10/1/93 - 02075

Baker

Baker Environmental, Inc.

David Forsythe

TECHNICAL REVIEW COMMITTEE (TRC) MEETING

for the

CAMP ALLEN LANDFILL
AREA A and AREA B
REMEDIAL INVESTIGATION
AND FEASIBILITY STUDY (RI/FS)
NAVAL BASE NORFOLK

BAKER ENVIRONMENTAL, INC.

September 30 & October 1, 1993

TRC MEETING AGENDA
September 30, 1993

• 8:30 - 9:00	GET ACQUAINTED, COFFEE/DONUTS	
• 9:~~00~~ 08 - 9:10	MEETING INTRODUCTION	~~NAVBASE~~ David Forsythe
• 9:10 - 9:~~20~~ 18	WELCOME BY DEPUTY BASE COMMANDER, CAPTAIN NORTON	
• 9:~~20~~ 18 - 9:~~30~~ 20	HISTORY OF INSTALLATION RESTORATION PROGRAM AND CAMP ALLEN LANDFILL AT NAVAL BASE, NORFOLK	NAVBASE ~~Tom~~ David Forsythe
• 9:30 - 10:15	SUMMARY OF RI FIELD ACTIVITIES	BAKER Tom Artman
• 10:15 - 10:30	BREAK	
• 10:30 - 11:15	SUMMARY OF RI RESULTS	BAKER
• 11:15 - 12:00	QUESTIONS AND ANSWERS	

TRC MEETING AGENDA
September 30, 1993
(continued)

• 12:00 - 1:00	LUNCH	
• 1:00 - 2:00	WINDSHIELD TOUR OF CAMP ALLEN LANDFILL	
• 2:00 - 3:00	SUMMARY OF BASELINE RISK ASSESSMENT	BAKER
• 3:00 - 4:00	QUESTIONS AND ANSWERS	

TRC MEETING AGENDA
October 1, 1993

• 9:00 - 9:30	REVIEW OF PREVIOUS DAY SUMMARIES	BAKER
• 9:30 - 9:45	AREA B REMOVAL ACTION OVERVIEW	BAKER
• 9:45 - 11:15	SUMMARY OF FS RESULTS	BAKER
• 11:15 - 12:00	PLANNED PREDESIGN AND REMEDIAL DESIGN ACTIVITIES	BAKER
• 12:00 - 1:00	LUNCH	
• 1:00 - 3:00	QUESTIONS, ANSWERS, and CLOSING COMMENTS	

SUMMARY OF RI FIELD ACTIVITIES

CAMP ALLEN LANDFILL
AREA A AND AREA B

HISTORICAL OVERVIEW

- Historical Land Use Information

WASTE INCINERATOR @ brig decommissioned in 1960's

- Original Bousch Creek Drainage Pattern
- Development of the Area
- "General Waste" Incineration

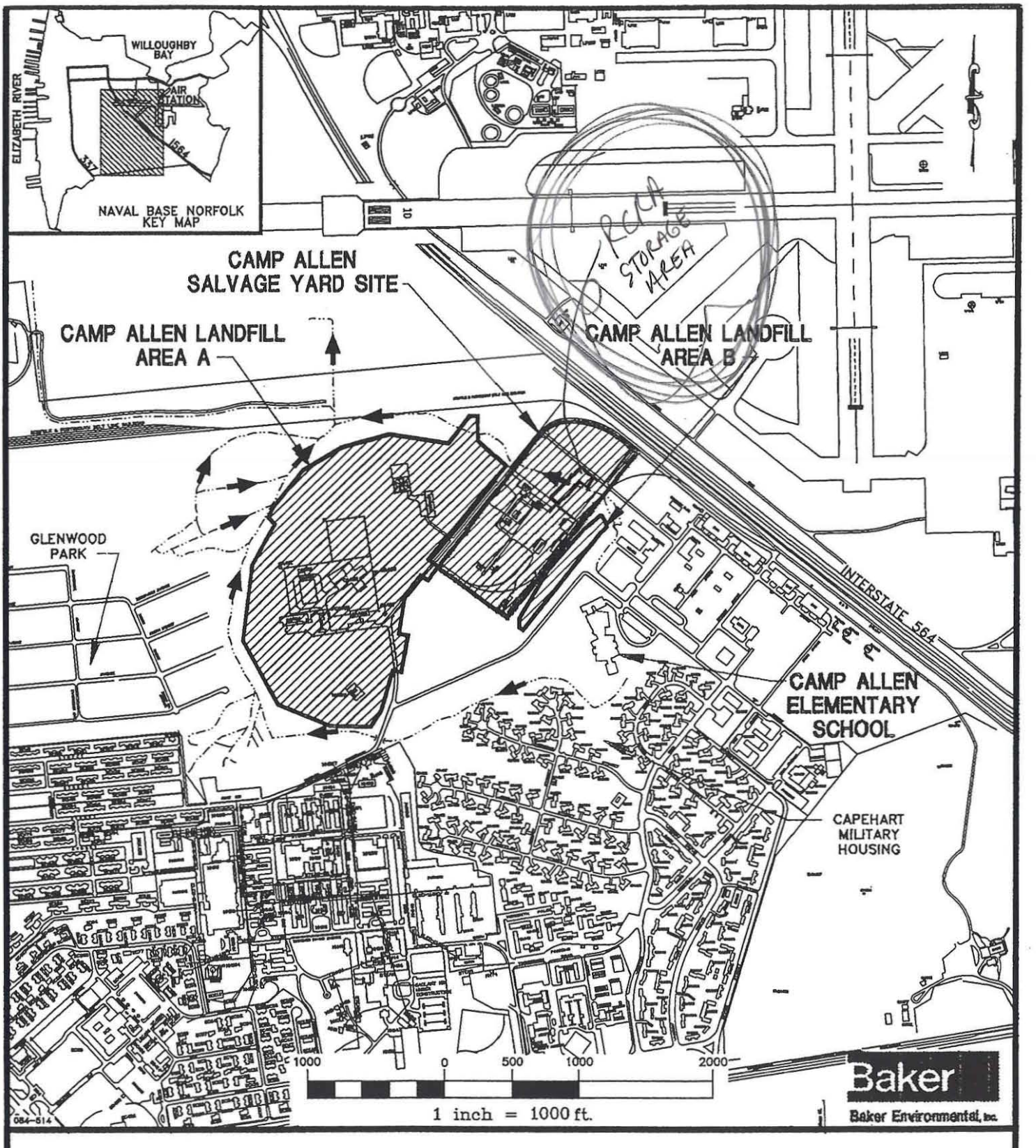
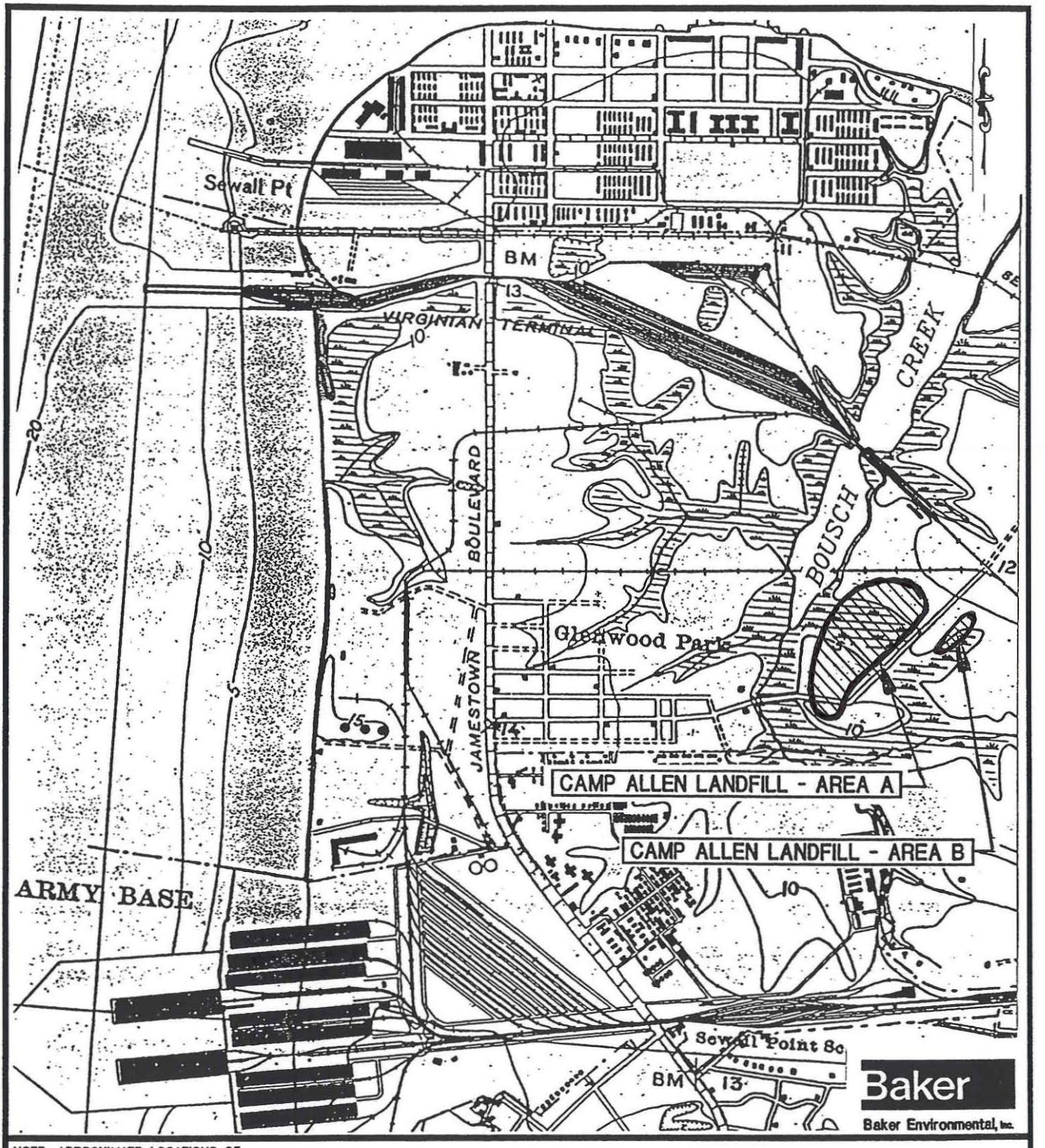


FIGURE 1-1
SITE LOCATION MAP
CAMP ALLEN LANDFILL

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

SOURCE: LANTDIV, OCTOBER 1991

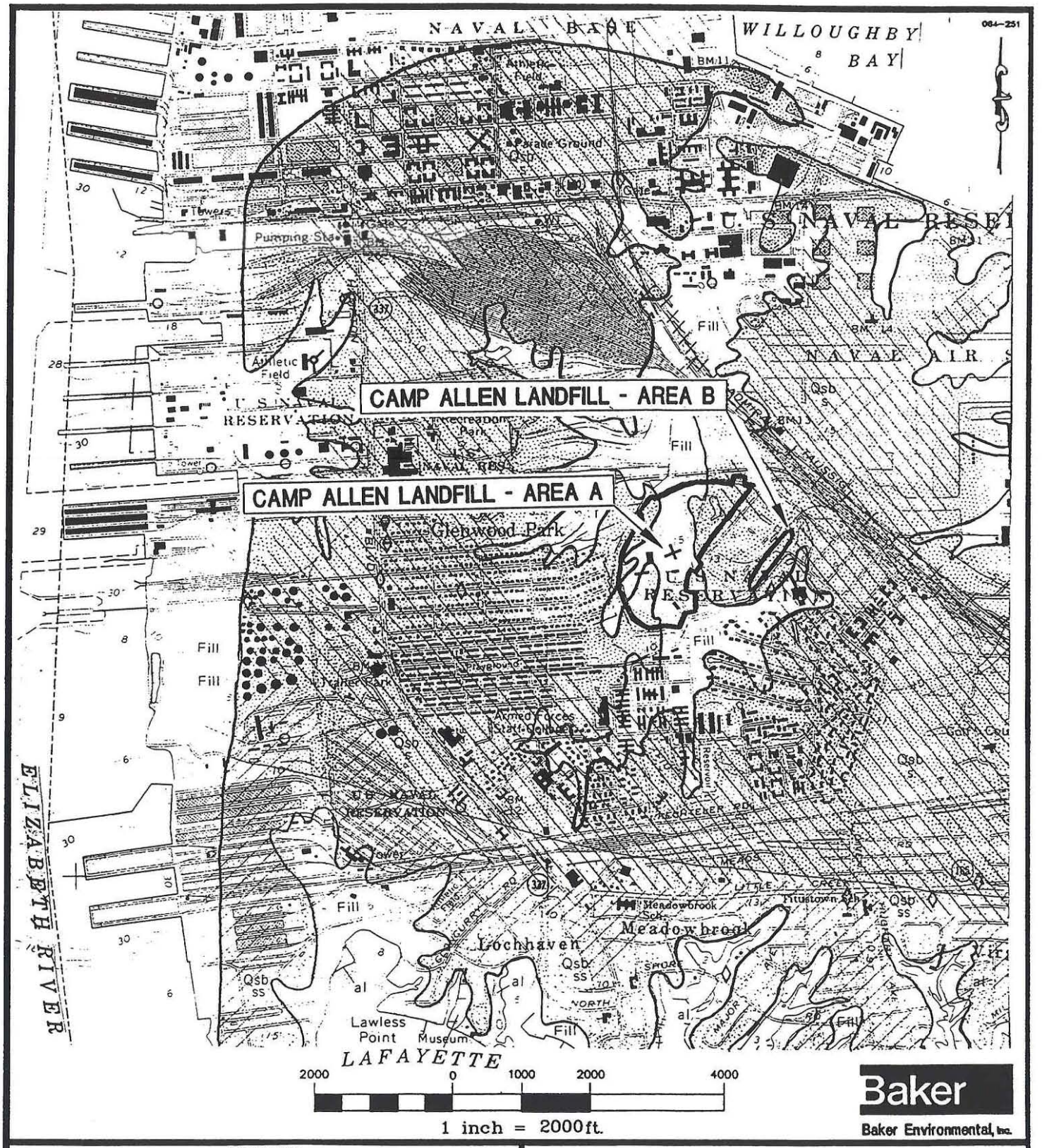


NOTE: APPROXIMATE LOCATIONS OF CAMP ALLEN LANDFILL AREAS A AND B –MAP PRE–1940

FIGURE 2–3
HISTORIC LOCATION OF BOUSCH CREEK
AT CAMP ALLEN LANDFILL SITE

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084–211



LEGEND

- FILL MATERIAL
- UNCONSOLIDATED MATERIAL

NOTE: THIS FIGURE DEPICTS A GENERAL RELATIONSHIP BETWEEN FILL MATERIAL AND UNCONSOLIDATED SEDIMENTS OF THE COASTAL PLAIN.

SOURCE: U.S.G.S., 1965 NORFOLK NORTH QUADANGLE

FIGURE 2-4
GEOLOGY OF THE NORFOLK NORTH QUADRANGLE (FILL AREA)
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
AREA A

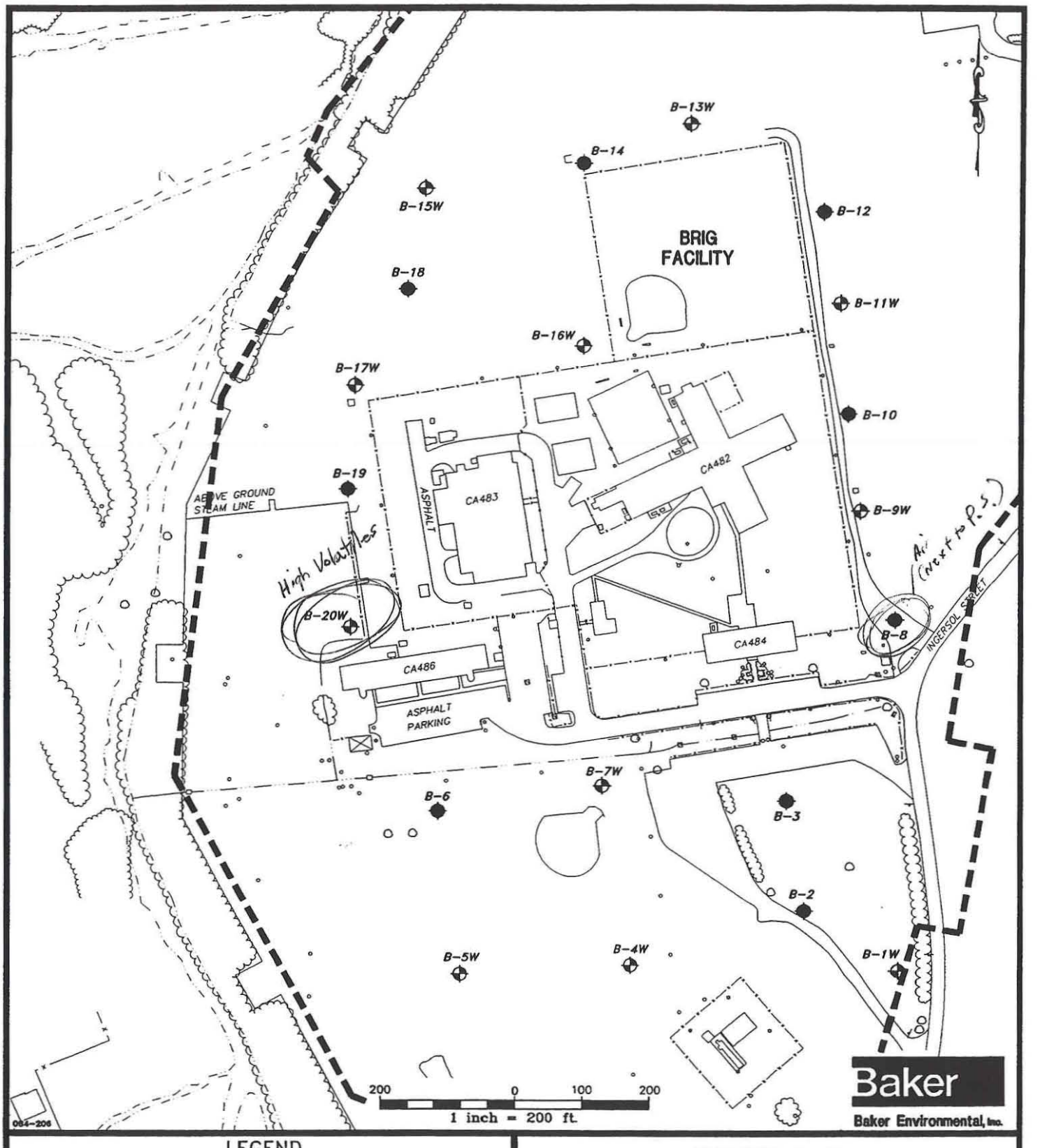
PREVIOUS INVESTIGATIONS

- Initial Assessment Study, 1983 (Malcolm Pirnie)
- Waste Disposal from 1940's to 1974 (45 acres)-
- ~ 40,000 pounds of metals plating sludge
- ~ 60,000 pounds of parts cleaning sludge
- ~ 400,000 pounds of paint stripping residue
- Miscellaneous waste (Demo debris, flyash, etc.)

CAMP ALLEN LANDFILL
AREA A

PREVIOUS INVESTIGATIONS

- Brig Assessment, 1984 (Malcolm Pirnie)
- 11 shallow monitoring wells
- Elevated volatile organics - B-20W
- Nine gas monitoring stations
- Elevated methane/gas concentrations - B-8



LEGEND

B-2 GAS MONITORING STATION

B-1W SHALLOW MONITORING WELL LOCATION

LIMITS OF AREA A LANDFILL

SSA CONDUCTED BY MALCOLM PIRNIE, INC.
MAP SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 1-3
SITE SUITABILITY ASSESSMENT
FOR PROPOSED BRIG EXPANSION
MONITORING WELL AND GAS
MONITORING STATION LOCATIONS

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
AREA A

PREVIOUS INVESTIGATIONS

- Initial Remedial Investigation, 1988 (Malcolm Pirnie)
- Three shallow monitoring wells
- Three surface water samples
- Confirmed volatile organic contamination at B-20W
- Metal concentrations (SW & GW)

SURFACE WATER GROUND WATER

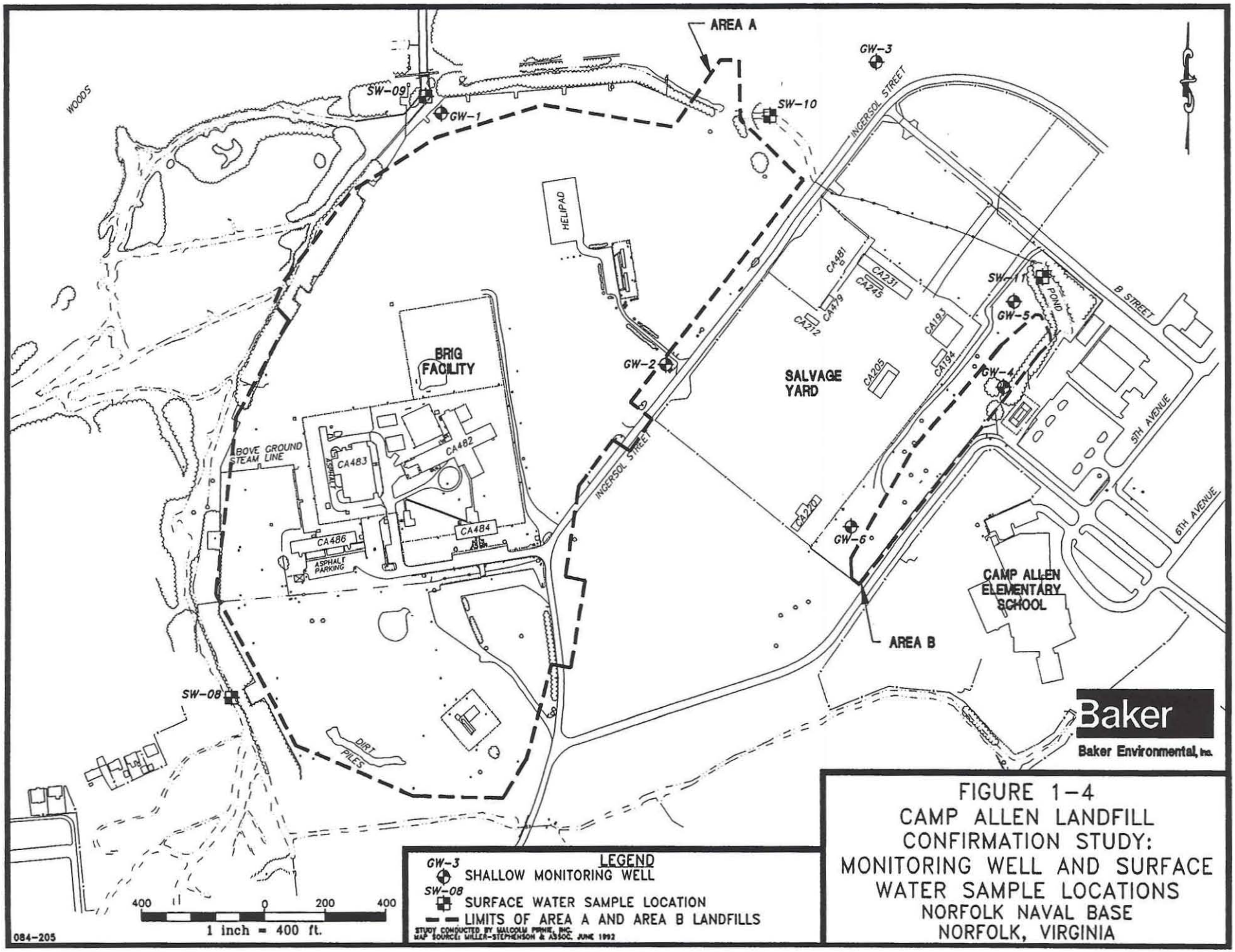


FIGURE 1-4
CAMP ALLEN LANDFILL
CONFIRMATION STUDY:
MONITORING WELL AND SURFACE
WATER SAMPLE LOCATIONS
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
AREA A

