United States Army
Corps of Engineers

Formerly Used Defense Sites Program

Final No DOD Action Indicated Report

Kogru River DEW Line Station
Main Cantonment Area
F10AK0022-03
North Slope Borough, Alaska

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1. Acronyms

The following acronyms are used in this report.

µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
DERP	Defense Environmental Restoration Program
DEW	Distant Early Warning
DOD	U.S. Department of Defense
DOWL	DOWL Engineers
DRO	Diesel Range Organics
EPA	Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GRO	Gasoline Range Organics
InPR	Inventory Project Report
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
OHM	OHM Remediation Services Corporation
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated bi-phenyl
PCP	Pentachlorophenol
POL	Petroleum/oil/lubricant
RRO	Residual Range Organics
SARA	Superfund Amendments and Re-Authorization Act
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
VRCA	VRCA Environmental Services, Inc.

2. Site Information

2.1. Site Location and Description

The Kogru Distant Early Warning (DEW) Line Radar Station was constructed in the late 1950s. The station was given the designator of "POW-B". The Kogru radar station was built on a gravel pad and a composite building, shop building, warehouse, radio tower, an aboveground storage tank (AST) with a pump house originally occupied the site. The site was decommissioned in the early 1960s.

The location of the site is along the northern shore of an ocean inlet named Kogru River and is shown in Figure 2.1. The site lies at approximately latitude 70.574 degrees north, longitude 152.258 degrees west and is depicted on the Harrison Bay C-4 U.S. Geological Survey quadrangle. The site lies in portions of sections 12 and 13 of township 14 north, range 2 west, and sections 7 and 18 of township 14 north, range 1 west of the Umiat Meridian.

This closure report includes only project F10AK0022-03, which includes all areas at the station except the West Landfill. Projects F10AK0022-04 and F10AK0022-05 pertain to various portions of the West Landfill at the site, and are excluded from this closure report.

In 1989, a site investigation was conducted (DOWL, 1992). A removal action took place at the site in 1995 (VRCA, 1996). The site was further cleaned up under the DERP-FUDS program during the summer of 1998 (OHM, 2000). The USACE collected soil, sediment, and water samples for additional site characterization in July 2003. Bristol performed an additional sampling event at the site in 2007, however this sampling event dealt primarily with the West Landfill and included a background metals study. The site currently occupies land under the jurisdiction of the U.S. Department of the Interior, Bureau of Land Management, as part of the National Petroleum Reserve, Alaska (NPR-A).

2.2. History

The U. S. Department of Defense (DOD) approved the DEW system defense plan in December 1952. Its purpose was to detect enemy aircraft flying over the Arctic to North America.

Three types of DEW Line Stations were constructed:

- Main stations, consisting of two 25-module building 'trains', equipped with rotating radar, garages, shops, and warehouses to provide service and logistics support of its sector of the radar system,
- Auxiliary stations consisted of a singe 25-module building, equipped with rotating radar, garages, warehouses, and bulk fuel storage tanks, and
- Intermediate stations consisted of a single 5-module building and support facilities. Intermediate sites contained Doppler-type radar fences, used as gap filling anchor points between rotating radar-equipped stations.

Kogru River was an intermediate station.

2.3. Formerly Used Defense Site Program Management

Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 established the Defense Environmental Restoration Program (DERP). USACE is the responsible agency for investigation and/or remediation of Formerly Used Defense Sites (FUDS).

The goal established for the FUDS program is to develop an execution strategy that includes reducing risk to human health and the environment through implementation and completion of effective, legally compliant, and cost-effective response actions (USACE 2004).

DOWL Engineers performed a site investigation at the site in 1989 (DOWL 1991). Results were detailed in a Pre-Design Final Report finalized in March of 1992.

VRCA performed a remedial action and sampling event at the site in 1995. Results were detailed in a Remedial Action Report published in 1996.

OHM Remediation Services performed a remedial action at the site in 1998. The final report for this action was completed in October of 2000.

The U.S. Army Corps of Engineers conducted a sampling event at the site in 2003 (USACE 2003). This sampling event included both the main cantonment area and the West Landfill. The portion of this work pertaining to the West Landfill is not included in this closure report.

Bristol Environmental and Engineering Service Corporation conducted an environmental sampling event in 2007 (Bristol 2008). The final report for this sampling event was produced in May of 2008. This sampling event primarily pertained to the West Landfill, however, a metals background study included in the report is referenced here.

2.4. Site Cleanup

2.4.1. 1995 VRCA

The following regulated and hazardous materials were encountered during the work activities on the Kogru DEW Line Site Restoration by the contractor VRCA in 1995.

1. Asbestos Containing Material - 24.85 cubic yards.
2. PCB containing electrical equipment - 3,148 lbs.
3. Lead contaminated soil - 1.5 tons.
4. POL contaminated water - 3 drums.
5. Lead Cell Batteries - 560 lb.
6. POL contaminated soil - 851.19 tons.
7. POL contaminated liquids - 215.75 gal.

All items listed above were removed from the site and disposed of by VRCA, except the POL contaminated soil.

In addition to removing the asbestos-containing material from the Composite Building, VRCA also disassembled the structure and removed it from its foundation. The building's creosote-treated wood foundation was also removed from the ground. Fuel day tanks and water tanks were also removed from the interior of the building. VRCA left the entire disassembled Composite Building, except for the asbestos-containing material and PCB electrical equipment, on site. This includes the interior day fuel and water tanks, and the creosote-piling foundation demolition debris. This debris was later removed by OHM.

VRCA removed the asbestos-containing material and ducting, lighting and conduit from the Warehouse Building, removed it from the site and disposed of it. VRCA also removed the arctic entry from the building and left that demolition debris on site. The arctic entry debris was later removed by OHM.

VRCA demolished the Shop Building foundation. The resulting debris was left on site and later disposed of underneath the Warehouse Building's foundation by OHM.

VRCA collected and crushed 57 drums. The empty crushed drums were left on site and later removed by OHM.

VRCA removed the compressed gas cylinders from the Composite Building's fire suppression system and verified that they were empty. The compressed gas cylinders were left on site and later removed by OHM.

VRCA excavated and containerized a total of 512 supersacks of POL contaminated soil and 1.5 tons (1 supersack) of lead contaminated soil from six different excavation areas: 125 supersacks of POL-contaminated soil were removed from excavation Area #1 at the west end of the former Composite Building, 34 supersacks of POL-contaminated soil were removed from excavation Area #2 at the east end of the former Composite Building, 21 supersacks of POL-contaminated soil were removed from excavation Area #3 located west of the concrete AST foundation, 31 supersacks of POL-contaminated soil were removed from excavation Area #4 adjacent to the west end of the Warehouse Building foundation remnant, 21 supersacks of POL-contaminated soil were removed from excavation Area #5 located south of the eastern portion of the Warehouse Building foundation remnant and one supersack of lead-contaminated soil and 281 supersacks of POL contaminated soil were removed from excavation Area #6 which encompassed the former Shop Building's location. The disassembly of the Composite Building facilitated the excavations at Areas #1 and #2. The demolition of the concrete foundation of the former Shop Building enabled the excavation at Area #6. The POL contaminated soil was placed in Super Sacks and left on site and later removed by OHM. The sacks were placed on a pit liner to protect them from ground moisture. Confirmation samples were collected from each excavation area.

VRCA collected 93 cubic yards of miscellaneous site debris. This debris was left on site and later removed by OHM.

VRCA removed 450 linear feet of POL pipelines from around the Composite and Warehouse Buildings. The debris was left on site and later removed by OHM.

Additional information regarding remedial action activities can be found in VRCA 1997.

2.4.2. 1998 OHM

OHM Remediation Services Corporation (OHM) performed the second remedial action at the Kogru River DEW Line Station in the summer of 1998.

The following work was performed during this action:

1. Demolition of the previously-disassembled Composite Building and removal of the debris.
2. Demolition of the Warehouse building down to its concrete foundation.
3. Removal of Miscellaneous Debris.
4. Disposal of the former Shop Building's foundation concrete demolition debris underneath the former Warehouse Building's foundation.
5. Removal of a Caterpillar Model 70 Scraper.
6. Removal of 525 cubic yards of POL-contaminated soil that was stockpiled by VRCA.
7. Berming of material around the warehouse foundation, to encapsulate the concrete debris disposed of underneath it.

Additional information regarding the 1998 remedial action can be found in OHM 2000.

2.5. Conceptual Site Model

The Human Health Conceptual Site Model Scoping Form and Graphical Conceptual Site Model are attached as Appendix E. Permafrost conditions inhibit the use of groundwater as a viable drinking water source. The migration to groundwater exposure pathway is effectively incomplete in the Arctic Zone. Contaminant concentrations in water were screened against the groundwater standards in 18 AAC 75. The surface water standards in 18 AAC 70 were also applied to the surface waters.

For contamination in soils, inhalation and ingestion are the two potentially complete pathways. 18 AAC 75 Method 2 cleanup levels for the Arctic zone, against which the site concentrations have been compared, include these two pathways.

The cleanup levels applied are protective of the complete exposure pathways identified in the conceptual site model.

2.6. Chemical Data

All contaminant concentration data collected of environmental media at the site are compared to the cleanup levels in the respective tables and this section.

Cleanup levels applied for soil and sediment were from 18 AAC 75, Method 2 for the Arctic Zone. These are found on Tables B1 and B2 of 18 AAC 75. The lowest value among the inhalation and ingestion cleanup levels was applied.

For a cleanup conducted under Method two, a chemical that is detected at one-tenth or more of the Table B1 ingestion and inhalation cleanup levels must be included when calculating cumulative risk (18 AAC 75.340(k)). Cumulative risk is defined as the sum of risks resulting from multiple contaminants and pathways to which humans may be exposed. This one-tenth screening level applies only to cleanup levels based upon inhalation and ingestion. However, migration to groundwater is not an applicable exposure pathway for the Arctic Zone. Therefore, every Arctic Zone Method 2 cleanup level is based upon the lower of either the inhalation or ingestion pathway figure. Ranges of petroleum hydrocarbons are not included in the evaluation of cumulative risks (18 AAC 75 and ADEC 2008). Lead is also not included in these evaluations; risks associated with lead contamination are evaluated independently (ADEC 2008).

Surface water samples were collected of surface water from tundra ponds. The surface water cleanup standards are found in 18 AAC 70. The standards for petroleum compounds consist of two parameters, Total Aromatic Hydrocarbons (TAH) and Total Aqueous Hydrocarbons (TAqH). Contaminant concentrations were also compared to the groundwater standards of 18 AAC 75 Table C to evaluate any potential site water issues. A similar cumulative risk evaluation process to that for soil, utilizing a one-tenth screening standard, is applied to groundwater. The surface water standards for petroleum from 18 AAC 70, TAH and TAqH, are not included in the evaluation of cumulative risk specified in 18 AAC 75.

The Kogru River DEW Line site was constructed on raised gravel pads. Natural ground surfaces in the area consist of tundra wetlands.

Only the 1995 (VRCA) sampling event had excavation confirmation samples.

2.6.1. 1989 DOWL

The results from the 1989 sampling event performed by DOWL Engineers are presented in Tables 2.6.1A and 2.6.1B. Because the West Landfill is now a separate FUDS project, samples collected from the West Landfill were excluded from this analysis.

Table 2.6.1A presents the results for soil and sediment. There were two results that exceeded the soil cleanup level for DRO. One of these was from below the former Shop Building's foundation. VRCA removed the foundation, excavated this soil and collected confirmation samples of the excavation. The second exceedance was taken from the edge of the gravel pad north of the Warehouse Building foundation. This area was re-sampled during the 2003 sampling event, and the concentration of DRO was found to be 10 mg/kg, well below the cleanup standard of 12,500 mg/kg.

One sample taken from the Warehouse area was found to contain arsenic at a concentration of 9.8 mg/kg. This exceeds the cleanup level of 6.1 mg/kg. VRCA removed soil from this area as part of excavation Area #4 in 1995. However, VRCA did not analyze the excavation

confirmation samples for metals other than lead. An arsenic background study was performed for the Kogru site as part of the 2007 sampling event. This background study determined that background arsenic concentrations in the area are on the order of 9.5 mg/kg (Table 6-3, Bristol 2008). The concentration of arsenic found is consistent with the background concentrations found in that study.

There were four additional analytical results that exceeded one-tenth of the cleanup level and had the potential to be retained for evaluation of cumulative risk. None of these results were retained for an evaluation of cumulative risk, either because the soils sampled were later removed by VRCA and excavation confirmation samples confirmed a concentration below one-tenth of the cleanup level, or there were no other contaminants present in the vicinity at concentrations exceeding one-tenth of the cleanup level. See the notes to Table 2.6.1A.

One surface water sample exceeded the groundwater cleanup level for GRO. GRO was also found in the laboratory method blank. This water body was re-sampled by VRCA in 1995 and found to have a GRO result of non-detect.

One surface water sample was found to exceed the groundwater cleanup level for methylene chloride. This result was also found in the laboratory method blank.

2.6.2. 1995 VRCA

The results from the 1995 sampling event are summarized in Tables 2.6.2A and 2.6.2B.

All soil and water samples collected as part of this sampling event were analyzed for BTEX, GRO, DRO, TPH, halogenated volatile organics, lead, pesticides and PCBs, semi-volatiles and volatiles, except that water sample -015W, taken from northwest of the composite building, was not analyzed for DRO and GRO.

For this sampling event, there were several water samples had results exceeding one tenth of the cleanup level for methylene chloride. Methylene chloride is a common lab contaminant and will not be discussed further.

