluminum drying pans or large plastic weighing boats for air drying may be used. After drying, remove all large organic debris and non-representative material (twigs, leaves, roots, insects, asphalt, rocks, etc.).

The sample should be sieved through a 10-mesh stainless steel sieve. Clumps of soil and sludge should be broken up against the sieve using a stainless steel spoon. Pebbles and organic matter remaining in the sieve should be discarded. The undersize fraction of the material constitutes the sample.

Although a maximum final particle size of 10-mesh is normally recommended, a smaller particle size may be desired. The sample should be mixed by dividing the sieved soil into quarters and physically mixing opposite quarters with a clean stainless steel spoon. Recombine and repeat the quartering and mixing procedure three times. Place the sieved sample in a clean glass sample jar and label it with both the site name and sample identification information.

The stainless steel sieves should be decontaminated using soap and water. They should be dried between samples.

One or more plastic XRF sample cups should be filled with the sieved soil for each SSCS sample. A piece of 0.2-mil polypropylene film should be cut and stretched (wrinkle-free) over the top of the X-ray sample cup and then sealed using the plastic securing ring. The cup should be labeled using both the site name and specimen identification information.

Either the XRF sample cup or the balance of the prepared sample is submitted to the approved laboratory for AA or ICP analysis of the requested element(s).

7.0 PROCEDURE

7.1 Prerequisites

If the Spectrace 9000 will be used in a location where AC power outlets are conveniently accessible, connect the battery charger to the electronic unit and plug the charger cord into the outlet. The probe cable must be connected before switching on the power. Plugging and unplugging this cable with the power on can damage the detector.

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To connect the battery, set the electronics unit on its face and use a flat blade screwdriver to loosen the two one-quarter turn fasteners on the back. Remove the battery pack. Inside, find the cord with the red cap covering the three-pronged plug. Remove the cap and plug it into the battery pack. Put the battery pack into the unit and tighten the fasteners.

Apply power to the Spectrace 9000 by pressing the <ON> button. The electronic unit may not come on with the battery charger hooked up if the battery has been totally drained. The drained battery may require a 10 minute charge prior to startup. In a few seconds the display shows the version of software. If necessary, adjust the contrast knob located on the underside of the front display. This knob can be turned so far that the display appears blank.

The initial screen displays for about 10 seconds and then a prompt will ask if the time and date are set correctly. The date **MUST** be set correctly otherwise serious errors in source-decay compensation can result. Additionally, results tables include the time and date of analysis. The main menu appears after the time and date screens.

If a "battery low" message appears, recharge or change the battery before proceeding, or operate the unit using line voltage.

Allow the Spectrace 9000 to warm up for approximately 30 minutes after it has been turned on before performing analysis.

7.1.1 Gain Control

Automatic gain compensation is a feature of both Soil and Thin Samples applications, which allows operation of the instrument over a wide range of ambient temperatures and from one day to another without standardization. To maintain gain control compensation, it is necessary to occasionally operate with a minimum acquisition time of 50 seconds on the Cd-109 source. If the automatic gain control fails or is out of range, an error message will appear on the screen. If the error message continues to appear after repeat analyses, then the Cd-109 measurement time should be checked and/or an energy calibration should be performed. If the problem continues, contact Spectrace Instruments for help.

7.1.2 Setting Data and Spectrum Store/Send Mode

The Set store/send modes option is located in the More screen which can be accessed from the main menu. Data and/or Spectrum storage must be enabled for automatic on-board storing to occur. Sufficient memory is available to store up to 300 sets of analysis results and up to 120 spectra (40 samples since each sample has three spectra). When the available memory is full, the respective spectra or results storage mode is automatically disabled. The spectra or results memory must be cleared (deleted) and the respective store mode enabled before results and/or spectra can be stored again.

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7.2 General Keys and Menu Software

This section outlines the general keys and basic menu software. Flow charts which describe the menu structure in detail are located on pages 4-13 through 4-17 in the Spectrace 9000 Operating Instructions.

7.2.1 The Keyboard

The row of numeric keys under the LCD screen performs functions defined by labels (a menu) written to the bottom line of the display by the Spectrace 9000 software. As the operator moves through the various menus, the keys are redefined to provide an efficient user interface.

The keypad to the right of the screen is used for numeric entry. The <Cont/Pause> key (referred to as the <Cont>) is used:

- to enter information as an <Enter> key
- to begin an analysis
- to pause an analysis in progress

The left arrow <-> key is used to edit entries before pressing <Cont>.

7.2.2 The Measure (Ready) Screen

This main menu selection displays the application name, revision date, measurement time for each source, and accesses other options (see flow diagrams in Spectrace 9000 Operating Instructions).

7.2.3 The Choose an Application Screen

This main menu selection lists the applications currently loaded in the unit. Applications are selected and source measurement times may be modified in this screen (see flow diagrams in Spectrace 9000 Operating Instructions).

7.2.4 The Review Stored Results Screen

This main menu selection lists the stored results. *Up* and *Down* scroll are used on many screens. When *Up* and *Down* are displayed, pressing the <0> (zero) key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. Stored results may be reviewed, deleted, or downloaded to the COM port (see flow diagrams in Spectrace 9000 Operating Instructions).

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7.2.5 The Review Stored Spectra Screen

This main menu selection lists the stored spectra which may be deleted or transmitted to the COM port (see flow diagrams in Spectrace 9000 Operating Instructions). You cannot display spectra under this screen. Spectra may be displayed in the *Examine Spectrum* portion of the More screen (accessed from the main menu) or in the *Examine Spectrum* selection from the Results screen under the *More Options* menu selection.

7.2.6 The More (Other Functions) Screen

This main menu selection lists the following functions:

- *Set clock/calendar*
- *Comm. port setup*
- *Set store/send modes*
- *Application maintenance*
- *Examine spectrum*

7.2.7 The Results Screen

The Results screen is displayed at the end of the analysis. If the automatic *Store Results* mode is enabled, you will be prompted for sample identification (*ID*) before the Results screen is displayed. *Up* or *Down* scrolls the screen to view more results. When *Up* and *Down* are displayed, pressing the <0> (zero) key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. *Send* transmits results to the COM port. *Store* prompts for an ID and then stores results in memory. *Measr* will immediately begin another analysis cycle. *Opts* displays the first of two screens listing special options under the Results screen (the second screen is located under *More Opts* of the first screen. See flow diagrams in Spectrace 9000 Operating Instructions). The most frequently used functions are the *Examine Spectrum* and *Enable/Disable Display Thresholds* located on the second screen of options.

7.3 Preoperational Checks

7.3.1 Energy Calibration Check

An energy calibration should be performed after an instrument is shipped and periodically (approximately 2 weeks) to ensure proper energy calibration. The *Energy Calibration* function is located in the *Options* section of the Measure Screen. You will be prompted to place the safety shield on the probe and then initiate a 600-second analysis that will update the X-ray energy calibration.

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7.3.3 Blank (Zero) Sample Check

The blank (Zero) sample check is performed to monitor the instrument's zero drift in the selected application. The blank sample check and the *Acquire Background Data* operation (discussed below) only apply to the application currently selected. This should be done once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift on a blank or low-level sample.

Mount the probe in the laboratory stand and select the *Soil Samples* application. Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the quartz blank provided with the unit (or a "clean" sand sample) using a minimum acquisition time of 60 seconds for each source. Review the results table. Most (95%) of the elemental results for elements number 24 (Cr) and higher in the periodic table should be within 2 standard deviations of zero ($0 \pm 2 \cdot |\text{STD}|$), and all of them (99%) should be within 3 standard deviations ($0 \pm 3 \cdot |\text{STD}|$). Repeat the measurement if the unit fails to meet these specifications. If several elements continue to be significantly out of these specifications, check the probe window and the blank sample for contamination or perform the *Acquire background data* operation located in the Measure (Ready) screen option. Perform the blank (Zero) sample check again. Save the results and spectra for documentation. Enable the display thresholds prior to sample analysis after the blank sample check procedure is completed.

7.3.4 Target Element Response Check

The purpose of the target element response check is to ensure that the instrument and the selected application are working properly prior to performing sample analysis. This check should be performed at the beginning of the day. Use low, mid, and high samples, or standards with known concentrations for some or all of the target elements to be checked. Select a low sample near the quantitation limit of the target elements. Select a mid sample near the site action level and a high sample near the maximum concentration of the target elements expected on site.

These samples should be measured using the same source acquisition times that will be used for sample analysis. Save the sample check results and spectra for documentation.

7.4 Selecting Source Measuring Time

The source measuring time may be modified under the Measure screen. Zero (seconds) measuring time should never be selected for any source for any application. Generally, the element detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Although counting statistics improve as measurement time increases, the

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The energy calibration check is performed in the field daily and after an energy calibration to verify proper energy calibration. To perform an energy calibration check, place the safety shield on the probe. Select the *Soil Samples* application and measure the safety shield using a minimum acquisition time of 60 seconds for each source. Save the results and spectra for documentation. Select *Optx, More Options*, and then *Examine Spectrum*. Examine the spectrum of each source. Locate and record the centroid KeV (using the x12 horizontal magnification) for each of the following peaks:

Source	Peak	Theoretical (KeV)	Specification (KeV)
Cd-109	Pb L-alpha	10.54	+/- 0.040
	Pb L-beta	12.61	+/- 0.040
	Pb L-gamma	14.76	+/- 0.040
	Emission peak	22.10	+/- 0.040
Fe-55	S K-alpha	2.31	+/- 0.010
	Emission peak	5.89	+/- 0.010
Am-241	Pb L-alpha	10.54	+/- 0.050
	Pb L-beta	12.61	+/- 0.050
	Emission peak	59.5	+/- 0.20

Perform an *Energy calibration* (see Spectrace 9000 Operating Instructions) and then do another energy calibration check if any of the peaks fail to meet specification. The energy calibration check should be performed once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift.

7.3.2 Resolution Check

The resolution check examines the detector's ability to resolve X-ray energies. This should be performed once at the beginning of the day. Select the *Soil Samples* application, and measure a sample of iron using a minimum acquisition time of 60 seconds for the Cd-109 source. Save the results and spectra for documentation. Select *Examine spectrum* under the More Options section of the Results screen. Examine the Cd-109 spectrum. Locate and record the maximum peak counts (must be >1000 counts) of the iron K-alpha peak (6.4 KeV) using the x12 horizontal magnification (see Figure 2, Appendix A). Divide the maximum peak counts by two. Examine the right side of the peak and record the counts and KeV of the channel with counts less than or equal to one-half the maximum peak count value (channel B, Figure 2). Examine the left side of the peak and record the counts and KeV of the channel with counts less than or equal to one-half the maximum peak count value (channel A, Figure 2). Subtract the left-side KeV from the right-side KeV (KeV at B - KeV at A, Figure 2). The difference should be less than 0.300 KeV. If the unit fails to meet this specification, call Spectrace Instruments for assistance.

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practical limit for typical applications is 600 to 800 seconds. The elements are grouped together according to the radioisotope used for their excitation with typical minimum detection limits shown in Sections 7.4.2. and 7.4.3.

Automatic gain compensation is a feature of both the Soil and Thin Samples applications which allows operation of the instrument over a wide range of ambient temperatures and from one day to another without standardization. To maintain this gain control compensation, it is necessary to occasionally operate with a minimum acquisition time of 50 seconds on the Cd-109 source.

The *Real/live* option toggles between real time (true clock time) and live time (total time the instrument is counting). The latter adds time to the analysis to correct for the time the system is busy processing pulses.

7.4.1 Minimum Source Measuring Times

A minimum measuring time (real or live) of 15 seconds for the Fe-55 source, 30 seconds for the Cd-109 source, and 10 seconds for the Am-241 source is recommended when using the Soil Samples application. Measuring times for a source that excites a target element can be increased if lower detection limits are required.

When using the Thin Samples application, the measuring time for any source may be reduced to 10 seconds if the source does not excite a target element since this application does not correct for interelement effects. If a source excites a target element, a minimum measuring time (real or live) of 60 seconds for the Fe-55 source, 60 seconds for the Cd-109 source, and 120 seconds for the Am-241 source is recommended.

A minimum of 60 seconds is recommended for the Cd-109 source when using the PbK in Paint application.

7.4.2 Typical Minimum Detection Limits (MDLs) for the Soil Samples Application

For source measuring times of 60 seconds, typical element MDLs (in milligram per kilogram, mg/kg) for the Soil Samples application are:

Source	Element	MDL (mg/kg)
Fe-55	Potassium (K)	325
	Calcium (Ca)	150
	Titanium (Ti)	110
	Chromium (CrLo)	180
Cd-109	Chromium (CrHi)	525
	Manganese (Mn)	410

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	Iron (Fe)	225
	Cobalt (Co)	205
	Nickel (Ni)	125
	Copper (Cu)	90
	Zinc (Zn)	70
	Mercury (Hg)	60
	Arsenic (As)	50
	Selenium (Se)	35
	Lead (Pb)	30
	Rubidium (Rb)	10
	Strontium (Sr)	10
	Zirconium (Zr)	10
	Molybdenum (Mo)	10
Am-241	Cadmium (Cd)	180
	Tin (Sn)	100
	Antimony (Sb)	65
	Barium (Ba)	20

NOTE: These typical MDLs are provided as an aid for selecting source measurement times; observed values for a given situation may vary depending on the matrix of the soil standard used to calculate MDLs, age of sources, moisture content, and other factors discussed in Section 4.

Generally, the detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Additionally, more elements may be added to the Soil Samples application. Contact Spectrace Instruments for information about modifications to applications.

7.4.3 Typical Minimum Detection Limits (MDLs) for the Thin Samples Application

For source measuring times of 200 seconds for the Fe-55 and Cd-109 sources, and 800 seconds for the Am-241 source, typical element MDLs (in microgram per square centimeter, $\mu\text{g}/\text{cm}^2$) for the Thin Samples application are:

Source	Element	MDL ($\mu\text{g}/\text{cm}^2$)
Fe-55	Potassium (K)	0.40
	Calcium (Ca)	0.20
	Titanium (Ti)	0.15
	Chromium (CrLo)	0.40
Cd-109	Chromium (CrHi)	0.90
	Manganese (Mn)	0.65
	Iron (Fe)	0.65
	Cobalt (Co)	0.50
	Nickel (Ni)	0.30
	Copper (Cu)	0.65

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	Zinc (Zn)	0.40
	Mercury (Hg)	0.45
	Arsenic (As)	0.40
	Selenium (Se)	0.15
	Lead (Pb)	0.50
	Rubidium (Rb)	0.10
	Strontium (Sr)	0.10
	Zirconium (Zr)	0.15
	Molybdenum (Mo)	0.10
Am-241	Cadmium (Cd)	2.5
	Tin (Sn)	2.5
	Antimony (Sb)	1.5
	Barium (Ba)	0.70

NOTE: These typical MDLs are provided as an aid for selecting source measurement times; observed values for a given situation may vary depending on the thin sample standard used to calculate MDLs, age of sources, and other factors discussed in Section 4.