PREVIOUS INVESTIGATIONS

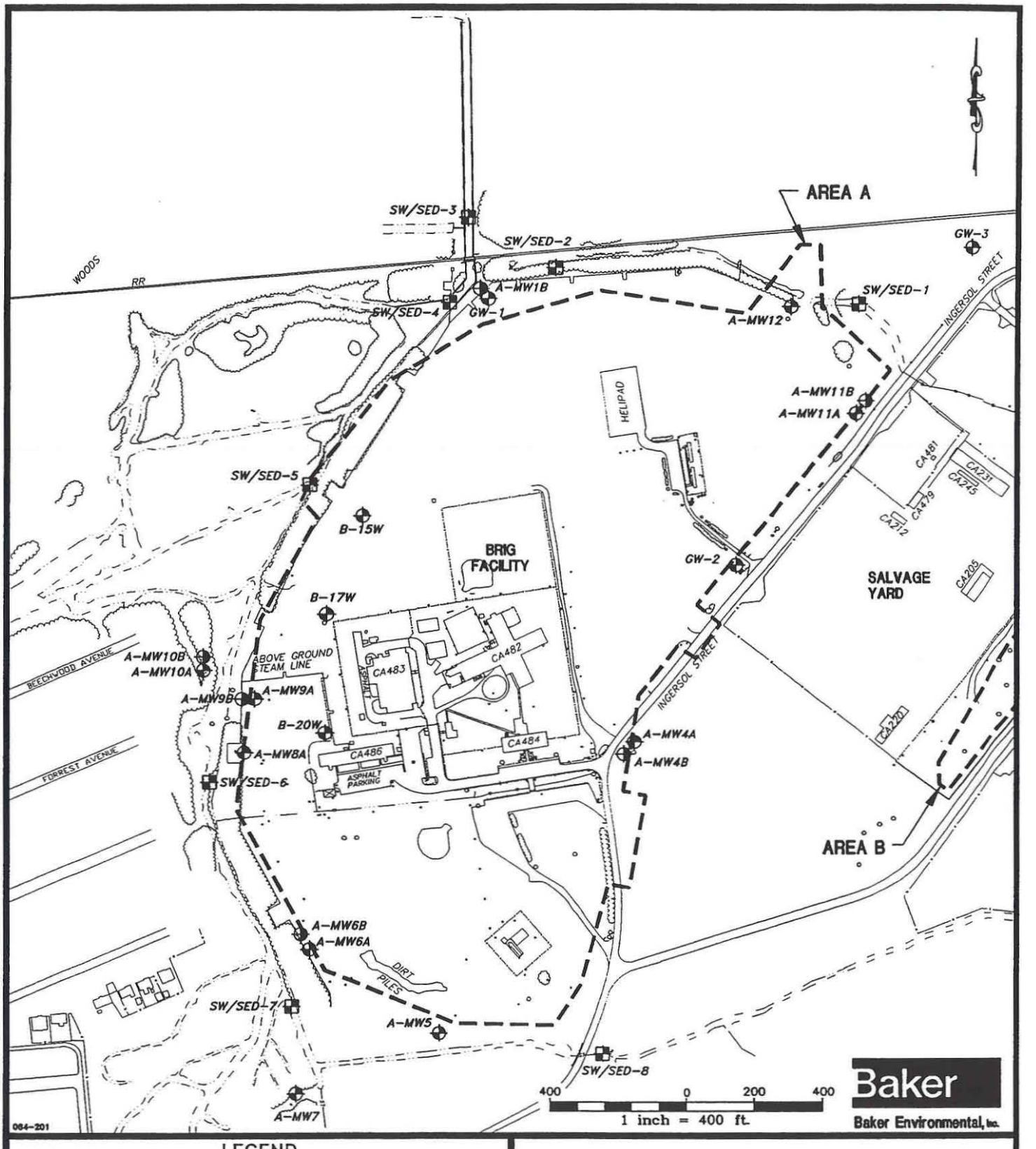
- Follow-up Remedial Investigation, 1990/1991 (CH2M Hill)
- Nine shallow monitoring wells; and six deep monitoring wells 1st in Yorktown Aquifer
- Eight surface water/sediment samples
- 55 Residential well shallow groundwater samples
- 21 shallow/deep groundwater samples

CAMP ALLEN LANDFILL
AREA A

PREVIOUS INVESTIGATIONS

- Follow-up Remedial Investigation, 1990/1991 (CH2M Hill) Results:
  - ▸ Volatile organic contamination in the shallow groundwater near B-20W
  - ▸ Volatile organic contamination in the deep groundwater downgradient
  - ▸ Four residential well samples - detectable amounts of volatile organics which DO NOT appear to be related to Area A
  - ▸ Metals in surface water and sediment samples - northern Area A

VDEQ why not related? T.A. Acetone in 1 (a lab contaminant)
2 Butanone in 2 (well construction Mat'l)
TCE in 1 (isolated from CA by other wells (shallow))



LEGEND

A-MW6A — SHALLOW MONITORING WELL

A-MW6B — DEEP MONITORING WELL

SW/SED-1 — SURFACE WATER/SEDIMENT SAMPLE LOCATION

— — — LIMITS OF AREA A LANDFILL

STUDY CONDUCTED BY CH2M HILL, INC.
MAP SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 1-5
CAMP ALLEN LANDFILL
INTERIM REMEDIAL INVESTIGATION:
AREA A SAMPLING POINTS

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
AREA B

PREVIOUS INVESTIGATIONS

- Initial Assessment Study, 1983 (Malcolm Pirnie)
- Area B - 1971 Salvage Yard Fire Waste Disposal (2 acres)
- Variable wastes : waste oils, solvents, paints, acids, caustics
- Trench-type disposal operations

CAMP ALLEN LANDFILL
AREA B

PREVIOUS INVESTIGATIONS

- Initial Remedial Investigation, 1988 (Malcolm Pirnie)
- Three shallow monitoring wells
- Surface water samples
- Volatile organic contamination at GW-04 and adjacent surface water

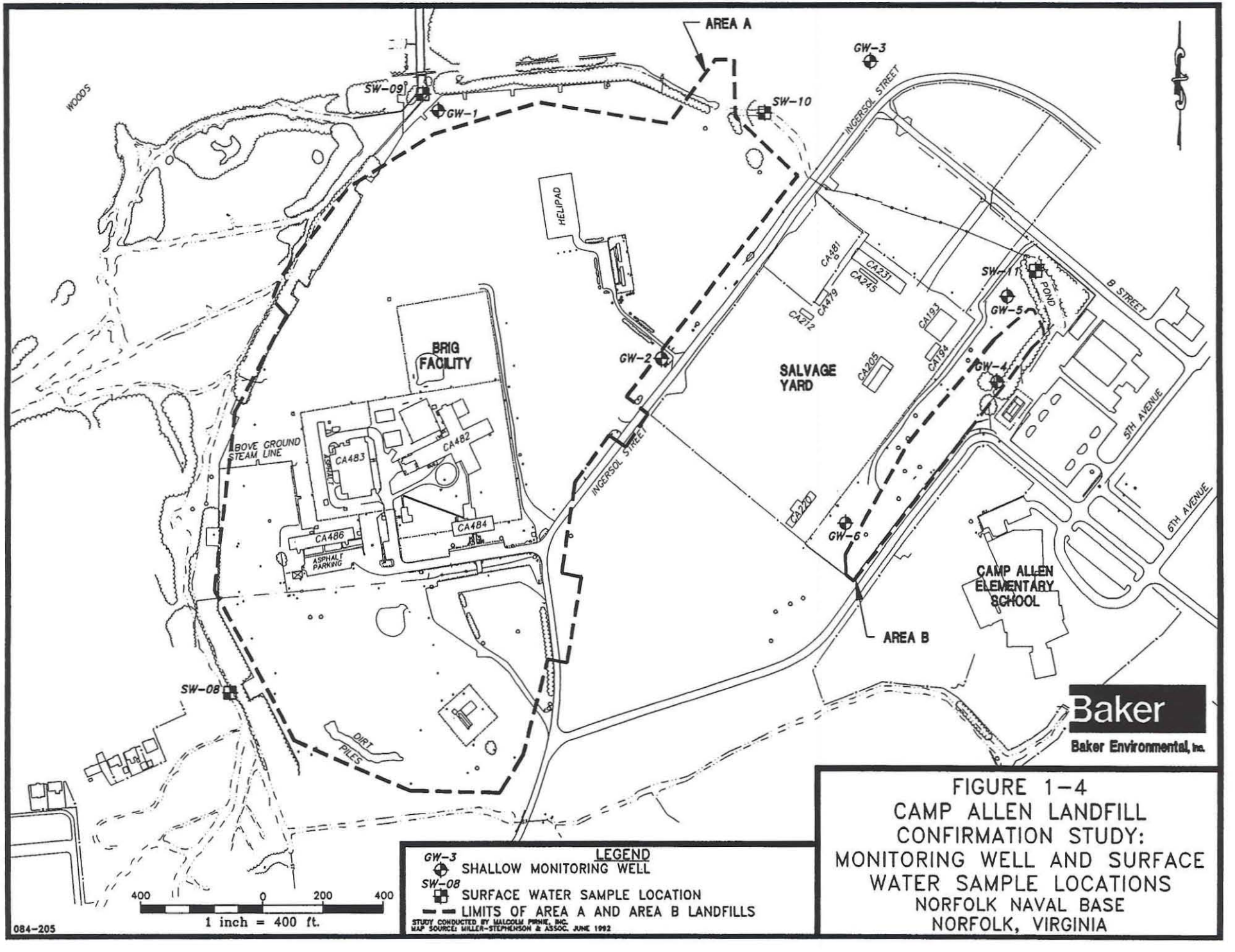


FIGURE 1-4
CAMP ALLEN LANDFILL
CONFIRMATION STUDY:
MONITORING WELL AND SURFACE
WATER SAMPLE LOCATIONS
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
AREA B

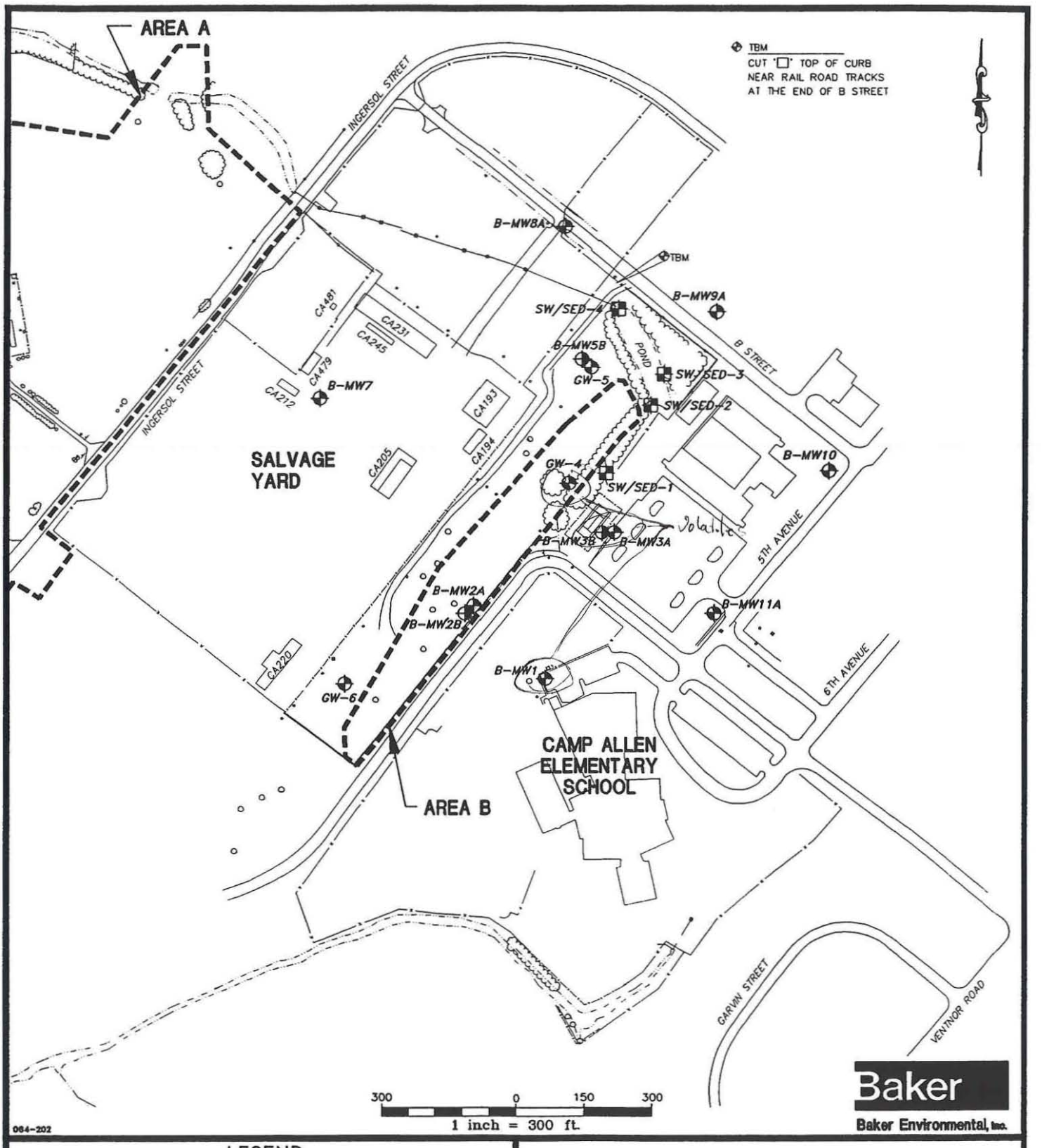
PREVIOUS INVESTIGATIONS

- Follow-up Remedial Investigation, 1990/1991 (CH2M Hill)
- Soil gas survey
- Eight shallow monitoring wells and three deep monitoring wells
- Four surface water and sediment samples

CAMP ALLEN LANDFILL
AREA B

PREVIOUS INVESTIGATIONS

- Follow-up Remedial Investigation, 1990/1991 (CH2M Hill) Results:
  - Soil Gas delineated primary waste disposal areas
  - Volatile organic contamination in downgradient shallow groundwater (GW-4)
  - Volatile organic contamination in all three deep wells (breach of confining clay unit)
  - Elevated volatile organic concentrations in surface water and sediment samples



LEGEND

A-MW6A — SHALLOW MONITORING WELL

A-MW6B — DEEP MONITORING WELL

SW/SED-1 — SURFACE WATER/SEDIMENT SAMPLE LOCATION

— — — LIMITS OF AREA A AND B LANDFILLS

STUDY CONDUCTED BY CN2M HILL, INC.
MAP SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 1-6
CAMP ALLEN LANDFILL
INTERIM REMEDIAL INVESTIGATION:
AREA B SAMPLING POINTS

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)
BAKER ENVIRONMENTAL, INC.

- Summary of RI/FS Project Plans
  - Work Plan, Sampling and Analysis Plan, Quality Assurance Project Plan, and Health & Safety Plan (Rounds 1 and 2)
  - Project Plan Addendum (Round 3)
  - Air Sampling Program Project Plan Addendum (Round 3)
  - Additional Wetland/Ecological Evaluation, Scope of Work and Attachments (Round 3)

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)
BAKER ENVIRONMENTAL, INC.

- Summary of RI Field Activities
  - Round 1 - non-intrusive testing and field verification sampling
  - Round 2 - comprehensive sampling of subsurface soil, surface soil, sediment, surface water, and groundwater
  - Round 3 - fill data gaps identified during preliminary evaluation of data from previous rounds

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Area A RI Activities

  - Geophysical Survey (EM, Resistivity, and Gamma)

  - Monitoring Well Installation
    - Ten in the Yorktown Aquifer;
    - One in the water table aquifer;
    - One, 4-inch pumping well in the Yorktown Aquifer; ~~and~~ (3 in Lower Yorktown)
    - One, 2-inch piezometer in the Yorktown Aquifer

  - 11 Geologic Borings

  - Source Characterization (nine subsurface soil samples)

  - Five Surface Soil Samples

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Area A RI Activities (continued)
  - 11 Surface Water Samples
  - 31 Sediment Samples
  - Two Additional Residential Well Groundwater Samples
  - Groundwater Sampling (three separate rounds)
  - Aquifer Testing (pumping test/slug test [10 wells])

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Area A RI Activities (continued)

  - Air Sampling

    - 12 locations in the Brig Facility
    - Five Ambient Air locations

  - Ecological Evaluation (Aquatic and Terrestrial)

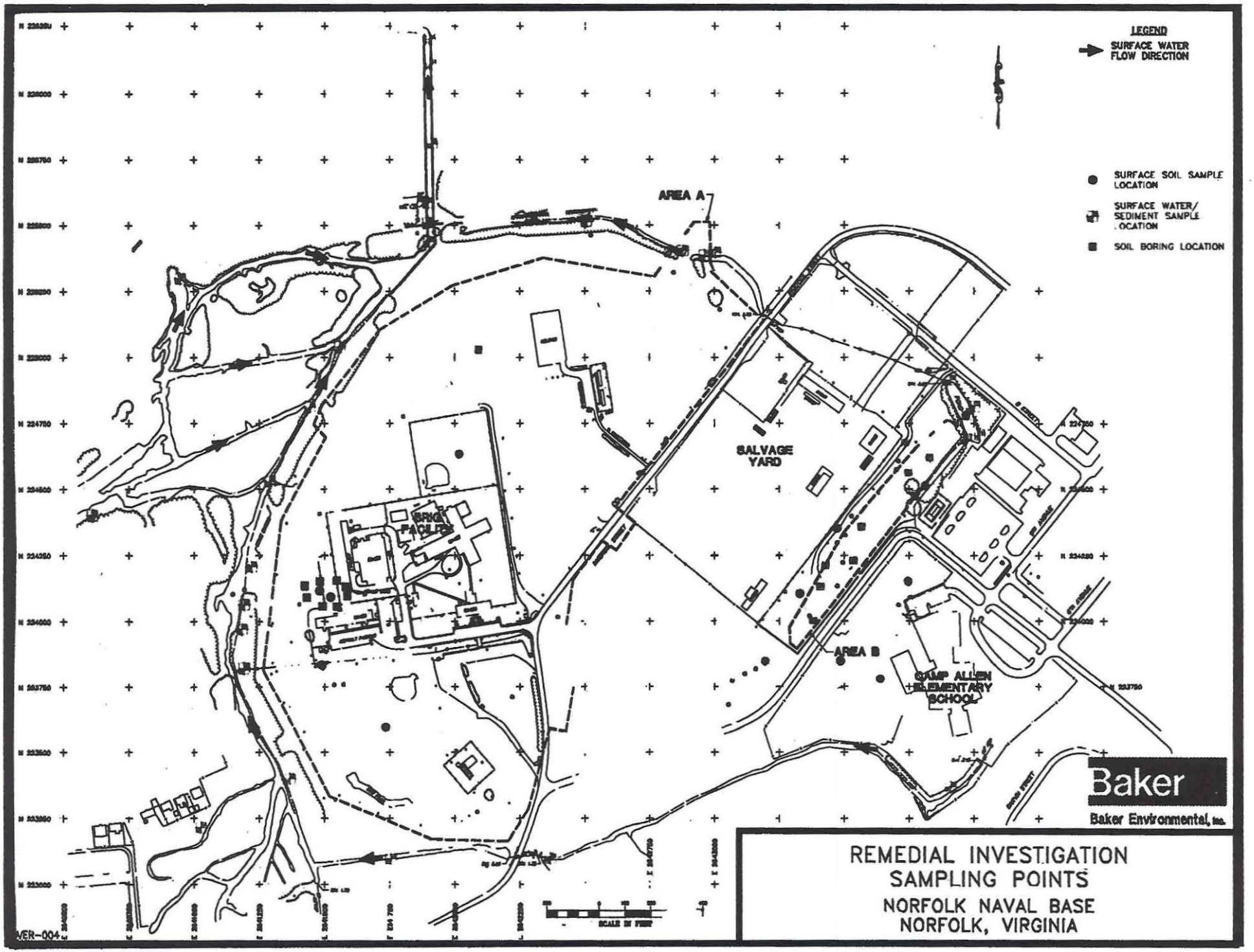
  - Land Surveying

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

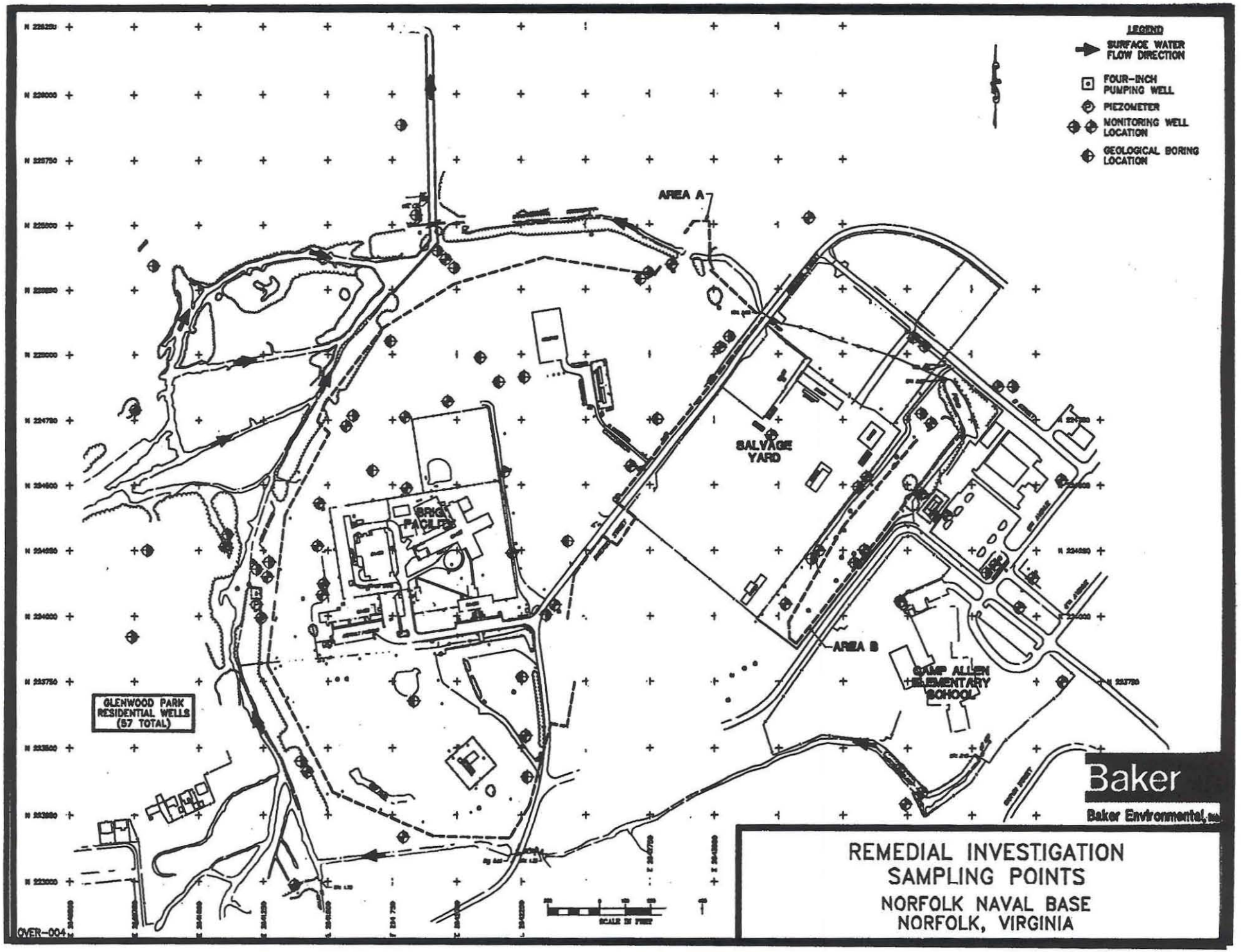
- Area B RI Activities
  - Geophysical Survey (EM and GPR)
  - In-situ Groundwater Sampling (water table aquifer)
    Hydropunch
  - Monitoring Well Installation
    - Four in the Yorktown Aquifer
    - Eight in the water table aquifer
  - Source Characterization (ten subsurface soil samples)
  - Eight Surface Soil Samples
    3 samples requested by EPA @ inst TRC mtg.