Confirmation results for the six excavation areas are discussed below:

Area #1

Excavation Area #1 is located at the west end of the former composite building. One soil sample, -003SL was collected from the excavation site before excavation began. Confirmation soil samples -026 SL, -027 SL, and -028 SL were collected following excavation. Two water samples, -005WA and -006WA, were collected from nearby tundra waters to the west. No cleanup level was exceeded. Where applicable for evaluations of cumulative risk, no contaminant concentration exceeded one tenth of its cleanup level.

Area #2

Excavation Area #2 is located at the east end of the former composite building. One soil sample, -004SL, was collected from the excavation site before excavation began. Confirmation soil samples -023SL, -024SL, and -025SL were collected following excavation. There are no water samples associated with this excavation area. No cleanup level was exceeded. Where applicable for evaluations of cumulative risk, no contaminant concentration exceeded one tenth of its cleanup level, except for a benzo(a)pyrene concentration of 0.089 J mg/kg in sample -024SL. Because this is the only result in the vicinity that exceeded one tenth of its cleanup level, an evaluation of cumulative risk is not necessary.

Area #3

Excavation Area #3 is located west of the concrete tank foundation. One triplicate soil sample, -005SL/-006SL/-007SL was collected from the excavation site before excavation began. Three excavation confirmation samples, -011SL, -012SL, and the replicate set of -013SL, -014SL and -015 SL, were collected. All soil results were below cleanup levels. Where applicable for evaluations of cumulative risk, all results were below one-tenth of the cleanup level, except as noted below.

The following soil contaminant concentrations were found associated with excavation Area #3: benzo(a)pyrene at 0.37mg/kg, benzo(k)fluoranthene at 0.77 mg/kg and benzo(a)anthracene at 1.7 mg/kg. These exceed one tenth of the respective cleanup levels and were retained for an evaluation of cumulative risk for the vicinity of excavation Area #3.

There were two samples of tundra waters collected in the vicinity of excavation Area #3. A benzene concentration of 0.002 mg/L was found in the sample taken west of excavation Area #3, -003WA. This exceeds one tenth of the cleanup level and was also retained for an evaluation of cumulative risk for the vicinity of excavation Area #3.

These three soil and one water contaminant concentrations have a cumulative cancer risk of 1 X $10^{-5.}$ This does not exceed the cancer risk management standard. This is a conservative evaluation, because the excavation has been filled with clean soil, minimizing risk.

Area #4

Excavation Area #4 is located next to the west end of the Warehouse building. One soil sample, -002SL, was collected from the excavation site before excavation began. Confirmation soil samples, -029SL, -030SL, and -031 SL were collected following excavation. There are no water samples associated with this excavation area. No cleanup level was exceeded. Where applicable for evaluations of cumulative risk, no contaminant concentration exceeded one tenth of its cleanup level.

Area #5

Excavation Area #5 is located next to the southeast side of the Warehouse building. Confirmation soil samples, -008SL, -009SL, and -010SL were collected after soil excavation was

completed. No soil contaminant concentration exceeded any cleanup level, or one-tenth of the cleanup level where applicable for evaluating cumulative risk.

There was one surface water sample associated with Area #5, -012WA. The result for DRO was 12 mg/L. This exceeds the cleanup level. However, these waters were re-sampled in 2003 as sample 03KOGRU06WA with a DRO concentration of 3.9 mg/L. The excavation performed by VRCA at excavation Area #5 appears to have significantly reduced DRO concentrations in this tundra water. There is little surface water present here. The water body was not deep enough for collecting a water sample, without first digging a hole (USACE 2003).

This water sample, -012WA, also had a concentration of benzene of 0.0082 mg/L. This exceeds the cleanup level. However, the 2003 re-sample, 03KOGRU06WA, had a benzene concentration of non-detect. The excavation performed by VRCA at excavation Area #5 appears to have significantly reduced benzene concentrations in this tundra water.

This water sample, -012WA, also had a 2-methylnaphthalene concentration of 0.062 mg/L. This exceeds one tenth of the cleanup level. The 2003 re-sample was not analyzed for 2-methylnaphthalene. However, since 2-methylnaphthalene is the only contaminant remaining in the area at a concentration above one tenth of the cleanup level, a cumulative risk analysis is not necessary.

Area #6

Area #6 is located under the former Shop Foundation. One soil sample, -001SL, was collected from the excavation site before excavation began. Confirmation soil samples, -016SL, -017SL, the triplicate set of -018 SL, -019SL and -020SL, -021SL, -022SL, -032SL, and -033SL were collected following excavation. Sample -016SL was collected from directly below the shop foundation sump area. One water sample, -001WA, is associated with this excavation. No cleanup level was exceeded. Where applicable for evaluations of cumulative risk, no contaminant concentration exceeded one tenth of its cleanup level, except for a concentration of PCBs (Arochlor 1254) of 0.69 mg/kg in sample -016SL. Because this is the only result in the vicinity that exceeded one tenth of its cleanup level, an evaluation of cumulative risk is not necessary.

Other Sample Results

Sample -014WA,taken from tundra wetlands northeast of the former Shop Building had a DRO concentration of 1.77 mg/L. This exceeds the cleanup level. Sample -014WA was part of a replicate set with -013WA and -013WA was non-detect for DRO. This surface water body was re-sampled in 2003 as sample 03KOGRU05WA, with a DRO concentration of 0.6 mg/L. This is below the cleanup level.

Water in tundra wetlands northeast of the former Shop Building, sample -014WA, was determined to have concentrations of two pesticides, dieldrin and alpha-hexachlorocyclohexane, above one tenth of the cleanup level. This sample was part of a replicate set with -013WA, which was non-detect for pesticides. However, the cumulative cancer risk of these two

pesticides at the concentrations found is 6 X 10^{-6}, which is below the cancer risk management standard of 1 X 10^{-5}.

2.6.3. 1998 OHM

All soil removed from the site by OHM in 1998 had been excavated and stockpiled on site by VRCA in 1995. No new soil excavation or sampling occurred in 1998.

2.6.4. 2003 Corps of Engineers

The results of this sampling event are summarized in Table 2.6.4. For water, one sample exceeded the cleanup levels for DRO and RRO. These were both for the same sample, 03KOGRU06WA, which was a re-collection of 1995 sample 95KOG012WA. The chromatographic pattern of the RRO in sample -06WA resembled tundra vegetation, rather than fuel (USACE 2003). There is little surface water present. The marshy area was tundra covered with an intermittent, shallow layer of surface water not deep enough to be considered a "pond" nor deep enough to collect a water sample; the field sampler dug a hole to a depth adequate to submerge the sample bottle, allowed the water to "settle out" for 25-30 minutes, prior to collecting a sample for chemical analysis. The field sampler noted it was difficult to achieve zero headspace for the samples from this site. Although results have been screened by these groundwater standards for DRO and RRO, the standards apply to groundwater only. These samples were of surface water. The 18 AAC 70 standards of TAH and TAqH apply to surface water contaminated with petroleum oils. Sample -06WA was also analyzed for and met the standards that apply to surface water, TAH and TAqH.

More information about the 2003 sampling event can be found in USACE 2003.

2.6.5. 2007 Bristol

A sampling event was conducted at the Kogru site by Bristol in 2007. The non-background samples collected during this sampling event pertained to the West Landfill. However, a background metals study was performed as part of this sampling effort. This effort determined a background concentration of arsenic in sediment of 9.5 mg/kg. This was compared to an arsenic result from 1989.

3. Ecological Risk

Exposure of ecological receptors, such as caribou, to contaminants remaining at the site is minimal, because concentrations remaining at the site do not exceed human health risk standards and also because the concentrations are present over a tiny area compared to the ecological resources' migratory range. For these reasons, contaminants remaining on site do not pose an unacceptable risk to ecological resources.

4. Certification of Remedy

The remedy for this site is protective of human health and the environment. All primary sources of contamination, such as drums, have been removed. Concentrations that remain at the site are below levels that would pose a risk to human health or the environment. Analytical results support this conclusion.

5. References

18 AAC 70, Water Quality Standards, Alaska Department of Environmental Conservation, as amended through September 19, 2009.

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ADEC 2008, Cumulative Risk Guidance, State of Alaska, Department Of Environmental Conservation, Division Of Spill Prevention and Response, Contaminated Sites Remediation Program, June 9, 2008.

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USACE 2003, Chemical Data Report, ERP067 Kogru DEW Line Site Additional Characterization for Site Closure, North Slope Borough, Alaska, U.S. Army Corps of Engineers, Alaska District, November 2003.

USACE 2004, Engineer Regulation (ER) 200-3-1, Formerly Used Defense Sites (FUDS) Program Policy, 10 May 2004.

VRCA 1996, Remedial Action Report Kogru DEW Line Station Kogru River, Alaska Site Restoration, VRCA Environmental Services, 1996.