Generally, the detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Use of thick filters or filters with high background or contamination will result in higher MDLs and require a background subtraction. Additionally, more elements may be added to the Thin Samples application. Contact Spectrace Instruments for information about modifications to applications.

7.5 Sample Handling and Presentation

When making XRF measurements, be sure to maintain constant measurement geometry in order to minimize variations in analysis results. Document any anomalies in measurement geometry, sample surface morphology, moisture content, sample grain size, and matrix (see Section 4.0).

7.5.1 Soil Samples

Soil samples may be analyzed either in-situ or in prepared X-ray sample cups. The Soil Samples application assumes the sample to be infinitely thick. For in-situ measurements this is almost always the case. However, for sample cup measurements it is advisable to fill the cup nearly full and tap it on the bench to compact the soil. This ensures that the sample is as uniformly thick as possible from analysis to analysis. The Spectrace 9000 laboratory stand and safety shield should be used when analyzing sample cups.

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An area for in-situ analysis should be prepared by removing large rocks and debris. The soil surface should be rendered flat and compact prior to analysis. The Spectrace 9000 probe should be held firmly on the ground to maximize instrument contact with the ground. The probe should not be moved during analysis. Analysis of water saturated soils should be avoided. A thin layer of 0.2-mil polypropylene XRF film may be mounted on the surface probe to minimize contamination. Use of varying thicknesses of plastic (bags) have been shown to interfere in the light element (low atomic number) measurement and may affect the FP calibration of the other element concentrations.⁽²⁾ Additionally, plastic may contain significant levels of target element contamination.

Course-grained soil conditions or nuggets of contaminated material may preclude a truly representative sample and adversely affect the analysis results (typically by under reporting the target element). Such samples should be prepared before analysis. Preparation consistency is important to minimize variation in analytical results.

This application is specifically designed for soil with the assumption that the balance of the material is silica. If samples with a much lighter (lower atomic number) balance are analyzed, the results will typically be elevated by a factor of two to four. Contact Spectrace Instruments for help in analysis of different matrices.

7.5.2 Thin (Filter) Samples

The Thin Samples application is for analysis of thin samples such as filters or wipes. The detection limits are affected by the thickness of the substrate. Best results are obtained on the thinnest substrates. Always use the probe safety cover when measuring thin samples. This is not only for user safety, but also ensures a controlled background environment and provides a reference signal for the automatic gain control. Probe safety covers should never be interchanged between instruments.

Filters and wipes should be prescreened before use to establish background and contamination levels. Care should be used to prevent zinc oxide contamination from disposable gloves. Small 37-mm filters can be mounted between two layers of 0.2-mil thick polypropylene XRF film on 40-mm XRF cups for analysis. Larger filters can be placed on the probe with a sheet of 0.2- mil thick polypropylene XRF film between the filter and probe to prevent the window from being contaminated. Then the probe safety cover may be placed over the filter prior to analysis. Filters should be presented loaded side down and wrinkle free.

7.5.3 Lead in Paint

The area selected for analysis should be smooth, representative and free of surface dirt. The Spectrace 9000 probe should be held firmly on the surface to maximize instrument contact. The probe should not be moved during analysis.

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When used for specimen application (e.g., on paint chips or nonbacked films) remember to use the probe safety cover. In the PbK Application, you should also position a thick neutral sample, such as the quartz disk (blank), behind the specimen before closing the safety lid. Otherwise, the PbK X-rays excited in the safety cover will be sensed by the detector. In this application, do not perform the *Acquire background data* option from the list of options under the Ready screen.

8.0 CALCULATIONS

The Spectrace 9000 is a direct readout instrument that does not require any calculations.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

9.1 Precision

The precision of the method is monitored by reading a low- or mid-target element concentration sample (or SSCS selected as described in Sections 6.1) at the start and end of sample analysis and after approximately every tenth sample. (A daily total of seven measurements is recommended.) Determining the precision around the site action level can be extremely important if the XRF results are to be used in an enforcement action. Therefore, selection of a sample with a target element concentration at or near the site action level or level of concern is recommended. The sample is analyzed by the instrument for the normal field analysis time, and the results are recorded. The standard deviation for each target element is calculated. The relative standard deviation (RSD) of the sample mean can be used to calculate precision. The RSD should be within ± 20 percent for the data to be considered adequately precise.⁽³⁾

9.1.1 Preliminary Minimum Detection Limit (PMDL) and Minimum Quantitation Limit (PMQL)

A preliminary PMDL and PMQL is needed to give the operator an indication of the instrument's capability in the field. A low or blank sample is selected that is representative of the sample matrix. A low or blank SSCS may be selected as described in Section 6.1. Alternatively, the quartz blank or "clean" sand may be used if a blank soil sample is unavailable. More than one standard may be needed to obtain low or blank concentration values for each element. Select the application that will be used for analysis of the samples. Disable the display thresholds to permit display of low or negative results.

The sample is measured 10 times without moving it using the anticipated field analysis measuring time. The sample standard deviation of the mean for each target element is calculated (using the N-1 formula).

If the standard deviation has a fractional component, round up to the next whole number prior to calculating the PMDL and PMQL.

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The definition of the PMDL is three times the calculated standard deviation value.

The definition of the PMQL is 10 times the calculated standard deviation value.

9.1.2 The Method Minimum Detection Limit (MMDL) and Method Quantitation Limit (MQL)

The MMDL and MQL may be calculated from the measurement of either a low or blank sample, (or a SSCS selected as described in section 6.1), at the start and end of sample analysis, and after approximately every tenth sample (a daily total of seven measurements is recommended). Alternatively, the quartz blank or "clean" sand may be used if a blank soil or sediment sample is unavailable.

Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the sample using the same application and measuring time used for the samples. Enable the display thresholds prior to analyzing the next sample.

The sample standard deviation of the mean for each target element is calculated. If the standard deviation has a fractional component, round up to the next whole number prior to calculating the MMDL and MQL.

The definition of the MMDL is three times the calculated standard deviation value.

The definition of the MQL is 10 times the calculated standard deviation value.

9.2 Reporting Results

All raw XRF data should be reported including the individual results of multiple analyses of samples and sampling points. The average and concentration range of each multiple analysis should also be reported.

A "reported" value for each analysis or average of multiple analyses should be processed in the following manner.

1. Round the value to the same degree of significance contained in the SSCS sample assay values (usually two) if the element's calibration has been adjusted (see Section 6.0).
2. Report all values less than the MMDL as not detected (ND).
3. Flag and note all values greater than or equal to the MMDL and less than the MQL (usually with a "J" next to the reported value).

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4. Report all values equal to or greater than the MQL and within the linear calibration range (if the element's calibration has been adjusted [see section 6.0]).
5. Flag and note all values above the linear calibration range (greater than the highest SSCS used in the calibration adjustment procedure) if SSCS were used and the calibration was adjusted.

9.3 Accuracy

Accuracy, relative to a specific digestion method and elemental analysis procedure, is determined by submitting an XRF analyzed sample (prepared sample cups may be submitted) for AA or ICP analysis at a laboratory.

The on-site analysis of soils by XRF instrumentation should be considered a screening effort only (QA1 data). Data derived from the instrument should be used with discretion. Confirmatory analyses on a subset of the screening samples (minimum 10 percent) can be used to determine the quality of the screening data (QA2 data). The confirmation samples should ideally be selected randomly from the sample set and include a number of samples at or near the critical level. The results of the metal analysis (dependent) and the XRF analysis (independent) are evaluated with a regression analysis. The correlation factor (R^2) should be 0.7 or greater.⁽³⁾

XRF results may be multiplied by the slope prior to substitution for metal analysis results in contouring, kriging programs, or removal volume estimates. Correcting the XRF results based on confirmatory analyses should only be undertaken after careful consideration. It must be understood that the confirmatory analysis (AA or ICP) is an estimate of the concentration of metal contamination and is dependent upon the specific instrumentation and sampling methodology used. Since XRF is a total elemental technique, any comparison with referee results must account for the possibility of variable extraction, dependent upon the digestion method used and its ability to dissolve the waste or mineral form in question.

9.3.1 Matrix Considerations

Other types of QA/QC verification should include verification that the instrument calibration is appropriate for the specific site to be assessed. This includes verification of potential multiple soil matrix types that may exist at a site. Matrix differences which affect the XRF measurement include large variations in calcium content, which may be encountered when going from siliceous to calcareous soils, as well as large variations in iron content.

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10.0 DATA VALIDATION

10.1 Confirmation Samples

Confirmation samples are recommended at a minimum rate of 10 percent and are required if QA2 data objectives have been established for site activities.⁽¹⁾ Ideally, the sample cup that was analyzed by XRF should be the same sample that is submitted for AA/ICP analysis. When confirming an in-situ analysis, collect a sample from a 6-inch by 6-inch area for both an XRF measurement and confirmation analysis.

The XRF and metals results are analyzed with a regression analysis using a statistical program such as SAS® or Statgraphics® with the intercept calculated in the regression. The correlation factor between XRF and AA/ICP data must be 0.7 or greater for QA2 data objectives.⁽²⁾

10.2 Recording Results

Record all results and monitoring activities in a laboratory or field notebook. Alternatively, record results electronically on a hard drive or floppy disk.

10.3 Downloading Stored Results and Spectra

Results (analytical reports) and spectra which have been stored in the Spectrace 9000 internal memory should be downloaded and captured in disk files on a PC (see section 5). Spectrace Instruments provides software for this purpose. Additionally, they provide software to prepare results or spectra for importing into a spreadsheet. Refer to the instructions provided with the programs for details on their operation.

Alternatively, other software with terminal data logging capabilities may be used to capture results and spectra to disk files.

After capturing results to a file, print a copy and save both the disk files and the printout for future reference and documentation purposes.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, corporate and/or any other applicable health and safety practices.

12.0 REFERENCES

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U.S. EPA ENVIRONMENTAL RESPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

STANDARD OPERATING PROCEDURES

**SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE
OPERATING PROCEDURE**

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DATE:

APPENDIX A

Figures

SOP #1713

December, 1992

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

STANDARD OPERATING PROCEDURES

SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE
OPERATING PROCEDURE

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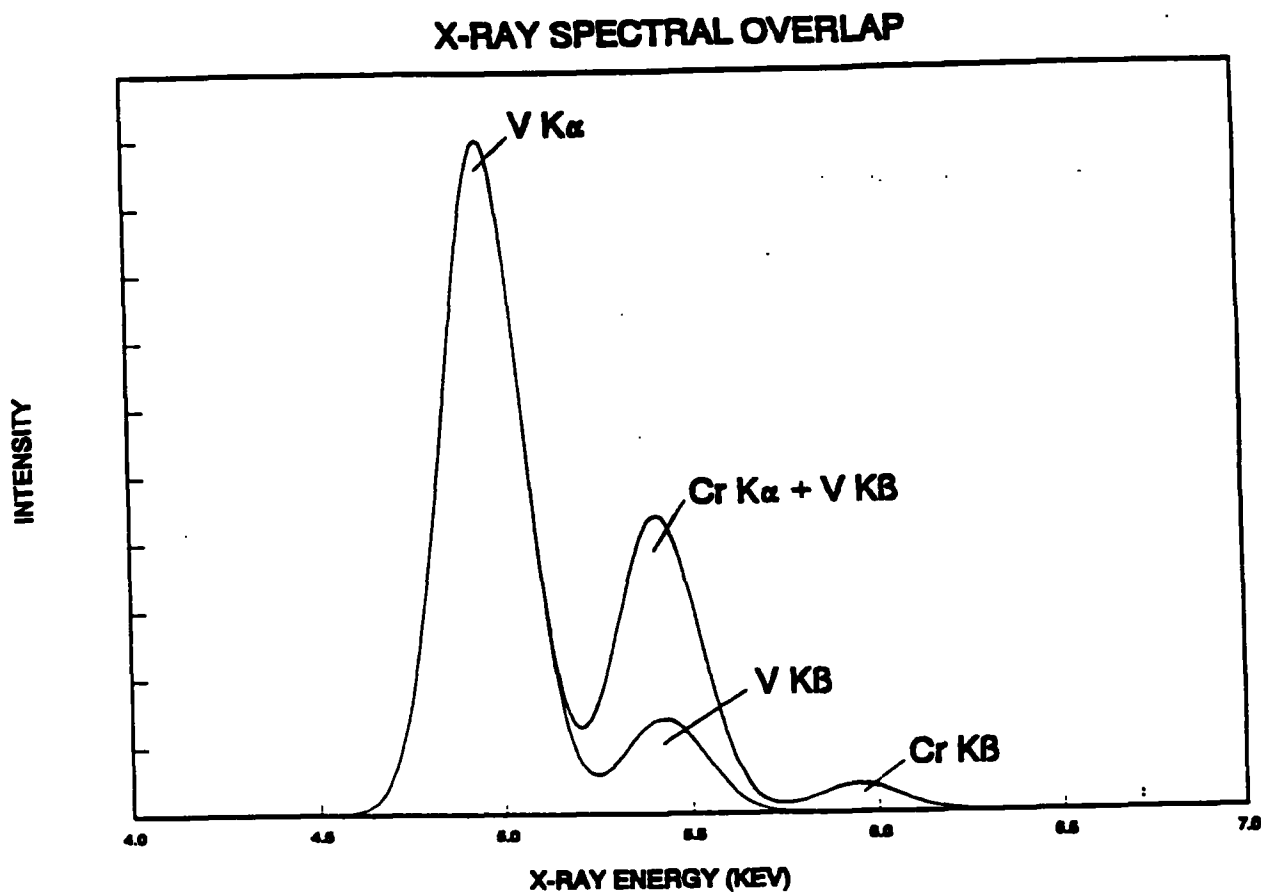


FIGURE 1. X-Ray Spectral Plot Showing Overlap of Vanadium K α X-Rays in the Chromium K α Measurement Region.