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

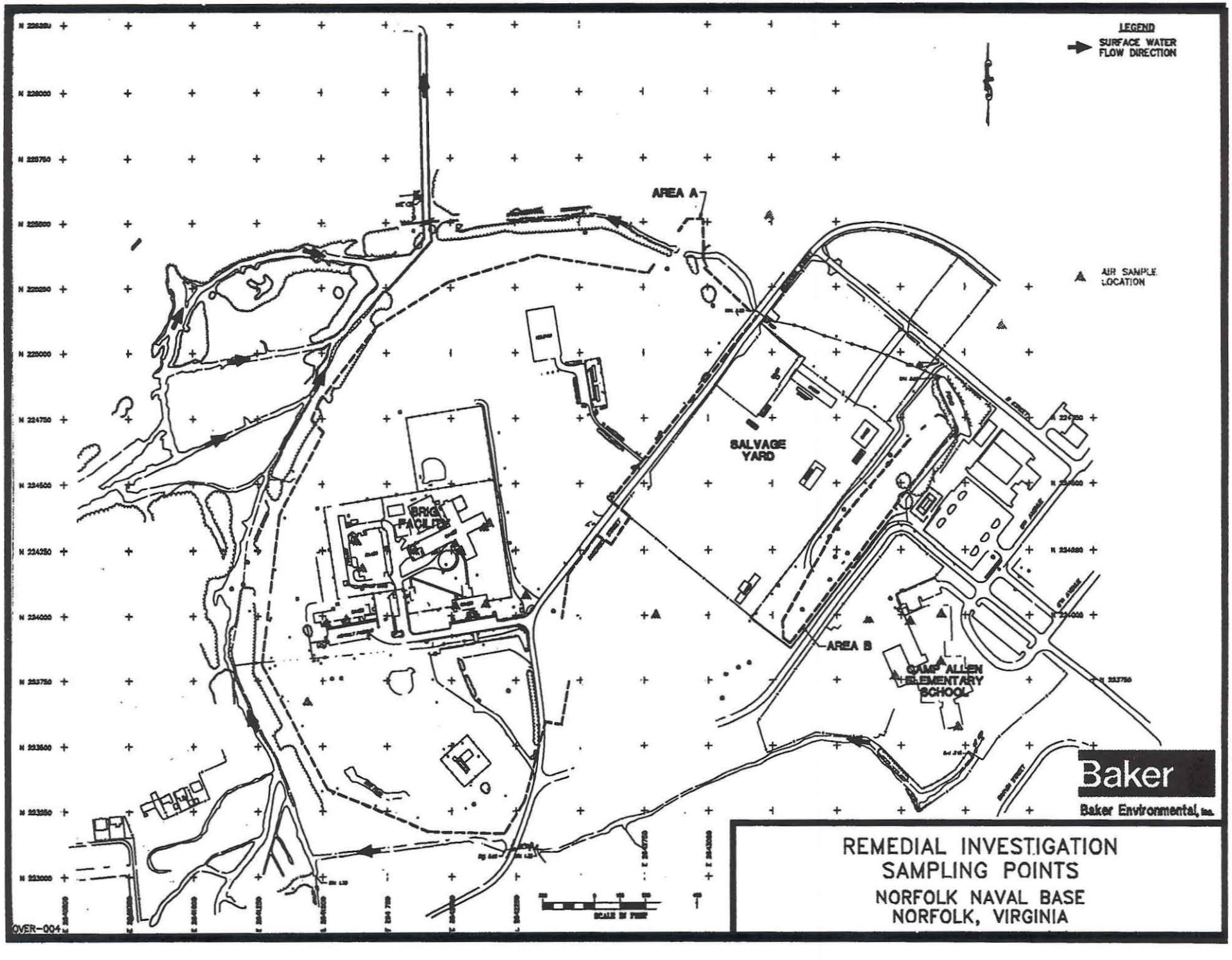
- Area B RI Activities (continued)
  - Five Surface Water Samples
  - Eight Sediment Samples
  - Groundwater Sampling (three separate rounds)
  - Aquifer Testing (slug tests - nine wells)
  - Air Sampling (Five locations in the Camp Allen Elementary School)
  - Ecological Evaluation (Aquatic and Terrestrial)
  - Land Surveying



REMEDIAL INVESTIGATION
SAMPLING POINTS
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



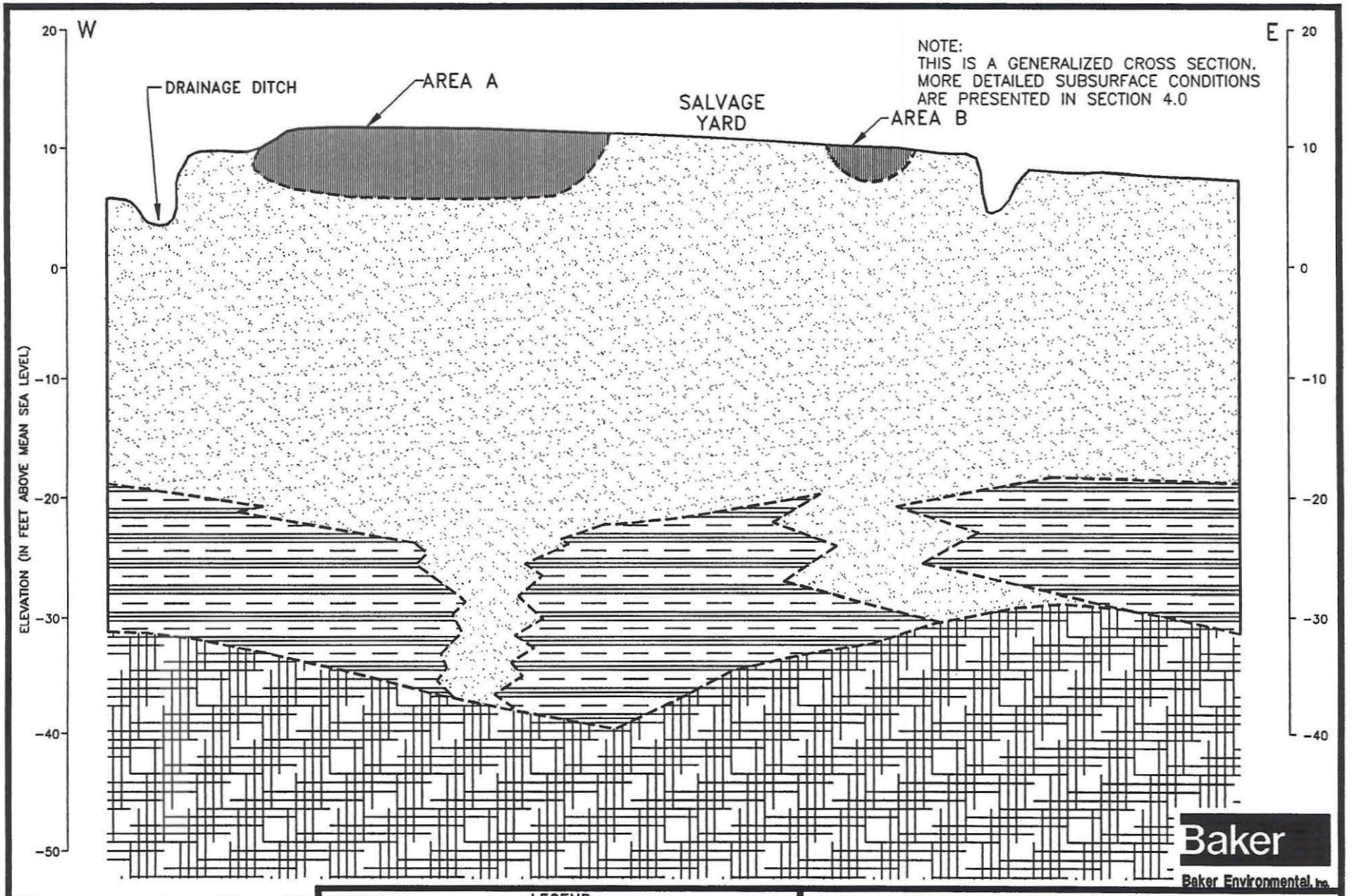
REMEDIAL INVESTIGATION
SAMPLING POINTS
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA


LEGEND
SURFACE WATER FLOW DIRECTION
AIR SAMPLE LOCATION
AREA A
AREA B
SALVAGE YARD
BRIG FACILITY
CAMP ALLEN ELEMENTARY SCHOOL
Baker
Baker Environmental, Inc.
REMEDIAL INVESTIGATION
SAMPLING POINTS
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA
OVER-004

SUMMARY OF RI RESULTS

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Physical Site Conditions
  - Site lithology
    - Unconsolidated sediments (Columbia Group) and fill to ~ 25 feet bgs
    - "Confining clay" unit at ~25-40 feet bgs
    - Unconsolidated sediments (Yorktown Formation) at ~40-130 feet bgs
  - "Clay breach" confirmed by geophysics and boring logs
  - Disposal areas (A and B) were delineated/profiled



300 0 150 300

1 inch = 300 ft.
HORIZONTAL SCALE

VERTICAL EXAGGERATION ±20x

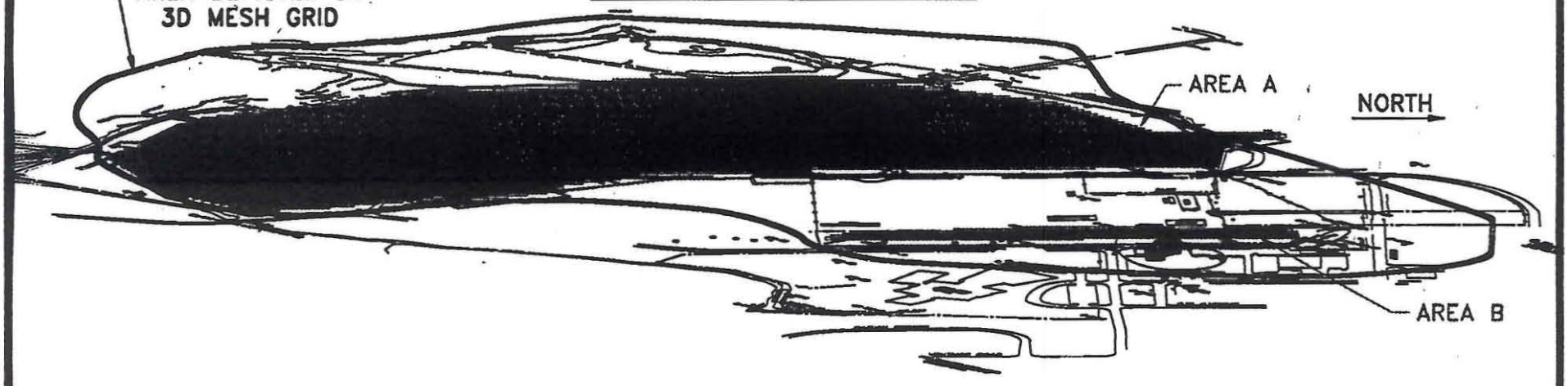
084-212

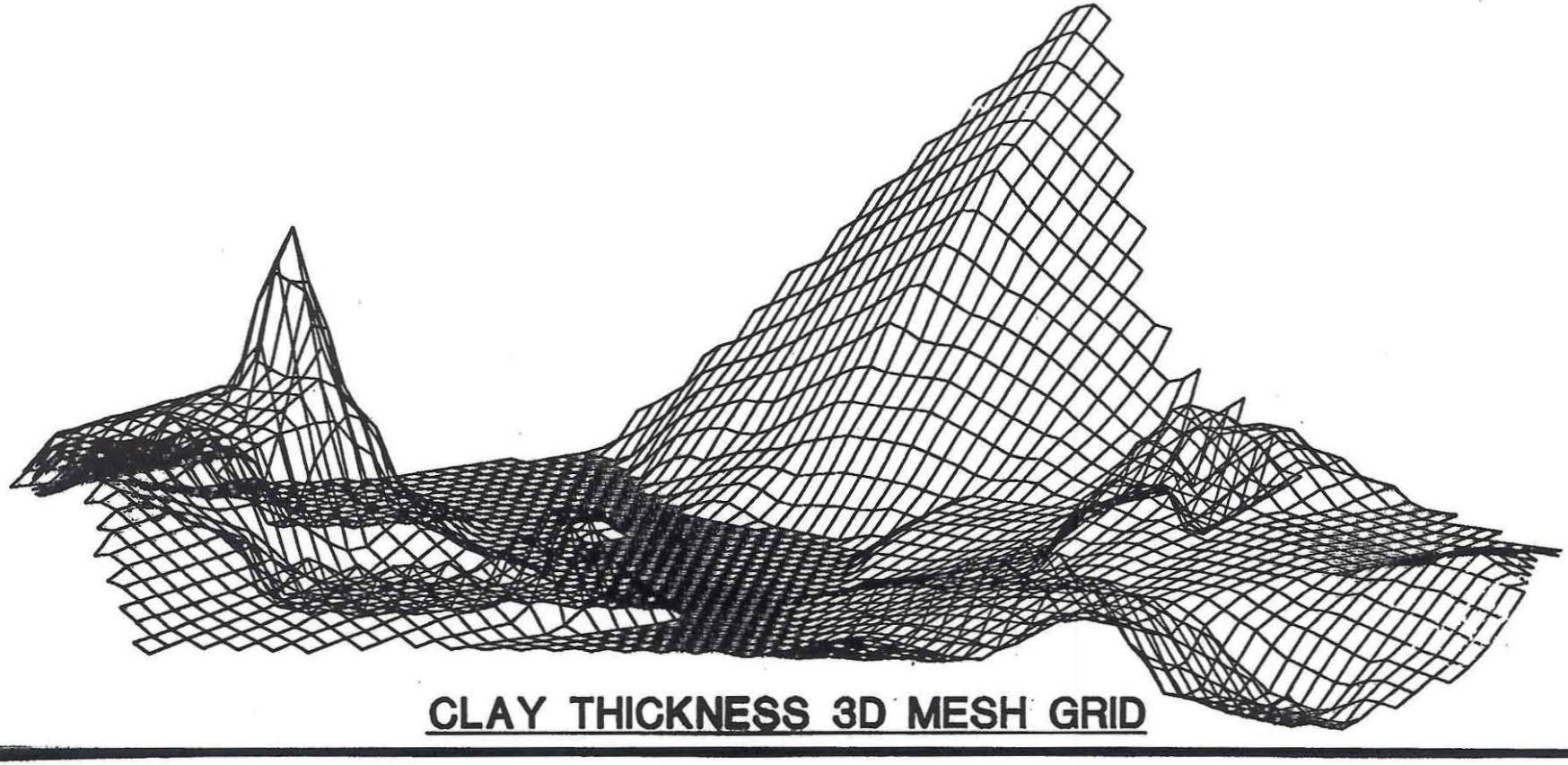
LEGEND

- FILL
- SILTY AND CLAYEY SANDS (COLUMBIA GROUP)
- CLAY WITH LITTLE SILT, SAND (YORKTOWN CONFINING UNIT: BREACHED AT PLACES)
- SILTY SANDS WITH SHELLS (YORKTOWN FORMATION)

FIGURE 2-5
GENERALIZED GEOLOGIC CROSS-SECTION
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
PERSPECTIVE VIEW





CLAY THICKNESS 3D MESH GRID

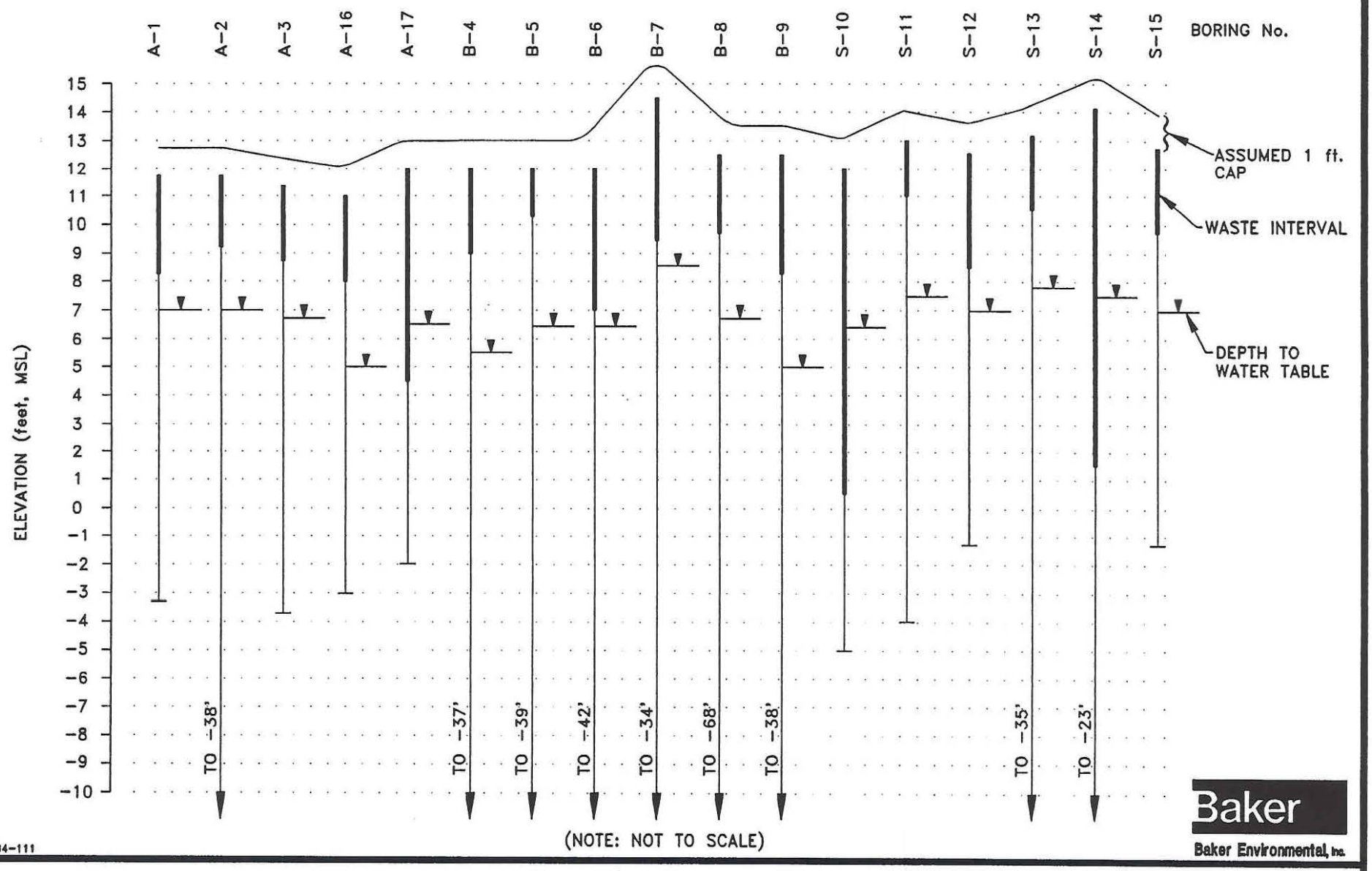
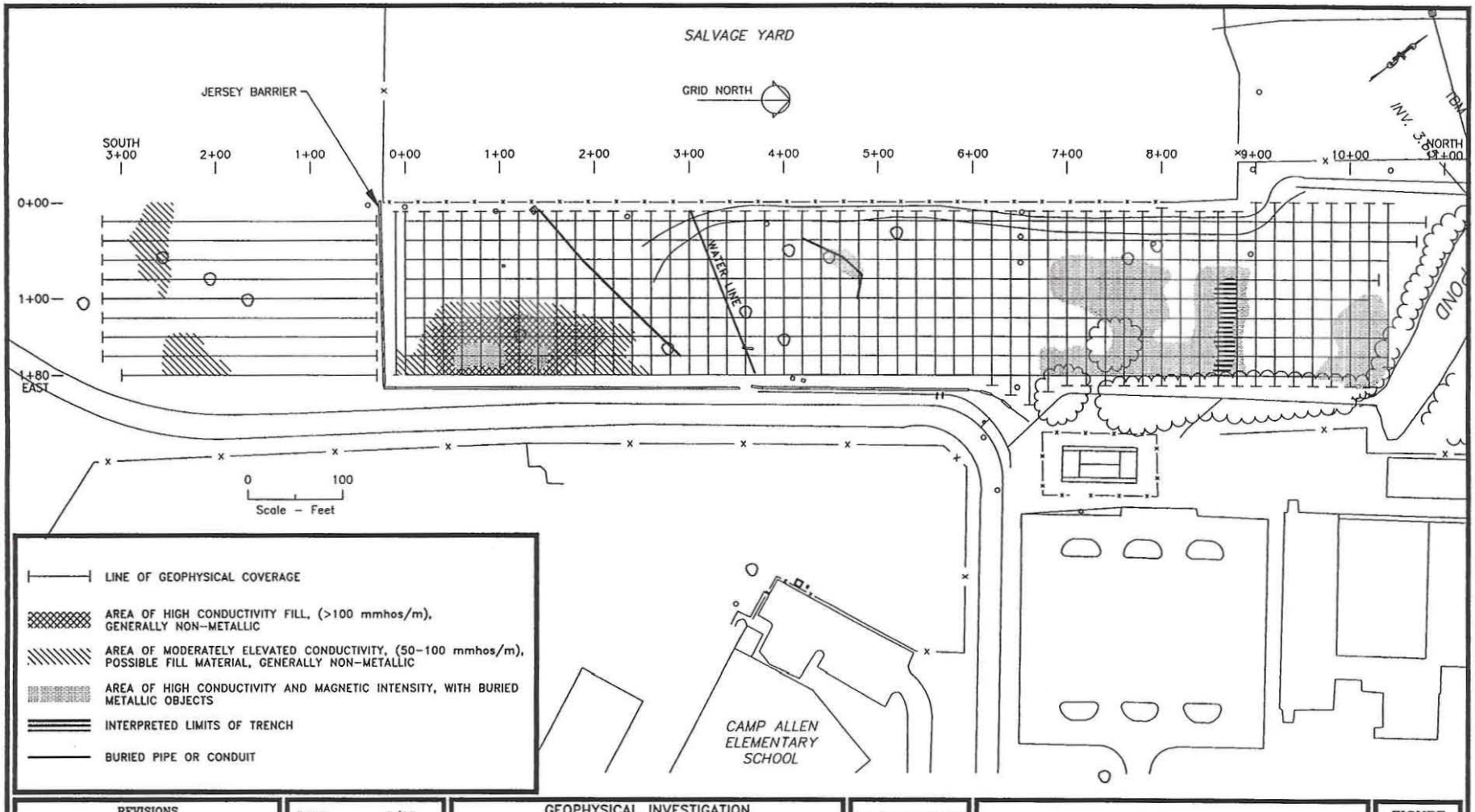


FIGURE 4-13
TYPICAL WASTE PROFILE
AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

SOURCE: LANTDIV DRAWING Nos. 84321 & 84332 (1973)



REVISIONS			
	DATE	2/93	
	SCALE	GRAPHIC	
	DRAWN	GLB	
	REVIEWED		
	S.O.#	19084	
	CADD#	084-501	

GEOPHYSICAL INVESTIGATION
CAMP ALLEN LANDFILL - AREA B
NORFOLK, VIRGINIA
PREPARED FOR BAKER ENVIRONMENTAL, INC

WESTON GEOPHYSICAL CORP.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.
WESTON GEOPHYSICAL CORP. IS A WHOLLY OWNED SUBSIDIARY OF BAKER ENVIRONMENTAL, INC.

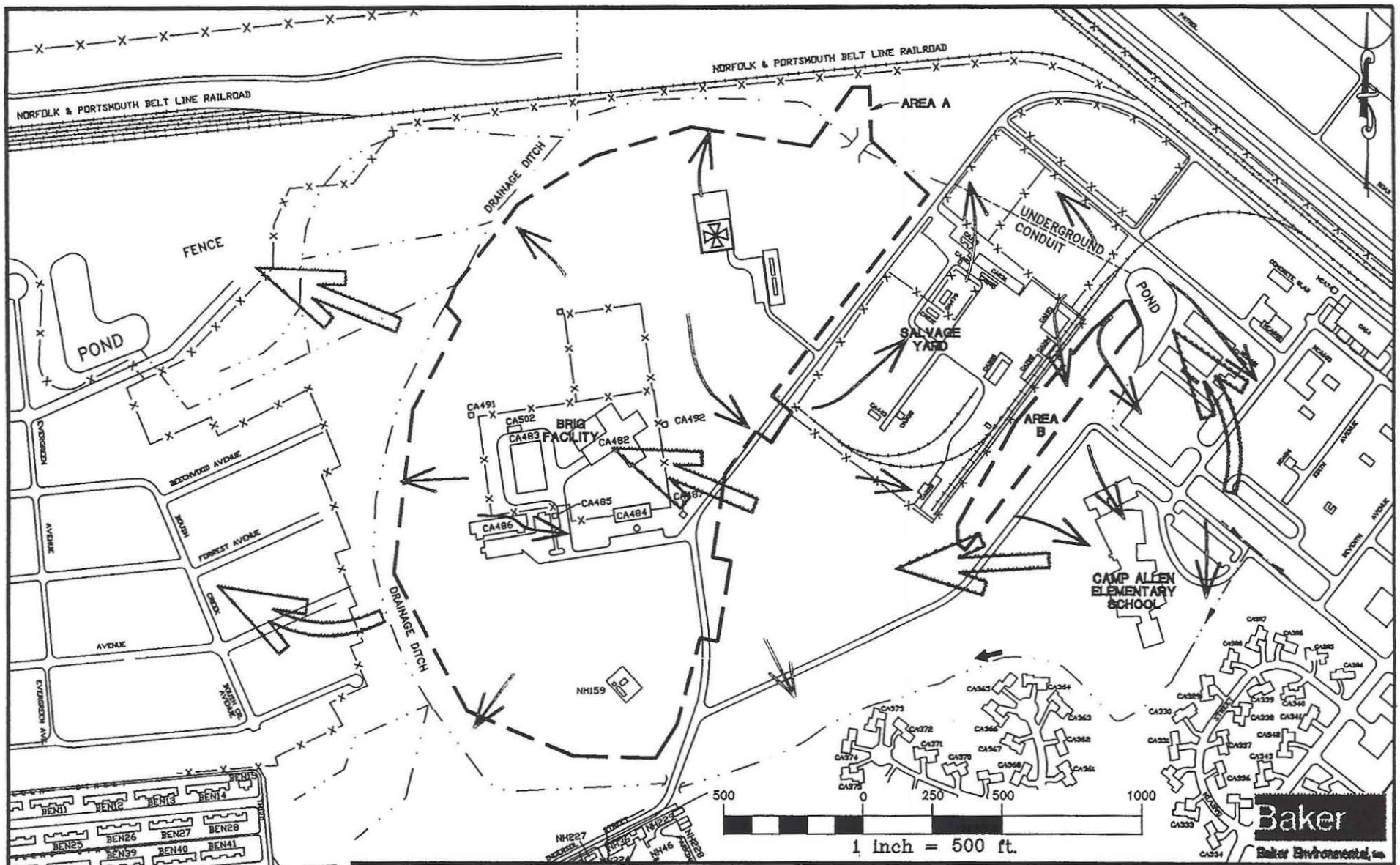
FIGURE 4-14
PRIMARY AREAS OF WASTE DISPOSAL
AREA B

SCALE GRAPHIC | DATE 2/93

FIGURE
4-14

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Physical Site Conditions (continued)
  - Water table aquifer - unconfined, average water level of six feet bgs
  - Shallow groundwater flow - follows site topography towards discharge areas (radial at Area A and southeast at Area B)
  - Yorktown Aquifer - semi-confined aquifer system
  - Deep groundwater flow - primarily to the northwest with localized fluctuations



LEGEND

ASSUMED LANDFILL BOUNDARY

GENERAL DEEP GROUNDWATER FLOW DIRECTION (YORKTOWN AQUIFER)

GENERAL SHALLOW GROUNDWATER FLOW DIRECTION (WATER TABLE AQUIFER)

NOTE: INFORMATION DEPICTED ON THIS FIGURE IS GENERALIZED AND DOES NOT INDICATE ACTUAL DEFINED PATTERNS.