FIGURES

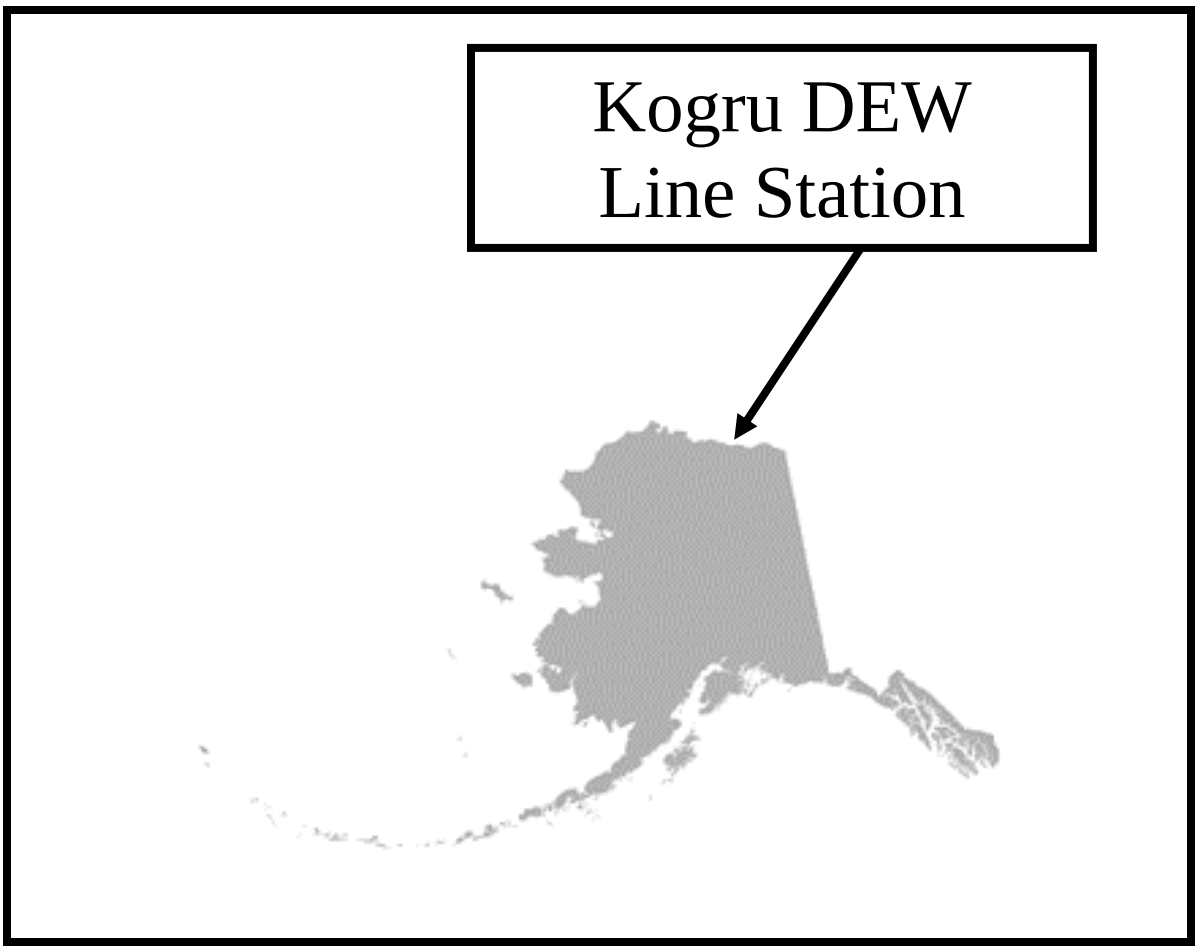


Figure 2.1: Kogru's Location in Alaska

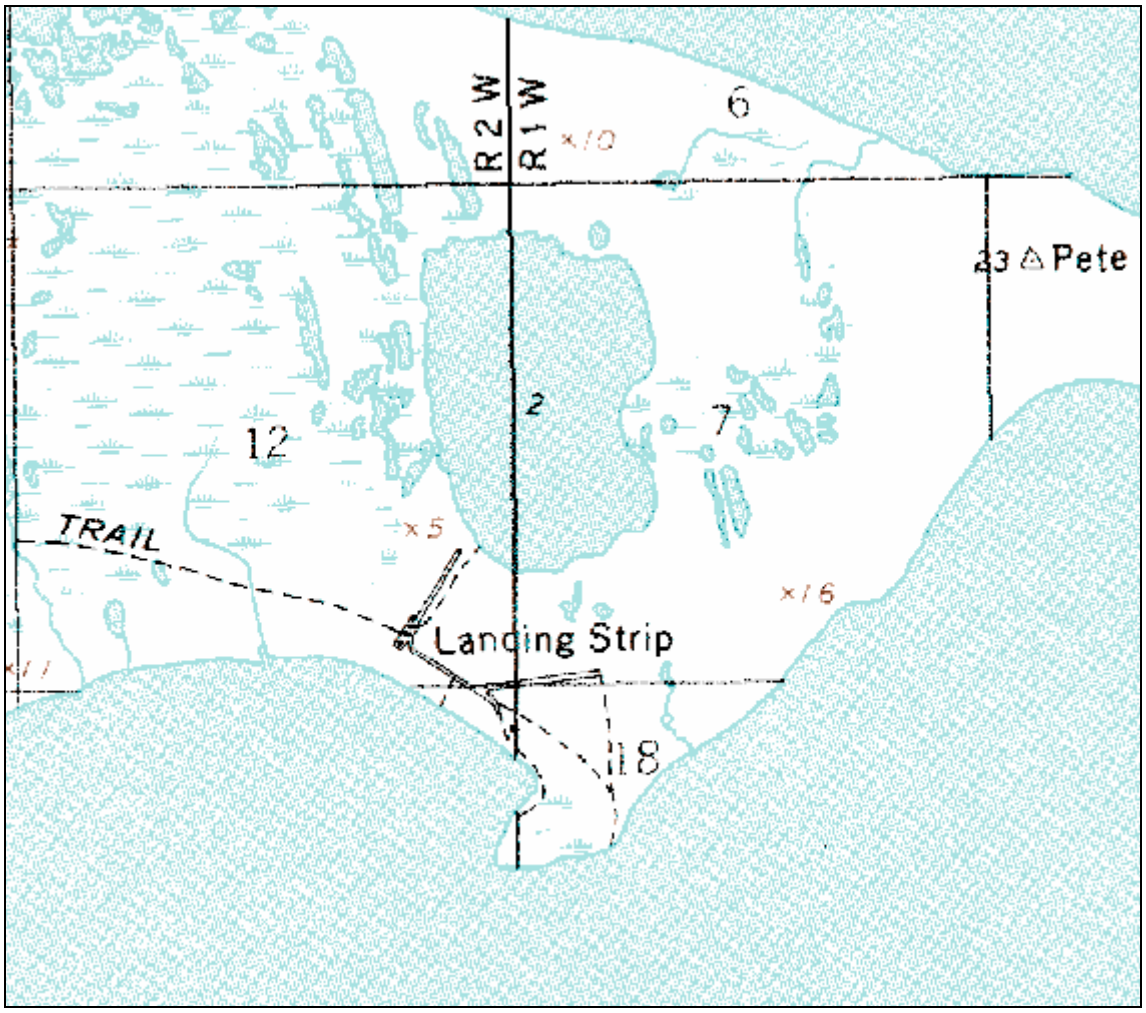


Figure 2.2: The Kogru DEW Line Station
Taken from the Harrison Bay C-4 USGS Quad

Figure 2.3: Figure 1.2 from VRCA 1995
Showing the Main Cantonment Area

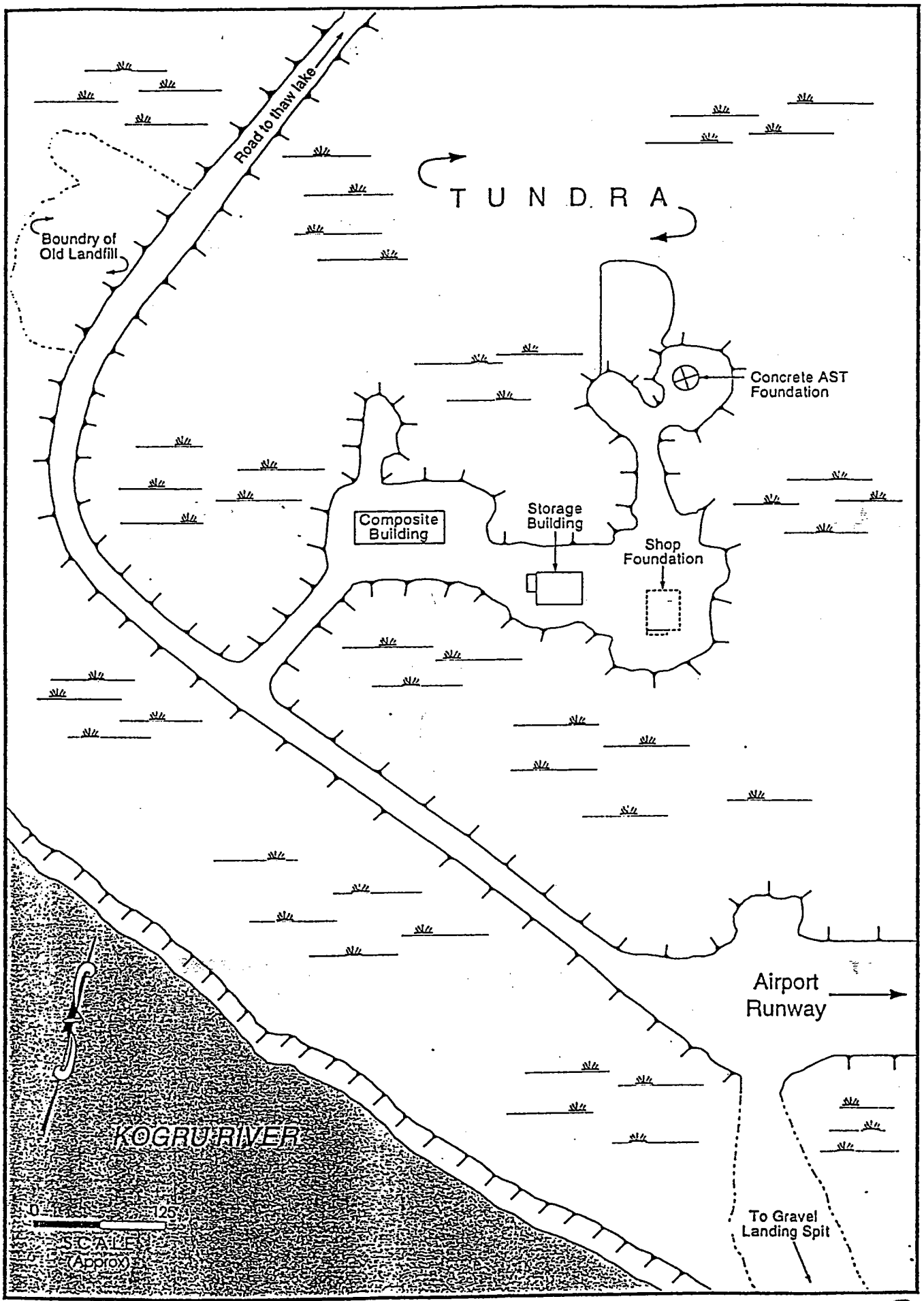


Figure 1.2 KOGRU RIVER DEW LINE SITE, ALASKA

Woodward-Clyde

TABLES

Table 2.6.1a: Site Sampling Data Summary, Kogru DEW Line – 1989 Sampling Event (DOWL 1992) Soil and Sediment						
Test Method	Units	Analyte	Highest Concn. Detected	18 AAC 75 Soil Cleanup Level	Incidence Above Cleanup Level	Incidence above 1/10th the Cleanup Level
8015	mg/kg	DRO	**17,600**[*1]	12,500	**2/27**[*1]	N/A
	mg/kg	GRO	17	1,400	0/27	N/A
	mg/kg	Kerosene	0.17	Not Available	Not Available	N/A
	mg/kg	Miscellaneous	2,620	13,700[*2]	0/27	N/A
8080	mg/kg	Arochlor 1254	0.471	1	0/29	**2/29**[*3]
	mg/kg	beta-Hexachlorocyclohexane	0.06	5.5	0/29	0/29
	mg/kg	4,4' DDT	0.024	29	0/29	0/29
	mg/kg	Heptachlor	0.012	1.7	0/29	0/29
8240	mg/kg	Methylene Chloride	4.18	240	0/7	0/7
	mg/kg	Acetone	4.5	102,000	0/7	0/7
	mg/kg	Trichloroethene	0.126	0.85	0/7	**1/7**[*4]
	mg/kg	Tetrachloroethene	0.005	15	0/7	0/7
	mg/kg	Toluene	0.32	220	0/7	0/7
	mg/kg	Total Xylenes	0.5	63	0/7	0/7
8270	mg/kg	Fluorene	2.4 J	3,200	0/22	0/22
	mg/kg	Fluoranthene	0.5 J	2,500	0/22	0/22
	mg/kg	Bis (2-ethylhexyl)phthalate	3.1 JB	300	0/22	0/22
	mg/kg	Butylbenzylphthalate	0.155 J	3,900	0/22	0/22
	mg/kg	Naphthalene	5.53	42	0/22	0/22
	mg/kg	2-Methylnaphthalene	12.42	380	0/22	0/22
	mg/kg	Phenanthrene	0.43 J	27,800	0/22	0/22
6010	mg/kg	Arsenic	**9.8**	6.1	**1/19**[*5]	**1/19**[*5]
	mg/kg	Chromium	61.8	410	0/19	**1/19**[*6]
	mg/kg	Lead	282	400	0/19	N/A

Table Notes:

Non-Detect results and samples taken from the West Landfill were excluded.

N/A – Petroleum hydrocarbon ranges and lead are not factored into evaluations of cumulative risk. The $1/10^{th}$ screening level does not apply.

J – Analyte was detected above the instrument detection limit, but below the analytical reporting limits.

B – Analyte was detected in the laboratory method blank.

D – Sample was diluted.

Not Available – No cleanup level available from the referenced sources.

*1 – The highest result was from sample -071SL. This soil sample was collected from underneath the Shop Building's foundation. In 1995, VRCA demolished the Shop Building's foundation and removed the soil at this location as part of excavation Area #6. After excavation, VRCA collected confirmation samples and analyzed them for DRO. The second highest DRO result, sample -121SL, had a concentration of 17,500 mg/kg, taken from the edge of the gravel pad north of the former warehouse. This area was re-sampled during the 2003 sampling event. A triplicate soil sample was collected and analyzed for DRO in 2003. The highest concentration of DRO in the triplicate set was 10 J mg/kg, well below the cleanup level of 12,500 mg/kg.

*2 – The cleanup level for RRO was used for method 8015's miscellaneous range.

*3 –The result of 0.471 mg/kg was from sample -071SL, which was taken from below the Shop Building foundation. In 1995, VRCA demolished the Shop Building's foundation and removed the soil at this location as part of excavation Area #6. After excavation, VRCA collected confirmation samples and analyzed them for PCBs. The second highest PCB result was 0.31 mg/kg from sample -191SL. Sample -191SL was taken from just east of the former composite building, a location that had no other contaminants exceeding one tenth of the cleanup level.

*4 – This trichloroethylene result is from sample -301SL, taken from northeast of the former fuel tank foundation. That location had no other contaminants exceeding one tenth of the cleanup level.

*5 – This arsenic concentration was found in sample -101SL, taken from the Warehouse area. In 1995, VRCA removed soil from this area as part of excavation Area #4, however, confirmation samples from the excavation were not analyzed for metals other than lead. Additionally, an arsenic background study was performed for the Kogru area as part of the 2007 sampling event. The study determined that background arsenic concentrations in the area are on the order of 9.5 mg/kg (Table 6-3, Bristol 2008). This result of 9.8 mg/kg is consistent with background.

*6 – This chromium result was from sample -071SL, taken from a location below the Shop Building's concrete foundation. In 1995, VRCA demolished the Shop Building's foundation and removed the soil at this location as part of excavation Area #6. VRCA did not analyze excavation confirmation samples for Area #6 for metals other than lead. However, no other contaminants are currently present at this location.

Table 2.6.1b: Site Sampling Data Summary, Kogru River – 1989 Sampling Event (DOWL 1992) Surface Water Compared to Groundwater Cleanup Levels						
Test Method	Units	Analyte	Highest Concn. Detected	18 AAC 75 Cleanup Level	Incidence Above Cleanup Level	Incidence above 1/10th the Cleanup Level
8015	mg/L	Gasoline	**17 B*1**	2.2	**1/6*1**	N/A
	mg/L	Kerosene	0.71	Not Available	N/A	
8240	mg/L	Chloroform	0.01	0.14	0/3	0/3
	mg/L	Acetone	0.025	33	0/3	0/3
	mg/L	Methylene Chloride	**0.006 B*2**	0.005	**1/3*2**	**1/3*2**

Table Notes:

Non-Detect results were excluded.

Not Available – No cleanup level available for kerosene from the referenced sources.

N/A – Hydrocarbon ranges such as gasoline and kerosene do not factor into evaluations of cumulative risk. The 1/10th screening level does not apply.

J – This is an estimated concentration between the instrument detection limit and the analytical reporting limit.

B – Analyte was detected in the laboratory method blank.

*1 – This GRO result was found in sample -353WA, collected from north of the fuel tank foundation area. Gasoline was also found in the associated method blank. This water body was re-sampled by VRCA in 1995 as sample 95KOG002WA with a GRO result of non-detect.

*2 – Methylene chloride is a common lab contaminant and was also found in the associated method blank.