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

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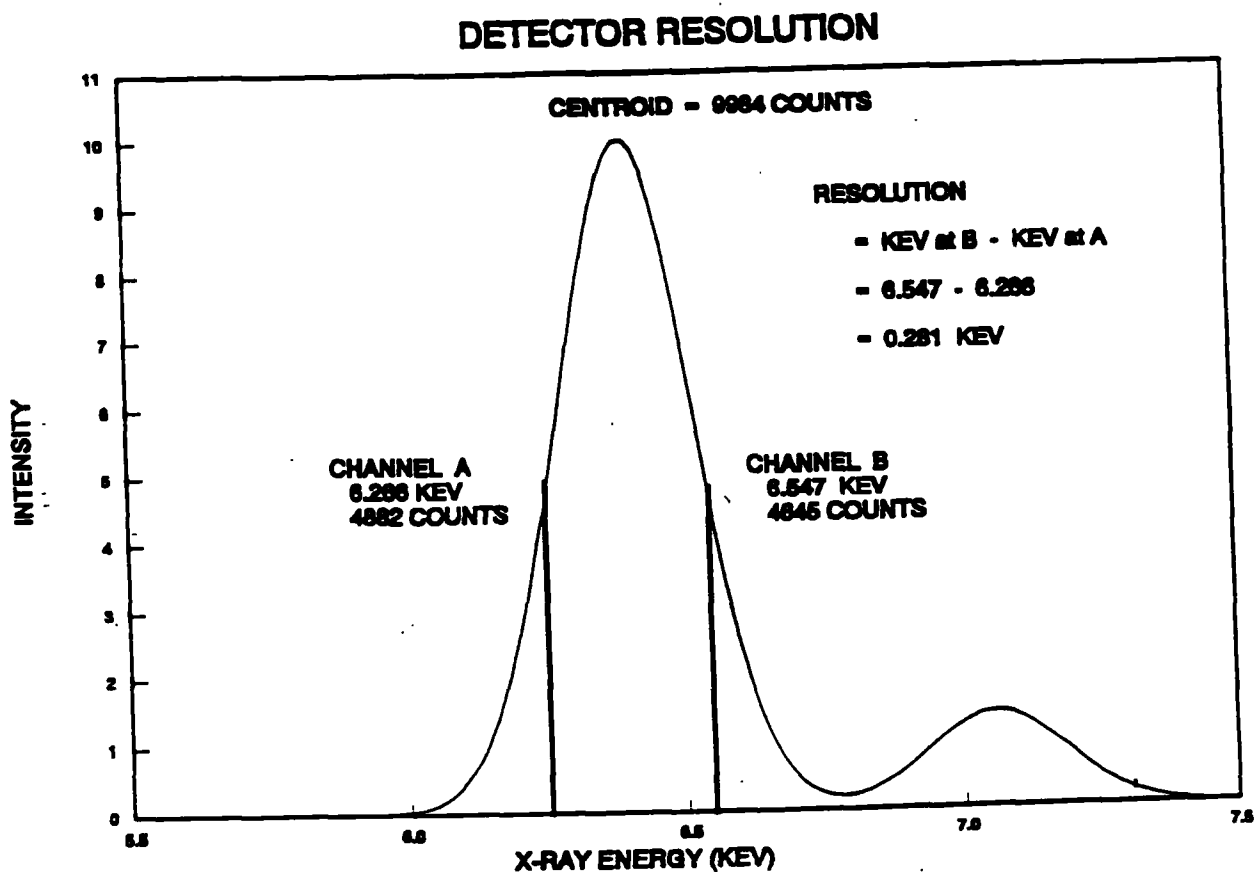


FIGURE 2. Iron X-Ray Spectrum Illustrating Detector Resolution Measurement.

SPECTRACE 9000 FPXRF DAILY INSTRUMENT CHECKOUT WORKSHEET

DATE _____

SPECTRACE SERIAL NO. _____

SITE _____

WA# _____

ENERGY CALIBRATION CHECK RESULTS (SAFETY SHIELD IN PLACE)

Source: Cd 109 Range
 Pb L - α _____ KeV (10.50 - 10.58)
 Pb L - β _____ KeV (12.57 - 12.65)
 Pb L - γ _____ KeV (14.72 - 14.80)
 Emission Peak _____ KeV (22.06 - 22.14)

Source: Fe55 Range
 S K - α _____ KeV (2.30 - 2.32)
 Emission Peak _____ KeV (5.88 - 5.90)

Source: Am 241 Range
 Pb L - α _____ KeV (10.49 - 10.59)
 Pb L - β _____ KeV (12.56 - 12.66)
 Emission Peak _____ KeV (59.3 - 59.7)

RESOLUTION CHECK RESULTS (Cd 109, IRON PURE)

Iron at maximum peak height (MPH) = _____ counts (MPH ≥ 1000 at 6.40 ± 0.02 KeV)

1/2 MPH = _____ counts

☐ Pass ☐ Fail: Counts \leq 1/2 MPH at 6.25 KeV

☐ Pass ☐ Fail: Counts \leq 1/2 MPH at 6.55 KeV

Cd 109	Intensity Check	Criteria
Fe	_____	(> 0.96)
Mn	_____	(< 0.003)
Co	_____	(< 0.003)

OPTIONAL: IRON K α RESOLUTION CALCULATION (MPH AT 6.40 ± 0.02 KeV)

right side of 1/2 MPH

left side of 1/2 MPH

_____ counts at _____ KeV

_____ counts at _____ KeV

_____ counts at _____ KeV

_____ counts at _____ KeV

Calculated FWHM = _____ KeV (< 0.300)

BLANK CHECK RESULTS

Check One: ☐ Quartz ☐ Teflon ☐ Sand ☐ Other (Specify) _____

☐ Pass ☐ Fail: 95% of elements Cr ($z=24$) and higher are within ± 2 std. deviations of zero

☐ Pass ☐ Fail: All elements Cr ($z=24$) and higher are within ± 3 std. deviations of zero

Comments _____

NOTE: All sources ≥ 60 seconds each acquisition time
 (All checks in Soil Samples Application mode)

Initials _____

APPENDIX B

ASTM Method D 4972-89
"Standard Method for pH of Soils"



Standard Test Method for pH of Soils¹

This standard is issued under the fixed designation D 4972; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of the pH of soils for uses other than for corrosion testing. Such measurements are used in the agricultural, environmental, and the natural resources fields. This measurement determines the degree of acidity or alkalinity in soil materials suspended in water and a 0.01 M calcium chloride solution. Measurement in both liquids are necessary to fully define the soil's pH. This variable is useful in determining the solubility of soil minerals, the mobility of ions in the soil, and assessing the viability of the soil-plant environment. A more detailed discussion of the usefulness of this parameter is not warranted here, however, it can be found in many discussions of the subject. A few such discussions are given as Refs (1)² through (6) at the end of the text.

1.2 The values given in SI units are regarded as standard.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 670 Practice for Preparing Precision and Bias Statements for Test Methods of Construction Materials³

G 51 Test Method for pH of Soil for Use in Corrosion Testing⁴

3. Summary of Test Method

3.1 Measurement of the pH of soils in both suspensions of water and a calcium chloride solution are made with either a potentiometer using a pH sensitive electrode system (Method A), or pH sensitive paper (Method B). The potentiometer is calibrated with buffer solutions of known pH. The pH sensitive paper is a less accurate measurement and should only be used for a rough estimate of the soil pH. The electrode must be used for this measurement unless the pH sensitive paper is specified.

4. Significance and Use

4.1 The pH of the soil is a useful variable in determining

the solubility of soil minerals, the mobility of ions in the soil, and assessing the viability of the soil-plant environment.

4.2 pH measurements are made in both water and a calcium chloride solution, because the calcium displaces some of the exchangeable aluminum. The low ionic strength counters the dilution effect on the exchange equilibrium by setting the salt concentration of the solution closer to that expected in the soil solution. The pH values obtained in the solution of calcium chloride are slightly lower than those measured in water due to the release of more aluminum ions which then hydrolyses. Therefore, both measurements are required to fully define the character of the soil's pH.

4.3 For the purpose of this test method the test soil must be sieved through a No. 10 sieve (2 mm sieve mesh openings). Measurements on soils or soil fractions having particle sizes larger than 2 mm by this test method may be invalid. If soil or soil fractions with particles larger than 2 mm are used, it must be stated in the report since the results may be significantly different.

4.4 All water used for this test method must be distilled and deionized.

5. Interferences

5.1 This test method as measured by a pH probe has possible interferences due to a suspension effect or sedimentation potential. Users interested in a detailed discussion of the mechanism of this effect can find it in Refs (5) and (6).

5.2 This effect is the main reason Test Method G 51 can not be used for general measurement of pH outside of that for corrosion analysis. Test Method G 51 measures pH (an aqueous parameter) without adding any aqueous phase to the soil. This results in excessive soil particle-pH probe contact that over-estimates the activity of the hydrogen ions in solution and is therefore unacceptable for general soil analysis.

5.3 The suspension effect can be mitigated by careful attention to 9.1.

6. Apparatus

6.1 *Method A, pH Meter*—Potentiometer equipped with glass-calomel electrode system. Follow the manufacturer's instructions for the pH meter used. A silver/silver chloride electrode system or similar is also acceptable.

6.2 *Method B, pH Paper*—pH paper sensitive to a pH range from 1 to 12, with resolution to the nearest 0.2 pH unit.

7. Reagents

7.1 *Purity of Reagents*—Reagent grade chemicals should be used in all tests. Unless otherwise indicated, it is intended that all reagents should conform to the specifications of the

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.06 on Physico-Chemical Properties of Soils and Rocks.

² Current edition approved Nov. 10, 1989. Published December 1989.

³ The boldface numbers in parentheses refer to a list of references at the end of this test method.

⁴ Annual Book of ASTM Standards, Vols 04.01, 04.02, 04.03, and 04.08.

⁵ Annual Book of ASTM Standards, Vol 03.02.

Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.⁵ Other grades may be used, provided it is first ascertained that the reagent is of sufficient purity to permit its use without lessening the accuracy of the determination.

7.2 Purity of Water—Water should be distilled, deionized water, but not necessarily free of carbon dioxide. The pH of the water should be checked prior to testing the soil. Should it fall outside the range of 6.5 to 7.5, it should be discarded and other water obtained for the test.

7.3 Acid Potassium Phthalate Buffer Solution (0.05 M)—Dissolve 10.21 g (dried 1 h at 105°C) of potassium phthalate in water and dilute to 1 L. The pH of this solution should be 4.0 at 20°C. Protect the solution against evaporation and against contamination with molds. Replace the solution when mold is noticed. The effect of temperature is:

°C	pH
5 to 37	4.0

This illustrates that the pH of the solution does not change over the range in temperature from 5 to 37°C.

7.4 Calcium Chloride Stock Solution (1.0 M)—Dissolve 147 g of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ in water in a 1-L volumetric flask, cool, dilute to volume with water, and mix. Dilute 15 mL of this solution to 200 mL with water in a volumetric flask.

7.5 Calcium Chloride Solution (0.01 M)—Dilute 20.0 mL of stock 1.0 M CaCl_2 solution to 2 L with water. The pH of this solution should be between 5 and 7.

7.6 Phosphate Buffer Solution (0.025 M)—Dissolve 3.40 g of KH_2PO_4 and 3.55 g of Na_2HPO_4 in water and dilute to 1 L. Dry salts 2 h at 130°C before use. The pH of this solution should be 6.9 at 20°C. The effect of temperature is as follows:

°C	pH
0	7.0
10	6.9
20	6.9
30	6.8
40	6.8

8. Calibration of pH Meter

8.1 Calibrate the pH meter using the acid potassium phthalate and phosphate buffer solutions. Adjustment of the pH meter should follow the manufacturers direction.

9. Procedure

9.1 When making measurements with the pH electrode, place the electrode into the partially settled suspension to mitigate the suspension effect.

9.2 For both methods, begin with an air dried soil that has been sieved through a No. 10 sieve (2 mm holes) to remove the coarser soil fraction. Air drying the soil is necessary to accomplish sieving and to control the amount of water present at the time of measurement.

9.3 pH in Distilled Water—For both methods, weigh out approximately 10 g of air dried soil. Place the soil into a glass container and add approximately 10 mL of distilled water.

Mix thoroughly and let stand for 1 h.

9.4 Method A—Read pH on pH meter.

9.5 Method B—Read pH on pH paper.

9.6 pH in 0.01 M Calcium Chloride Solution—For both methods weigh out approximately 10 g of air dried soil. Place the soil into a glass container and add approximately 10 mL of the 0.01 M CaCl_2 solution. Mix thoroughly and let stand for 1 h.

9.7 Method A—Read pH on pH meter.

9.8 Method B—Read pH on pH paper.

9.9 The mixture should be at approximately room temperature (15 to 25°C) at the time of pH measurement.

10. Report

10.1 Report the pH of the soil to the first decimal place. Specify which of the pH measurements is in water and which is in the calcium chloride solution. Also specify whether the determinations were made with Method A or Method B. If size fractions other than sieved through the No. 10 sieve are used, it must be stated in the report since the results may be significantly different.

11. Precision and Bias

11.1 Precision:

11.1.1 Within-Laboratory Precision—The within laboratory standard deviations for Method A are 0.031 (pH units) for the water mixture and 0.139⁶ (pH units) for the calcium chloride mixture. Therefore, results of two properly conducted tests in the same or different laboratories should not differ by more than 0.065⁶ (pH units) for the water mixture and 0.389 pH units for the calcium chloride mixture. The within-laboratory standard deviations for Method B are 0.189 (pH units) for the water mixture and 0.212⁶ (pH units) for the calcium chloride mixture. Therefore, results of two properly conducted tests in the same or different laboratories should not differ by more than 0.53⁶ (pH units) for the water mixture and 0.60 pH units for the calcium chloride mixture.

11.1.1.1 The precision of Method A presented was determined by the National Technical Center of the United States Department of Agriculture. In their evaluation they used 174 replicates for the water mixture and 32 replicates in testing the calcium chloride mixture.

11.1.1.2 The precision of Method B presented was determined by the United States Army Environmental Hygiene Agency. In their evaluation they used 25 replicates in testing each mixture.

11.1.2 Between-Laboratory Precision—The between-laboratory standard deviation has not been determined for either method. Subcommittee D18.06 is actively seeking data to evaluate the between laboratory precision of this test method.

11.2 Bias—There is no accepted reference value for this test method; therefore, bias cannot be determined.

12. Keywords

12.1 soil; pH; acidity; alkalinity; reaction

⁵ "Reagent Chemicals, American Chemical Society Specifications." Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards, by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the United States Pharmacopeia.

⁶ These data satisfy the 1S and D2S requirements outlined in Practice C 670.