SOURCE: LANTDIV, OCTOBER 1991

FIGURE 3-1
GENERAL GROUNDWATER FLOW PATTERNS
CAMP ALLEN LANDFILL AREAS A & B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Physical Site Condition (continued)
  - Potential Off-site Sources of Contamination various - USTs
  - Camp Allen Area Utility Services (Areas A and B)
  - Pumping Well Inventory - Sheller Globe Wells, MCA600 Well, and Residential Wells
  - Surface Water Features (drainage ditches and wetlands)
  - Ecological Features (aquatic and terrestrial)

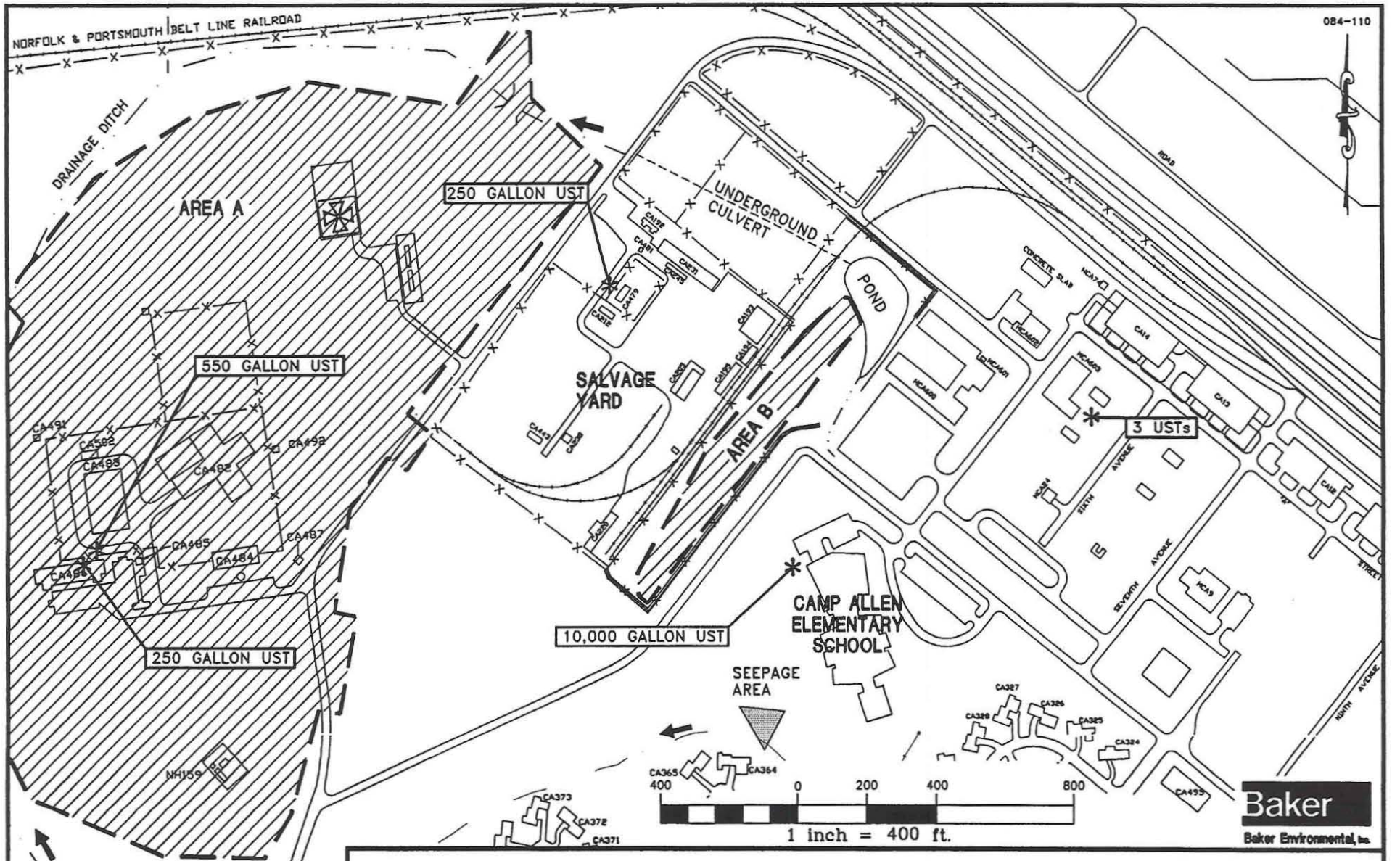
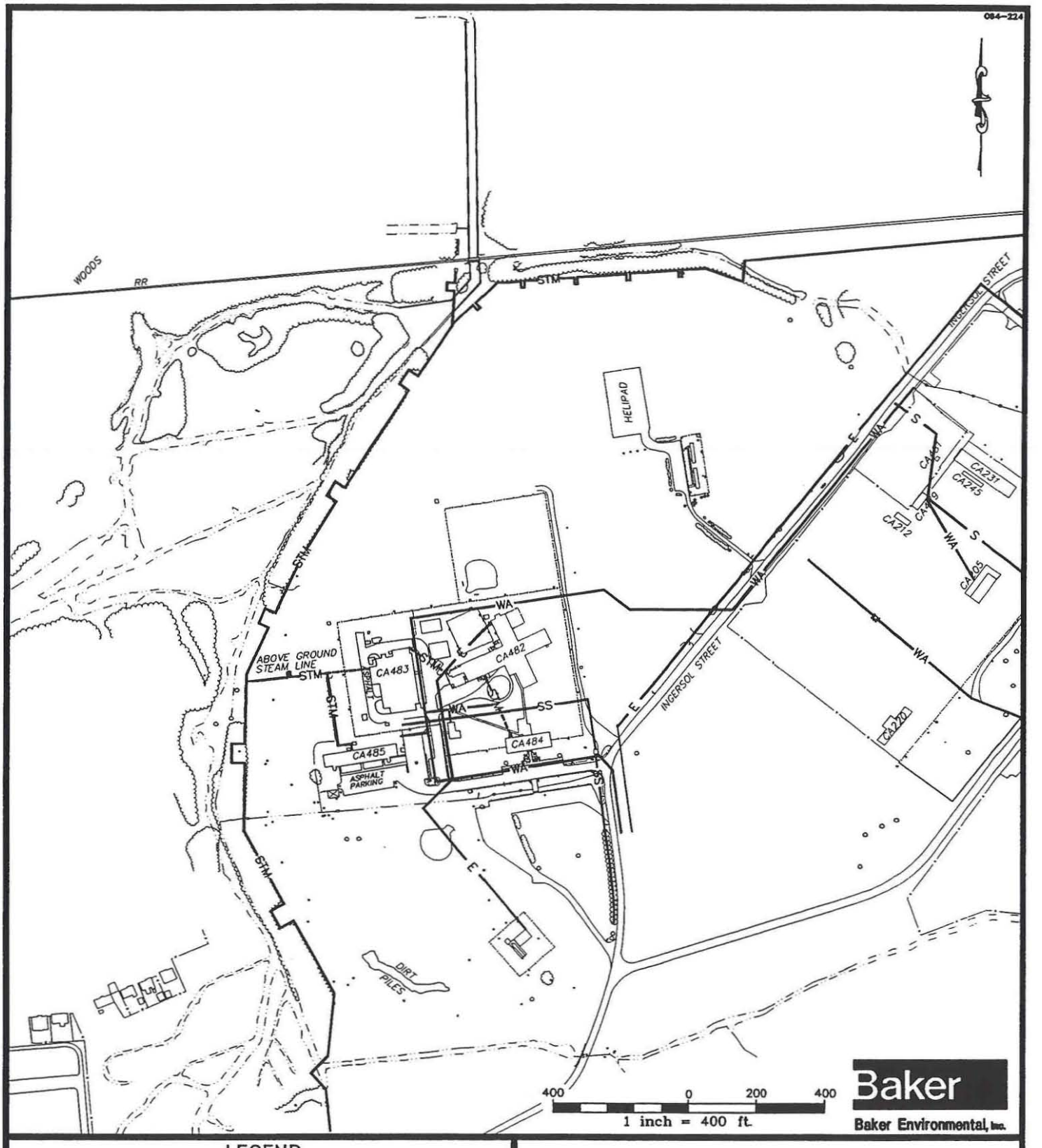


FIGURE 4-24
POTENTIAL OFFSITE SOURCE LOCATIONS
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

SOURCE: LANTDIV, OCTOBER 1991



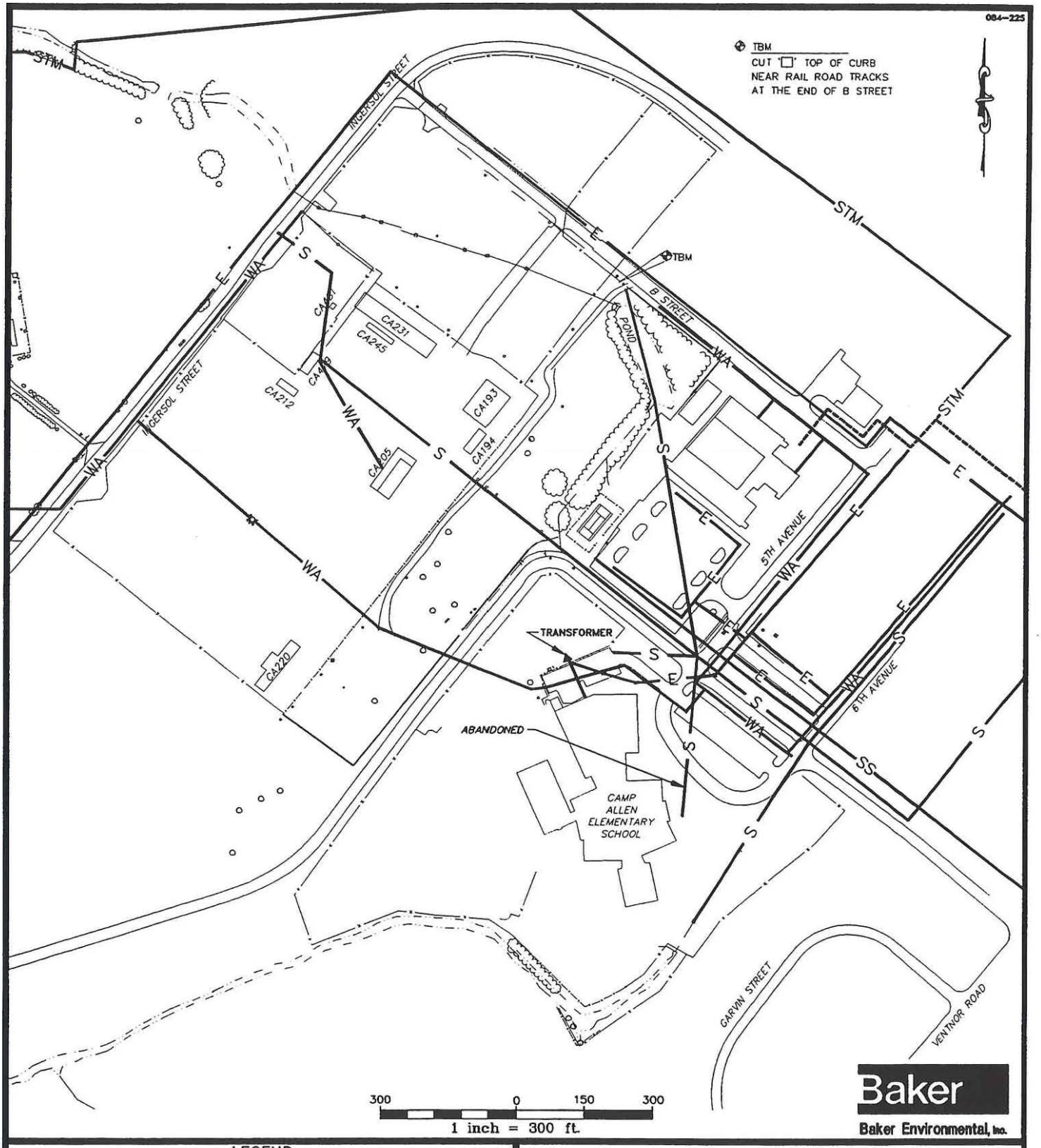
LEGEND

- SS — APPROXIMATE LOCATION OF SANITARY SEWER
- S — APPROXIMATE LOCATION OF STORM SEWER
- STM — APPROXIMATE LOCATION OF STEAM LINE
- STM — APPROXIMATE LOCATION OF UNDERGROUND STEAM LINE
- E — APPROXIMATE LOCATION OF ELECTRIC LINE
- WA — APPROXIMATE LOCATION OF WATER LINE

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 4-21
EXISTING UTILITIES
LOCATION MAP
CAMP ALLEN LANDFILL AREA A

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



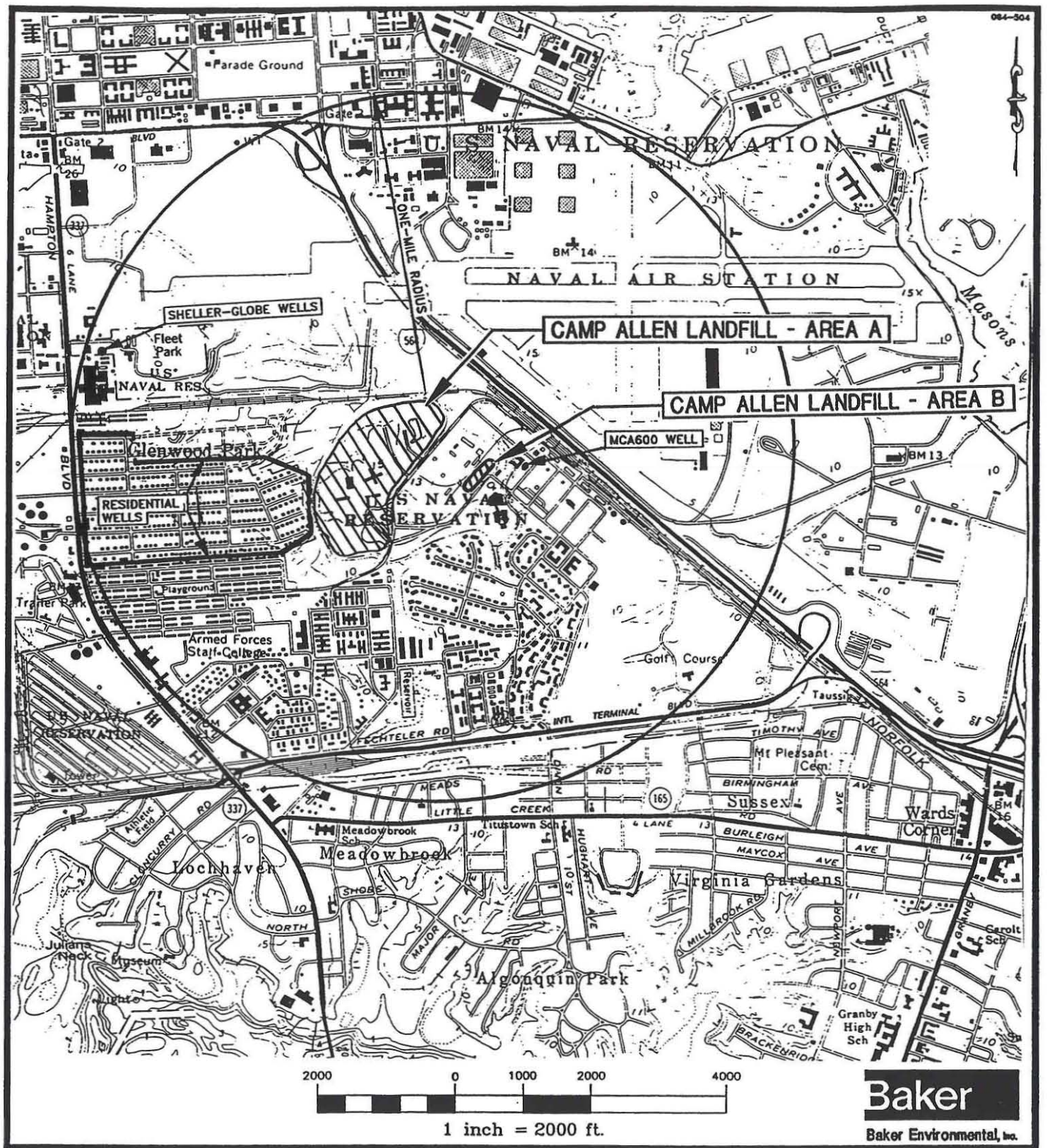
LEGEND

- SS — APPROXIMATE LOCATION OF SANITARY SEWER
- S — APPROXIMATE LOCATION OF STORM SEWER
- STM — APPROXIMATE LOCATION OF STEAM LINE
- STM — APPROXIMATE LOCATION OF UNDERGROUND STEAM LINE
- E — APPROXIMATE LOCATION OF ELECTRIC LINE
- WA — APPROXIMATE LOCATION OF WATER LINE

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 4-22
EXISTING UTILITIES
LOCATION MAP
CAMP ALLEN LANDFILL AREA B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