Table 2.6.2a: Site Sampling Data Summary, Kogru River – 1995 Sampling Event (VRCA 1996) Soils						
EPA Test Method	Units	Analyte	Highest Concn. Detected	18 AAC 75 Cleanup Level	Incidence Above Cleanup Level	Incidence above 1/10th Cleanup Level
BTEX	mg/kg	Benzene	ND	17	0/27	0/27
	mg/kg	Toluene	0.071	220	0/27	0/27
	mg/kg	Ethylbenzene	0.13	110	0/27	0/27
	mg/kg	Xylenes, Total	0.56	63	0/27	0/27
AK101	mg/kg	GRO/VPH	190	1,400	0/27	N/A
AK102	mg/kg	DRO/EPH	6,920	12,500	0/27	N/A
TPH	mg/kg	TPH	7,500	No CL	N/A	N/A
Halo-genated Volatile Organics	mg/kg	Methylene Chloride	0.11 JB	240	0/27	0/27
	mg/kg	1,1,1-Trichloroethane	0.0037	360	0/27	0/27
	mg/kg	Tetrachloroethene	0.029	15	0/27	0/27
	mg/kg	Bromomethane	0.03 JB	21	0/27	0/27
	mg/kg	Carbon Tetrachloride	0.064 E	4.5	0/27	0/27
	mg/kg	Chloromethane	0.057	37	0/27	0/27
	mg/kg	2-Chloroethylvinylether (CAS 110-75-8)	0.0077	No CL	N/A	N/A
Lead, Total	mg/kg	Lead, Total	30.2 D	400	0/27	N/A
Pesticides/ PCBs	mg/kg	Aroclor 1254	0.69	1	0/27	**1/27**[*1]
	mg/kg	Dieldrin	0.005 J	0.43	0/27	0/27
	mg/kg	Methoxychlor	0.01 J	440	0/27	0/27
Semi-Volatile Organics	mg/kg	Bis(2-Ethylhexyl) phthalate	0.24 JB	330	0/27	0/27
	mg/kg	Naphthalene	1.2	42	0/27	0/27
	mg/kg	2-Methylnaphthalene	7.9 D	380	0/27	0/27
	mg/kg	Acenaphthene	6.7 D	3800	0/27	0/27
	mg/kg	Dibenzofuran	2.5	270	0/27	0/27
	mg/kg	Fluorene	7.7 D	3200	0/27	0/27

Semi-Volatile Organics	mg/kg	Phenanthrene	10 D	27,800	0/27	0/27
	mg/kg	Anthracene	7.4 D	27,800	0/27	0/27
	mg/kg	Di-n-butylphthalate	0.06 J	10,700	0/27	0/27
	mg/kg	Benzo(a)pyrene	0.37	0.66	0/27	**3/27**[*2]
	mg/kg	Indeno(1,2,3-cd)pyrene	0.093 J	6.6	0/27	0/27
	mg/kg	Benzo(g,h,l)perylene	0.082 J	1,900	0/27	0/27
	mg/kg	Fluoranthene	14 D	2,500	0/27	0/27
	mg/kg	Pyrene	11 D	1,900	0/27	0/27
	mg/kg	Benzo(a)anthracene	1.7	6.6	0/27	**2/27**[*3]
	mg/kg	Chrysene	1.9	660	0/27	0/27
	mg/kg	Acenaphthalyene	0.06	3,800	0/27	0/27
	mg/kg	Benzo(b)fluoranthene	0.77	6.6	0/27	**2/27**[*4]
Volatiles by GC/MS	mg/kg	Methylene Chloride	0.99	240	0/27	0/27
	mg/kg	Acetone	1.8 E	102,000	0/27	0/27
	mg/kg	1,1-Dichloroethylene	0.0021 J	1.3	0/27	0/27
	mg/kg	2-butanone (MEK)	0.032 DJ	23,300	0/27	0/27
	mg/kg	1,1,1-Trichloroethane	0.22	360	0/27	0/27
	mg/kg	Tetrachloroethene	0.039	15	0/27	0/27
	mg/kg	Toluene	0.076	220	0/27	0/27
	mg/kg	Ethylbenzene	0.0082	110	0/27	0/27
	mg/kg	m,p-Xylenes	0.038	63	0/27	0/27
	mg/kg	o-Xylene	0.024	63	0/27	0/27
	mg/kg	Cis-1,2-Dichloroethene	0.39 D	190	0/27	0/27
	mg/kg	Trichloroethene	0.011 JD	17	0/27	0/27
	mg/kg	Benzene	0.005 JB	17	0/27	0/27
	mg/kg	Trichlorotrifluoroethane (CAS 76-13-1)	0.1 D	750	0/27	0/27
	mg/kg	Methyl Methacrylate (CAS 80-92-6)	0.017	No CL	N/A	N/A

Notes:

Non-detect results were excluded.

Cleanup Levels taken from 18 AAC 75, Method Two for the Arctic Zone.

No CL – No Cleanup Level available from 18 AAC 75.

B - Analyte was detected in the laboratory method blank.

J – Analyte was detected above the instrument detection limit, but below the analytical reporting limits.

D - Analyte was diluted to bring within instrument calibration range or to remove matrix interference.

N/A – Hydrocarbon Ranges and lead are not included in evaluations of cumulative risk, and are not compared to one tenth of the standard.

All soil samples collected during this sampling event were excavation confirmation samples, except for samples -001SL through -004SL and the triplicate set of -005SL, -006SL and 007SL.

*1 – The arochlor 1254 result exceeding the one tenth standard was found in sample -016SL, a confirmation sample from excavation Area #6, the Shop Building vicinity. This location had no other results above one tenth of the cleanup level.

*2 – The results for benzo(a)pyrene exceeding one tenth of the cleanup level were: 0.1 J mg/kg for sample -007SL, 0.37 mg/kg for sample -013SL and 0.093 J mg/kg for sample -014SL and 0.089 J mg/kg for sample -024SL. Sample -007SL was part of a triplicate set with samples -005SL and -006SL taken from excavation Area #3 before excavation. The other two replicates were non-detect for benzo(a)pyrene. Also, subsequent to collection of sample -007SL, the soil in the area was excavated, removed and disposed of offsite. Confirmation samples were collected from the excavation and analyzed for semi-volatiles. Samples -013SL, -014SL and -15SL are a triplicate set collected from excavation Area #3. The results for samples -13SL and -14SL are counted as one exceedance in the table. A concentration of benzo(a)pyrene of 0.37 mg/kg is retained for evaluation of cumulative risk for the vicinity of excavation Area #3. See Note 4. Sample -024SL was a confirmation sample collected from excavation Area #2. No other samples collected in the vicinity of excavation Area #2 had a result exceeding the one tenth standard.

*3 – The results for benzo(a)anthracene exceeding one tenth of the cleanup level were samples -013SL at 1.4 mg/kg and -011SL at 1.7mg/kg. Both of these were confirmation samples from excavation Area #3. Sample -013SL was taken in triplicate with samples -014SL and -015SL, which had concentrations of benzo(a)anthracene of 0.4 and 0.5 J mg/L, respectively. A concentration of benzo(a)anthracene of 1.7 mg/kg is retained for evaluation of cumulative risk at excavation Area #3. See Note 4.

*4 – The results for benzo(k)fluoranthene exceeding one tenth of the cleanup level were samples -011SL and -012SL, both of which were confirmation samples from excavation Area #3, with results of 0.77 mg/kg and 0.76 mg/kg, respectively. For the vicinity of excavation Area #3, 0.37 mg/kg of benzo(a)pyrene, 0.77 mg/kg of benzo(k)fluoranthene and 1.7 mg/kg of benzo(a)anthracene are retained for evaluation of cumulative risk. See Note 1 of Table 2.6.2b.

Table 2.6.2b: Site Sampling Data Summary, Kogru River – 1995 Sampling Event (VRCA 1996) Water						
EPA Test Method	Units	Analyte	Highest Concn. Detected	18 AAC 75 Cleanup Level	Incidence Above Cleanup Level	Incidence above 1/10th Cleanup Level
BTEX	mg/L	Benzene	**0.007**[*1]	0.005	**1/11**[*1]	**2/11**[*1]
	mg/L	Toluene	0.009	1.0	0/11	0/11
	mg/L	Ethylbenzene	0.008	0.7	0/11	0/11
	mg/L	Xylenes, Total	0.083	10	0/11	0/11
AK101	mg/L	GRO/VPH	0.48	2.2	0/10	N/A
AK102	mg/L	DRO/EPH	**12**[*2]	1.5	**2/10**[*2]	N/A
TPH	mg/L	TPH	7	No CL	N/A	N/A
Halo-genated Volatile Organics	mg/L	Methylene Chloride	0.0008 J	0.005	0/11	**1/11**[*3]
	mg/L	Chloroform	0.0014	0.14	0/11	0/11
Lead, Total	mg/L	Lead, Total	0.0011	0.015	0/11	N/A
Pesticides/ PCBs	mg/L	Dieldrin	0.00002 J	0.000053	0/11	**1/11**[*4]
	mg/L	Aldrin	0.000004	0.00005	0/11	0/11
	mg/L	Alpha-Hexachlorocyclohexane (Alpha-BHC)	0.00003 J	0.00014	0/11	**1/11**[*4]
	mg/L	Delta-BHC (CAS 319-86-8)	0.000019	No CL	0/11	0/11
	mg/L	Heptachlor	0.000012	0.0004	0/11	0/11
	mg/L	4,4'-DDD	0.00001	0.0035	0/11	0/11
	mg/L	4,4'-DDE	0.000009	0.0025	0/11	0/11
Semi-Volatile Organics	mg/L	Bis(2-Ethylhexyl) phthalate	0.006	0.006	0/11	**2/11**[*5]
	mg/L	Naphthalene	0.042	0.73	0/11	0/11
	mg/L	Isophorene	0.001	0.9	0/11	0/11
	mg/L	Phenol	0.0004	11	0/11	0/11

	mg/L	2-Methylnaphthalene	0.062	0.15	0/11	**1/11**[*6]
	mg/L	Butylbenzylphthalate	0.02 J	7.3	0/11	0/11
Volatiles by GC/MS	mg/L	Methylene Chloride	0.0028	0.005	0/11	**11/11**[*7]
	mg/L	Acetone	0.065	33	0/11	0/11
	mg/L	Chloroform	0.0015	0.14	0/11	0/11
	mg/L	2-butanone (MEK)	0.0036	22	0/11	0/11
	mg/L	Toluene	0.0031	1.0	0/11	0/11
	mg/L	Benzene	**0.0082**[*8]	0.005	**1/11**[*8]	**1/11**[*8]

Notes:

No CL – No cleanup level is provided in the referenced sources.

*1 – Sample -012WA, taken from tundra wetlands just south of the former Warehouse Building, reported the highest benzene concentration. This surface water body was re-sampled during 2003 as sample 03KOGRU06WA with a benzene result of non-detect. Sample -003WA, taken from tundra wetlands just west of excavation Area #3 and the concrete tank foundation, reported benzene at 0.002 mg/L, but was non-detect for benzene using the volatiles method. This concentration of benzene in the water near excavation Area #3 is retained for an evaluation of cumulative risk. This is coupled with the soil results from the vicinity of excavation Area #3 retained for a cumulative risk evaluation: 0.37 mg/kg of benzo(a)pyrene, 0.77 mg/kg of benzo(k)fluoranthene and 1.7 mg/kg of benzo(a)anthracene. The cumulative cancer risk of benzene in water, and benzo(a)pyrene, benzo(a)anthracene and benzo(k)fluoranthene in soil at these concentrations at the excavation Area #3 vicinity is 1×10^{-5}, an acceptable risk. This is a conservative evaluation because excavation Area #3 was backfilled with clean soil, minimizing exposure risk for the contaminants in soils.

*2 – Sample -012WA, taken from tundra wetlands just south of the former Warehouse Building, reported the highest concentration of DRO. The surface water at this location was re-sampled in 2003 as sample 03KOGRU06WA and analyzed for DRO. See Note 1 of Table 2.6.4. Sample -014WA, taken from tundra wetlands northeast of the former Shop Building, reported the second highest concentration of DRO at 1.77 mg/L. Sample -014WA was part of a duplicate set with sample -013WA, which was non-detect for DRO. The surface water body from which samples -013WA and -014WA were collected was re-sampled in 2003 as sample 03KOGRU05WA with an estimated DRO result of 0.6 mg/L. This concentration is below the cleanup level.

*3 – This estimated concentration was reported by sample -006WA, taken from southwest of the former Composite Building and excavation Area #1. Methylene chloride is a common lab contaminant.

*4 – These estimated results for pesticides were from sample -014WA, taken from tundra wetlands northeast of the former Shop Building. This sample was part of a replicate set with sample -013WA, which was non-detect for pesticides. Water in this location was re-sampled in 2003 as sample 03KOGRU05WA, but not analyzed for pesticides. The

cumulative cancer risk of the two pesticides at these concentrations is 6 X 10^{-6}, an acceptable risk.

*5 – The highest result for bis(2-ethylhexyl)phthalate was found in sample -14WA, which was part of a replicate set with sample -013WA, which was non-detect for bis(2-ethylhexyl) phthalate. These samples were taken from tundra wetlands northeast of the former Shop Building, an area where the water was re-sampled in 2003 as sample 03KOGRU05WA, but not analyzed for bis(2-ethylhexyl)phthalate. Although these water samples are screened against groundwater cleanup levels, these are surface waters. This cleanup level for bis(2-ethylhexyl) phthalate is for groundwater. Bis(2-ethylhexyl)phthalate, being miscible in oil but not water, can be considered an oil constituent. The standards for oil in surface water, TAH and TAqH, are found in 18AAC70. The 2003 resample met these standards. The second highest result was 0.0011 mg/L, or 18.3% of the groundwater cleanup level, in sample -009WA, taken from tundra wetlands north of the former Warehouse Building. Sample -009WA was part of a triplicate set with samples -007WA and -008WA, both of which were non-detect for bis(2-ethylhexyl) phthalate. There were no other contaminants detected at concentrations above the one tenth standard in this area north of the former Warehouse Building.

*6 – The highest 2-Methylnaphthalene result of 41.3% of the cleanup level was found in sample -012WA, taken from tundra wetlands south of the former Warehouse Building. This location was re-sampled in 2003 as sample 03KOGRU06WA, however, that sample was not analyzed for 2-Methylnaphthalene. Although sample -012WA also had a benzene result exceeding the one tenth standard, the 2003 re-sample was non-detect for benzene. Therefore, no contaminants other than 2-Methylnaphthalene remain for an evaluation of cumulative risk at this location.