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- (4) Davies, J. T., and Rideal, E. K., *Interfacial Phenomena*. Academic, NY, 1963.
- (5) Hunter, R. J., *Zeta Potential in Colloid Science*. Academic, NY, 1981.
- (6) Perrin, D. D., and Dempsey, B., *Buffers for pH and Metal Ion Control*. Chapman and Hall, London, 1974.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

**Attachment D: Results from 2017 HDOH Site
Assessment**

Table 1. Soil Sample Results
Factory Street, Honolulu, Oahu, Hawaii

			Sample Results (mg/kg)						
		Antimony	Arsenic	Barium	Cadmium	Chromium	Lead	Zinc	TPH-Residual Range Organics
Tier 1 EAL (Residential)		6.3	24	1,000	14	1,100	200	1,000	500
Tier 1 EAL (Commercial/Industrial)		93	95	2,500	74	1,100	800	2,500	1,000
Sample ID	Sample date								
DU1-A	7/26/2017	<0.12	4.36	333	<0.084	107	228	123	2,420
DU1-B	7/26/2017	<0.12	4.52	661	<0.084	137	50.6	128	1,840
DU1-C	7/26/2017	<0.12	5.83	359	<0.084	202	28.8	153	140
DU1-D	7/26/2017	<0.12	7.41	361	<0.084	265	10.7	174	NA
DU1-E	7/26/2017	<0.12	7.77	608	<0.084	312	9.06	196	NA
DU1-F	7/26/2017	<0.12	7.65	615	<0.084	293	7.21	207	NA
DU2-A	7/27/2017	<0.12	3.88	432	<0.084	98.7	291	175	1,890
DU2-B	7/27/2017	<0.12	4.87	497	<0.084	191	66.7	210	1,980
DU2-C	7/27/2017	<0.12	4.74	354	<0.084	173	54.7	203	320
DU2-D	7/27/2017	<0.12	7.3	429	<0.084	259	12.8	205	NA
DU2-E	7/27/2017	<0.12	3.87	325	<0.084	171	50	187	NA
DU2-F	7/27/2017	<0.12	5.93	513	<0.084	306	7.35	207	NA
DU3-A	7/27/2017	<0.12	3.85	409	<0.084	108	704	122	2,080
DU3-B	7/27/2017	<0.12	4.44	484	<0.084	158	1,010	176	1,290
DU3-C	7/27/2017	<0.12	5.41	412	<0.084	161	125	254	286
DU3-D	7/27/2017	<0.12	7.34	683	<0.084	184	25.7	181	NA
DU3-E	7/27/2017	<0.12	6.85	715	<0.084	200	11	188	NA
DU3-F	7/27/2017	<0.12	6.69	1,150	<0.084	217	11.7	210	NA
DU4-A	7/27/2017	1.03	4.24	316	<0.084	112	4,660	128	2,630
DU4-B	7/27/2017	<0.12	4.31	447	<0.084	109	472	136	2,100
DU4-C	7/27/2017	<0.12	5.32	457	<0.084	132	223	184	699
DU4-D	7/27/2017	<0.12	5.62	484	<0.084	158	24.8	213	NA
DU4-E	7/27/2017	<0.12	5.86	782	1.39	186	12.7	336	NA
DU4-F	7/27/2017	<0.12	6.92	883	<0.084	216	15.7	227	NA
DU5-A	7/28/2017	1.37	3.89	412	1.6	71.8	8,450	303	3,410
DU5-B	7/28/2017	1.1	3.98	447	<0.084	74.5	429	130	4,260
DU5-C	7/28/2017	<0.12	5.56	552	1.47	101	124	288	1,960
DU5-D	7/28/2017	<0.12	6.56	1,070	<0.084	351	72.8	474	NA
DU5-E	7/28/2017	<0.12	11.3	732	1.59	157	45.8	251	NA
DU5-F	7/28/2017	<0.12	7.82	878	1.06	144	21.8	197	NA
DU6-A-T1	7/28/2017	3.68	3.51	139	<0.084	65.7	14,300	104	4,070
DU6-B-T1	7/28/2017	<0.12	3.52	252	<0.084	99.7	264	108	4,340
DU6-C-T1	7/28/2017	<0.12	4.14	491	1.26	137	239	185	1,300
DU6-D-T1	7/28/2017	<0.12	7.57	764	<0.084	171	92.8	178	NA
DU6-E-T1	7/28/2017	<0.12	7.83	946	<0.084	134	2,440	160	NA
DU6-F-T1	7/28/2017	<0.12	5.9	1,110	<0.084	124	20	160	NA
DU6-A-T2	7/28/2017	3.65	6.41	230	1	112	24,800	122	3,600
DU6-B-T2	7/28/2017	<0.12	5.92	390	1	130	634	163	3,140
DU6-C-T2	7/28/2017	<0.12	6.47	484	1.73	167	239	329	909
DU6-D-T2	7/28/2017	<0.12	8.61	653	<0.084	188	125	225	NA
DU6-E-T2	7/28/2017	<0.12	37.1	717	2.11	142	30.3	190	NA
DU6-F-T2	7/28/2017	<0.12	5.47	1,330	<0.084	140	20.8	198	NA
DU6-A-T3	7/28/2017	3.26	4.6	181	<0.084	78.8	13,400	133	2,680
DU6-B-T3	7/28/2017	1.04	4.65	322	<0.084	116	840	163	3,350
DU6-C-T3	7/28/2017	<0.12	5.41	461	1.26	142	497	341	1,540
DU6-D-T3	7/28/2017	<0.12	5.7	592	<0.084	172	141	234	NA
DU6-E-T3	7/28/2017	<0.12	5.66	1,460	<0.084	145	32.5	211	NA
DU6-F-T3	7/28/2017	<0.12	6.42	846	<0.084	135	129	191	NA

Acronyms and Abbreviations:
EAL = Environmental Action Level (non-drinking water resource; <150 meters to nearest surface water body)
Results exceed the residential EAL
Results exceed the commercial/industrial EAL
mg/kg = milligrams per kilogram
NA = Not analyzed
TPH = Total petroleum hydrocarbons

Notes:
Only chemicals detected above the respective method detection limits are presented in this table.
Letters A to F in sample names referebce depths of layers as follows:
A = 0 to 0.5 foot bgs (includes asphalt)
B = 0.5 to 1 foot bgs
C = 1 to 2 feet bgs
D = 2 to 3 feet bgs
E = 3 to 4 feet bgs
F = 4 to 5 feet bgs

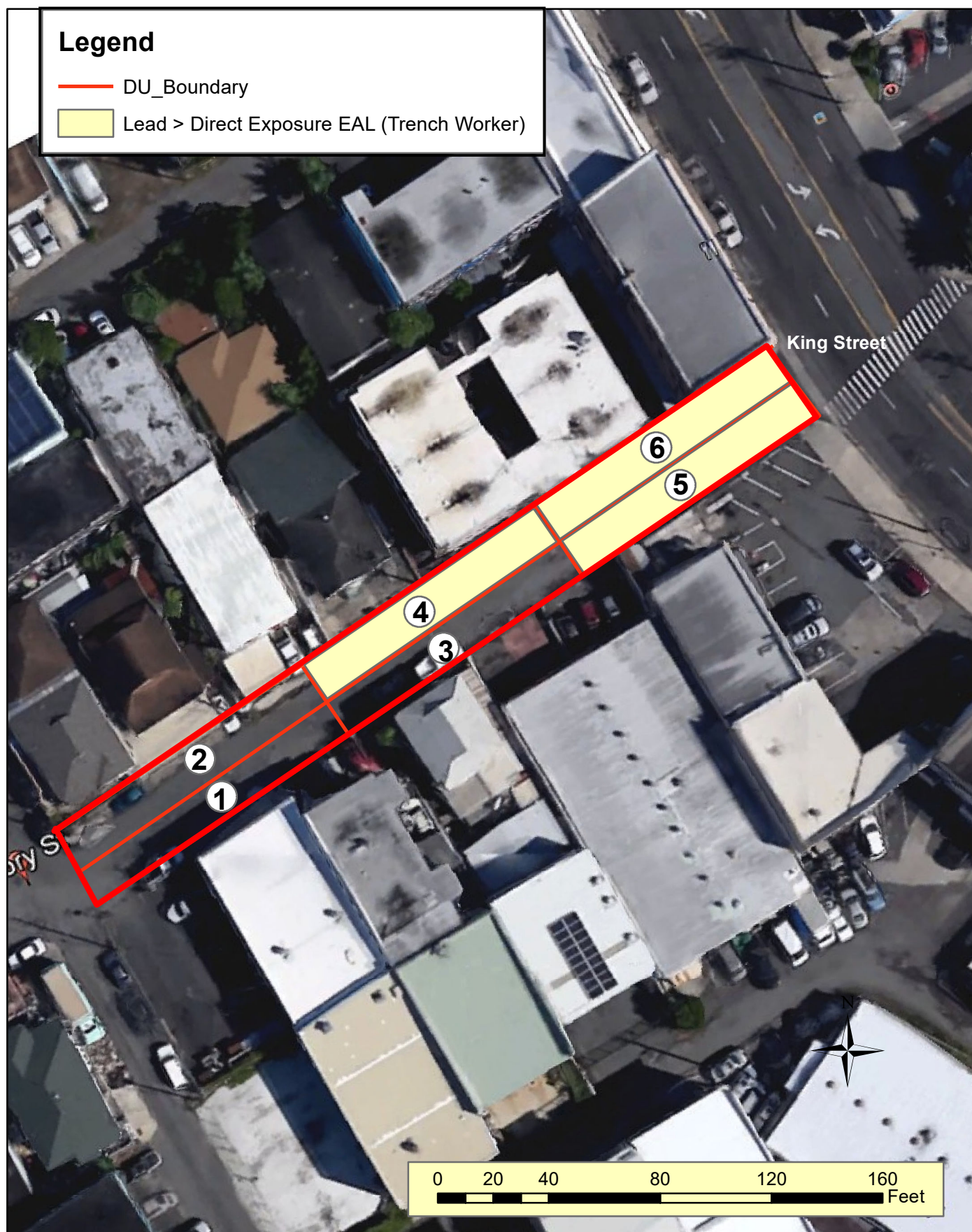


Figure 1a: DUs of 2017 Site Assessment with lead > 800 mg/kg (0 to 0.5 feet bgs)



Figure 1b: DUs of 2017 Site Assessment with lead > 800 mg/kg at 0.5 to 1 ft bgs



Figure 1c: DUs of 2017 Site Assessment with lead > 800 mg/kg at 3 to 4 ft bgs

Attachment E:
Dissolution of Kalihi Taro And Land Company,
Limited

The Anahulu Whiskey Company, Limited

In the Matter of the Dissolution and
Disincorporation of

KALIHI TARO AND LAND COMPANY, LIMITED,

an Hawaiian corporation.

DECREE OF DISSOLUTION.

TO WHOMSOEVER THESE PRESENTS SHALL COME:

I, HENRY C. HAPAI, Treasurer of the Territory of Hawaii,
send greeting:

WHEREAS, under the provisions of Section 3371 of the
Revised Laws of Hawaii, 1925, as amended by Act 138 of the
Session Laws of 1925, the Treasurer of the Territory is
empowered to dissolve corporations in certain cases therein
specified; and

WHEREAS, KALIHI TARO AND LAND COMPANY, LIMITED, has failed
for a period of two years to file its Annual Exhibit as required
by law, and due notice of my intention to dissolve said cor-
poration and annul its Articles of Association has been published
as required by law;

NOW THEREFORE, KNOW YE, that all the provisions of law
necessary to effect a legal dissolution having been complied with
and no good reason to the contrary appearing, I do hereby
declare the said corporation, KALIHI TARO AND LAND COMPANY,
LIMITED, dissolved and its Articles of Association annulled.

IN WITNESS WHEREOF, I have hereunto
set my hand and affixed the seal
of the Treasurer's Office at the
Capitol at Honolulu, this 25th
day of January, 1926.


Treasurer, Territory of Hawaii

In the Matter of the Dissolution and)
Disincorporation of)
KALIHI TARO AND LAND COMPANY, LIMITED,)
an Hawaiian corporation.)

ORDER APPOINTING TRUSTEE UPON DISSOLUTION.

The Decree of Dissolution of KALIHI TARO AND LAND COMPANY, LIMITED, in accordance with the provisions of Section 3371 of the Revised Laws of Hawaii, 1925, as amended by Act 138 of the Session Laws of 1925, having been made and filed this 25th day of January, 1926, I now do hereby appoint as trustee for the creditors and stockholders

A. Y. SETO,

with full powers to settle the affairs of said company according to law.

Dated at Honolulu, Oahu, Territory of Hawaii,

January 25, 1926.


Treasurer, Territory of Hawaii.

Attachment F:
City and County of Honolulu Letter Regarding
Pavement & Maintenance of Factory Street

DEPARTMENT OF FACILITY MAINTENANCE
CITY AND COUNTY OF HONOLULU

1000 Ulu`ohia Street, Suite 215, Kapolei, Hawaii 96707
Phone: (808) 768-3343 • Fax: (808) 768-3381
Website: www.honolulu.gov

KIRK CALDWELL
MAYOR



July 20, 2016

ROSS S. SASAMURA, P.E.
DIRECTOR AND CHIEF ENGINEER

EDUARDO P. MANGLALLAN
DEPUTY DIRECTOR

IN REPLY, REFER TO:
DEM 16-1

RECEIVED
DEPARTMENT OF HEALTH
2016 JUL 26 A 8:40
HEER OFFICE

Mr. Steven P. Mow, Supervisor
Site Discovery, Assessment, and Remediation Section
HEER Office
State of Hawaii, Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801-3378

Dear Mr. Mow:

SUBJECT: Pavement and Maintenance of Factory Street

This letter is in response to your letter dated July 5, 2016, in regards to the pavement and maintenance of Factory Street.

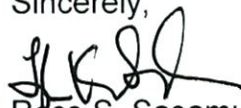
Factory Street was identified as a private roadway that the City has been providing surface maintenance pursuant to Chapter 14, Article 32 of the Revised Ordinances of Honolulu, as amended ("ROH"). Factory Street was identified as in need of resurfacing and will be part of the Rehabilitation of Localized Streets Phase 12C construction project. This contract will be administered by the Department of Design and Construction.

Pursuant to Chapter 14, Article 32, Section 14-32.2(b) of the ROH, "*maintenance work to be performed by the city pursuant to this section shall not include installation or maintenance of curbs, shoulders, gutters, drainage facilities, or similar infrastructure.*" Therefore, the resurfacing of Factory Street will not include the shoulder areas.

To determine the ownership of the street, you would need to perform a title search of Factory Street.

If you have any questions, please contact Mr. Kyle Oyasato of the Division of Road Maintenance at 768-3608.