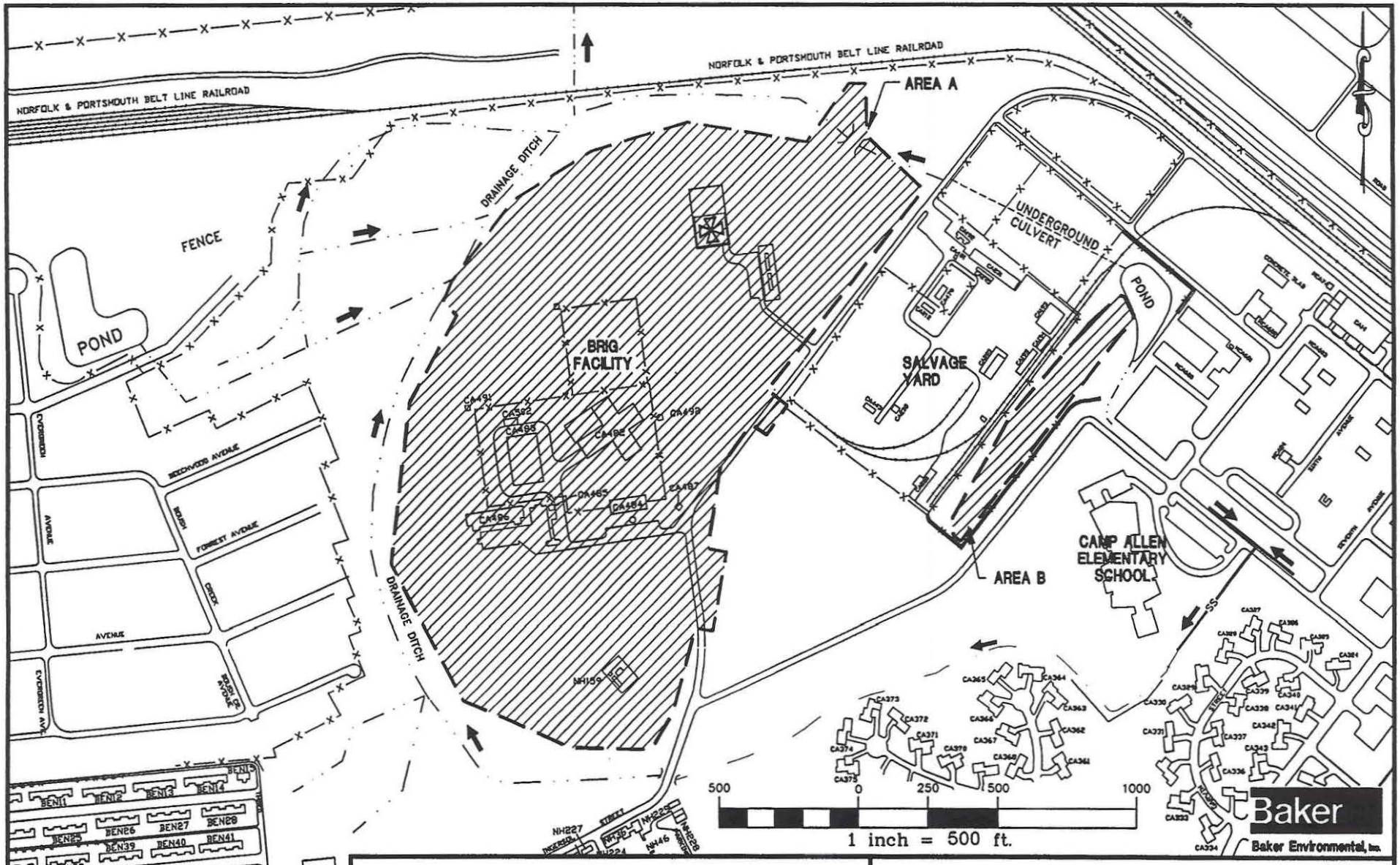


NOTE: LOCATION OF PUMPING WELLS OBTAINED FROM THE VIRGINIA STATE WATER CONTROL BOARD

FIGURE 4-23
PUMPING WELL LOCATION MAP
CAMP ALLEN LANDFILL

SOURCE: VIRGINIA STATE WATER CONTROL BOARD AND LANTDIV

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

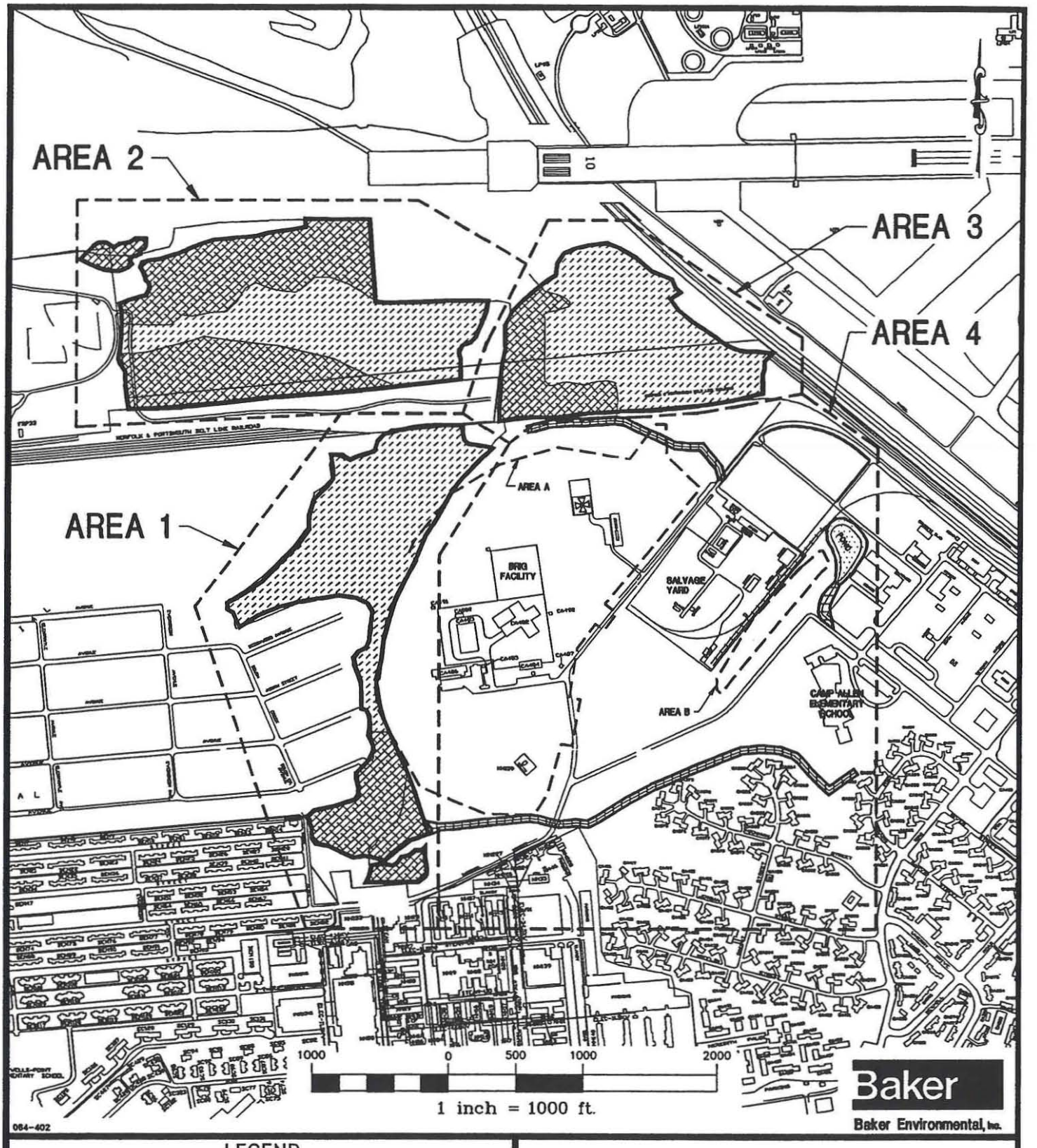
ASSUMED LANDFILL BOUNDARY

SURFACE WATER FLOW DIRECTION

SOURCE: LANTDIV, OCTOBER 1991

FIGURE 2-2
SURFACE DRAINAGE MAP
CAMP ALLEN LANDFILL AREAS A & B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



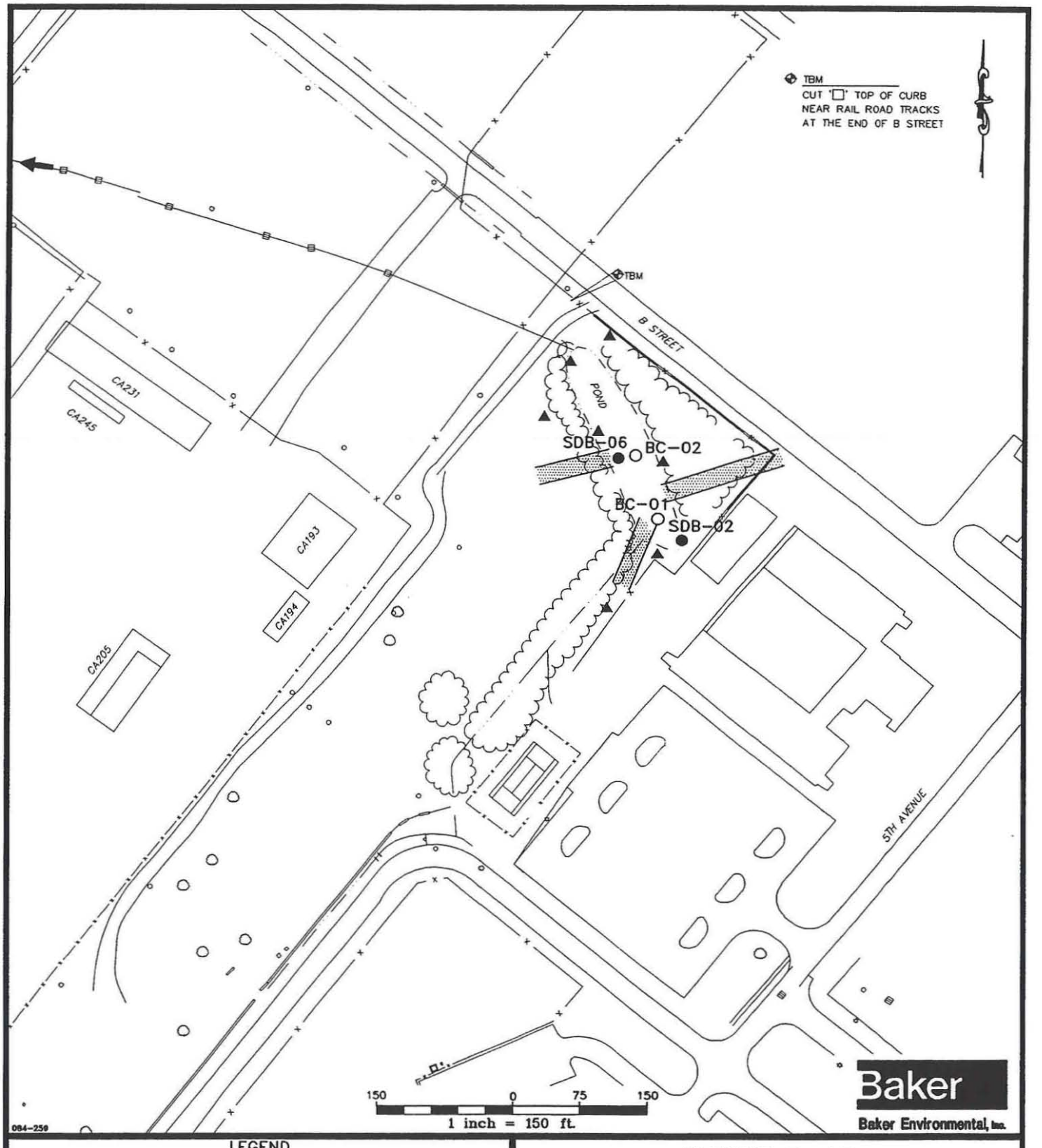
LEGEND

- PALUSTRINE EMERGENT WETLAND (PEM)
- PALUSTRINE SCRUB SHRUB (PSS)
- RIVERINE STREAM BED SUBSYSTEM (R4SB)
- PALUSTRINE UNCONSOLIDATED BOTTOM (PUB)

SOURCE: USFWS/NATIONAL RESOURCE MANAGEMENT STAFF, ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

FIGURE 2-7
WETLAND LOCATION MAP
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

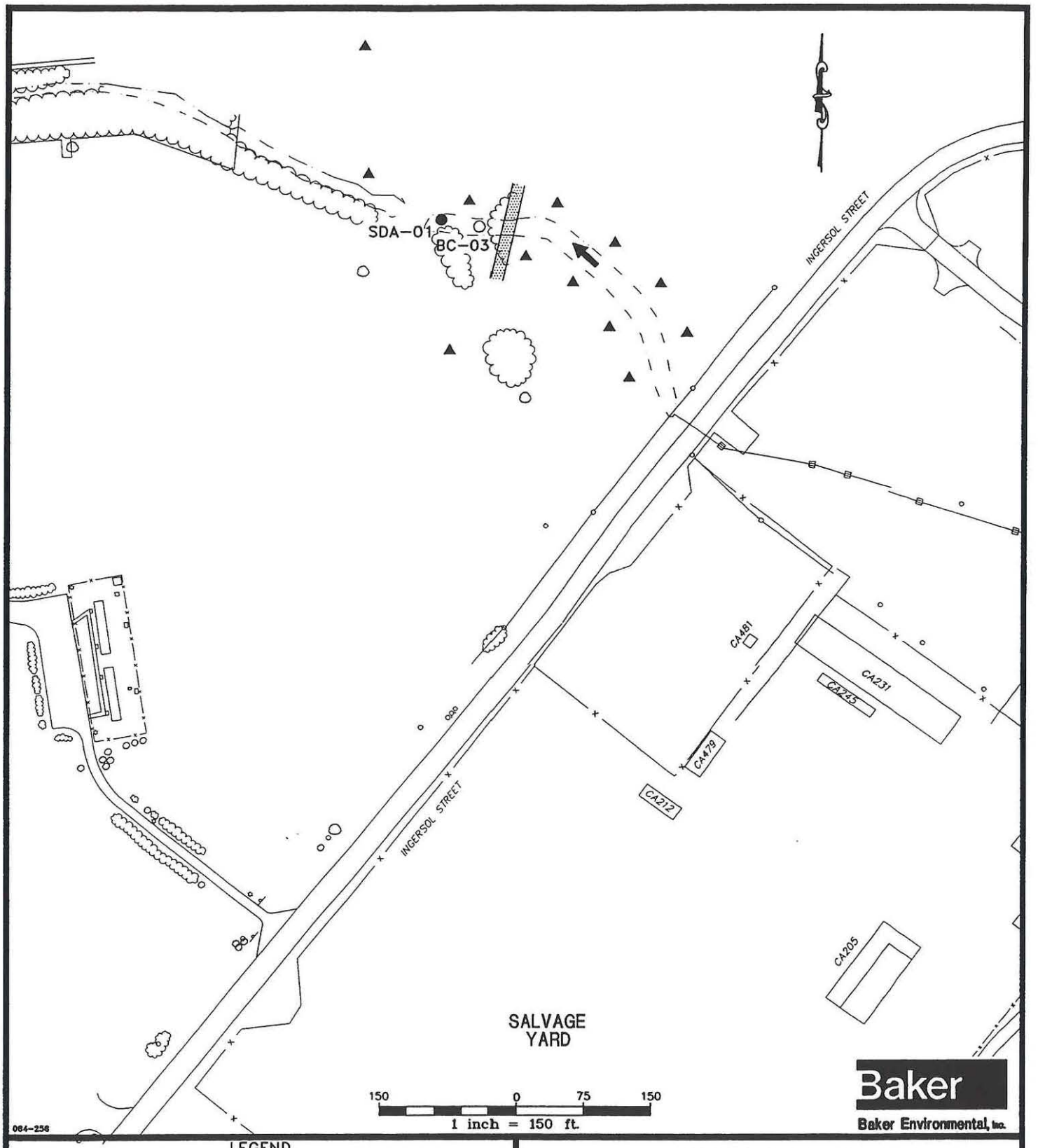


LEGEND

- ▲ WILDLIFE OBSERVATION POINT
- ← STREAM FLOW DIRECTION
- SDB-02 ● SEDIMENT SAMPLE LOCATION
- BC-01 ○ BENTHIC MACROINVERTEBRATE SAMPLE LOCATION
- VEGETATION STUDY
- x —— x FENCE

FIGURE 3-18
ECOLOGICAL FIELD
INVESTIGATION LOCATIONS
AREA B POND
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

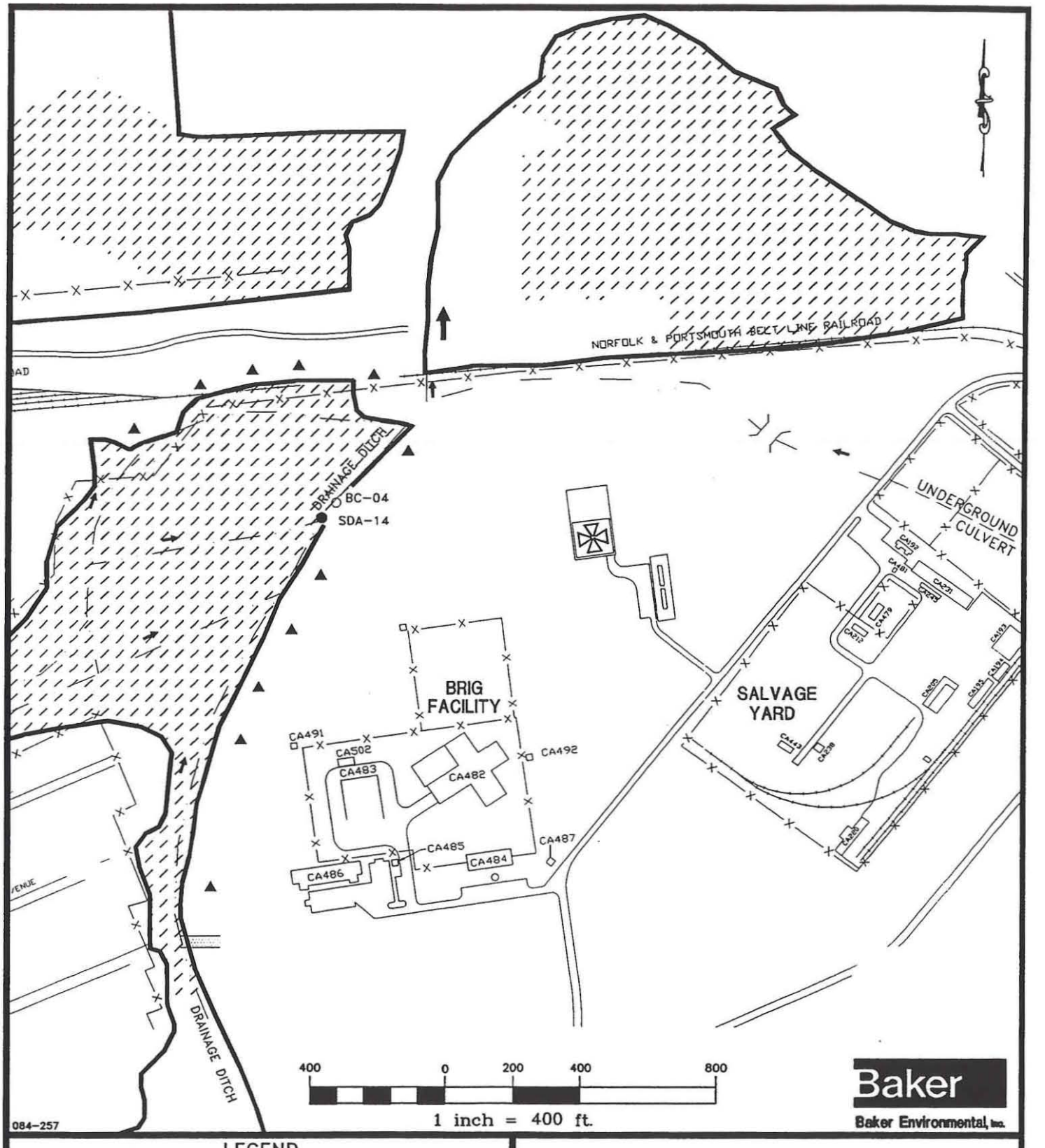


LEGEND

- ▲ WILDLIFE OBSERVATION POINTS
- SDA-01 ● SEDIMENT SAMPLE LOCATION
- BC-03 ○ BENTHIC MACROINVERTEBRATE SAMPLING LOCATION
- ← STREAM FLOW DIRECTION
- VEGETATION STUDY
- x—x FENCE

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 3-19
ECOLOGICAL FIELD INVESTIGATION LOCATIONS
AREA A DRAINAGE WAY
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



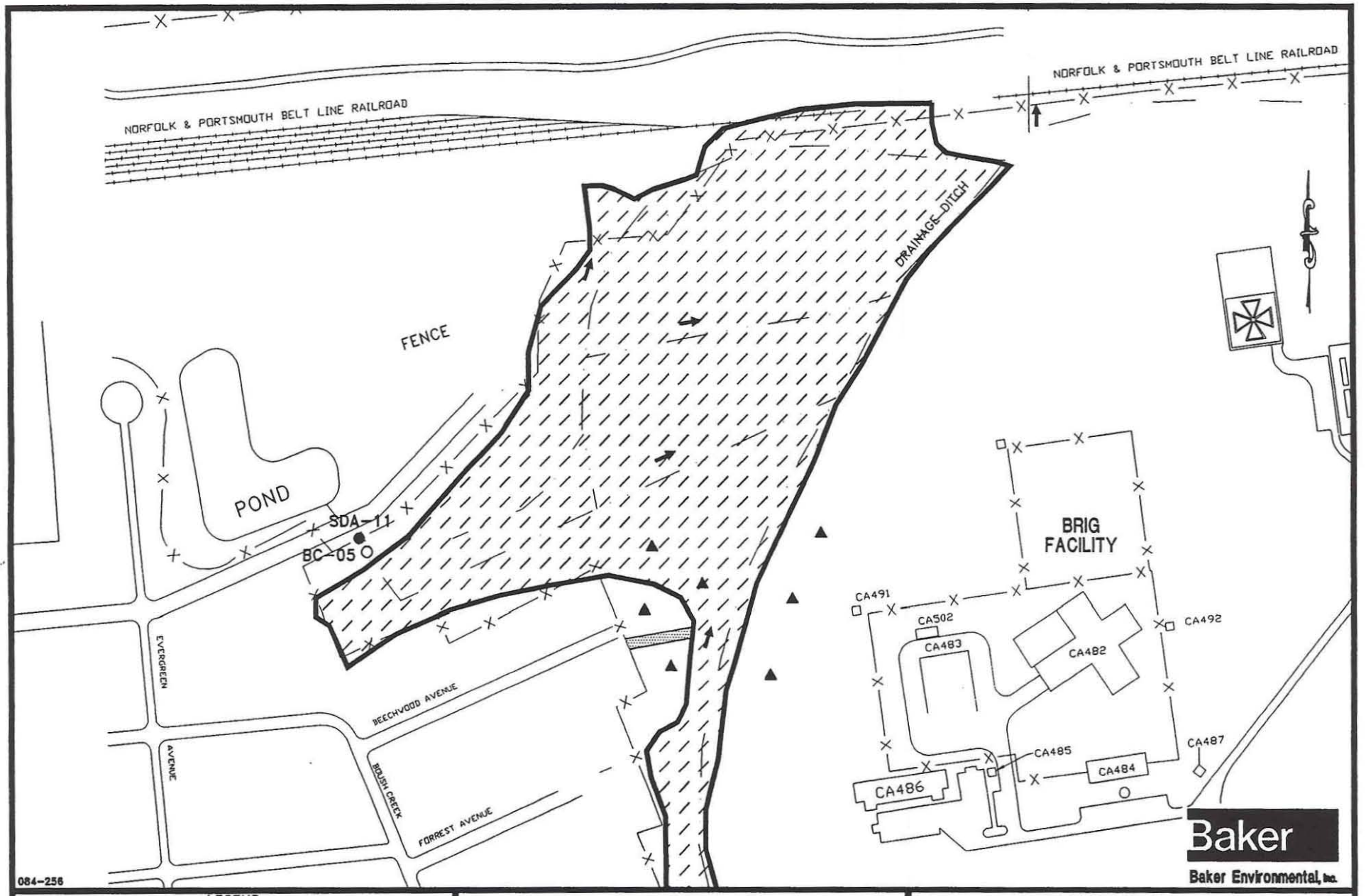
LEGEND

- SDA-14 ● SEDIMENT SAMPLE LOCATION
- BC-04 ○ BENTHIC MACROINVERTEBRATE SAMPLING LOCATION
- ▲ WILDLIFE OBSERVATION POINTS
- VEGETATION STUDY
- STREAM FLOW DIRECTION
- WETLANDS
- x—x FENCE

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 3-20
ECOLOGICAL FIELD INVESTIGATION LOCATIONS
AREA A DRAINAGE WAY

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



SDA-11 LEGEND

- SEDIMENT SAMPLE LOCATION
- BC-05 BENTHIC MACROINVERTEBRATE SAMPLING LOCATION
- STREAM FLOW DIRECTION
- X—X FENCE
- WETLANDS
- VEGETATION STUDY
- WILDLIFE OBSERVATION POINTS

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

300 0 150 300 600

1 inch = 300 ft.

FIGURE 3-21
ECOLOGICAL FIELD INVESTIGATION LOCATIONS
CAMP ALLEN LANDFILL
AREA A DRAINAGE WAY
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Overview of Area A RI Results
  - Source Characterization results confirm volatile organic compounds detected in groundwater (two potential source areas - A1/A2)
  - Soil Sample results revealed nominal findings
  - Surface water and sediment samples collected at Area A identified volatile organic concentrations at the northeastern border of Area A. ("above-background" metal concentrations and to a lesser extent pesticides were detected throughout the drainage area.
  - Air Sample results revealed nominal findings

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Overview of Area A RI Results (continued)
  - Shallow groundwater monitoring results indicate two areas of volatile organic contamination (A1/A2)
  - Primary constituents include vinyl chloride, TCE, DCE and DCA
  - Contaminated shallow groundwater "contained" in Area A
  - Residential Well Sampling revealed no site related contaminants
  - Detected inorganic constituents do not appear to be site related contaminants

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Overview of Area A RI Results (continued)
  - Deep groundwater monitoring results indicate two areas of volatile organic contamination (A1/A2)
  - Primary constituents include vinyl chloride, TCE, DCE and DCA
  - Deep groundwater contamination appears to be limited to upper portion of Yorktown Aquifer
  - Detected inorganic constituents do not appear to be site related contaminants

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

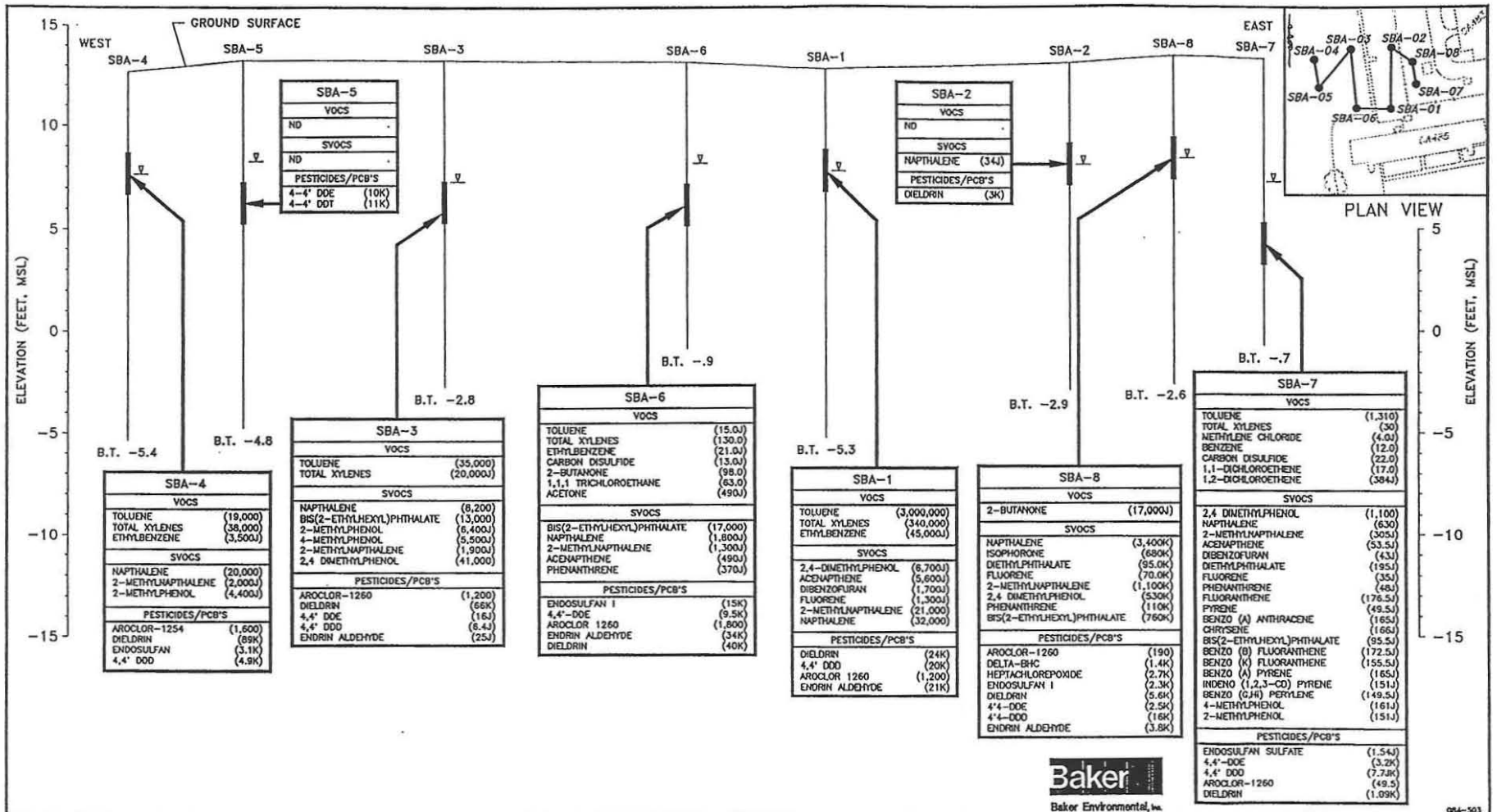
- Overview of Area B RI Results
  - Source Characterization results further define waste disposal areas, volatile organics are the primary contaminants
  - Soil Sample results revealed nominal findings
  - Surface water and sediment samples collected at Area B identified volatile organic concentrations in the ponded area. ("above-background" metal concentrations and to a lesser extent pesticides were detected.
  - Air Sample results revealed nominal findings

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Overview of Area B RI Results (continued)
  - In-situ groundwater sampling and shallow groundwater monitoring results indicate volatile organic contaminants are following groundwater flow and preferred pathways to the southeast/southwest
  - Primary constituents include vinyl chloride, TCE, DCE and DCA
  - Detected inorganic constituents do not appear to be site related contaminants

CAMP ALLEN LANDFILL
RI/FS ACTIVITIES (1992-1993)

- Overview of Area B RI Results (continued)
  - Deep groundwater monitoring results indicate volatile organic contamination beneath Area B
  - Primary constituents include vinyl chloride, TCE, DCE and DCA
  - Detected inorganic constituents do not appear to be site related contaminants



LEGEND

- ▽ GROUNDWATER ENCOUNTERED DURING DRILLING
- B.T. X' BORING TERMINATED, ELEVATION MSL
- SAMPLE LOCATION
- VOCS VOLATILE ORGANIC COMPOUNDS
- SVOCS SEMI VOLATILE ORGANIC COMPOUNDS
- ND NOT DETECTED
- ALL UNITS IN ug/kg

40 0 20 40 80

Horizontal Scale: 1 inch = 40 ft.