*7 – Methylene Chloride is a common lab contaminant.

*8 – This benzene result was from sample -012WA. This location was re-sampled in 2003 as sample 03KOGRU06WA, and found to be non-detect for benzene. The location was found to meet the standards for TAH and TAqH.

Table 2.6.4: Site Sampling Data Summary, Kogru River – 2003 Sampling Event (USACE 2003)Surface Water Compared to Groundwater and Surface Water Cleanup Levels					
Units	Analyte	Highest Concn. Detected	18 AAC 70 or 75 Cleanup Level	Incidence Above Cleanup Level	Incidence above 1/10th the Cleanup Level
mg/L	GRO	0.055 B	2.2	0/2	N/A
mg/L	DRO	**3.9**	1.5	**1/2**[*1]	N/A
mg/L	RRO	**4.13**	1.1	**1/2**[*1]	N/A
mg/L	Toluene	0.00066	1.0	0/2	0/2
mg/L	o-xylene	0.00076	10	0/2	0/2
mg/L	Acenapthene	0.000411	2.2	0/2	0/2
mg/L	Benzo(g,h,i)perylene	0.000481	1.1	0/2	0/2
mg/L	Chrysene	0.0000203	0.12	0/2	0/2
mg/L	Fluoranthene	0.0000483	1.5	0/2	0/2
mg/L	Fluorene	0.000739	1.5	0/2	0/2
mg/L	Naphthalene	0.00309	0.73	0/2	0/2
mg/L	Phenanthrene	0.000490	11	0/2	0/2
mg/L	Pyrene	0.0000541	1.1	0/2	0/2
mg/L	TAH	0.0034	0.01	0/2	N/A
mg/L	TAqH	0.009	0.015	0/2	N/A

Table Notes:

Non-detect results and samples associated with the West Landfill are excluded.

One solids (soil or sediment) sample, a triplicate, was collected during this sampling event that was not associated with the West Landfill. It was analyzed for DRO. The highest result of the triplicate was 10 J mg/kg.

TAH and TAqH were calculated by using half the practical quantitation limit (PQL) for non-detect results.

N/A – TAH and TAqH and hydrocarbon ranges do not factor into evaluations of cumulative risk. The 1/10th screening level does not apply.

*1 – The exceedances in DRO and RRO are both for sample -06WA, which was a re-collection of 1995 sample 95KOG012WA. The chromatographic pattern of the RRO in sample -06WA resembled tundra vegetation, rather than fuel (USACE 2003). There is little surface water present. The marshy area was tundra covered with an intermittent, shallow layer of surface water not deep enough to be considered a "pond" nor deep

enough to collect a water sample; the field sampler dug a hole to a depth adequate to submerge the sample bottle, allowed the water to "settle out" for 25-30 minutes, prior to collecting a sample for chemical analysis. The field sampler noted it was difficult to achieve zero headspace for the samples from this site. Although results have been screened by these groundwater standards for DRO and RRO, the standards apply to groundwater only. These samples were of surface water. The 18 AAC 70 standards of TAH and TAqH apply to surface water contaminated with petroleum oils. Sample 03KOGRU06WA was also analyzed for and met the standards that apply to surface water, TAH and TAqH.

Appendix A

ADEC Cumulative Risk Calculator Output

Method Three & Cumulative Risk Calculator

East of AST Foundation, VRCA Area #3, Kogru DEW

The following are cumulative cancer risks and hazard quotients by chemical.

Note that petroleum ranges (GRO, DRO, and RRO) are not included in cumulative risks. Also, if PCBs or dioxins are present at the site, the cumulative risks associated with these chemicals may also need to be considered; please contact the ADEC project manager for your site for information on how to address these chemicals.

Chemicals in red are carcinogenic.

Direct Contact Risks

Chemical	Soil Concentration (mg/kg)	Cancer Risk	Hazard Quotient
Benzene	0	0	0
Benzo(a)anthracene	1.7	0.0000026	0
Benzo(k)fluoranthene	0.77	0.00000012	0
Benzo(a)pyrene	0.37	0.0000056	0

Inhalation Risks

Chemical	Soil Concentration (mg/kg)	Cancer Risk	Hazard Quotient
Benzene	0	0	0
Benzo(a)anthracene	1.7	0	0
Benzo(k)fluoranthene	0.77	0	0
Benzo(a)pyrene	0.37	0	0

Groundwater Risks

Chemical	Groundwater Concentration (mg/L)	Cancer Risk	Hazard Quotient
Benzene	0.002	0.0000013	0.013
Benzo(a)anthracene	0	0	0
Benzo(k)fluoranthene	0	0	0
Benzo(a)pyrene	0	0	0

Cumulative Risk

Cumulative Cancer Risk	0.00001
Cumulative Hazard Index	0.01

Method Three & Cumulative Risk Calculator

Northeast of Former Shop Building, Kogru DEW Line

The following are cumulative cancer risks and hazard quotients by chemical.

Note that petroleum ranges (GRO, DRO, and RRO) are not included in cumulative risks. Also, if PCBs or dioxins are present at the site, the cumulative risks associated with these chemicals may also need to be considered; please contact the ADEC project manager for your site for information on how to address these chemicals.

Chemicals in red are carcinogenic.

Direct Contact Risks

Chemical	Soil Concentration (mg/kg)	Cancer Risk	Hazard Quotient
Dieldrin	0	0	0
alpha-Hexachlorocyclohexane	0	0	0

Inhalation Risks

Chemical	Soil Concentration (mg/kg)	Cancer Risk	Hazard Quotient
Dieldrin	0	0	0
alpha-Hexachlorocyclohexane	0	0	0

Groundwater Risks

Chemical	Groundwater Concentration (mg/L)	Cancer Risk	Hazard Quotient
Dieldrin	0.00002	0.0000038	0.011
alpha-Hexachlorocyclohexane	0.00003	0.0000021	0

Cumulative Risk

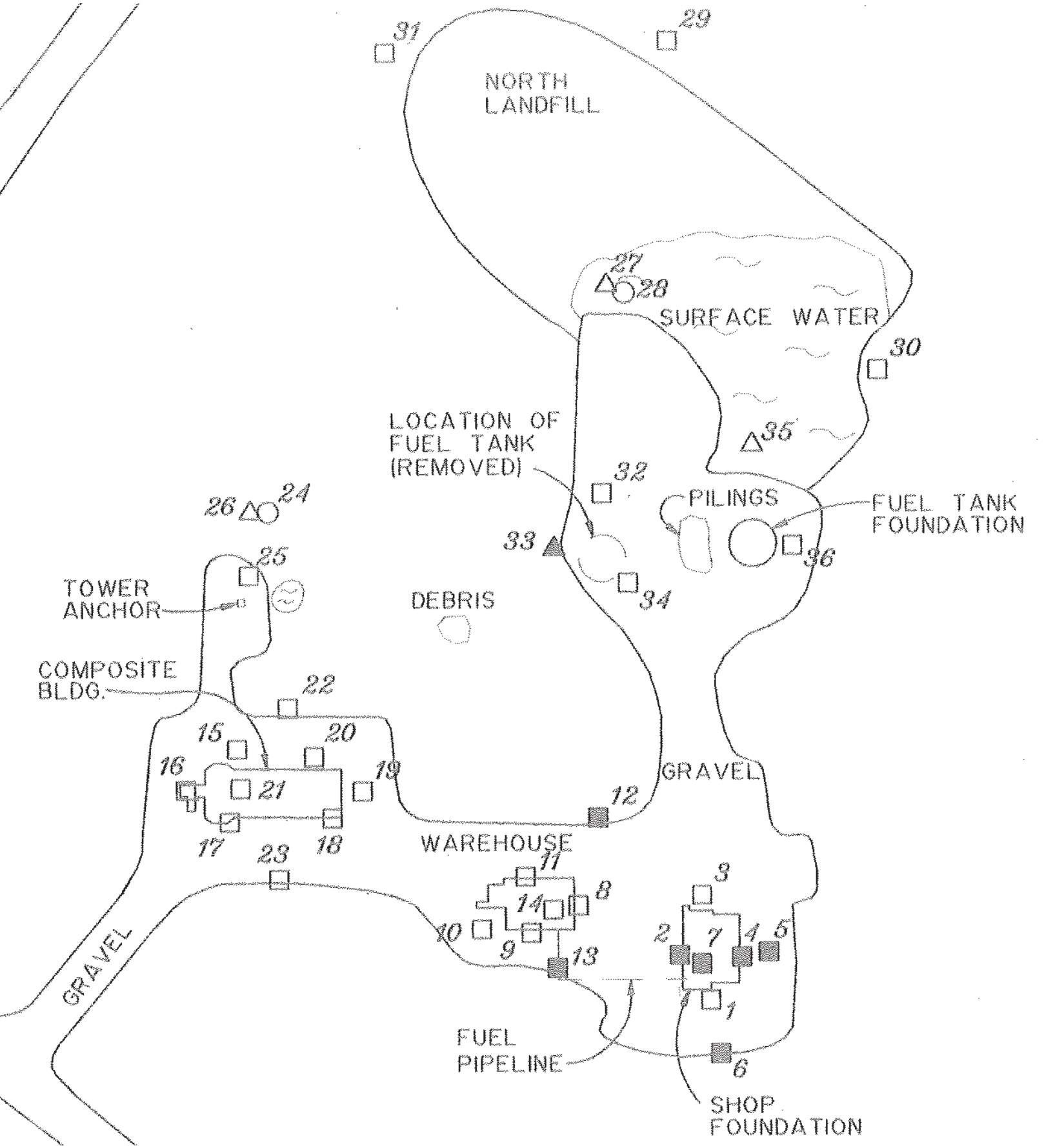
Cumulative Cancer Risk	0.000006
Cumulative Hazard Index	0.01

Appendix B

Figure from DOWL 1992

Squares represent soil samples, circles represent sediment samples
and triangles represent water samples.

The first two digits of the sample designator denote the location. (Sample -071SL was taken from location 7 and samples -291SL, -292SL and -293SL were all collected from location 29.)


NORTH
LANDFILL
SURFACE WATER
LOCATION OF
FUEL TANK
(REMOVED)
PILINGS
FUEL TANK
FOUNDATION
TOWER
ANCHOR
DEBRIS
COMPOSITE
BLDG.
GRAVEL
WAREHOUSE
GRAVEL
FUEL
PIPELINE
SHOP
FOUNDATION
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Appendix C