Sincerely,

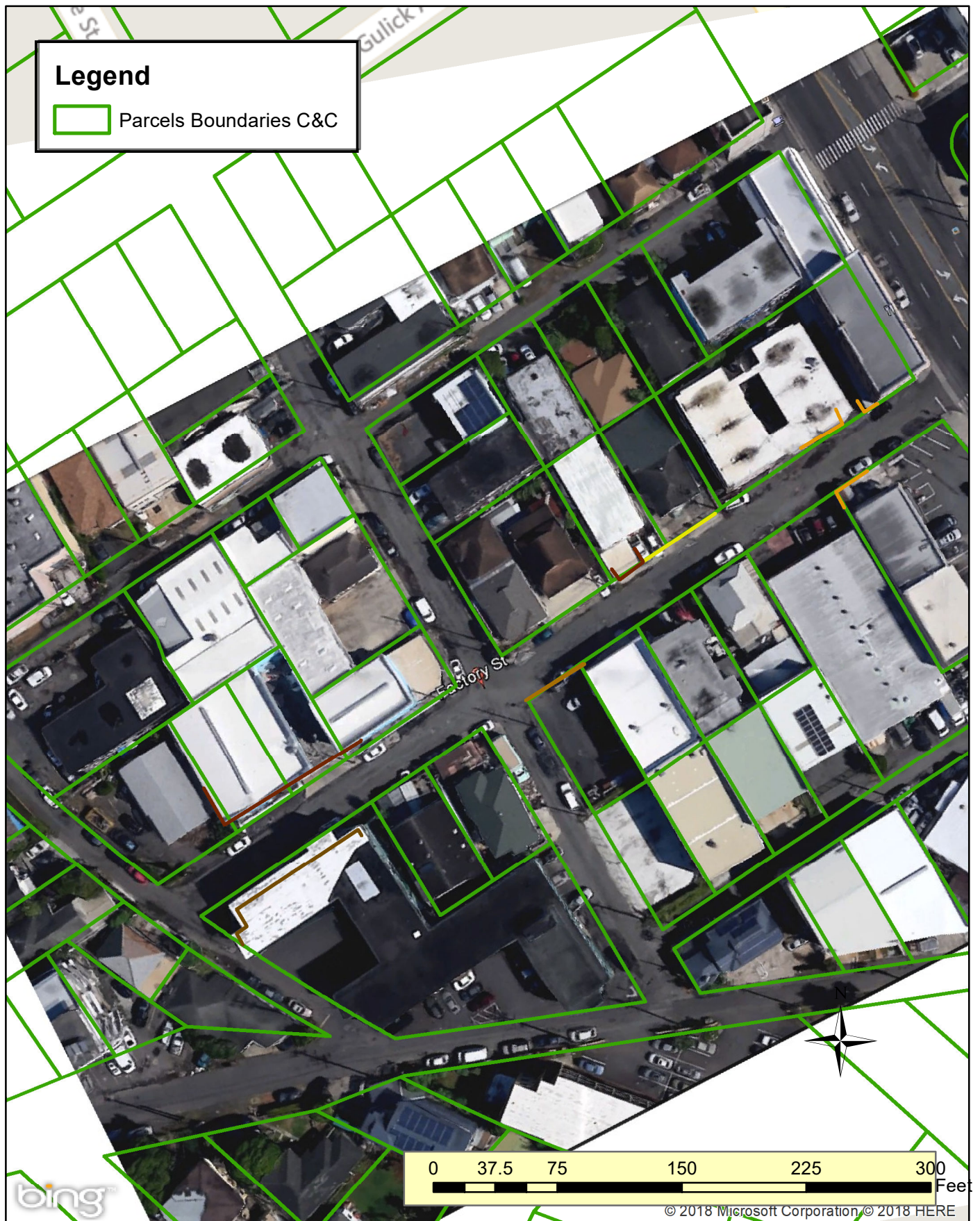

w Ross S. Sasamura, P.E.
Director and Chief Engineer

cc: Department of Design and Construction

 **SCANNED**

121141

**Attachment G: Reconstruction of Property Lines at
Factory Street**



Property Boundaries In Relationship to Buildings



Lauwa'e C.

RECEIVED
DEPARTMENT OF HEALTH

2017 FEB - 6 A 10: 42

HEER OFFICE

2/2/2017

State of Hawaii
Department of Health
Hazard Evaluation and Emergency Response Office
919 Ala Moana Boulevard, Room 206
Honolulu, Hawaii 96814
Attention: Iris van der Zander, Remedial Project Manager

Subject: 815 & 817 Factory Street Hazard Inquiry

Aloha Ms. Van der Zander,

I have enclosed the documents regarding my partial ownership with my sister-in-law, Barbara Jean L. Ah Mau.

Please note the following:

815 Factory Street

- Address: 815 / ***817 is used to identify our property for L Cazimero & Barbara Jean Ah Mau for mail purposes***
- Address: 815 Factory Street is the inner lot fronted by Factory Street only.

817 Factory Street

- Address: 817 / ***819 is used to identify property owner, Kealii Lum, for mail purposes***
- Please send a separate inquiry with all of the same documents to Kealii Lum, because he is the legal owner of the parcel that you note as "817 Factory Street". It is the corner lot fronted by Waterhouse and Factory Streets
- I crossed out Ah Mau & Cazimero on upper left corner and attached a label with ***Kealii Lum*** as owner of this parcel to photo you have marked as 817 Factory Street, Honolulu, HI

I'm not quite sure what this all entails, but will be on standby for any information you may be able to provide regarding the testing of samples from our property.

Sincerely,

Mrs. Lauwa'e Cazimero / Part Owner
817 Factory Street
Honolulu, HI 96819

124395

Ms. Ah Mau & Ms Cazimero,
Attachment B: Identification of Ownership of Property of Interest

The red outlined highlighted area in Attachment A (please check what is applicable)

☐ Is not part of my property

☒ Is part of my property

☐ Is unknown if it is part of my property

L. Cazimero Lauwa'e A. Cazimero + Barbara J. Ah Mau
(Print Name) Barbara J. Ah Mau

[Signature]
Signature(s)

7 February 2017
Date

Ms. Ah Mau & Ms Cazimero,
Attachment B: Identification of Ownership of Property of Interest

Attachment B: Identification of Ownership of Property of Interest

OWNERSHIP OF PROPERTY

815 Factory Street, Honolulu, HI



Part of 815 Factory Street Property?

Ms. Ah Mau & Ms Cazimero,
Attachment A: Property of Interest

~~Ms. Ah Mau & Ms Cazimero,~~
Attachment A: Property of Interest

Attachment A: 817 Factory (819)
Property Interest belongs to:
~~X~~ Kealii Lum
Legal owner

817 Factory Street, Honolulu, HI



Part of 817 Factory Street Property?



WESLEY T. TENGAN

Licensed Professional Land Surveyor

P.O. Box 240953 • Honolulu, Hawaii 96824 • 735-4207 phone • 735-6037 fax

Monday, March 03, 2003

Guardian Escrow Services
2347 S. Beretania St., Suite 200
Honolulu, Hawaii 96826

Attn: Frances Goo

RE: Parcel 2 of Tax Map Key 1-2-11
914 Factory Street
Seller: Bautista

Dear Ms. Goo,

This is to inform you that on February 26, 2003, a survey crew under my supervision and direction staked the subject lot and located improvements along the perimeter.

The following is a list of improvements located along with their respective positions:

- A. End of metal gate extends approximately 0.1 ft. into Parcel 3.
- B. Shed extends approximately 0.2 ft. to 0.2 ft. for a length of 20.6 ft. into Parcel 3.
- C. Tile wall is on Parcel 3.
- D. Concrete extends approximately 0.2 ft. to 0.2 ft. for a length of 58.1 ft. into Parcel 3.
- E. Shed extends approximately 0.2 ft. to 0.25 ft. for a length of 18.3 ft. into Parcel 3.
- F. End of tile wall extends approximately 6.3 ft. into Parcel 3 and Parcel 43. Another portion of it extends approximately 0.2 ft. to 0.1 ft. for a length of 39.5 ft. into Parcel 44.
- G. Tile wall is on subject Parcel 2.
- H. Shed is on subject Parcel 2.
- J. Asphalt extends approximately 0.1 ft. to 0.3 ft. to 0.1 ft. for a length of 79.1 ft. into subject Parcel 2.
- K. Chainlink fence extends approximately 0.0 ft. to 0.4 ft. to 0.0 ft. for a length of 78.3 ft. into subject Parcel 2.
- L. Concrete is on subject Parcel 2.
- M. Garage extends approximately 0.2 ft. into Parcel 1. Another portion of it extends 0.5 ft. into Factory Street.
- N. Wood deck extends approximately 0.5 ft. to 0.5 ft. for a length of 6.1 ft. into Factory Street.

Should you have any questions, please contact me at 735-4207 or on my pager at 539-6158.

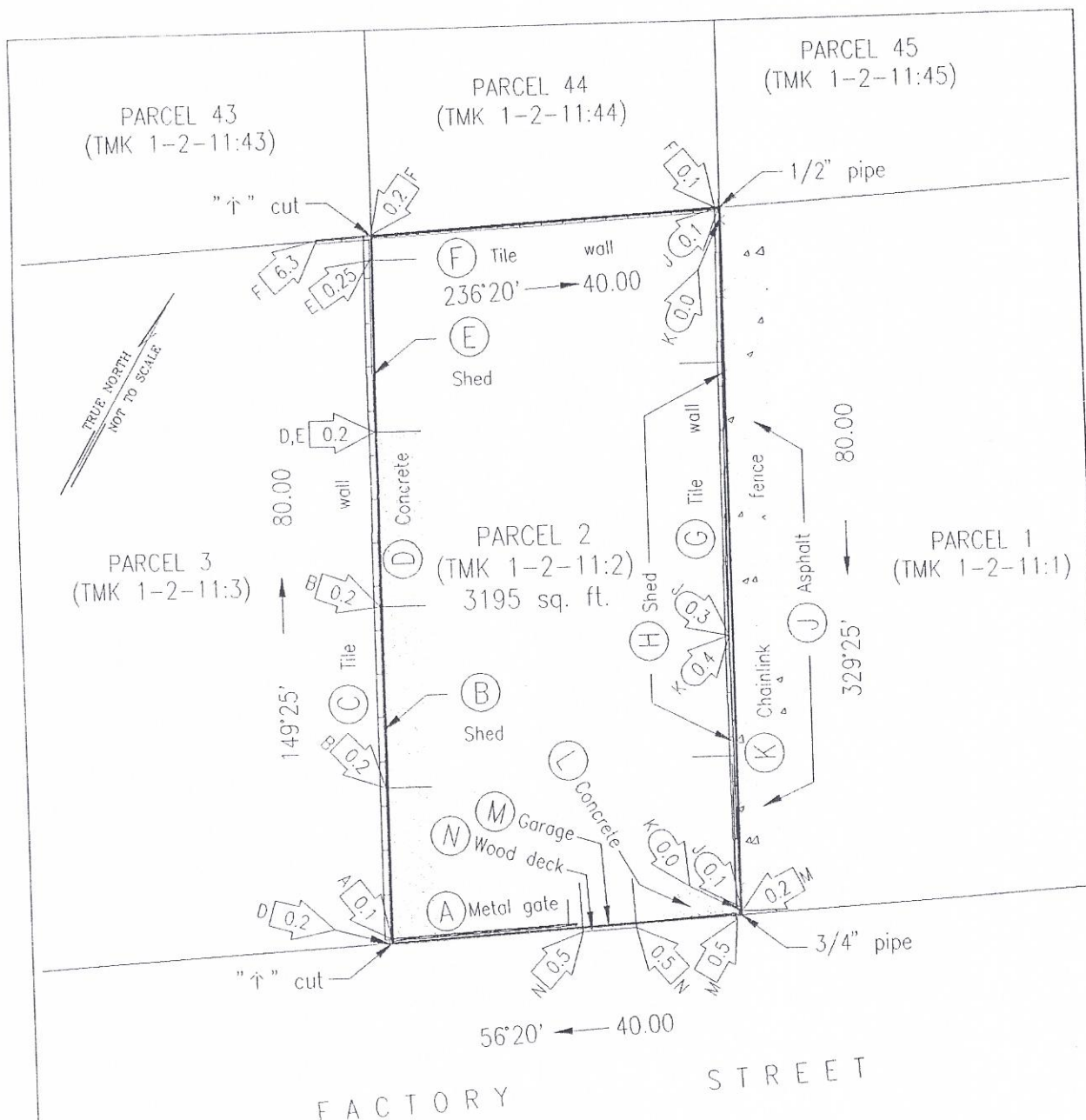
Very Truly Yours,

Wesley T. Tengan
WESLEY T. TENGAN
Licensed Professional Land Surveyor

REVIEWED BY: [Signature]

BY: [Signature]
DATE: 3/3/03

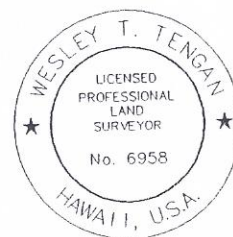
Thank You ...



PERIMETER MAP

PARCEL 2

Kalihi, Honolulu, Oahu, Hawaii
 Date: February 26, 2003
 Tax Map Key: 1-2-11:2
 Seller: Bautista



THIS WORK WAS PREPARED BY ME
 OR UNDER MY SUPERVISION

Wesley T. Tengan
 Signature

Notes:

- Only improvements shown were located
- 0.1 denotes approximate distance out of property
- 0.1 denotes approximate distance into property

WESLEY T. TENGAN
LICENSED PROFESSIONAL LAND SURVEYOR

P.O. Box 240953
Honolulu, Hawaii 96824
(808)735-4207 Office (808)539-6158 Pager (808)735-6037 Fax

INVOICE

BILL TO: Guardian Escrow Services
2347 S. Beretania St., Suite 200
Honolulu, Hawaii 96826

JOB ADDRESS: 914 Factory Street

SELLER: Bautista

ESCROW OFFICER: Frances Goo

REALTOR: Robert Fulford

DESCRIPTION OF WORK:

For restaking of boundaries for Parcel 2
of Tax Map Key 1-2-11

For perimeter map

SERVICES:	\$1,150.00
TAX:	46.00
TOTAL AMOUNT:	\$1,196.00

WORK ORDERED BY:
Robert Fulford

DATE COMPLETED:
3/3/03



Thank you!