5 0 2.5 5 10

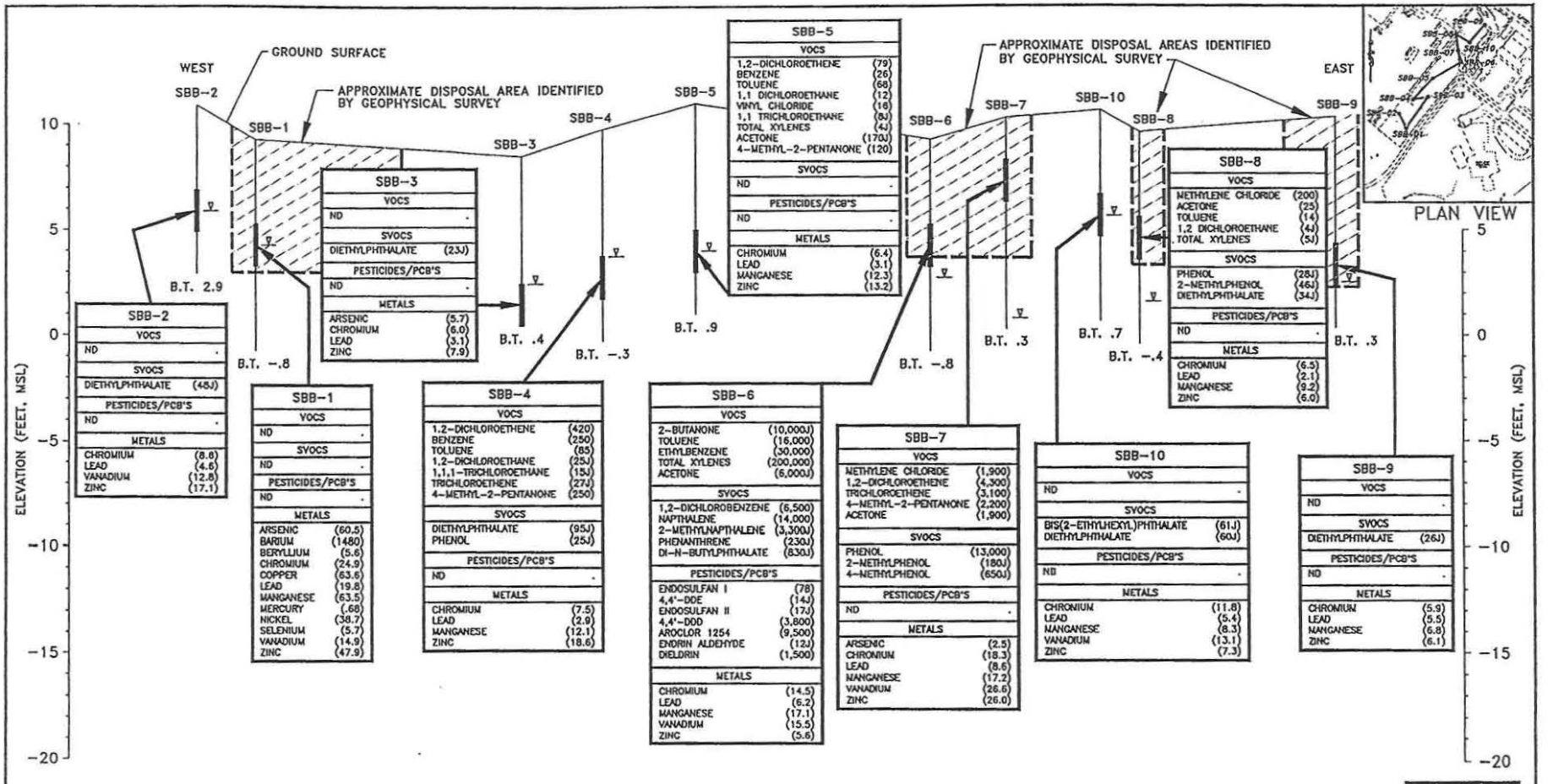
Vertical Scale: 1 inch = 5 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 6-1
SOURCE CHARACTERIZATION SAMPLE RESULTS
AREA A
CAMP ALLEN LANDFILL

DRAFT

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

▽	GROUNDWATER ENCOUNTERED DURING DRILLING
B.T. X'	BORING TERMINATED, ELEVATION MSL
—▬—	SAMPLE LOCATION
VOCS	VOLATILE ORGANIC COMPOUNDS
SVOCS	SEMI VOLATILE ORGANIC COMPOUNDS
ND	NOT DETECTED
	ALL UNITS IN ug/kg EXCEPT METALS (mg/kg)

90 0 45 90 180

Horizontal Scale: 1 inch = 90 ft.

5 0 2.5 5 10

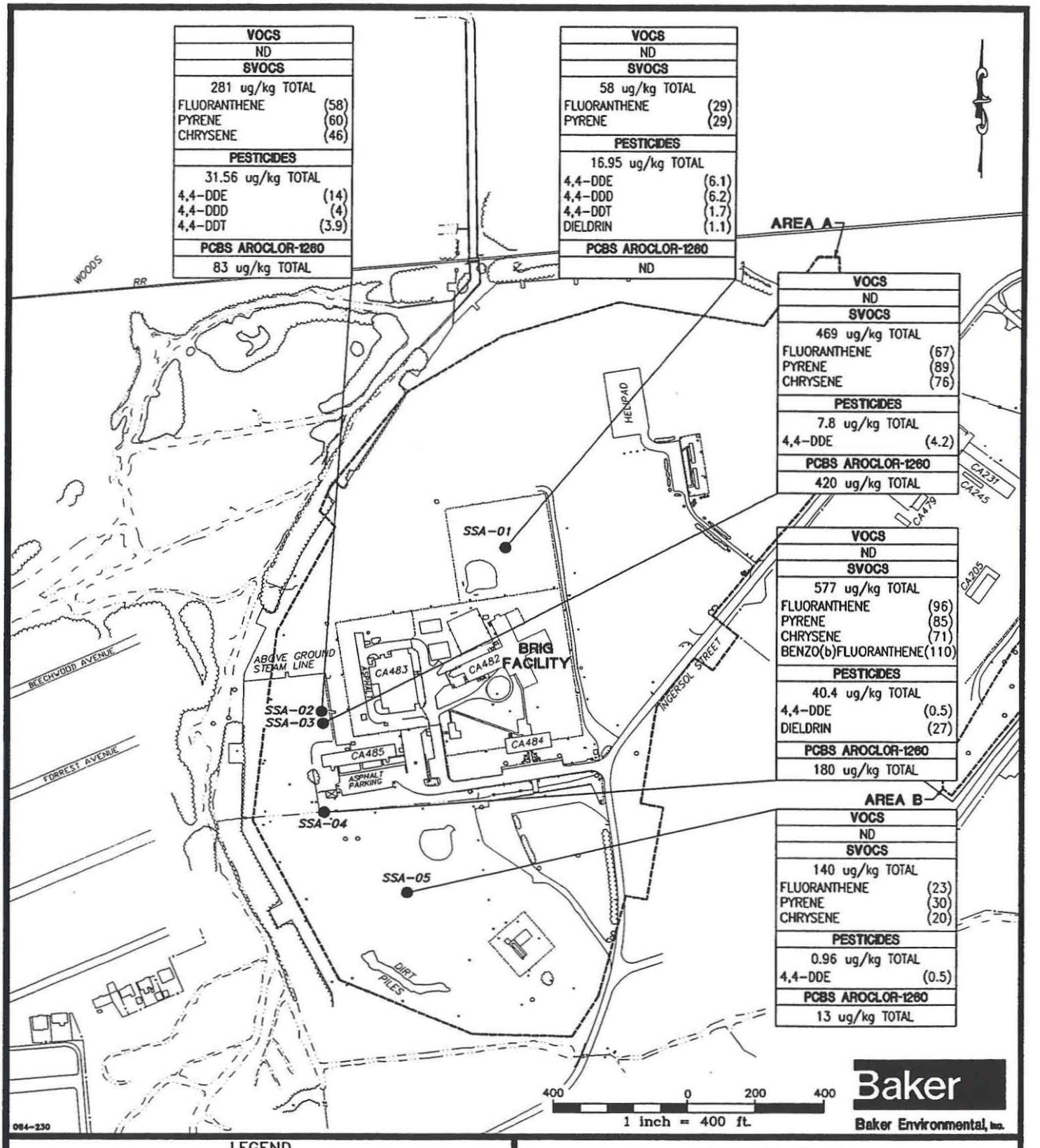
Vertical Scale: 1 inch = 5 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 6-2
SOURCE CHARACTERIZATION SAMPLE RESULTS
AREA B
CAMP ALLEN LANDFILL

DRAFT

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

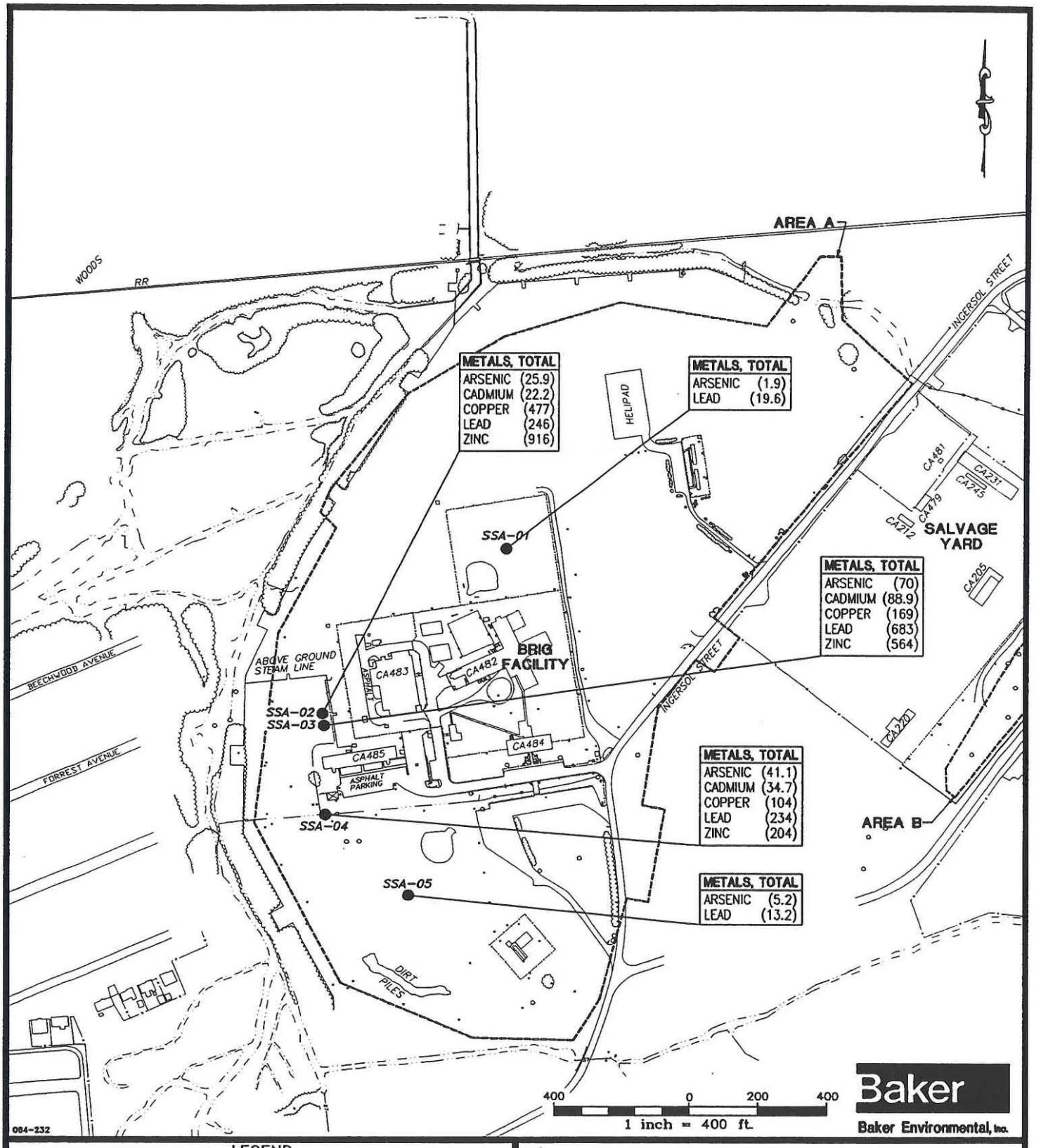


LEGEND

SSA-01 ●	SURFACE SOIL SAMPLE
ug/kg	MICROGRAM/KILOGRAM (ppb)
PCB	POLYCHLORINATED BIPHENYLS
SVOCS	SEMIVOLATILE ORGANIC COMPOUNDS
VOCS	VOLATILE ORGANIC COMPOUNDS
ND	NOT DETECTED

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 6-3
SURFACE SOIL SAMPLE RESULTS
(ORGANICS)
AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



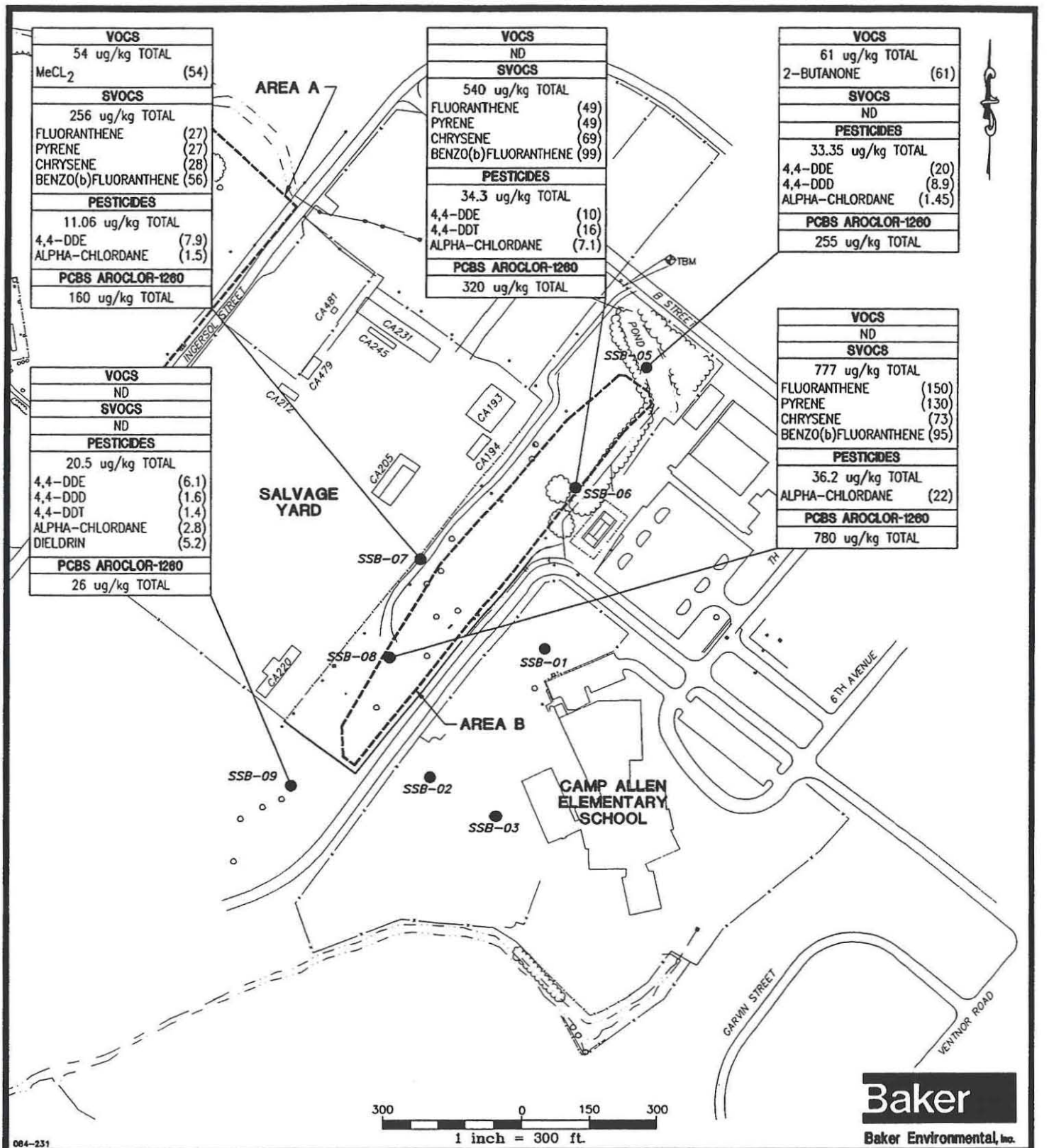
LEGEND

SSA-01 ● SURFACE SOIL SAMPLE

NOTE: ALL RESULTS ARE PRESENTED IN mg/kg (ppm).

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 6-4
SURFACE SOIL SAMPLE RESULTS
(INORGANICS)
AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



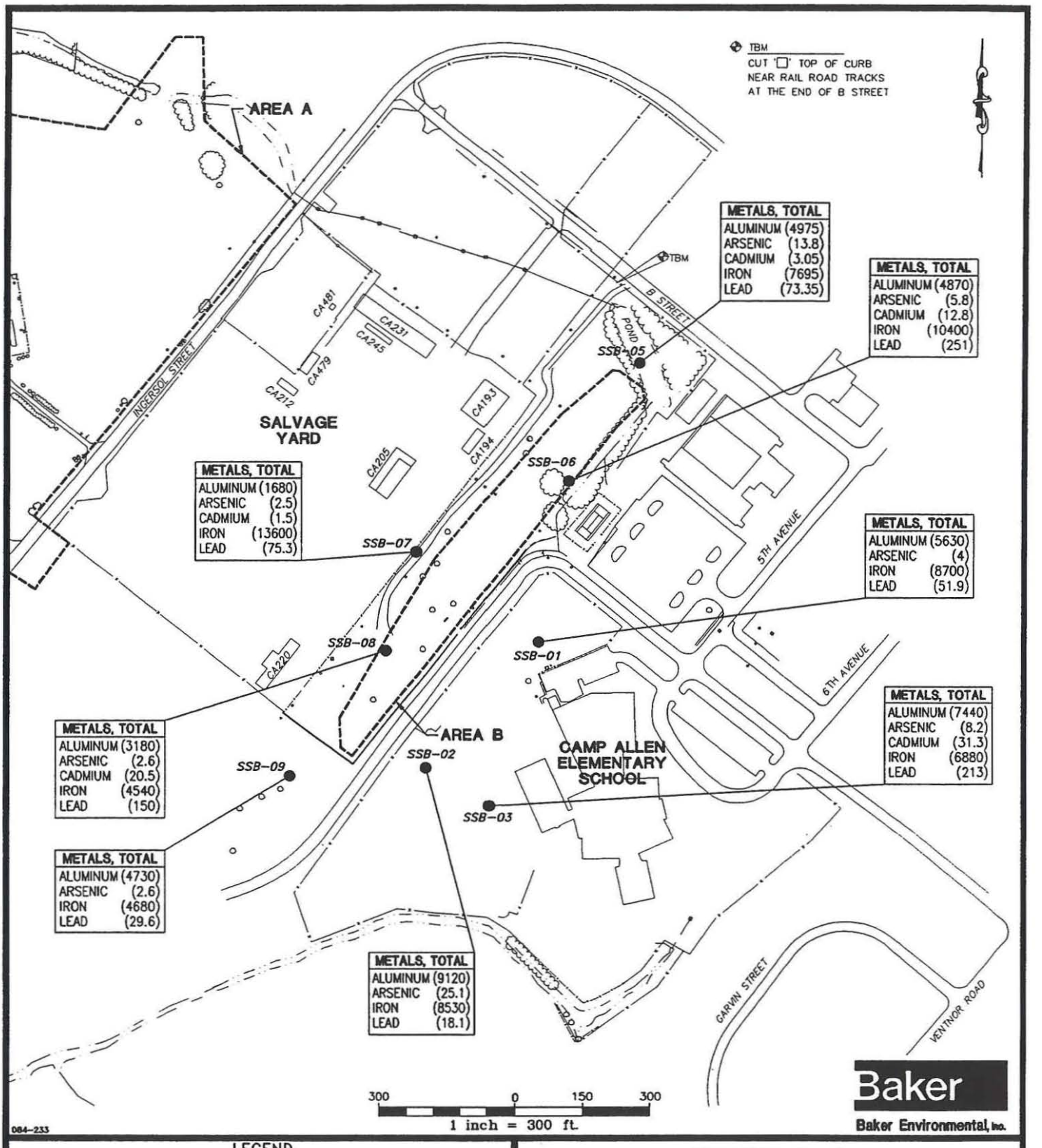
LEGEND

SSB-05 ●	SURFACE SOIL SAMPLE LOCATION
ug/kg	MICROGRAMS/KILOGRAMS (ppb)
PCB	POLYCHLORINATED BIPHENYLS
$MeCL_2$	METHYLENE CHLORIDE
SVOCS	SEMIVOLATILE ORGANIC COMPOUNDS
VOCS	VOLATILE ORGANIC COMPOUNDS
ND	NOT DETECTED

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 6-5
SURFACE SOIL SAMPLE RESULTS (ORGANICS)
AREA B
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



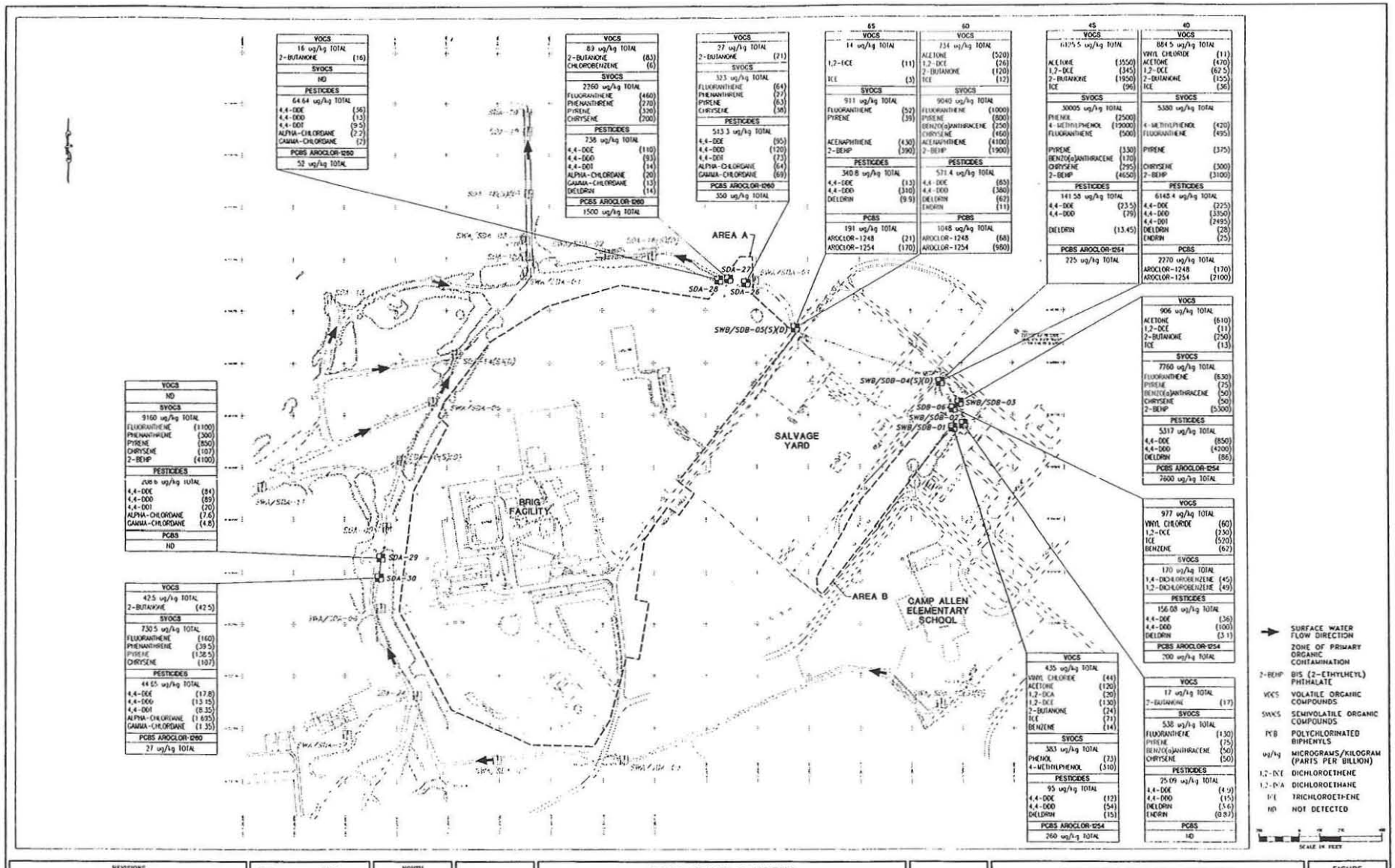
LEGEND

SSB-05 ● SURFACE SOIL SAMPLE LOCATION

NOTE: ALL RESULTS ARE PRESENTED IN mg/kg (ppm).