Excerpts from VRCA 1995

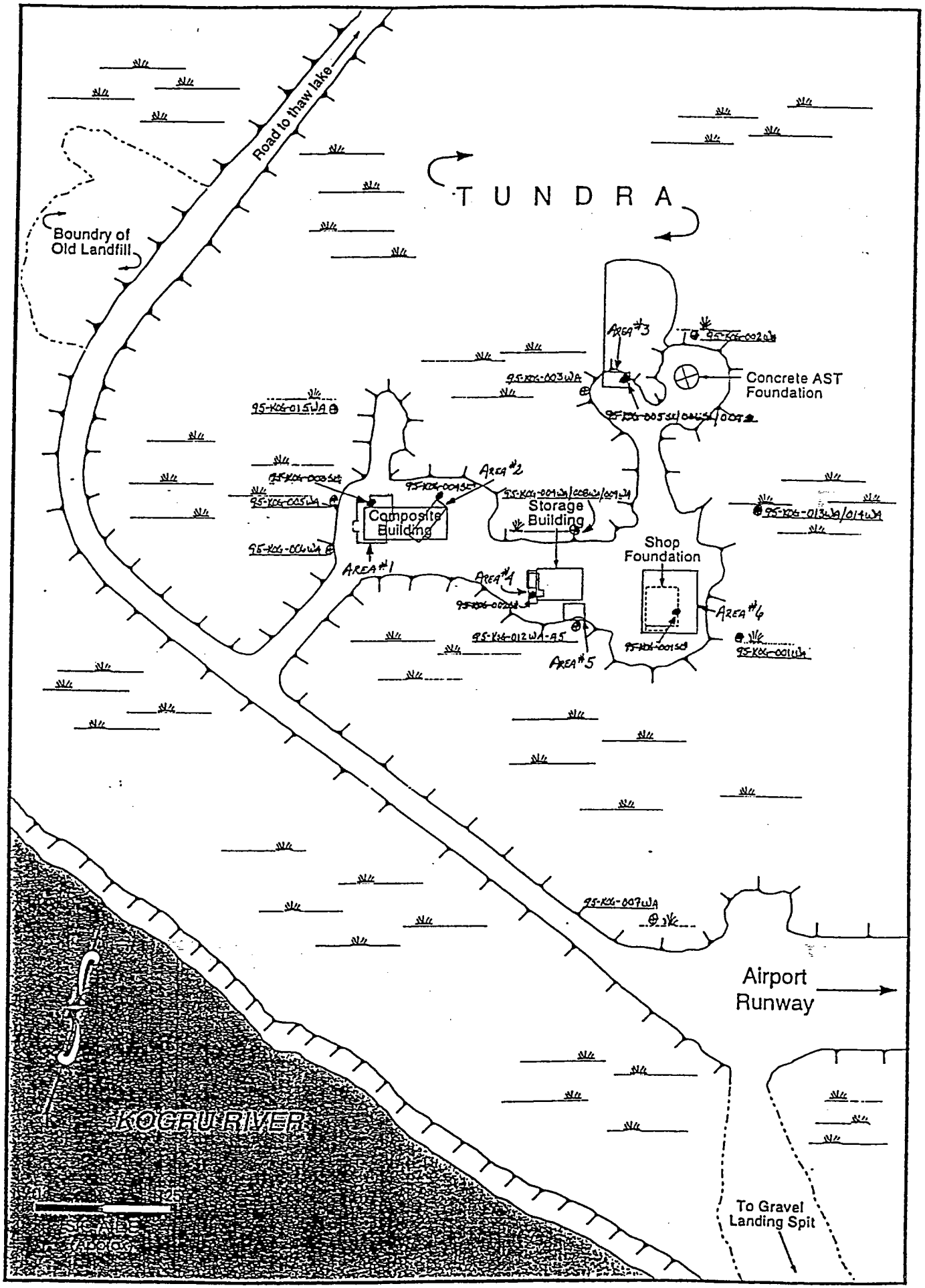
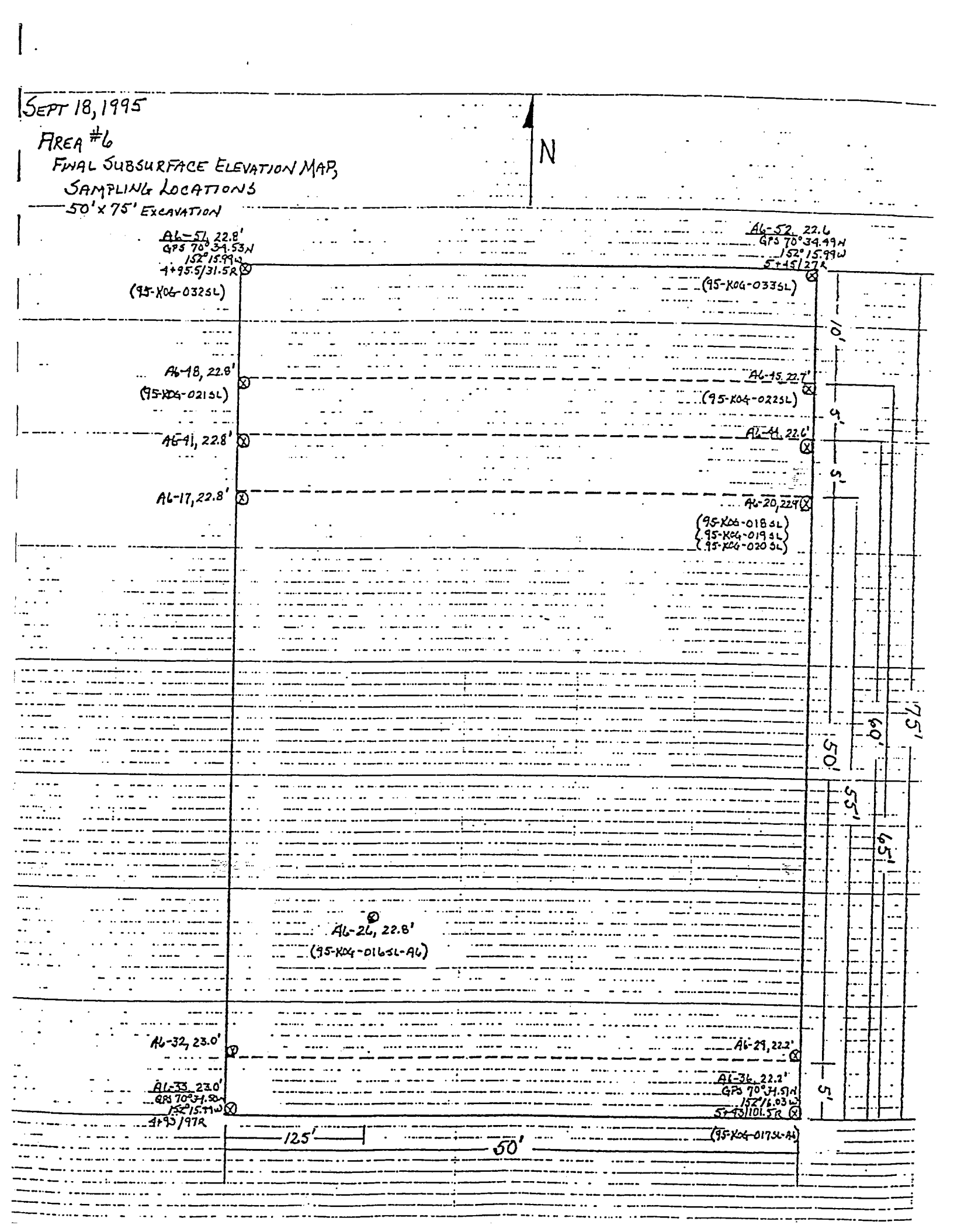
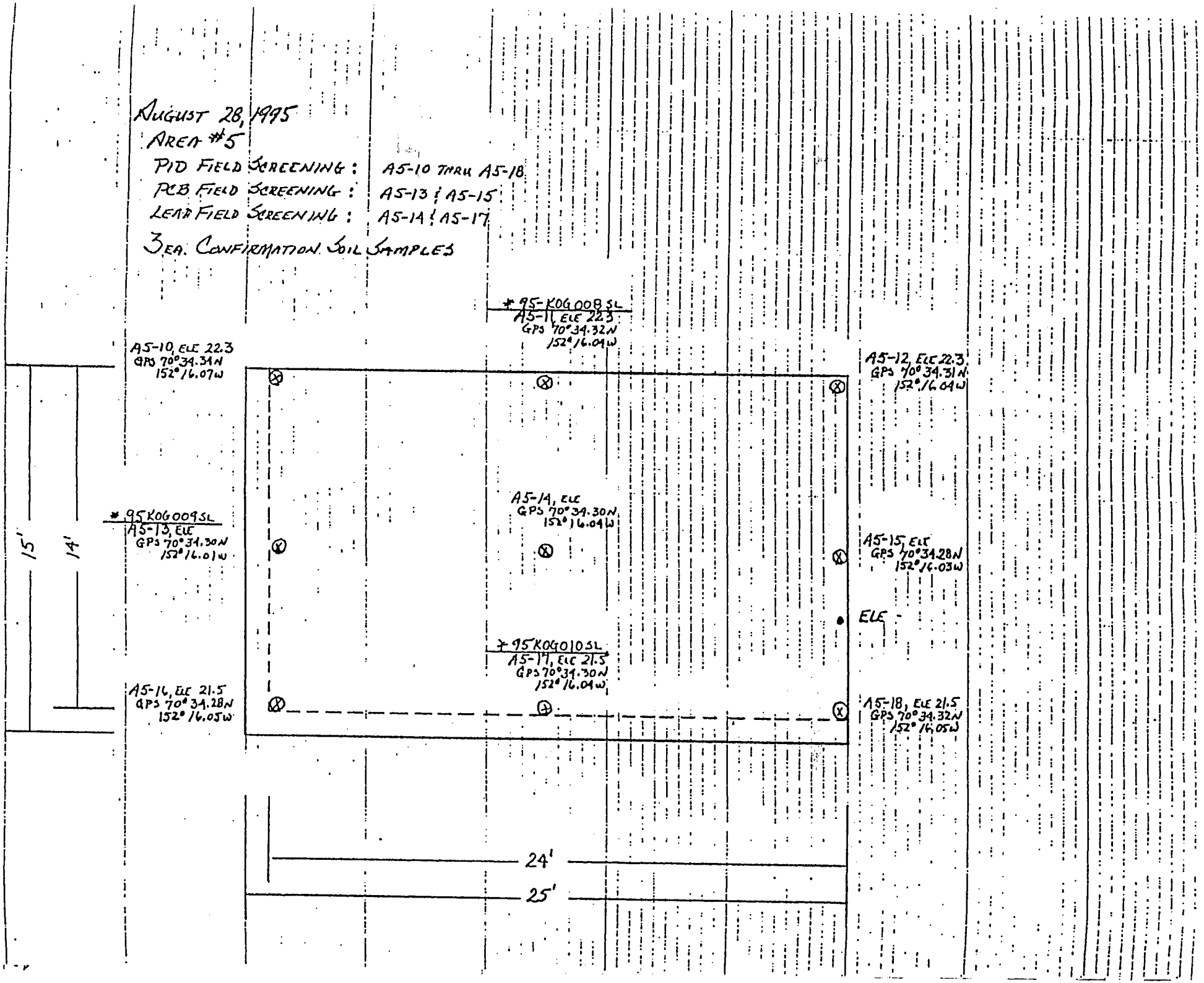


Figure 3.1 KOGRU RIVER DEW LINE SITE, ALASKA

Woodward-Clyde

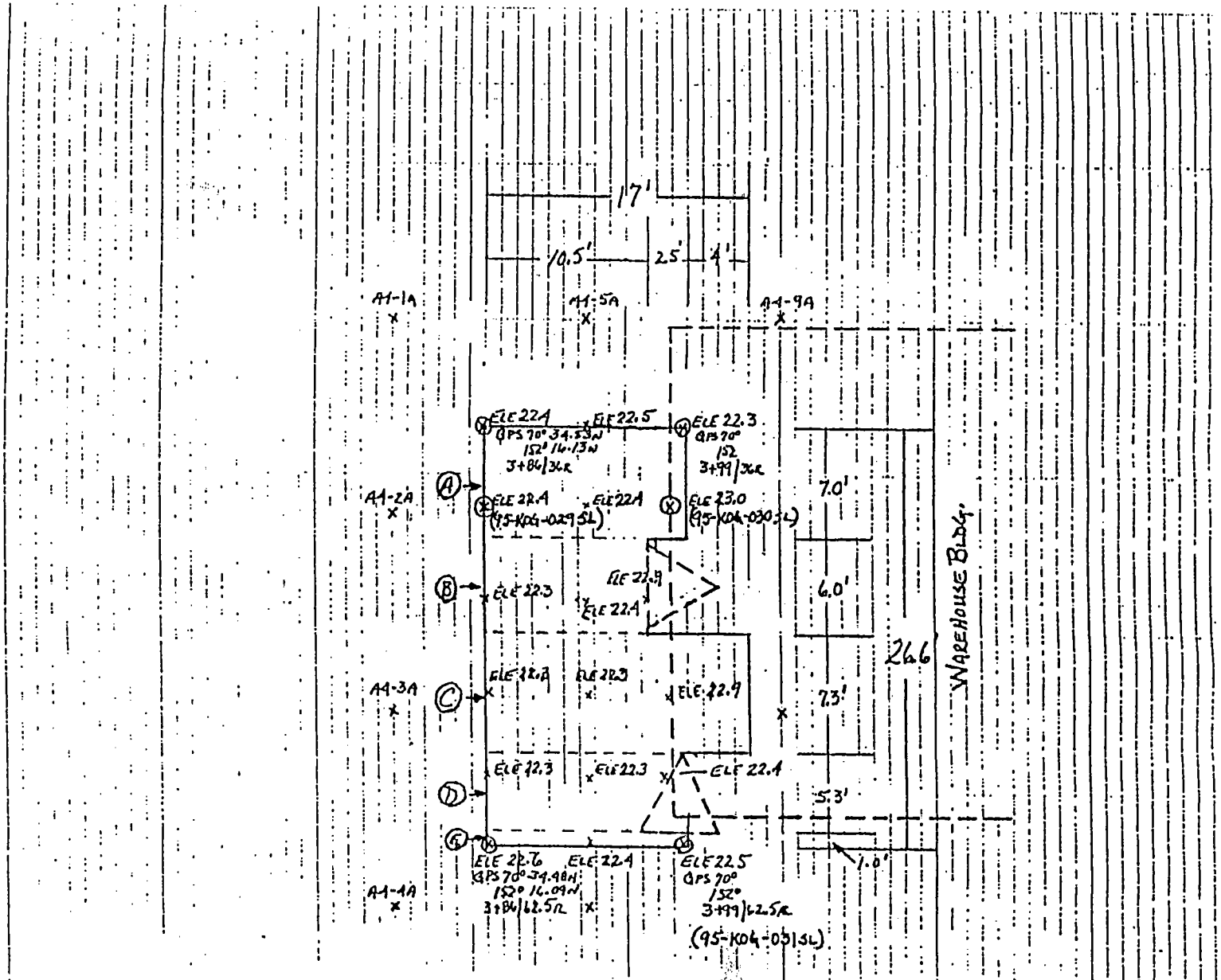

SEPT 18, 1995
AREA #6
FINAL SUBSURFACE ELEVATION MAP,
SAMPLING LOCATIONS
50' x 75' EXCAVATION
N
AL-51, 22.8'
GPS 70° 34.53N
152° 15.99W
4+95.5/31.5R
(95-X04-032SL)
AL-52, 22.6
GPS 70° 34.49N
152° 15.99W
5+45/27R
(95-X04-033SL)
AL-18, 22.8'
(95-X04-021SL)
AL-15, 22.7'
(95-X04-022SL)
AL-41, 22.8'
AL-44, 22.6'
AL-17, 22.8'
AL-20, 22.9'
(95-X04-018SL)
(95-X04-019SL)
(95-X04-020SL)
AL-26, 22.8'
(95-X04-016SL-AL)
AL-32, 23.0'
AL-29, 22.2'
AL-33, 23.0'
GPS 70°34.90N
152°15.99W
4+95/19R
AL-36, 22.2'
GPS 70°34.51N
152°16.03W
5+45/101.5R
(95-X04-017SL-AL)
10'
5'
5'
5'
60'
50'
55'
65'
75'
125'
50'