GOODSILL ANDERSON QUINN & STIFEL

A LIMITED LIABILITY LAW PARTNERSHIP LLP

FIRST HAWAIIAN CENTER, SUITE 1600 • 999 BISHOP STREET
HONOLULU, HAWAII 96813

MAIL ADDRESS: P.O. BOX 3196
HONOLULU, HAWAII 96801

TELEPHONE (808) 547-5600 • FAX (808) 547-5880
info@goodsill.com • www.goodsill.com

DAVID J. REBER
THOMAS W. WILLIAMS, JR.
LANI L. EWART
RANDALL K. STEVERSON
LISA WOODS MUNGER
PETER T. KASHIWA
RUSSELL S. KATO
VINCENT A. PIEKARSKI
MICHAEL J. O'MALLEY
GAIL Y. COSGROVE
LEIGHTON J.H.S. YUEN
BARBARA A. PETRUS
PATRICIA M. NAPIER
MIKI OKUMURA
AUDREY E. J. NG
ALAN S. FUJIMOTO
RAYMOND K. OKADA
GAIL O. AYABE
DALE E. ZANE
LINDALEE K. FARM

JUDY YURIKO LEE
LENNE S. OMURO
PETER Y. KIKUTA
THOMAS BENEDICT
EDMUND K. SAFFERY
LISA A. BAIL
CAROLYN K. WONG
REGAN M. IWAO
DAWN T. SUGIHARA
ROSEMARIE S. J. SAM
JOHNATHAN C. BOLTON
BRETT R. TOBIN
CLAIRE E. GOLDBERG
WALTER K. CORONEL
H. GREGORY NASKY
CALVIN E. YOUNG
DAVID A. GRUEBNER
MICHAEL L. KORNICZKY
JOHN S. MACKEY

JOANNE J. LEE
STACY Y. MA
DAVID J. HOFTIEZER
SCOTT K.D. SHISHIDO
TRAVIS M. AGUSTIN
SHIMPEI OKI
JORDAN M. ODO
ALANA PEACOTT-RICARDOS
JENNIFER M. YAMANUHA
LISA Y. TELLIO
LYNDA L. ARAKAWA
CHRISTINE A. TERADA
JENNIFER F. CHIN
MAEGAN A. RUGGLES
LAUREN K. CHUN
ANDREW K. RECKTENWALD
DANIEL R. LAM
KELLY K. SUZUKA
DYLAN J. TASCHNER

COUNSEL:
JACQUELINE L.S. EARLE
ROBERT J. HACKMAN
ELIZABETH H. LEE
NICOLE Y. ALTMAN

OF COUNSEL:
MARTIN ANDERSON
CONRAD M. WEISER
RONALD H. W. LUM

MARSHALL M. GOODSILL
(1916-2004)
WILLIAM F. QUINN
(1919-2006)
RICHARD E. STIFEL
(1920-1993)
JOHN R. LACY
(1942-2014)

June 1, 2017

E-MAIL AND CERTIFIED MAIL

Steven P. Mow
Supervisor, Site Discovery, Assessment, and Remediation
Office of Hazard Evaluation and Emergency
Hawaii Department of Health
919 Ala Moana Boulevard, Room 206
Honolulu, Hawaii 96814
steven.mow@doh.hawaii.gov

Dear Mr. Mow:

I am writing on behalf of my client, Merton Lau, in response to your letter dated May 5, 2017. Your letter states that the Department of Health, Office of Hazard Evaluation and Emergency Response ("DOH") "has determined that a release or threat of release of a hazardous substance to the environment as defined in HRS § 128D-1 has occurred at and from your property." The letter notifies Mr. Lau of his "potential liability pursuant to HRS § 128D-6 with respect to this release at the Site," and "requires investigation and characterization of the release and additional response actions as appropriate on Factory Street and its shoulder area." (Emphasis added).

Through the months of August, September and October 1993, Mr. Lau worked closely with William Perry and Mike Cripps of DOH in conducting a removal action at his property at 2003 N. King Street (the "Property") and on October 12, 1993, he received a "no further action" letter from DOH, as acknowledged in your letter. We do not understand your letter to request further investigation of the Property, only of "Factory Street and its shoulder area." If DOH is asking for Mr. Lau to conduct investigation activities within his Property boundary, we request that you clarify: (1) the exact locations on the Property that are the subject of your request; and (2) the reasons why the previous "no further action letter" obtained after working under close supervision by Mr. Perry, is not sufficient to answer questions about the extent of lead impacts within the Property. We have enclosed a surveyor's map of the Property showing the property boundaries for your ready reference.

Steven P. Mow
June 1, 2017
Page 2

Insofar as your requests relate to “Factory Street and its shoulder area,” however, Mr. Lau is not willing to conduct investigative activities that are not located on property he does not own, which includes Factory Street.

According to the 1995 EPA Factory Street Lead Site Assessment Report (“EPA Report”)¹, which assessed the Factory Street area for lead contamination, the lead contamination in the area came from the manufacture of fishing weights at a fishing supply shop formerly located at the site. EPA Report at 1. A citizen who grew up in the affected area called DOH HEER on August 26, 1993 and identified the Property as having once been the site of a fishing supply store named Kalihi Fishing Supply. *Id.* at 4. According to the citizen, Kalihi Fishing Supply “dumped lead ash from the manufacture of sinkers on the ground behind the store from at least 1955 through 1966.” *Id.* (emphasis added). The citizen indicated that the lead may have been derived from discarded automobile batteries. *Id.*

Mr. Lau purchased the Property on December 24, 1986, about 20 years after the ash was dumped. Mr. Lau did not acquire any part of Factory Street when he purchased the Property. Mr. Lau therefore cannot be held liable under HRS Chapter 128D for cost recovery because he is not a potentially responsible party (“PRP”), as follows.

First, Mr. Lau is not an owner or operator of Factory Street pursuant to HRS § 128D-6. Indeed, the EPA Report concluded that “the land which the street occupies has been abandoned.” EPA Report at 17.

Second, Mr. Lau did not own or operate “any facility at which . . . hazardous substances were disposed of” at the time of their disposal. *Id.* As noted above, the lead contamination occurred from 1955 through 1966, and Mr. Lau did not purchase the Property until 1986. Furthermore, the objective of the EPA’s 1995 soil investigation was, “To determine if lead contamination originating at the site had migrated off site.” EPA Report at 15. EPA noted in its report that “[m]oderate levels were also found in surface soils away from the apartment complex site,” and concluded that “[t]his contamination could not be directly attributed to a source on the site.” EPA Report at 1 (emphasis added); *see also id.* at 15. Therefore, causation of any off-site contamination has already been investigated by EPA, and EPA has concluded that the Property was not the cause of any off-site contamination.

Finally, Mr. Lau is not an “arranger” or “transporter” pursuant to HRS § 128D-6 because the contamination activities occurred prior to his involvement with the Property.

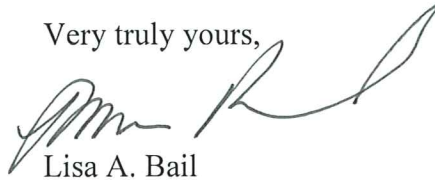
It is therefore clear that Mr. Lau is not a PRP relating to Factory Street. While he is willing to cooperate with DOH relating to the No Further Action letter issued by DOH for the

¹ On July 11, 1994, the EPA Emergency Response Section (“ERS”) directed the Zone II Region IX Technical Assistance Team (“TAT”) to conduct a site assessment of the four-block area centered on the intersection of Factory and King Streets.

Steven P. Mow
June 1, 2017
Page 3

contamination on his Property, he is not willing to conduct off-site investigation activities.
Please do not hesitate to contact me if you have any questions.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Lisa A. Bail', with a stylized flourish extending to the right.

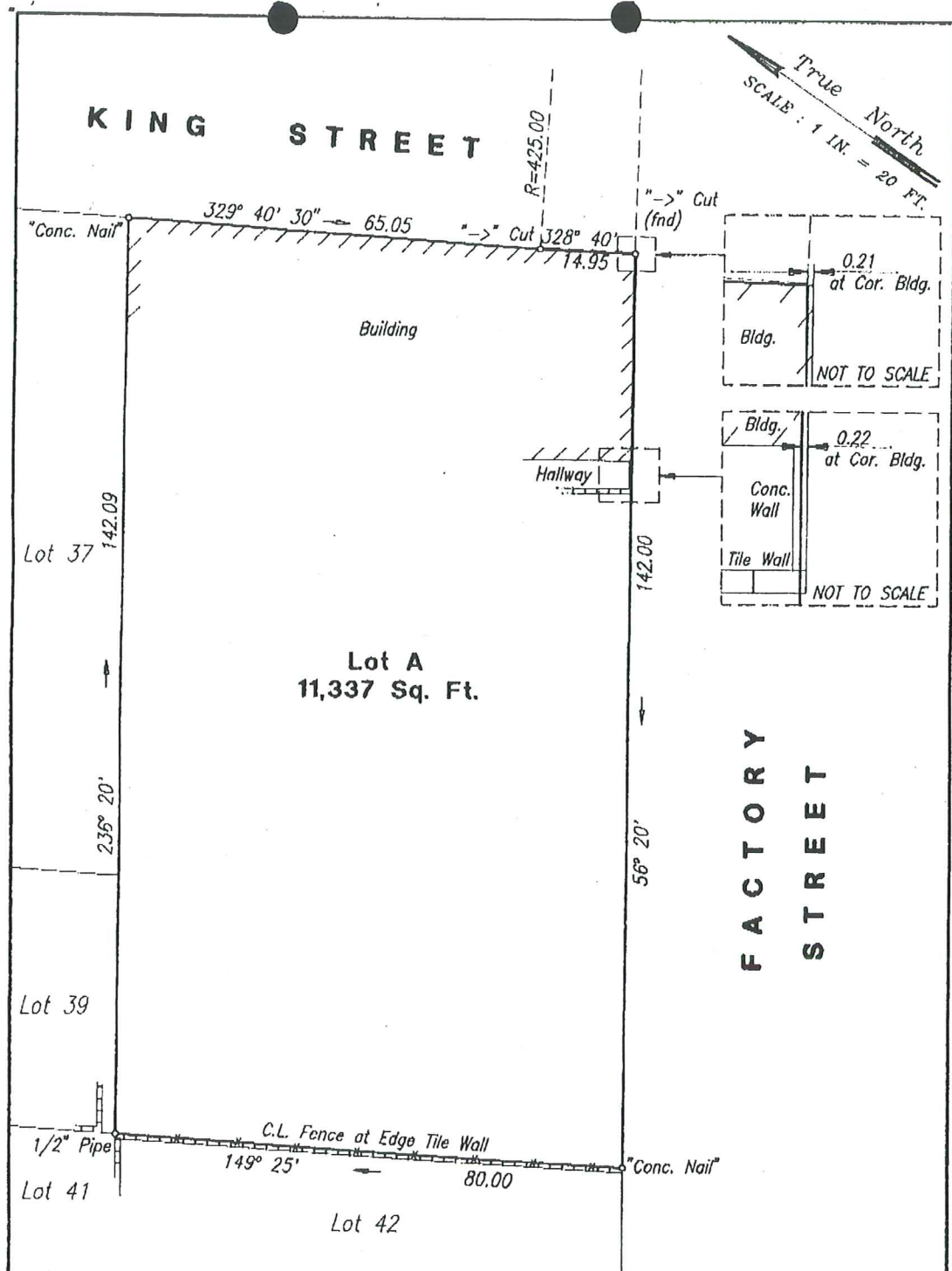
Lisa A. Bail

LAB

Enclosure:

Plan Showing TMK 1-2-11:01, prepared by Engineers Surveyors Hawaii, Inc. (August 5, 1993)

cc (w/encl): Merton Lau
Kathleen Ho, Esq.



Plan Showing
 Lot A of File Plan 79
 of portion of "Waterhouse Tract"
 at Kalihi-Kai, Honolulu, Oahu, Hawaii
 T.M.K. : 1-2-11 : parcel 01

This work was prepared by me or
 under my direct supervision.

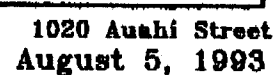
Kendall N. H. Hee
 Registered Professional Land Surveyor
 Certificate Number 5649

Client: Merton Lau

Honolulu, Hawaii
 FB: 900 / pgs. 39-41
 93-105

ENGINEERS SURVEYORS HAWAII, INC.
 CIVIL ENGINEERS ~ LAND SURVEYORS ~ PLANNERS

1020 Auahi Street
 August 5, 1993



vanderZander, Iris

From: Bail, Lisa A. <lbail@goodsill.com>
Sent: Tuesday, July 18, 2017 8:24 AM
To: vanderZander, Iris
Cc: Ho, Kathleen S; Grange, Gabrielle Fenix; Mow, Steven P; Galvez, Elizabeth (Liz)
Subject: RE: Factory Street -path forward

Iris,

This confirms the following:

- we have provided all survey maps we have been able to find in our files
- we have confirmed that Merton does not have any easement rights that would allow him to maintain the street
- we are unable to remove parking signs (there are two parking signs, but they do not belong to Merton and are not on his property)

Please keep us apprised of scheduling for DOH's contractor, and send me a copy of one of the notices that gets sent to the residents in advance of that work.

Lisa A. Bail, Esq.

Goodsill Anderson Quinn & Stifel
A LIMITED LIABILITY LAW PARTNERSHIP LLP

First Hawaiian Center / Suite 1600 / 999 Bishop Street / Honolulu, Hawaii 96813
P. (808) 547-5787 / F. (808) 441-1202
E. lbail@goodsill.com
www.goodsill.com

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From: vanderZander, Iris [mailto:iris.vanderzander@doh.hawaii.gov]
Sent: Thursday, July 06, 2017 9:28 AM
To: Bail, Lisa A.
Cc: Ho, Kathleen S; Grange, Gabrielle Fenix; Mow, Steven P; Galvez, Elizabeth (Liz)
Subject: RE: Factory Street -path forward

Lisa,

Thanks, for the clarification and getting back to me quickly. We will be sending out notifications to the residents that we will be conducting the assessment (outside your client's property boundaries that we based on the BWS engineering



WESLEY T. TENG.

Licensed Professional Land Surveyor

P.O. Box 240953 • Honolulu, Hawaii 96824 • 735-4207 phone • 735-6037 fax

Monday, September 06, 2004

Affordable Homes Insp.
P.O. Box 26350
Honolulu, Hawaii 96825

Attn: Jeffrey Aki

RE: Parcel 63 of Tax Map Key 1-2-1
905 Factory Street
Lot 12 of Kalihi Poi Factory Tract
Seller: Angelo

Dear Mr. Aki,

This is to inform you that on September 1, 2004, a survey crew under my supervision and direction staked the subject lot and located improvements along the perimeter.