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 6-6
SURFACE SOIL SAMPLE RESULTS
(INORGANICS)
AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



REVISIONS

DRAFT

DATE	7/93
SCALE	GRAPHIC
DRAWN	GLB
REVIEWED	TEA
SO #	19084
CADD#	084-236

NORTH

CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

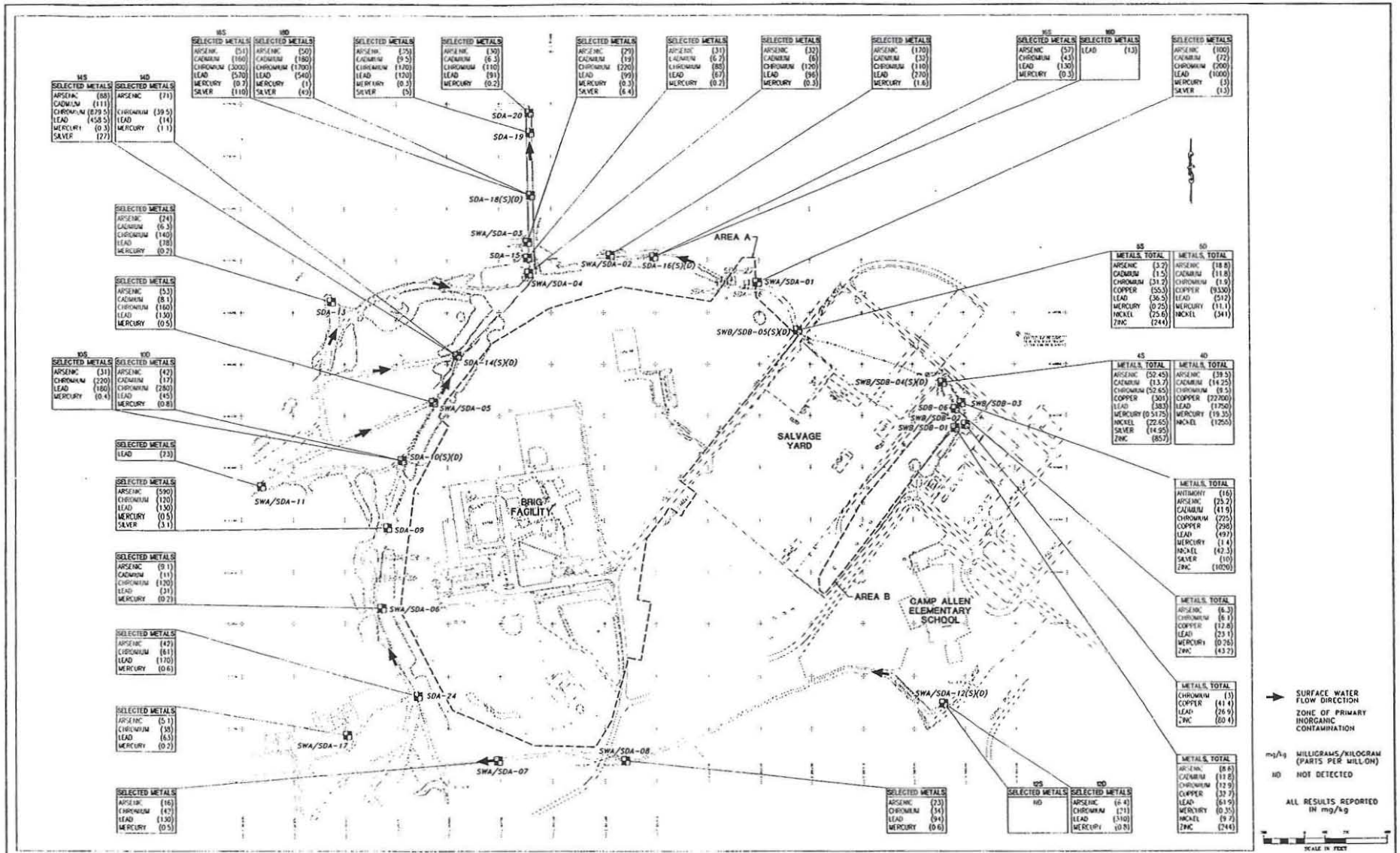
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

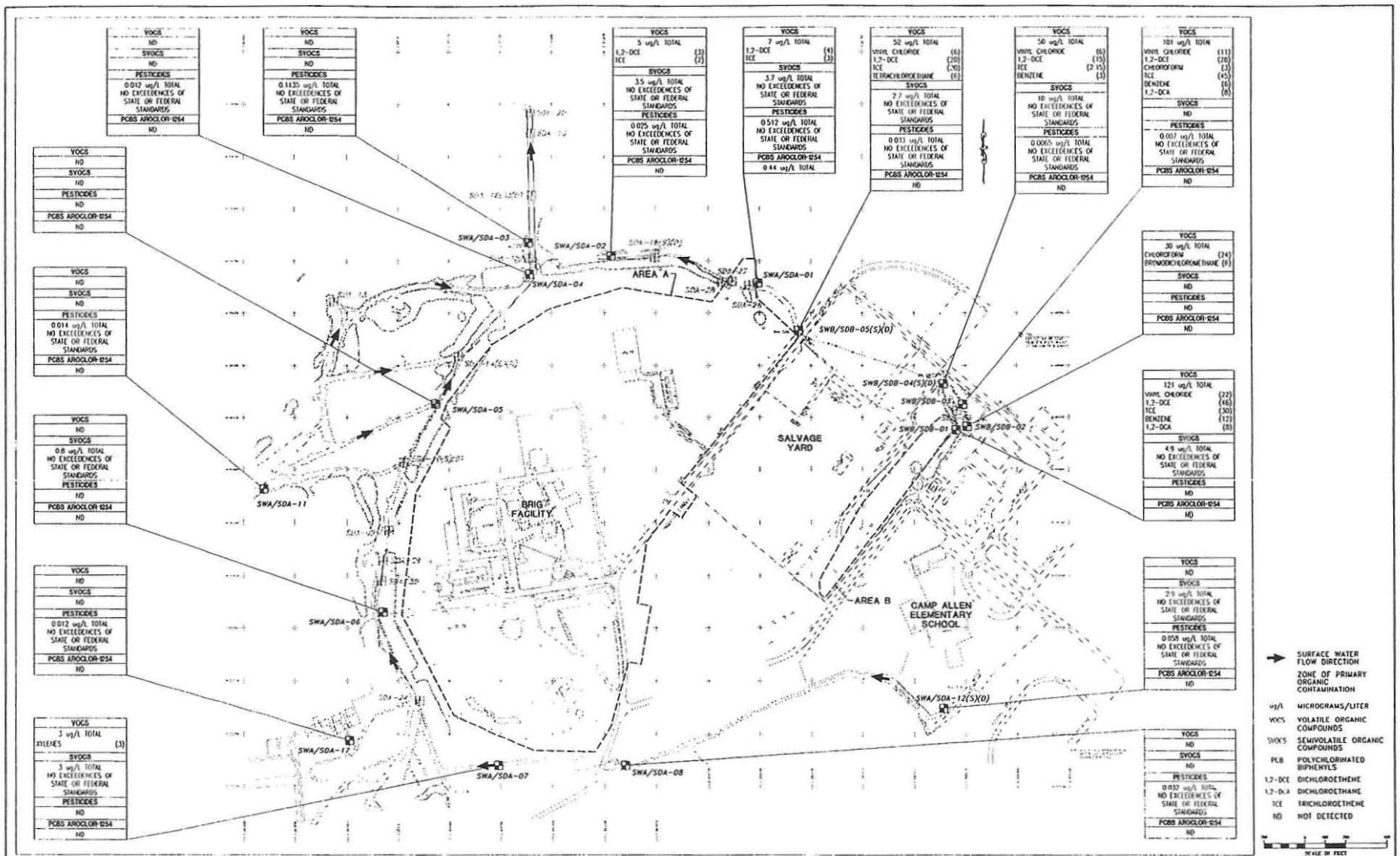
SEDIMENT SAMPLE RESULTS
AREAS A AND B
(ORGANICS)

SCALE GRAPHIC DATE 7/93

FIGURE
6-7



REVISIONS					
DRAFT	DATE 7/93 SCALE GRAPHIC DRAWN GLB REVIEWED TEA SO # 19084 CADD# 084-237	NORTH	CAMP ALLEN LANDFILL NORFOLK NAVAL BASE NORFOLK, VIRGINIA BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania	Baker Baker Environmental, Inc.	SEDIMENT SAMPLE RESULTS AREAS A AND B (INORGANICS) SCALE GRAPHIC DATE 7/93	FIGURE 6-8



REVISIONS

DRAFT

DATE	7/93
SCALE	GRAPHIC
DRAWN	GLB
REVIEWED	TEA
SO #	19084
CADD#	084-234

NORTH

CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

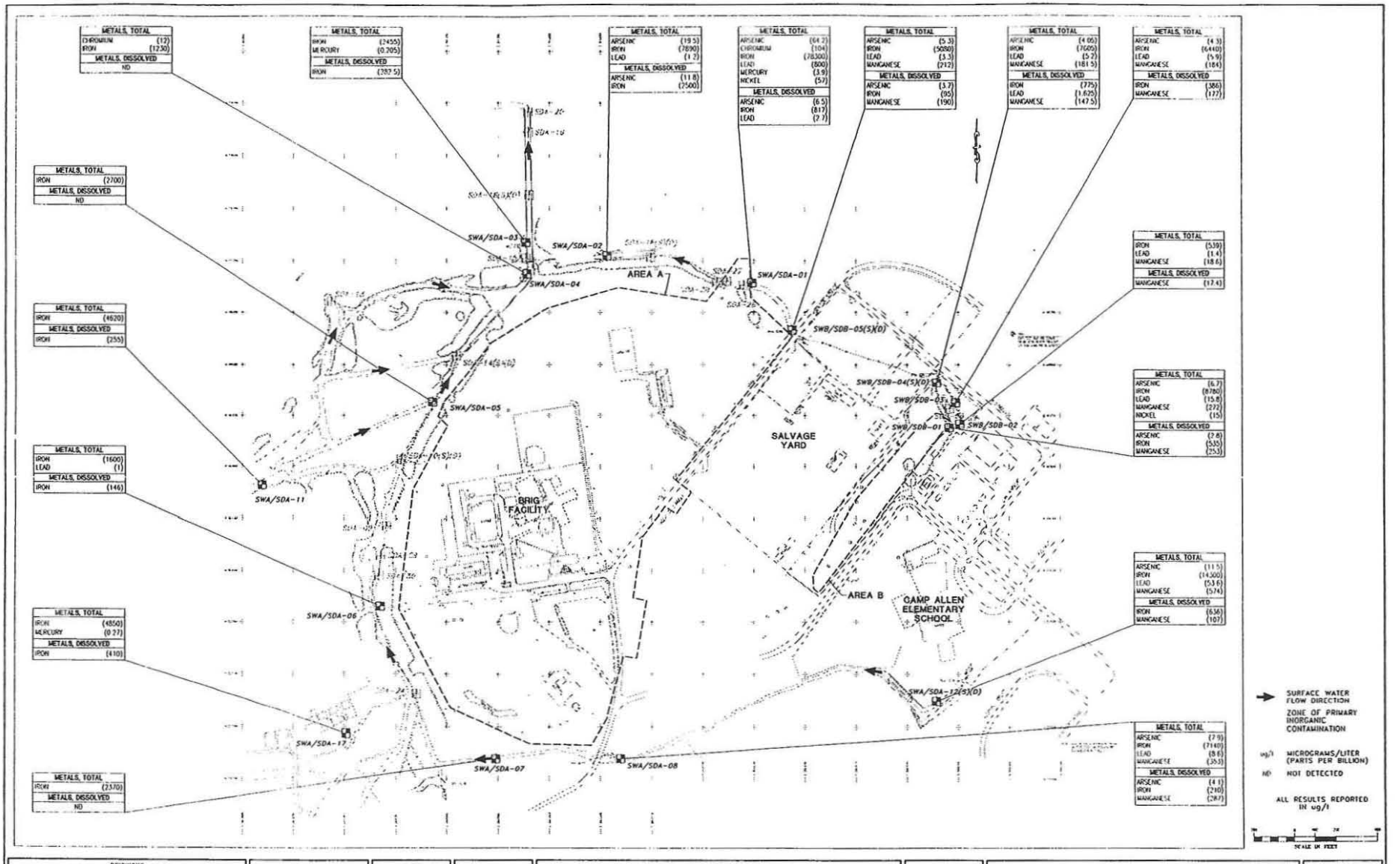
BAKER ENVIRONMENTAL, Inc
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

SURFACE WATER SAMPLE RESULTS
AREAS A AND B
(ORGANICS)

SCALE GRAPHIC DATE 7/93

FIGURE
6-9



REVISIONS

DRAFT

DATE	7/93
SCALE	GRAPHIC
DRAWN	GLB
REVIEWED	TEA
SO #	19084
CADD#	084-235

NORTH

CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

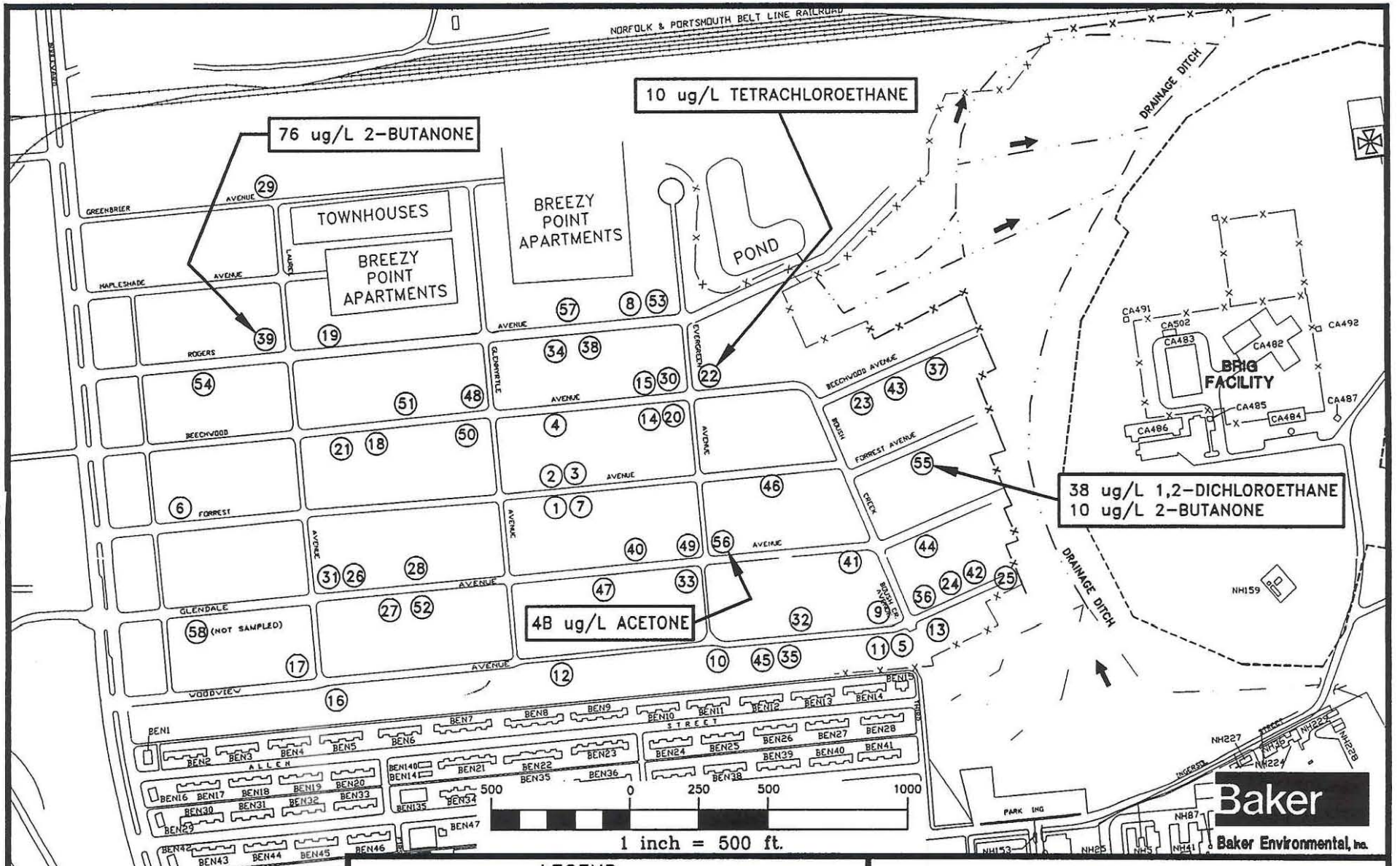
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

SURFACE WATER SAMPLE RESULTS
AREAS A AND B
(INORGANICS)

SCALE GRAPHIC DATE 7/93

FIGURE
6-10



LEGEND

(1) RESIDENTIAL WELL

→ FLOW DIRECTION

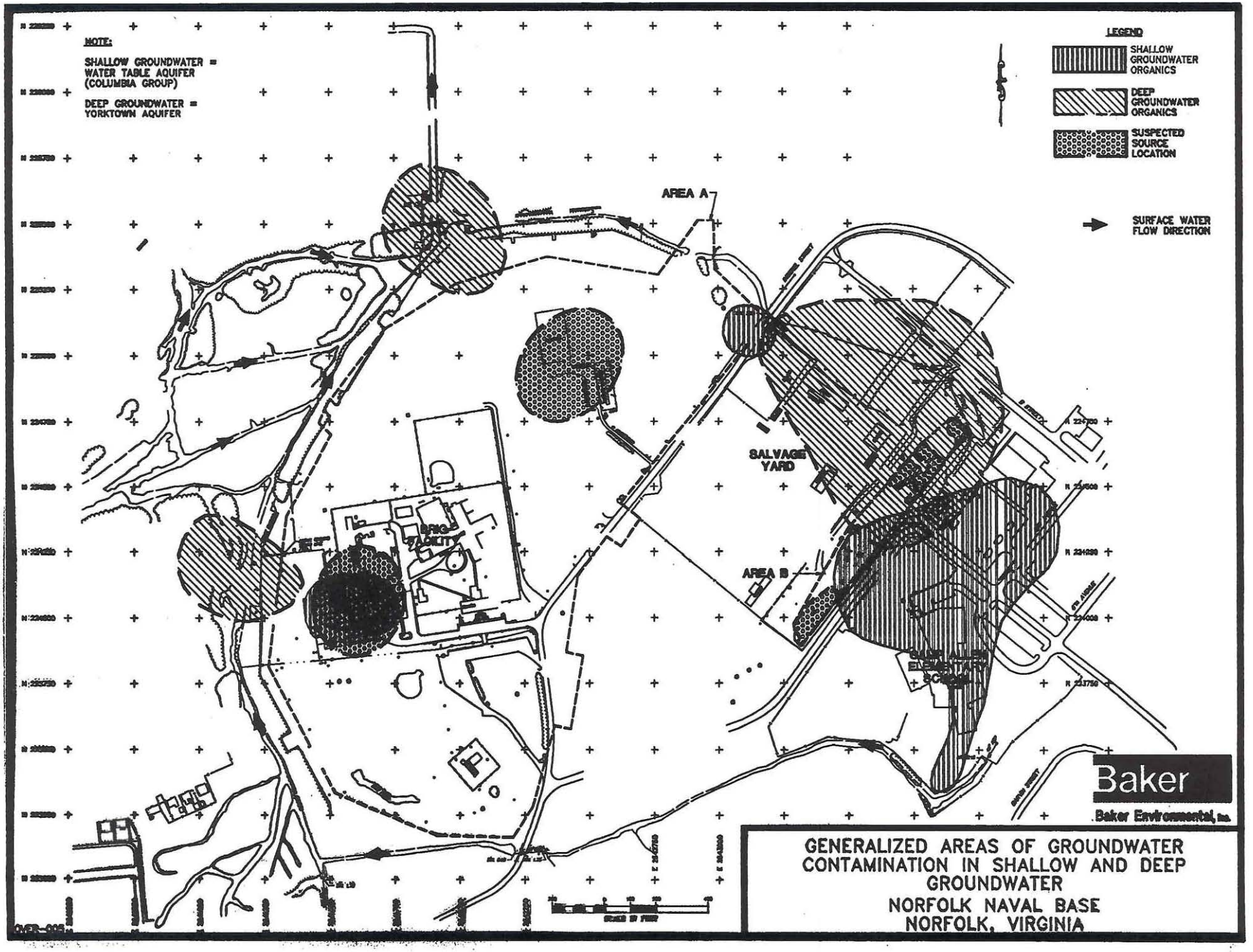
---- LIMITS OF LANDFILL AREA A

ALL UNITS IN ug/L

SOURCE: LANTDIV, OCTOBER 1991

FIGURE 6-11
RESIDENTIAL WELL LOCATIONS
SAMPLING RESULTS
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

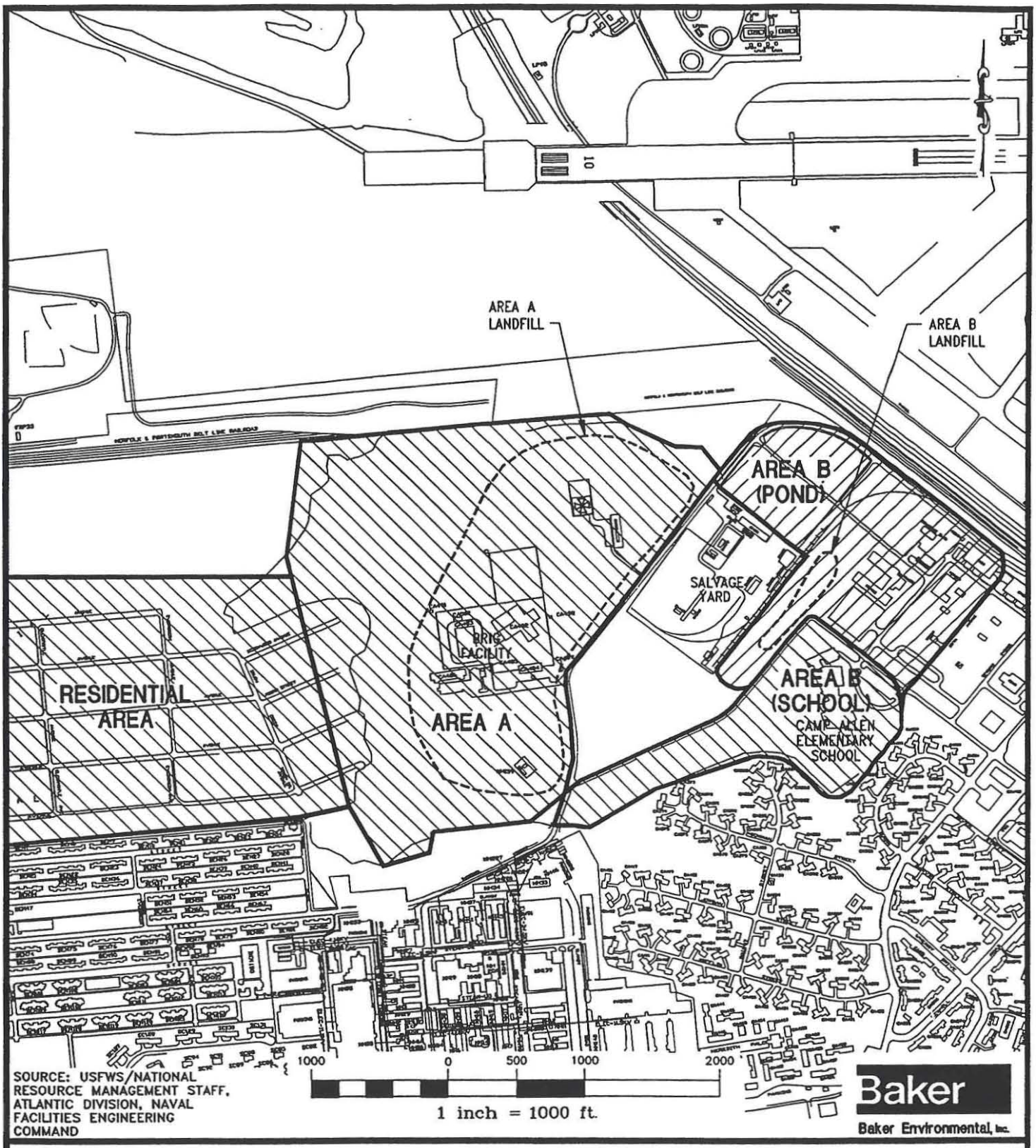


GENERALIZED AREAS OF GROUNDWATER CONTAMINATION IN SHALLOW AND DEEP GROUNDWATER
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

SUMMARY OF BASELINE RISK ASSESSMENT RESULTS

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

- Introduction
- Identification of Chemicals of Potential Concern
- Exposure assessment
- Toxicity Assessment
- Risk Characterization
  - Human Health
  - Ecological
- Summary of Risk Assessment Results



SOURCE: USFWS/NATIONAL RESOURCE MANAGEMENT STAFF, ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

IDENTIFICATION OF STUDY AREAS
BASELINE RISK ASSESSMENT
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084-506

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

Identification of Potential Chemicals of Concern

- Identification Criteria:
  - Site History
  - Chemical Prevalence
  - Comparison to Literature Background Concentrations
  - Comparison to State & Federal Regulatory Criteria
  - Comparison to USEPA Region III Risk Based Concentrations

Area A

Groundwater	*Surface Water*	*Sediment*	*Surface Soil*
Benzene	1,2-Dichloroethene	Chlorobenzene	Aroclor-1260
1,2-Dichloroethene	Trichloroethene	Carbon disulfide	Arsenic
1,2-Dichloroethane	Xylenes (total)	Aroclor-1260	Cadmium
Tetrachloroethene	Arsenic	Arsenic	Lead
Trichloroethene	Mercury	Cadmium	Zinc
Vinyl Chloride	Nickel	Chromium	
Xylenes (total)		Lead	
Arsenic		Mercury	
Beryllium		Silver	
Cadmium			
Chromium			
Copper			
Lead			
Mercury			
Nickel			
Zinc			