AUGUST 28, 1995
AREA #5
PID FIELD SCREENING : A5-10 THRU A5-18
PCB FIELD SCREENING : A5-13 ; A5-15
LEAD FIELD SCREENING : A5-14 ; A5-17
3 EA. CONFIRMATION SOIL SAMPLES
* 95-K06008SL
A5-11, ELE 22.3
GPS 70°34.32N
152°16.09W
A5-10, ELE 22.3
GPS 70°34.31N
152°16.07W
A5-12, ELE 22.3
GPS 70°34.31N
152°16.04W
* 95K06009SL
A5-13, ELE
GPS 70°34.30N
152°16.01W
A5-14, ELE
GPS 70°34.30N
152°16.04W
A5-15, ELE
GPS 70°34.28N
152°16.03W
ELE
* 95K06010SL
A5-17, ELE 21.5
GPS 70°34.30N
152°16.04W
A5-16, ELE 21.5
GPS 70°34.28N
152°16.05W
A5-18, ELE 21.5
GPS 70°34.32N
152°16.05W
15'
14'
24'
25'

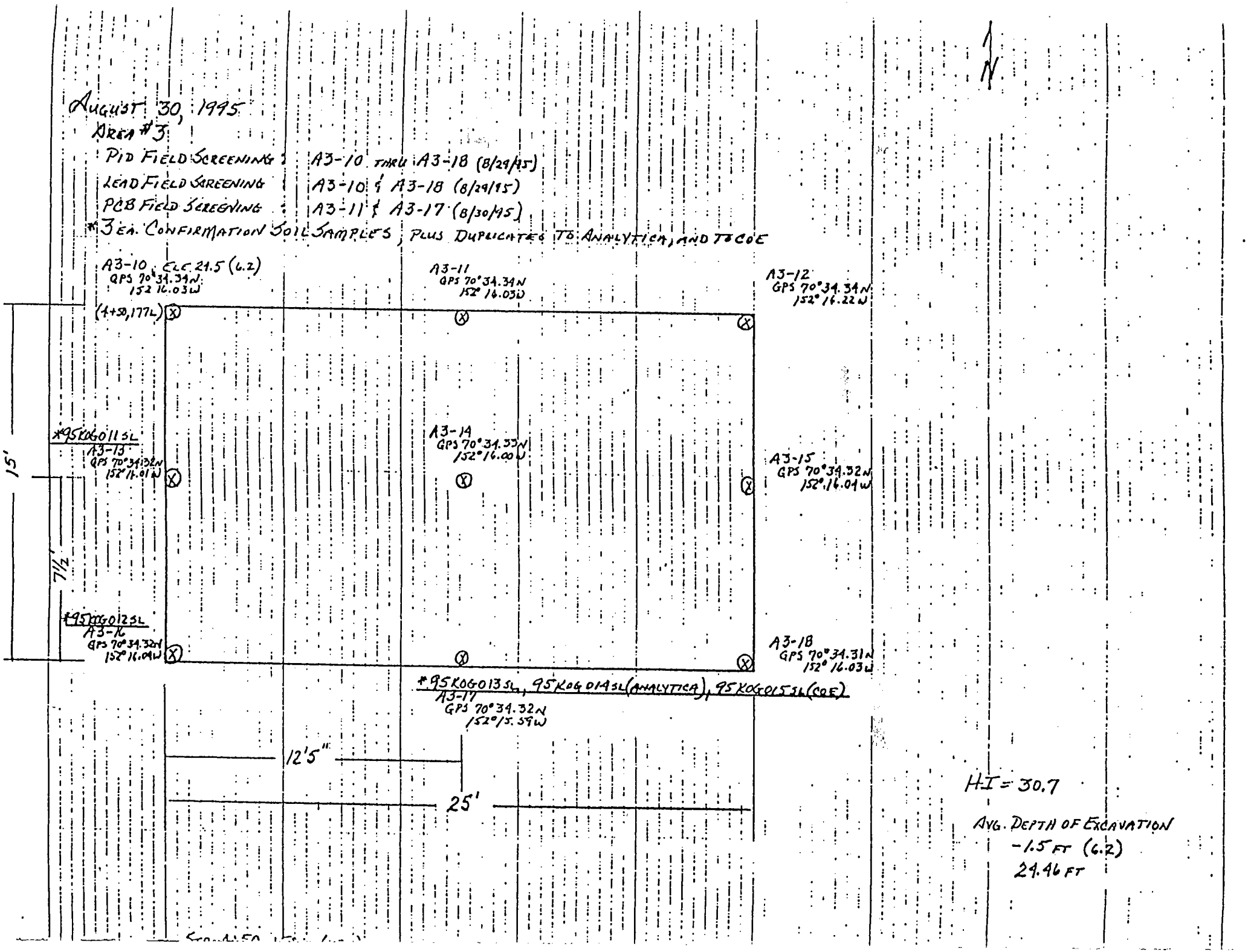
SEPT. 16, 1995

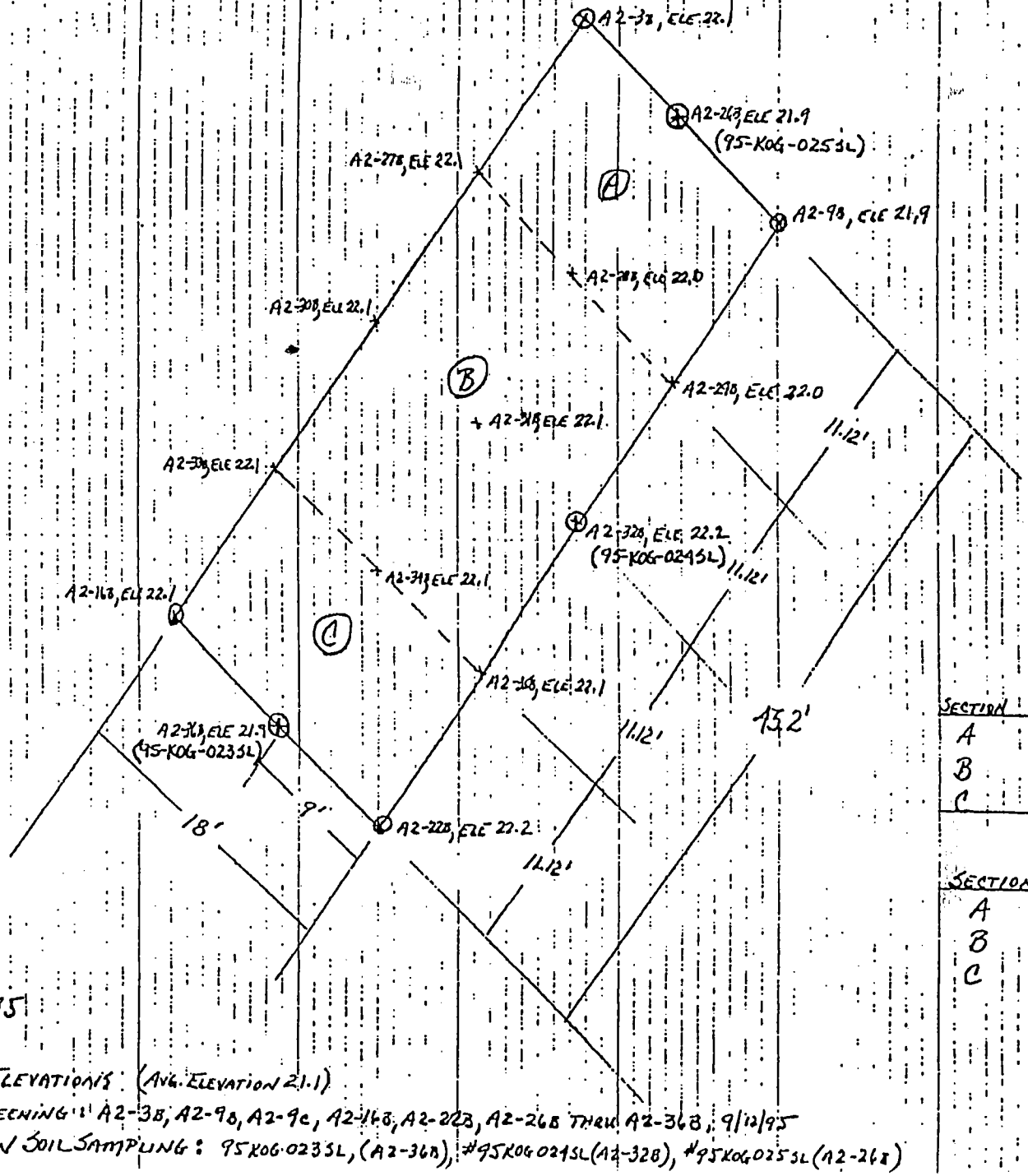
AREA #4

EXCAVATION ELEVATIONS



SECTION	SIZE	AVG. ELEVATION DEPTH	AVG. DEPTH ELEVATION	AVG. SURFACE ELEVATION	CU. YDS.	TONS
A	7 x 13	2.5	22.5	25.0	8.42	14.03
B	6 x 10.5	2.4	22.5	24.9	5.60	9.32
C	7.3 x 17	2.4	22.5	24.9	11.03	18.37
D	5.3 x 10.5	2.4	22.3	24.7	4.95	8.24
E	1 x 13	2.3	22.5	24.7	1.11	1.84
				TOTALS	31.11	51.8


August 30, 1995
Area #3
PID Field Screening : A3-10 thru A3-18 (8/29/95)
Lead Field Screening : A3-10 & A3-18 (8/29/95)
PCB Field Screening : A3-11 & A3-17 (8/30/95)
*3 ea. Confirmation Soil Samples, Plus Duplicates to Analytica, and to COE
A3-10 Elc 21.5 (6.2)
GPS 70° 34.34 N
152 16.03 W
(1+50, 177 L)
A3-11
GPS 70° 34.34 N
152° 16.03 W
A3-12
GPS 70° 34.34 N
152° 16.22 W
*95K0G011SL
A3-13
GPS 70° 34.32 N
152° 16.01 W
A3-14
GPS 70° 34.33 N
152° 16.00 W
A3-15
GPS 70° 34.32 N
152° 16.04 W
15'
7½'
*95K0G012SL
A3-16
GPS 70° 34.32 N
152° 16.04 W
A3-18
GPS 70° 34.31 N
152° 16.03 W
*95K0G013SL, 95K0G014SL(Analytica), 95K0G015SL(COE)
A3-17
GPS 70° 34.32 N
152° 15.59 W
12'5"
25'
N
HI = 30.7
Avg. Depth of Excavation
-1.5 ft (6.2)
24.46 ft



HI = 28.12

SECTION	SIZE	AVG. SURFACE ELE.	AVG DEPTH ELE	AVG FT.
A	18x11.12	23.85	22.0	-1.85
B	18x22.24	23.10	22.1	-1.0
C	18x11.12	23.50	22.1	-1.4

SECTION	SIZE	Cu. Yds
A	18x11.0x1.85	13.57
B	18x21.2x1.0	14.13
C	18x11.0x1.4	10.27
	TOTAL Cu. Yds	37.97
	WEIGHT CONV.	1.665
	TOTAL TONS	63.22

SEPT. 13, 1995

AREA #2

EXCAVATION ELEVATIONS (AVG. ELEVATION 21.1)

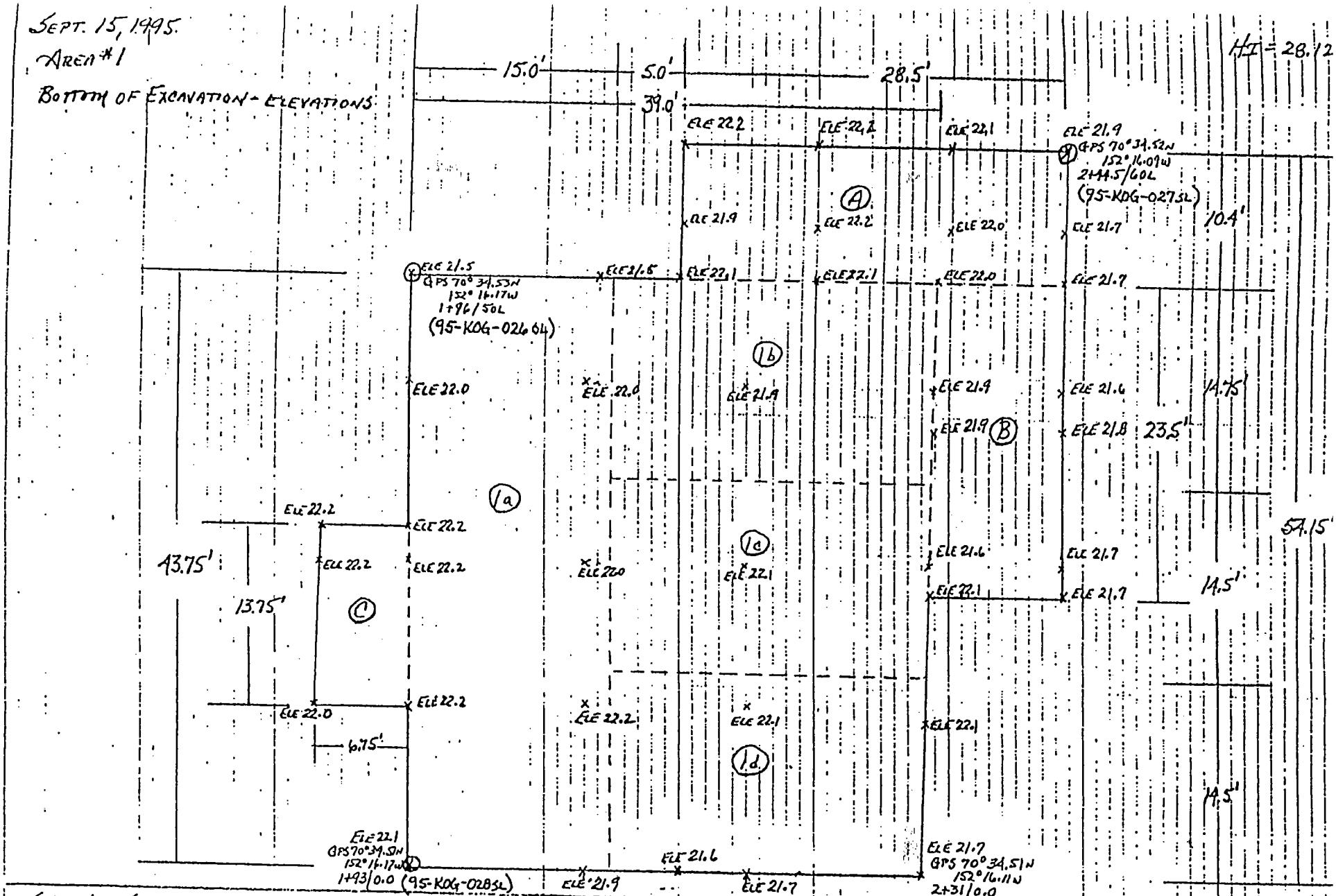
PID FIELD SCREENING: A2-3B, A2-9B, A2-9C, A2-16B, A2-22B, A2-26B THRU A2-36B, 9/12/95

CONFIRMATION SOIL SAMPLING: 95KOG-0235L, (A2-36B), #95KOG-0249SL(A2-32B), #95KOG-0253L(A2-26B)

SEPT. 15, 1995.