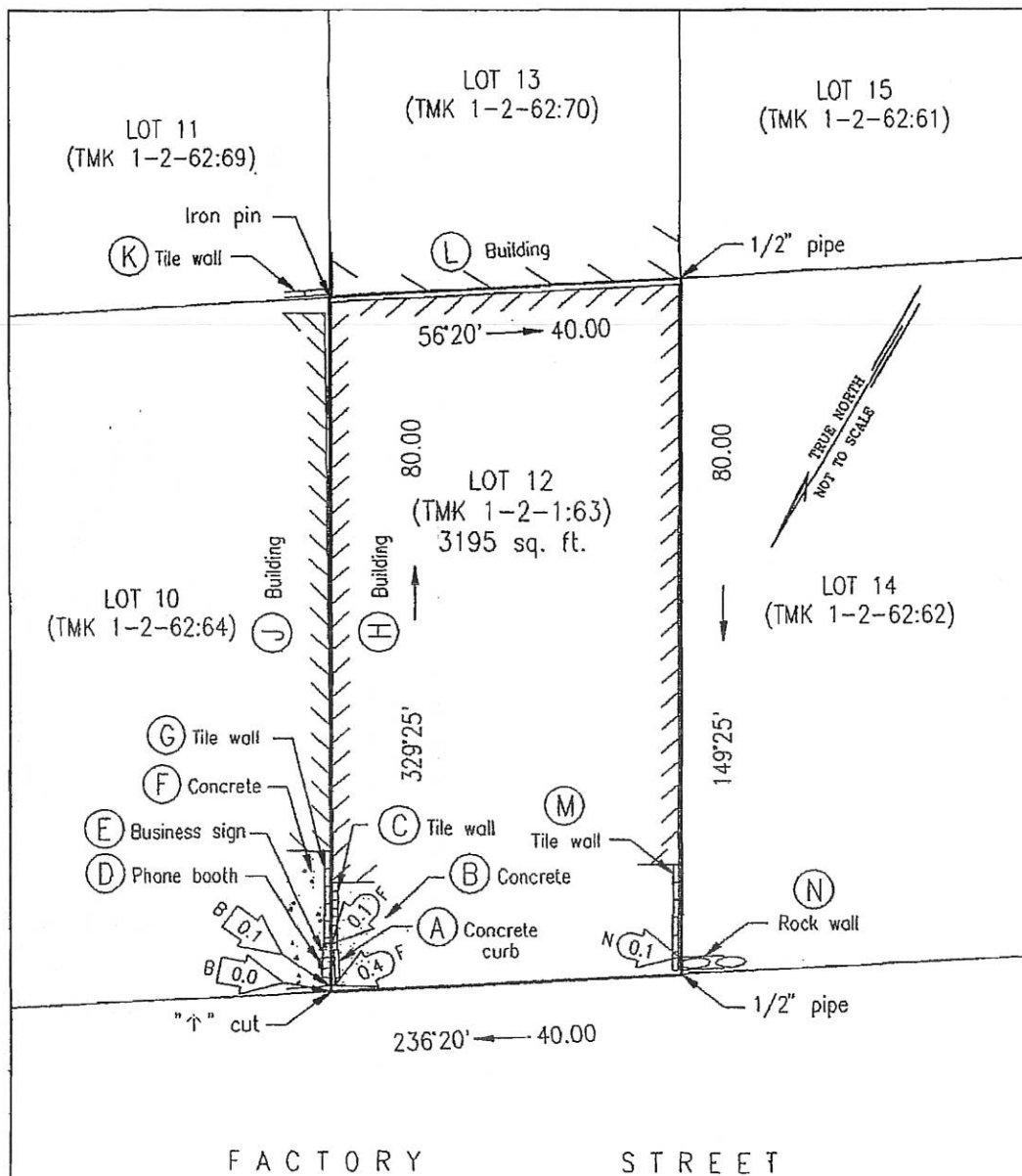
The following is a list of improvements located along with their respective positions:

- City*
- A. Concrete curb is on subject Lot 12.
 - B. Concrete from subject Lot 12 extends approximately 0.0 ft. to 0.1 ft. for a length of 0.6 ft. into Lot 10.
 - C. Tile wall is on subject Lot 12.
 - D. Phone booth is on Lot 10.
 - E. Business sign is on Lot 10.
 - City* ~~F.~~ Concrete from Lot 10 extends approximately 0.4 ft. to 0.1 ft. for a length of 4.8 ft. into subject Lot 12.
 - G. Tile wall is on Lot 10.
 - H. Building is on subject Lot 12.
 - J. Building is on Lot 10.
 - K. Tile wall is on Lot 11.
 - L. Building is on Lot 13.
 - ~~M.~~ Tile wall is on subject Lot 12.
 - ~~N.~~ End of rock wall from Lot 14 extends approximately 0.1 ft. into subject Lot 12.

Should you have any questions, please contact me at 735-4207 or on my pager at 539-6158.

Very truly yours,

WESLEY T. TENGAN
Licensed Professional Land Surveyor



PERIMETER MAP
LOT 12
KALIHI POI FACTORY TRACT
FILE PLAN 247

Niau & Mokauea, Kalihi, Honolulu, Oahu, Hawaii

Date: September 1, 2004

Tax Map Key: 1-2-1:63

Seller: Angelo



THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

Wesley T. Tengan
Signature

Notes:

1. Only improvements shown were located
2. All easements may not be shown
3. 0.1 denotes approximate distance out of property
4. 0.1 denotes approximate distance into property

905 Factory Street, Honolulu



905 Factory Street, Honolulu



Site walk on 1/25/2017- 806 Factory Street



Photo 1: Property marker as shown by Wei Ling Fung (Owner) and Summer Xia at 806 Factory Streets on 1/24/2017. The marker is behind the fence line and the shoulder area.



Site walk on 1/25/2017- 806 Factory Street



Photo 2: End of Property as shown by Weil Ling Fung (Owner) and Summer Xia at 806 Factory Streets on 1/24/2017 at corner of Factory Street and Stanley Street (behind hedge towards the house). No marker was apparent, but the location agrees with the boundary as marker by the marker in Photo 1.



±
1/25/2017

Factory Street 806 Property, Honolulu, HI



Part of 806 Factory Street Property?

Wei Ling Fung

Attachment B: Identification of Ownership of Property of Interest

The yellow highlighted area in Attachment A (please check what is applicable)

- ☒ Is not part of my property
- ☐ Is part of my property
- ☐ Is unknown if it is part of my property

WEI LING FUNG
(Print Name)

Wei Ling Fung
Signature(s)

1/24/2017
Date

vanderZander, Iris

From: Bail, Lisa A. <lbail@goodsill.com>
Sent: Tuesday, July 18, 2017 8:24 AM
To: vanderZander, Iris
Cc: Ho, Kathleen S; Grange, Gabrielle Fenix; Mow, Steven P; Galvez, Elizabeth (Liz)
Subject: RE: Factory Street -path forward

Iris,

This confirms the following:

- we have provided all survey maps we have been able to find in our files
- we have confirmed that Merton does not have any easement rights that would allow him to maintain the street
- we are unable to remove parking signs (there are two parking signs, but they do not belong to Merton and are not on his property)

Please keep us apprised of scheduling for DOH's contractor, and send me a copy of one of the notices that gets sent to the residents in advance of that work.

Lisa A. Bail, Esq.

Goodsill Anderson Quinn & Stifel
A LIMITED LIABILITY LAW PARTNERSHIP LLP

First Hawaiian Center / Suite 1600 / 999 Bishop Street / Honolulu, Hawaii 96813

P. (808) 547-5787 / F. (808) 441-1202

E. lbail@goodsill.com

www.goodsill.com

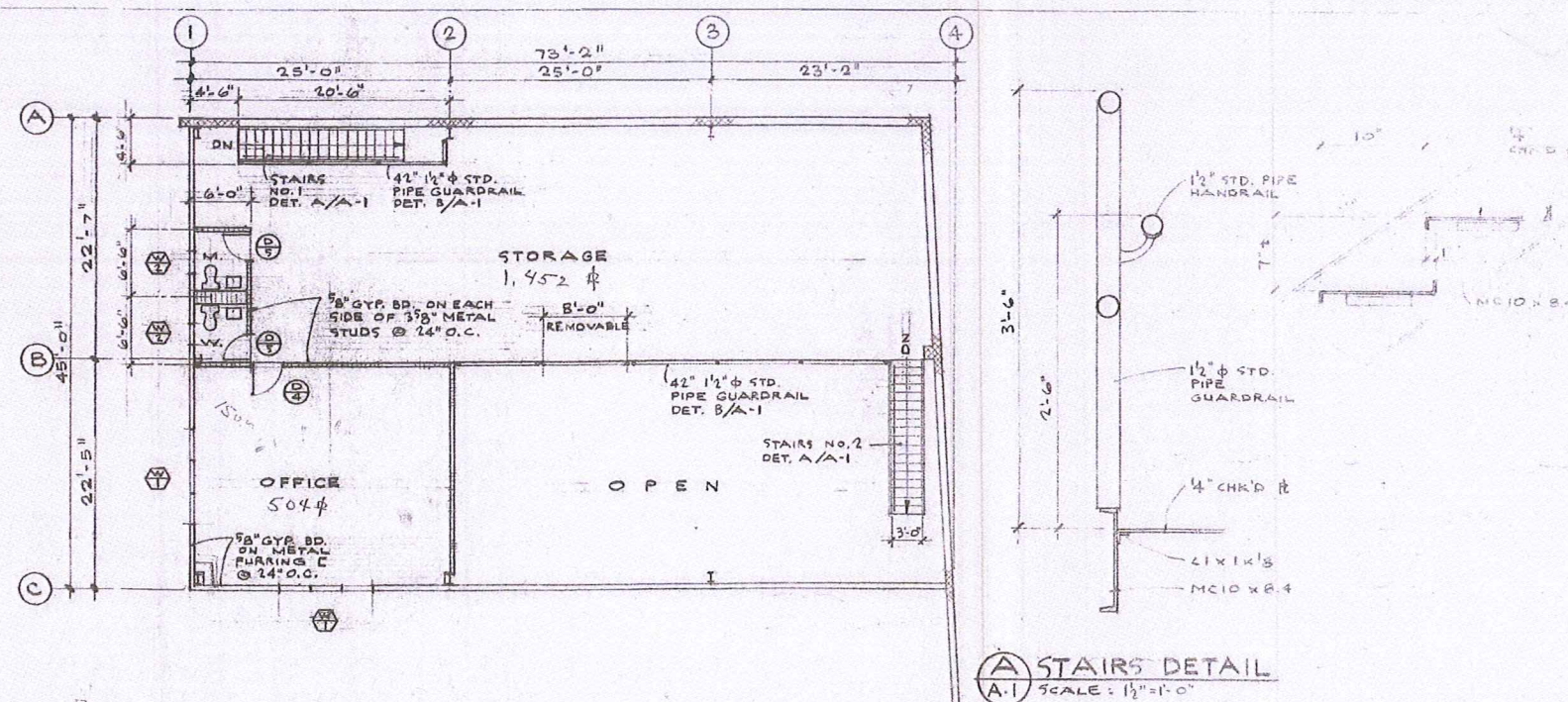
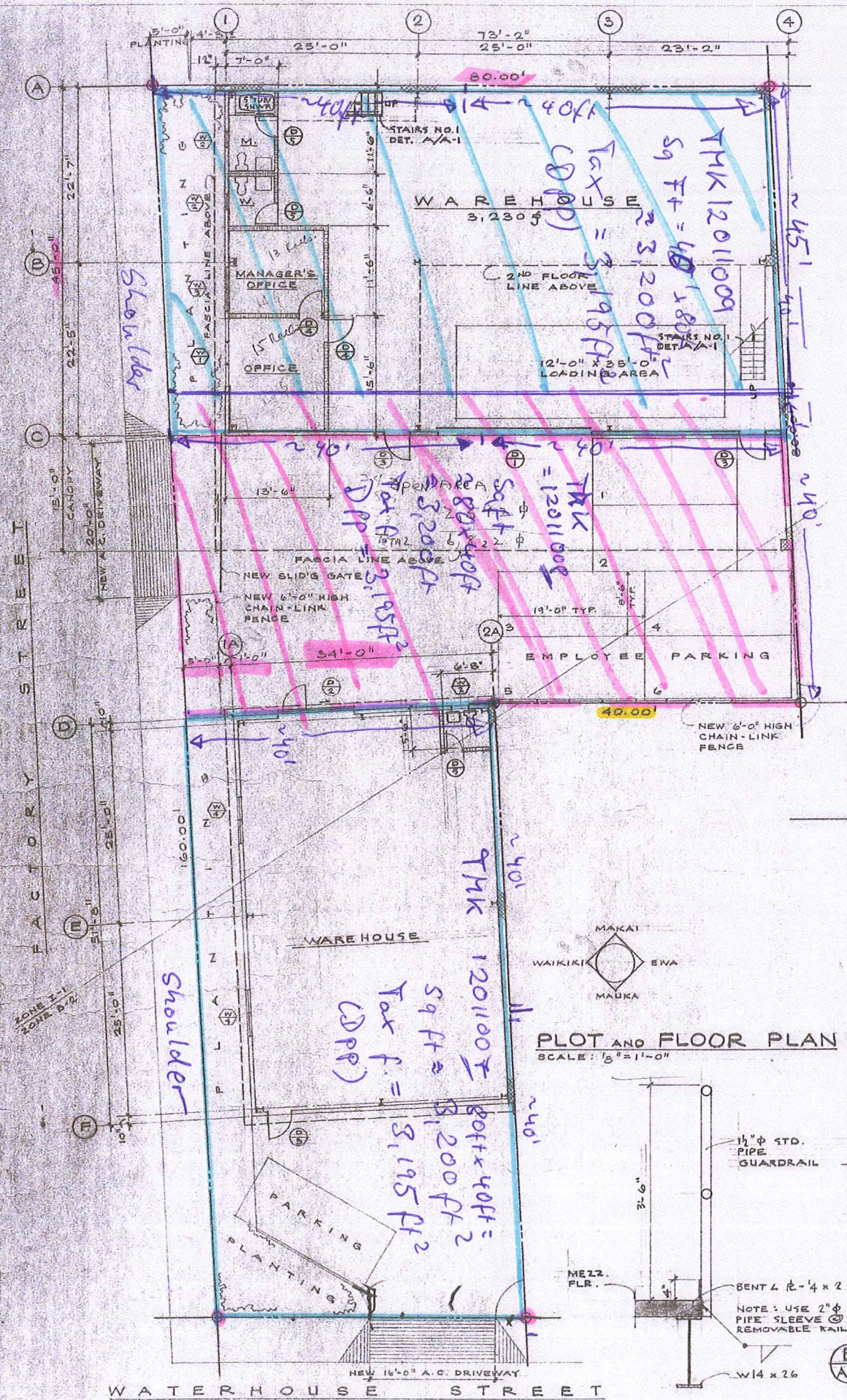
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From: vanderZander, Iris [mailto:iris.vanderzander@doh.hawaii.gov]
Sent: Thursday, July 06, 2017 9:28 AM
To: Bail, Lisa A.
Cc: Ho, Kathleen S; Grange, Gabrielle Fenix; Mow, Steven P; Galvez, Elizabeth (Liz)
Subject: RE: Factory Street -path forward

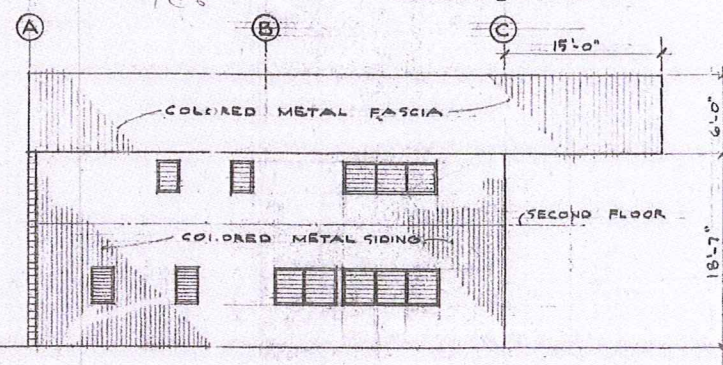
Lisa,

Thanks, for the clarification and getting back to me quickly. We will be sending out notifications to the residents that we will be conducting the assessment (outside your client's property boundaries that we based on the BWS engineering

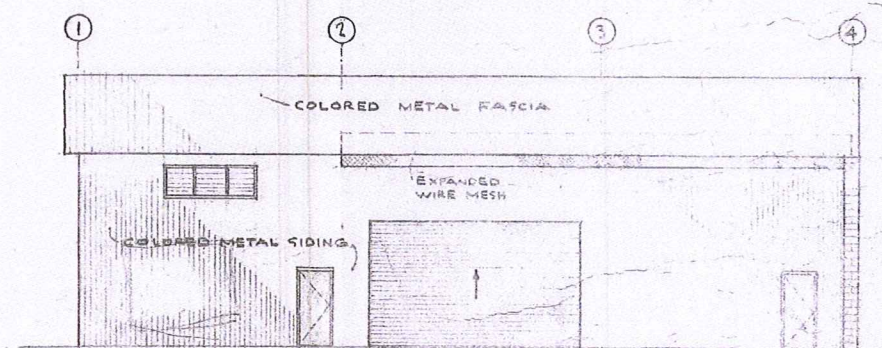
Attachment I:
Building Permits showing 5 foot setback enforcement
by City and County DPP at
Factory Street 808



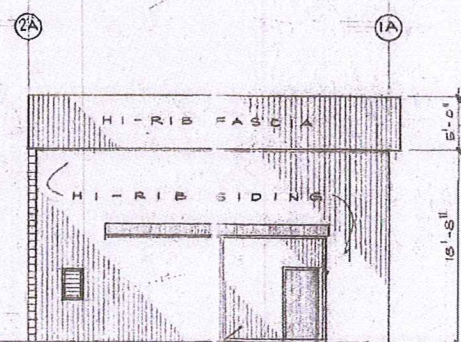
SECOND FLOOR PLAN
SCALE: $\frac{1}{8}'' = 1'-0''$



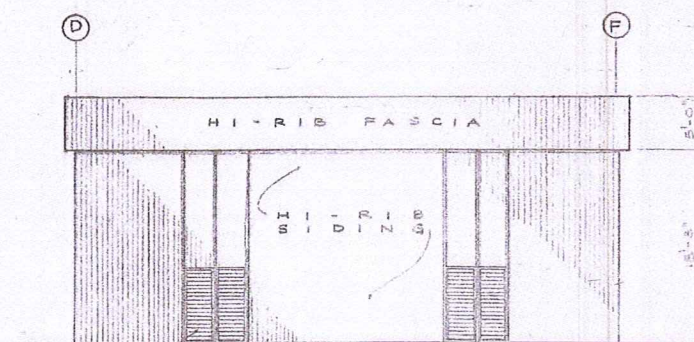
WAIKIKI ELEVATION - WHSE.
SCALE: 1" = 1'-0"



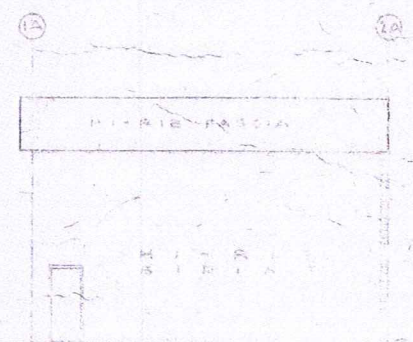
MAUKA ELEVATION - WHEEL
SCALE: 1/8" = 1'-0"



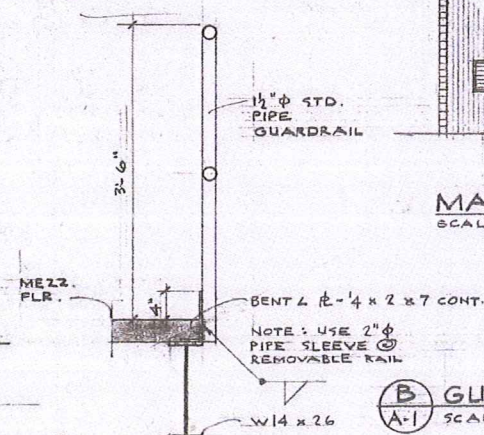
MAKAI ELEV. -
SCALE: 1" = 1'-0"



WAIKIKI ELEV. -
SCALE: 1" = 1'-0"



www.nasa.gov
www.nasa.gov/pdf
www.nasa.gov/pdf

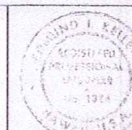


(B) GUARDRAIL DETAIL
A-1 SCALE: 1" = 1'-0"

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THE PROJECT WILL BE UNDER MY SUPERVISION.

SIGNATURE _____

NOTE:
CONTRACTOR TO CHECK AND VERIFY ALL DIMEN
SIONS AT JOB BEFORE PROCEEDING WITH WORK



SCALE
AS NOTED

DATE 9/1/73

NEW WORKSHOP FOR
INTERNATIONAL PLUMBING

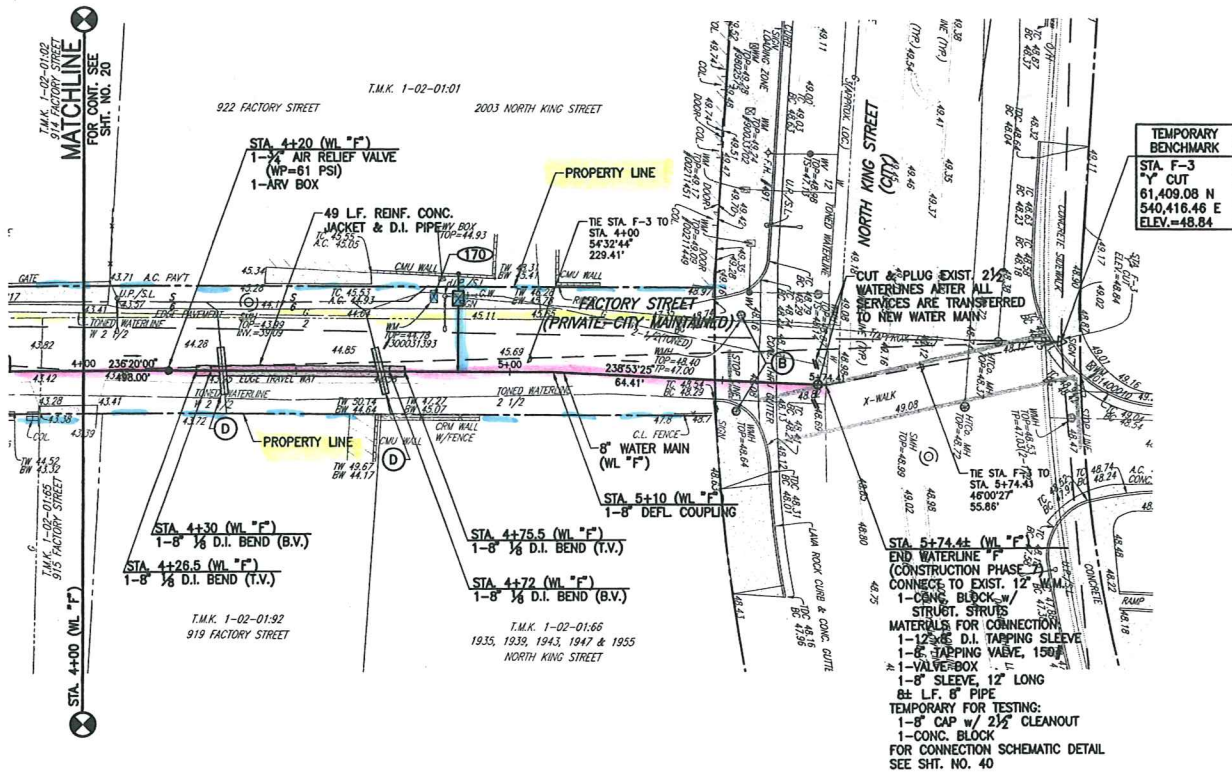
PLOT AND BLOCK PLAN
EXTERIOR ELEVATION



MUTUAL FIDELITY CO. 11
721 1/2 N. 4TH ST. MINN.

SERVICE CONNECTION SCHEDULE									
EXISTING					NEW				
ID#	PREM-ID	M/N	MTR SIZE	LAT TYPE	BOX TYPE	CU RECON TYPE BOX	LATERAL TYPE BOX	COMMENTS	
170	1027691	00700039	07	E	CU	B	E/III		

- NOTES:
- 4" THROUGH 8" WATER MAIN SHALL BE PVC DR14 CLASS 200 PIPE. ALL FITTINGS SHALL BE DI.
 - FOR SERVICE LATERAL TAPS INTO THE PVC MAIN, USE DOUBLE DI HUB TEE WITH BOSS.
 - TO THE EXTENT CALLED OUT ON THE PLANS, THE CONTRACTOR SHALL ABANDON THE EXISTING WATER MAIN AFTER TRANSFER OF ALL SERVICES TO THE NEW WATER MAIN.
 - WATER MAINS SHOWN ON THIS SHEET ARE PART OF THE 180' SYSTEM.



New 8" Water main

Laterals

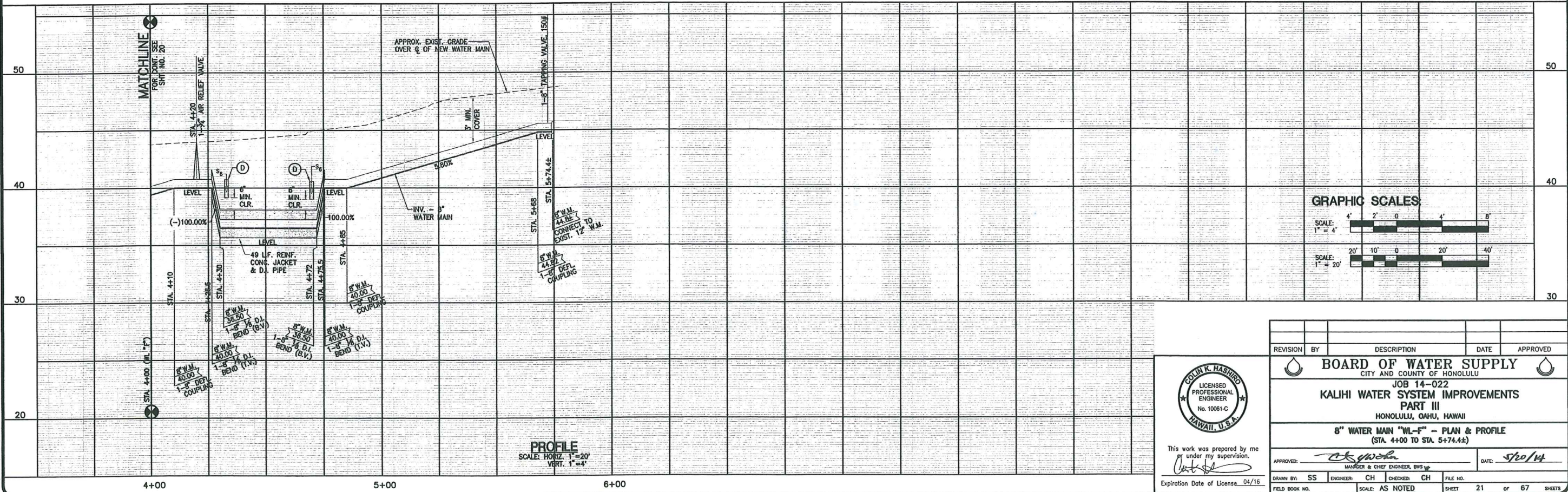
Edge of pavement

Property Line

LEGEND

- // CUT & PLUG
- (A) DEMOLISH VALVE BOX, SALVAGE VALVE BOX FRAME & COVER.
- (B) DEMOLISH MANHOLE, SALVAGE MANHOLE FRAME & COVER.
- (C) DEMOLISH EXIST. FIRE HYDRANT RISER & VALVE BOX/WMH REMOVE EXIST. FIRE HYDRANT REFLECTIVE MARKER. SALVAGE FIRE HYDRANT & VALVE BOX/WMH FRAME & COVER.
- (D) 11 L.F. REINFORCED CONCRETE JACKET
- (E) 7 L.F. REINFORCED CONCRETE JACKET
- (F) PROTECT CATCH BASIN IN-PLACE AND INSTALL SEDIMENT CONTROL FILTER.

PLAN
SCALE: 1"=20'



GRAPHIC SCALES



This work was prepared by me or under my supervision.

Expiration Date of License: 04/16

REVISION	BY	DESCRIPTION	DATE	APPROVED
<div> <div> </div> <div> BOARD OF WATER SUPPLY CITY AND COUNTY OF HONOLULU JOB 14-022 KALIHI WATER SYSTEM IMPROVEMENTS PART III HONOLULU, OAHU, HAWAII 8" WATER MAIN "WL-F" - PLAN & PROFILE (STA. 4+00 TO STA. 5+74.42) </div> </div>				
APPROVED:		DATE: 5/20/14		
DRAWN BY: SS	ENGINEER: CH	CHECKED: CH	FILE NO.:	
FIELD BOOK NO.:		SCALE: AS NOTED		SHEET 21 OF 67 SHEETS