AREA #1

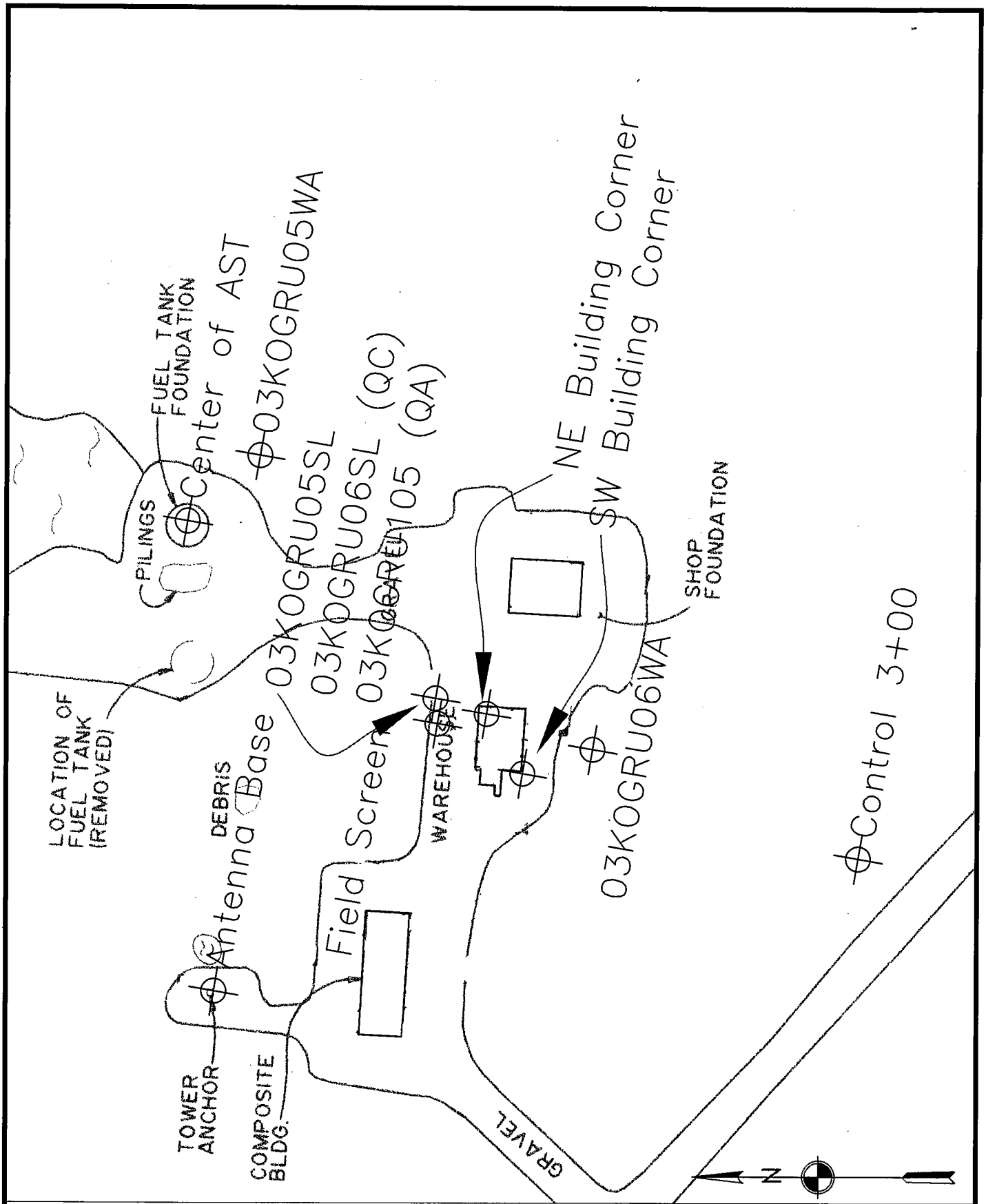
BOTTOM OF EXCAVATION - ELEVATIONS



SECTION	SIZE	AVG EXCAVATION DEPTH	AVG DEPTH ELEVATION	AVG SURFACE ELEVATION	CU. YDS.	CONVERSION FACTOR	TONS
1a	13x13.75	1.8	21.9	23.7	43.75	1.665	72.84
1b	24x14.75	1.9	21.9	23.8	24.91	1.665	41.47
1c	23.5x14.50	0.8	21.9	22.7	10.10	1.665	16.81
1d	23x14.50	1.1	21.9	23.0	13.59	1.665	22.62
A	28.5x10.4	2.5	22.0	24.5	27.44	1.665	45.69
B	23.5x8.4	1.8	21.8	23.6	13.16	1.665	21.91
C	6.75x13.75	1.4					
TOTALS					137.76 C		
					229.37 To		

Appendix D

Excerpts from USACE 2003



ALASKA DISTRICT CORPS OF ENGINEERS MATERIALS BRANCH	FIGURE 3B KOGRU DEW LINE SITE – SHOP AREA AUGUST 2003 SAMPLING LOCATIONS	SCALE: NONE DATE: 28 NOV 2003 DWG/RVW: RAR/JSD

Appendix E

Conceptual Site Model

Human Health Conceptual Site Model
Scoping Form

Site Name: Kogru Main Cantonment Area

File Number: F10AK0022-03

Completed by: SWM

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, a CSM graphic and text must be submitted with the site characterization work plan.

General Instructions: Follow the italicized instructions in each section below.

1. *General Information:*

Sources *(check potential sources at the site)*

- ☐ USTs
- ☑ ASTs
- ☐ Dispensers/fuel loading racks
- ☐ Drums
- ☐ Vehicles
- ☑ Landfills
- ☑ Transformers
- ☑ Other: Pipelines

Release Mechanisms *(check potential release mechanisms at the site)*

- ☑ Spills
- ☑ Leaks
- ☐ Direct discharge
- ☐ Burning
- ☐ Other: _____

Impacted Media *(check potentially-impacted media at the site)*

- ☑ Surface soil (0-2 feet bgs*)
- ☐ Subsurface Soil (>2 feet bgs)
- ☐ Air
- ☐ Groundwater
- ☑ Surface water
- ☐ Other: _____

Receptors (*check receptors that could be affected by contamination at the site)*

- ☑ Residents (adult or child)
- ☑ Commercial or industrial worker
- ☑ Construction worker
- ☑ Subsistence harvester (i.e., gathers wild foods)
- ☑ Subsistence consumer (i.e., eats wild foods)
- ☑ Site visitor
- ☑ Trespasser
- ☑ Recreational user
- ☑ Farmer
- ☐ Other: _____

* bgs – below ground surface

2. *Exposure Pathways:* *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact –

1 Incidental Soil Ingestion

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

If both boxes are checked, label this pathway complete: Complete

2 Dermal Absorption of Contaminants from Soil

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption). ☑

Arsenic	Lindane
Cadmium	PAHs
Chlordane	Pentachlorophenol
2,4-dichlorophenoxyacetic acid	PCBs
Dioxins	SVOCs
DDT	

If all of the boxes are checked, label this pathway complete: Complete

b) Ingestion –

1 Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future? ☐

Could the potentially affected groundwater be used as a current or future drinking water source? *Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.* ☐

If both the boxes are checked, label this pathway complete: _____

2 Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future? ☑

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? *Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).* ☑

If both boxes are checked, label this pathway complete: Complete

3 Ingestion of Wild Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food? ☑

Do the site contaminants have the potential to bioaccumulate (*see* Appendix A)? ☑

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that **could be** connected to surface water, etc.) ☑

If all of the boxes are checked, label this pathway complete: Complete

c) Inhalation

1 Inhalation of Outdoor Air

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Are the contaminants in soil volatile (*See Appendix B*)? ☑

If all of the boxes are checked, label this pathway complete: Complete

2 Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, <u>or</u> subject to "preferential pathways" that promote easy airflow, like utility conduits or rock fractures) ☑

Are volatile compounds present in soil or groundwater (*See Appendix C*)? ☑

If both boxes are checked, label this pathway complete: Complete

3. Additional Exposure Pathways: *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- Climate permits recreational use of waters for swimming,
- Climate permits exposure to groundwater during activities, such as construction, without protective clothing, or
- Groundwater or surface water is used for household purposes.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Volatile Compounds in Household Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- The contaminated water is used for household purposes such as showering, laundering, and dish washing, and
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix B)

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Fugitive Dust

Generally DEC soil ingestion cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway, although this is not true in the case of chromium. Examples of conditions that may warrant further investigation include:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers. This size can be inhaled and would be of concern for determining if this pathway is complete.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during recreational or some types of subsistence activities. People then incidentally **ingest** sediment from normal hand-to-mouth activities. In addition, **dermal absorption of contaminants** may be of concern if people come in contact with sediment and the contaminants are able to permeate the skin (see dermal exposure to soil section). This type of exposure is rare but it should be investigated if:

- Climate permits recreational activities around sediment, and/or
- Community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

ADEC soil ingestion cleanup levels are protective of direct contact with sediment. If they are determined to be over-protective for sediment exposure at a particular site, other screening levels could be adopted or developed.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

4. Other Comments (*Provide other comments as necessary to support the information provided in this form.)*

HUMAN HEALTH CONCEPTUAL SITE MODEL

Site: Kogru Main Cantonment Area
F10AK0022-03

Completed By: SWM

Date Completed: 28SEP2010

Follow the directions below. Do not consider engineering or land use controls when describing pathways.

(1)
Check the media that could be directly affected by the release.

(2)
For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Briefly list other mechanisms or reference the report for details.

(3)
Check exposure media identified in (2).

(4)
Check exposure pathways that are complete or need further evaluation. The pathways identified must agree with Sections 2 and 3 of the CSM Scoping Form.

(5)
Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, or "C/F" for both current and future receptors.

Media	Transport Mechanisms	Exposure Media	Exposure Pathways	Current & Future Receptors: Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
✔ Surface Soil (0-2 ft bgs)	✔ Direct release to surface soil — *check soil*	✔ soil	✔ Incidental Soil Ingestion	X	X	X	X	X		
	✔ Migration or leaching to subsurface — *check soil*		✔ Dermal Absorption of Contaminants from Soil	X	X	X	X	X		
	☐ Migration or leaching to groundwater — *check groundwater*									
	✔ Volatilization — *check air*									
	✔ Runoff or erosion — *check surface water*									
	✔ Uptake by plants or animals — *check biota*									
	☐ Other (*list*): Kogru Main Cantonment Area									
✔ Subsurface Soil (2-15 ft bgs)	✔ Direct release to subsurface soil — *check soil*	☐ groundwater	☐ Ingestion of Groundwater							
	☐ *Migration to groundwater* — *check groundwater*		☐ Dermal Absorption of Contaminants in Groundwater							
	✔ *Volatilization* — *check air*		✔ Inhalation of Volatile Compounds in Tap Water							
	☐ *Other (list):* F10AK0022-03									
☐ Ground-water	☐ Direct release to groundwater — *check groundwater*	✔ air	☐ Inhalation of Outdoor Air	X	X	X	X	X		
	✔ *Volatilization* — *check air*		☐ Inhalation of Indoor Air	X	X	X	X	X		
	✔ *Flow to surface water body* — *check surface water*		☐ Inhalation of Fugitive Dust							
	✔ *Flow to sediment* — *check sediment*									
	✔ *Uptake by plants or animals* — *check biota*									
	✔ *Other (list):* SWM									
☐ Surface Water	☐ Direct release to surface water — *check surface water*	✔ surface water	☐ Ingestion of Surface Water	X	X	X	X	X		
	☐ *Volatilization* — *check air*		☐ Dermal Absorption of Contaminants in Surface Water							
	☐ *Sedimentation* — *check sediment*		✔ Inhalation of Volatile Compounds in Tap Water							
	☐ *Uptake by plants or animals* — *check biota*									
	☐ *Other (list):* Pipelines									
✔ Sediment	✔ Direct release to sediment — *check sediment*	✔ sediment	✔ Direct Contact with Sediment							
	✔ *Resuspension, runoff, or erosion* — *check surface water*									
	✔ *Uptake by plants or animals* — *check biota*									
	✔ *Other (list):*	✔ biota	✔ Ingestion of Wild Foods						X	

Revised 3/21/06