Residential Area

Groundwater

Tetrachloroethene

1,2-Dichloroethane

Area B

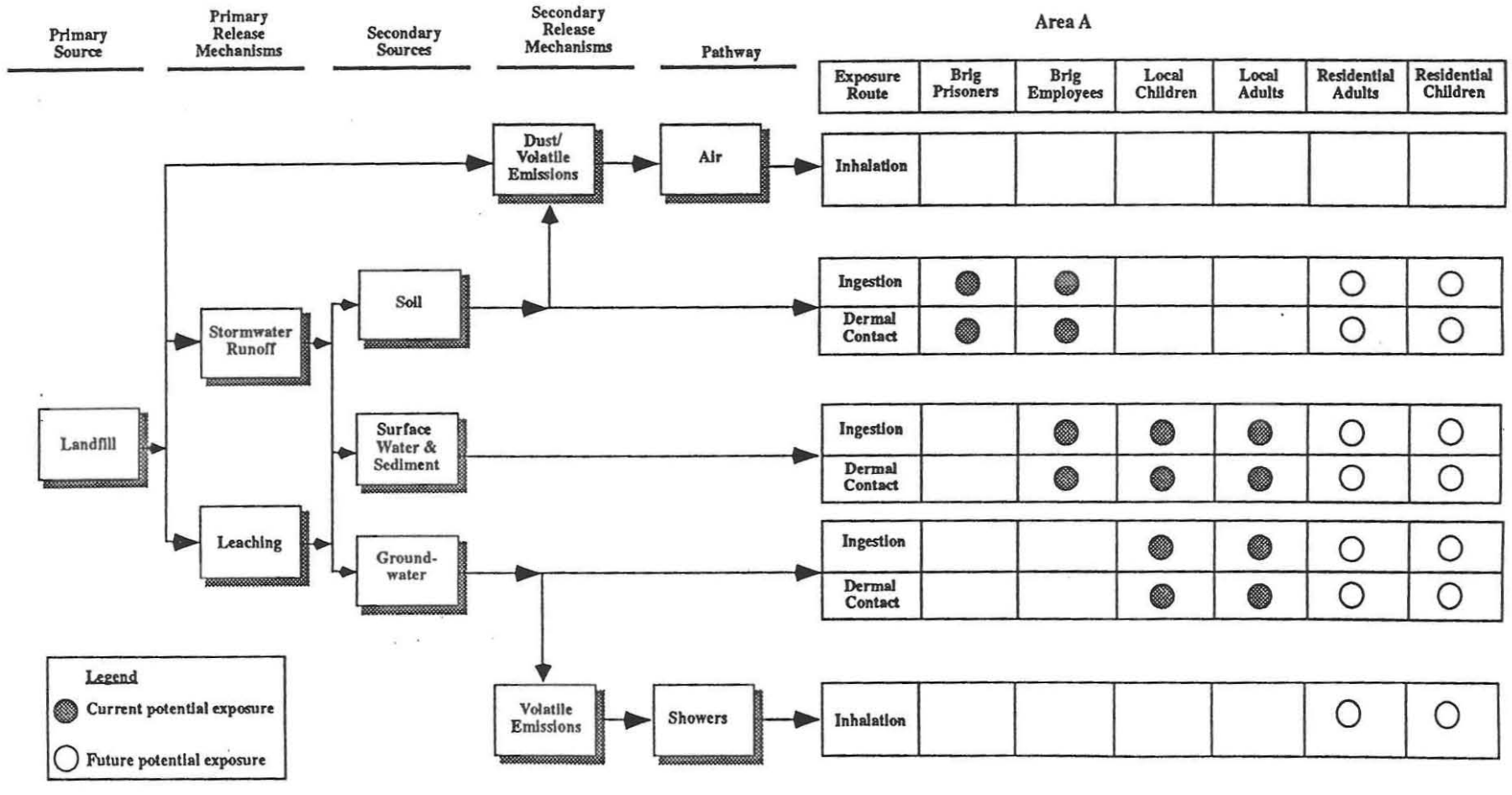
Groundwater	*Surface Water*	*Sediment*	*Surface Soil*
Benzene	Benzene	Benzene	Aroclor-1260
1,2-Dichloroethene	1,2-Dichloroethene	1,2-Dichloroethene	Cadmium
1,2-Dichloroethane	Trichloroethene	1,2-Dichloroethane	Lead
Trichloroethene	Vinyl Chloride	Trichloroethene	
Vinyl Chloride	Manganese	Vinyl Chloride	
Xylenes (total)	Arsenic	Lead	
Antimony	Iron	Arsenic	
Beryllium		Cadmium	
Cadmium		Copper	
Chromium		Mercury	
Lead		Silver	
Nickel		Zinc	
Zinc			

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

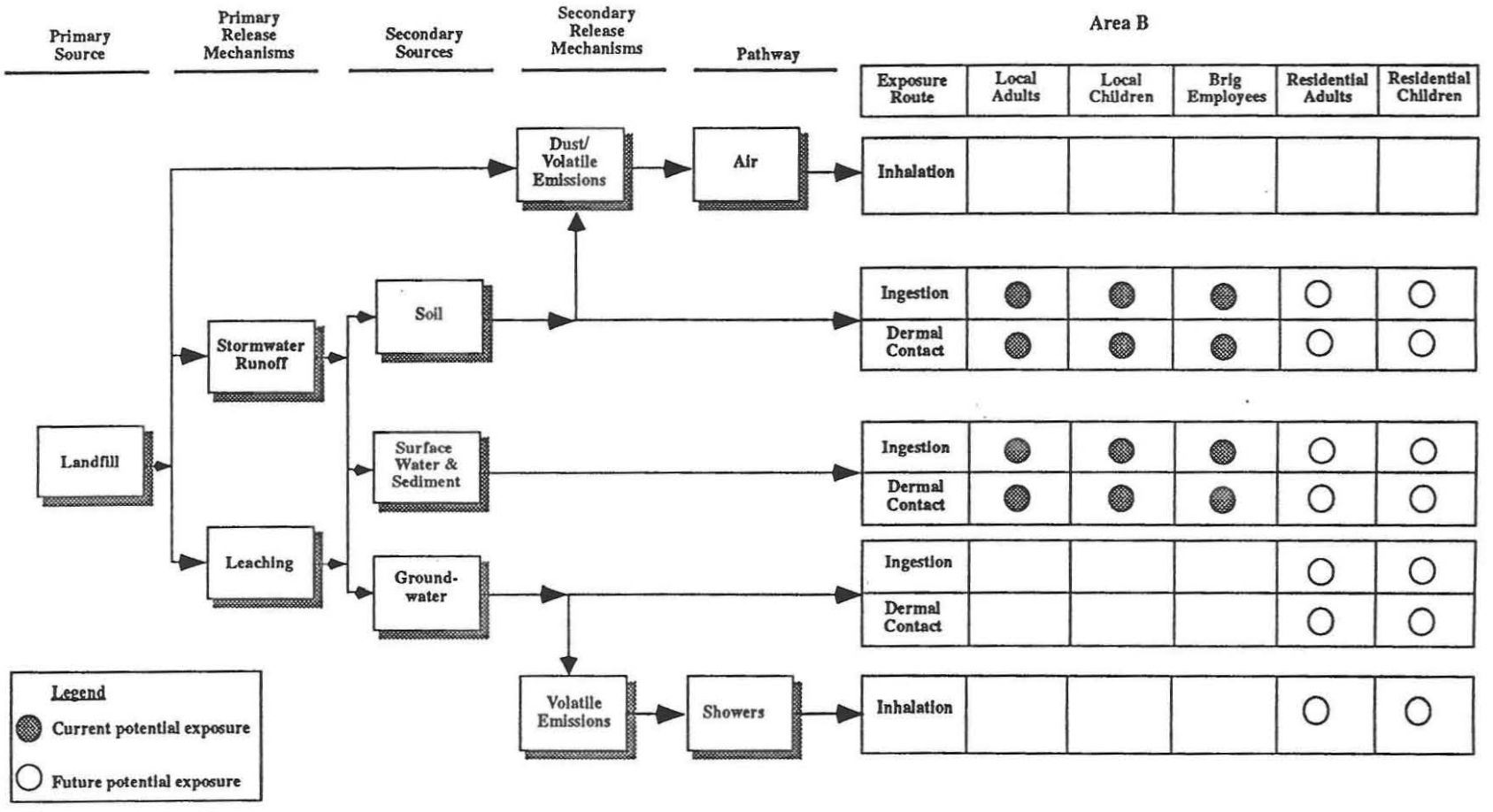
Exposure Assessment

- Area A
  - Current Potential Exposure Pathways
  - Future Potential Exposure Pathways
- Area B
  - Current Potential Exposure Pathways
  - Future Potential Exposure Pathways

CONCEPTUAL SITE MODEL
CAMP ALLEN LANDFILL - AREA A
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA



CONCEPTUAL SITE MODEL
CAMP ALLEN LANDFILL - AREA B (POND AND SCHOOL AREAS)
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA



EXPOSURE INPUT PARAMETERS FOR LOCAL ADULTS AND CHILDREN POTENTIALLY EXPOSED TO COPCs IN THE AREA A AND THE RESIDENTIAL AREA ,CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor		References
			Child	Adult	
ED, Exposure Duration	Sediment	year	9	30	Professional Judgment and USEPA, 1991
	Groundwater	year	6	30	USEPA, 1991
	Surface Water	year	9	30	Professional Judgment and USEPA, 1991
EF, Exposure Frequency	Sediment	day/year	28	7	Professional Judgment and USEPA, 1988
	Groundwater	day/year	28	28	Professional Judgment and USEPA, 1988
	Surface Water	day/year	28	7	Professional Judgment and USEPA, 1988
ET, Exposure Time	Surface Water	hour/day	2.6	2.6	USEPA, 1988
	Groundwater	hour/day	2.6	1.0	USEPA, 1988 and Professional Judgment
IR, Ingestion Rate	Sediment	mg/day	100	50	USEPA, 1991
	Groundwater	L/day	0.05	0.05	USEPA, 1988
	Surface Water	L/hour	0.05	0.05	USEPA, 1988
SA, Surface Area	Sediment	cm^2	3,820	3,500	USEPA, 1992a
	Groundwater	cm^2	8,023	6,350	USEPA, 1992a
	Surface Water	cm^2	3,820	3,500	USEPA, 1992a

EXPOSURE INPUT PARAMETERS FOR LOCAL ADULTS AND CHILDREN POTENTIALLY EXPOSED TO COPCs IN THE AREA A AND THE RESIDENTIAL AREA ,CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor		References
			Child	Adult	
AT, Averaging Time					
AT_{nc}, noncarcinogenic	Sediment	day	3,285	10,950	USEPA, 1989a
	Groundwater	day	2,190	10,950	USEPA, 1989a
	Surface Water	day	3,285	10,950	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	25,550	USEPA, 1989a
ABS, Absorbance Factor					
Organics	All media	N/A	0.01	0.01	USEPA, 1992c
Inorganics	All media	N/A	0.001	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	(1)	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	Chemical-specific	see CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.

Notes: (1) Child body weights: 1 to 6 years = 15 Kg; 6 to 15 years = 37 Kg
NA = Not Applicable

EXPOSURE INPUT PARAMETERS FOR BRIG PRISONERS AND EMPLOYEES POTENTIALLY EXPOSED TO COPCs IN AREA A, CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor		References
			Brig Prisoner	Brig Employee	
ED, Exposure Duration	Sediment	year	NA	25	Site-specific values
	Surface Water	year	NA	25	Site-specific values
	Soil	year	2	25	Site-specific values
EF, Exposure Frequency	Sediment	day/year	NA	12	Professional Judgment and Site-specific values
	Surface Water	day/year	NA	12	Professional Judgment and Site-specific values
	Soil	day/year	350	250	USEPA Default Exposure Factors
ET, Exposure Time	Surface Water	hour/day	NA	2.6	Professional Judgment
IR, Ingestion Rate	Sediment	mg/day	NA	50	USEPA, 1991
	Surface Water	L/hour	NA	0.05	USEPA, 1989a
	Soil	mg/day	50	50	USEPA, 1989a
SA, Surface Area	Sediment	cm^2	NA	3,500	USEPA, 1988
	Surface Water	cm^2	NA	3,500	USEPA, 1988
	Soil	cm^2	2,000	2,000	USEPA, 1988
AT, Averaging Time AT_{nc}, noncarcinogenic	Sediment	day	NA	9,125	USEPA, 1989a
	Surface Water	day	NA	9,125	USEPA, 1989a
	Soil	day	730	9,125	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	25,550	USEPA, 1989a

EXPOSURE INPUT PARAMETERS FOR BRIG PRISONERS AND EMPLOYEES POTENTIALLY EXPOSED TO COPCs IN AREA A, CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor		References
			Brig Prisoner	Brig Employee	
ABS, Absorbance Factor					
Organics	N/A	N/A	0.01	0.01	USEPA, 1992c
Inorganics	N/A	N/A	0.001	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	70	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	Chemical-specific	See CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.
NA = Not Applicable

EXPOSURE INPUT PARAMETERS FOR FUTURE RESIDENT CHILDREN AND ADULTS POTENTIALLY EXPOSED TO COPCs IN AREA A , CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Future Receptor		References
			Child	Adult	
ED, Exposure Duration	Sediment	year	6	30	USEPA, 1991
	Groundwater	year	6	30	USEPA, 1991
	Surface Water	year	6	30	USEPA, 1991
	Soil	year	6	30	USEPA, 1991
	Air, Shower	year	6	30	USEPA, 1991
EF, Exposure Frequency	Sediment	day/year	137	34	Professional Judgment
	Groundwater	day/year	350	350	USEPA, 1991
	Surface Water	day/year	137	34	Professional Judgment
	Soil	day/year	350	350	USEPA, 1991
	Air, Shower	day/year	350	350	USEPA, 1991
ET, Exposure Time	Surface Water	hour/day	2.5	2.5	Professional Judgment
	Air, Shower	hour/day	0.2	0.2	USEPA, 1988
	Groundwater	hour/day	0.2	0.2	USEPA, 1991
IR, Ingestion Rate	Sediment	mg/day	100	50	Professional Judgment
	Groundwater	L/day	1	2	USEPA, 1991
	Surface Water	L/hour	0.05	0.05	USEPA, 1989a
	Soil	mg/day	200	100	USEPA, 1991
	Air, Shower	m^3/hour	0.6	0.6	USEPA, 1989a
SA, Surface Area	Sediment	cm^2	3,820	2,000	USEPA, 1992a
	Groundwater	cm^2	8,023	18,150	USEPA, 1992a
	Surface Water	cm^2	3,820	2,000	USEPA, 1992a
	Soil	cm^2	2,006	5,300	USEPA, 1992a

EXPOSURE INPUT PARAMETERS FOR FUTURE RESIDENT CHILDREN AND ADULTS POTENTIALLY EXPOSED TO COPCs IN AREA A , CAMP ALLEN LANDFILL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Future Receptor		References
			Child	Adult	
AT, Averaging Time					
AT_{nc}, noncarcinogenic	Sediment	day	2,190	10,950	USEPA, 1989a
	Groundwater	day	2,190	10,950	USEPA, 1989a
	Surface Water	day	2,190	10,950	USEPA, 1989a
	Soil	day	2,190	10,950	USEPA, 1989a
	Air, Shower	day	2,190	10,950	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	25,550	USEPA, 1989a
ABS, Absorbance Factor					
Organics	All media	N/A	0.01	0.01	USEPA, 1992c
Inorganics	All media	N/A	0.001	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	(1)	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	Chemical-specific	see CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.

Notes: (1) Child body weights: 1 to 6 years = 15 Kg; 6 to 15 years = 37 Kg
NA = Not Applicable

EXPOSURE INPUT PARAMETERS FOR
LOCAL CHILDREN AND ADULTS POTENTIALLY EXPOSED TO
COPCs IN AREA B - ELEMENTARY SCHOOL
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor		References
			Child (6 to 12 yrs.)	Adult Employee	
ED, Exposure Duration	Sediment	year	6	25	USEPA, 1991
	Surface Water	year	6	25	USEPA, 1991
	Soil	year	6	25	USEPA, 1991
EF, Exposure Frequency	Sediment	day/year	137	12	Professional Judgment
	Surface Water	day/year	137	12	Professional Judgment
	Soil	day/year	180	250	USEPA, 1991
ET, Exposure Time	Surface Water	hour/day	2.5	2.5	Professional Judgment
IR, Ingestion Rate	Sediment	mg/day	200	50	USEPA, 1991
	Surface Water	L/hour	0.05	0.05	USEPA, 1989a
	Soil	mg/day	200	50	USEPA, 1991
SA, Surface Area	Sediment	cm^2	3,407	2,000	USEPA, 1992a
	Surface Water	cm^2	3,407	2,000	USEPA, 1992a
	Soil	cm^2	3,407	5,300	USEPA, 1988
AT, Averaging Time					
AT_{nc}, noncarcinogenic	Sediment	day	2,190	9,125	USEPA, 1989a
	Surface Water	day	2,190	9,125	USEPA, 1989a
	Soil	day	2,190	9,125	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	25,550	USEPA, 1989a

EXPOSURE INPUT PARAMETERS FOR
LOCAL CHILDREN AND ADULTS POTENTIALLY EXPOSED TO
COPCs IN AREA B - ELEMENTARY SCHOOL
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Receptor		References
			Child	Adult	
ABS, Absorbance Factor Organics	N/A	N/A	0.01	0.01	USEPA, 1992c
Inorganics	N/A	N/A	0.001	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	31	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	Chemical-specific	See CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.
NA = Not Applicable

EXPOSURE INPUT PARAMETERS FOR
LOCAL ADULTS POTENTIALLY EXPOSED TO COPCs IN AREA B - POND
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Current Receptor	References
			Adult Employee	
ED, Exposure Duration	Sediment	year	25	USEPA, 1991
	Soil	year	25	USEPA, 1991
	Surface Water	year	25	USEPA, 1991
EF, Exposure Frequency	Sediment	day/year	12	Professional Judgment
	Soil	day/year	250	USEPA, 1991
	Surface Water	day/year	12	Professional Judgment and USEPA, 1992b
ET, Exposure Time	Surface Water	hour/day	2.6	USEPA, 1988
IR, Ingestion Rate	Sediment	mg/day	50	USEPA, 1991
	Soil	mg/day	50	USEPA, 1988
	Surface Water	L/hour	0.05	USEPA, 1988
SA, Surface Area	Sediment	cm^2	3,500	USEPA, 1992a
	Soil	cm^2	5,300	USEPA, 1992a
	Surface Water	cm^2	3,500	USEPA, 1992a
AT, Averaging Time AT_{nc}, noncarcinogenic	Sediment	day	9,125	USEPA, 1989a
	Soil	day	9,125	USEPA, 1989a
	Surface Water	day	9,125	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	USEPA, 1989a

EXPOSURE INPUT PARAMETERS FOR
LOCAL ADULTS POTENTIALLY EXPOSED TO COPCs IN AREA B - POND
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Receptor	References
			Adult	
ABS, Absorbance Factor				
Organics	N/A	N/A	0.01	USEPA, 1992c
Inorganics	N/A	N/A	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	See CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.
NA = Not Applicable

EXPOSURE INPUT PARAMETERS FOR
FUTURE RESIDENT ADULTS AND CHILDREN POTENTIALLY EXPOSED TO
COPCs IN AREA B - POND AND ELEMENTARY SCHOOL
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Future Receptor		References
			Child	Adult	
ED, Exposure Duration	Sediment	year	6	30	USEPA, 1991
	Groundwater	year	6	30	USEPA, 1991
	Surface Water	year	6	30	USEPA, 1991
	Soil	year	6	30	USEPA, 1991
	Air, Shower	year	6	30	USEPA, 1991
EF, Exposure Frequency	Sediment	day/year	137	34	Professional Judgment
	Groundwater	day/year	350	350	USEPA, 1991
	Surface Water	day/year	137	34	Professional Judgment
	Soil	day/year	350	350	USEPA, 1991
	Air, Shower	day/year	350	350	USEPA, 1991
ET, Exposure Time	Surface Water	hour/day	2.5	2.5	Professional Judgment
	Air, Shower	hour/day	0.2	0.2	USEPA, 1988
IR, Ingestion Rate	Sediment	mg/day	200	100	USEPA, 1991
	Groundwater	L/day	1	2	USEPA, 1991
	Surface Water	L/hour	0.05	0.05	USEPA, 1989a
	Soil	mg/day	200	100	USEPA, 1991
	Air, Shower	m^3/hour	0.6	0.6	USEPA, 1989a
SA, Surface Area	Sediment	cm^2	3,820	2,000	USEPA, 1992a
	Groundwater	cm^2	8,023	18,150	USEPA, 1989a
	Surface Water	cm^2	3,820	2,000	USEPA, 1992a
	Soil	cm^2	2,006	5,300	USEPA, 1992a

EXPOSURE INPUT PARAMETERS FOR
FUTURE RESIDENT ADULTS AND CHILDREN POTENTIALLY EXPOSED TO
COPCs IN AREA B - POND AND ELEMENTARY SCHOOL
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

Input Parameter	Media	Units	Future Receptor		References
			Child	Adult	
AT, Averaging Time					
AT_{nc}, noncarcinogenic	Sediment	day	2,190	10,950	USEPA, 1989a
	Groundwater	day	2,190	10,950	USEPA, 1989a
	Surface Water	day	2,190	10,950	USEPA, 1989a
	Soil	day	2,190	10,950	USEPA, 1989a
	Air, Shower	day	2,190	10,950	USEPA, 1989a
AT_c, carcinogenic	All Media	day	25,550	25,550	USEPA, 1989a
ABS, Absorbance Factor					
Organics	All media	N/A	0.01	0.01	USEPA, 1992c
Inorganics	All media	N/A	0.001	0.001	USEPA, 1992c
AF, Adherence Factor	Soil/Sediment	mg/cm^2	1	1	USEPA, 1992c
BW, Body Weight	All Media	Kg	(1)	70	USEPA, 1989a
PC, Permeability Constant	All Media	cm/hr	Chemical-specific	Chemical-specific	see CDI calculations, Appendix C

References:

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications - Interim Report.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.
USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1989b. Exposure Factors Handbook.

Notes: (1) Child body weights: 1 to 6 years = 15 Kg; 6 to 15 years = 37 Kg
NA = Not Applicable

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

Toxicity Assessment

TOXICITY FACTORS FOR CHEMICALS OF CONCERN
AREAS A AND B
CAMP ALLEN LANDFILL, NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	RfD	RfI	CSF	CSFI	WOE	Reference
VOCs:						
Benzene	PDG	PDG	0.029	0.029	A	IRIS, 1993
Carbon Disulfide	0.1	0.0029	--	--	--	USEPA Region III, 1992 IRIS, 1993
Chlorobenzene	0.02	0.0057	--	--	D	USEPA Region III, 1992 IRIS, 1993
1,2-Dichloroethane	ND	ND	0.091	0.091	B2	IRIS, 1993
1,2-Dichloroethene	0.003	ND	ND	ND	--	USEPA Region III, 1992 IRIS, 1993
Ethylbenzene	0.1	0.286	--	--	D	USEPA Region III, 1992 IRIS, 1993
1,1,1-Trichloroethane	0.09	0.286	NE	NE	D	USEPA Region III, 1992
Tetrachloroethene	0.01	ND	0.052	0.002	--	USEPA Region III, 1992 IRIS, 1993
Toluene	0.2	0.114	--	--	D	USEPA Region III, 1992 IRIS, 1993
Trichloroethene	0.006	PDG	0.011	0.006	--	USEPA Region III, 1992 IRIS, 1993
Vinyl Chloride	--	--	1.9	0.3	--	USEPA Region III, 1992
Xylenes (total)	2	PDG	--	--	D	IRIS, 1993

TOXICITY FACTORS FOR CHEMICALS OF CONCERN
AREAS A AND B
CAMP ALLEN LANDFILL, NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	RfD	RfI	CSF	CSFI	WOE	Reference
PCBs:						
Aroclor-1260	ND	ND	7.7	--	B2	IRIS, 1993
Inorganics:						
Antimony	0.0004	--	--	--	--	USEPA Region III, 1992 IRIS, 1993
Arsenic	0.0003	ND	1.75	15.1	A_I	USEPA Region III, 1992 IRIS, 1993
Beryllium	0.005	ND	4.3	8.4	B2	IRIS, 1993
Cadmium	0.0005	PDG	--	6.3	$B1_I$	USEPA Region III, 1992 IRIS, 1993
Chromium (as VI)	0.005	PDG	--	42	A_I	IRIS, 1993
Copper	0.071	ND	--	--	D	USEPA Region III, 1992
Lead	--	ND	--	--	B2	IRIS, 1993
Manganese	0.005	0.00011	--	--	D	IRIS, 1993
Mercury	0.0003	0.00008 6	--	--	D	USEPA Region III, 1992 IRIS, 1993
Nickel	0.02	PDG	--	--	--	IRIS, 1993
Silver	0.005	ND	--	--	D	USEPA Region III, 1992 IRIS, 1993
Zinc	0.3	ND	--	--	D	IRIS, 1993

Notes: RfD - reference dose, oral
RfI - reference dose, inhalation
CSF - cancer slope factor, oral
CSFI - cancer slope factor, inhalation
WOE - weight of evidence
ND - No data available
PDG - pending

IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
USEPA - Environmental Protection Agency
A_I, B_I - carcinogenic by inhalation
NE - Not evaluated

Rob Thomson Why didn't you use a model for lead?

Rich Hoff - not applicable

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT
RISK CHARACTERIZATION

- Human Health

  - Area A

    - Local Adults and Children
    - Brig Employees and Prisoners
    - Future Residents

  - Area B

    - School Employees
    - School Children
    - Brig Employees (Pond Area)
    - Future Residents (Pond and School Areas)

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI) FOR LOCAL ADULTS AND CHILDREN - RESIDENTIAL AREA AND AREA A NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors					
	Adults		Children (1 to 6 years)		Children (6 to 15 years)	
Pathway	HI	ICR	HI	ICR	HI	ICR
Shallow Groundwater						
Ingestion	6E-5	9E-8	3E-4	9E-8	NA	NA
Dermal Contact	3E-4	2E-7	0.005	5E-7	NA	NA
Inhalation	NA	NA	NA	NA	NA	NA
Sediment						
Ingestion	0.009	1E-6	NA	NA	0.1	6E-6
Dermal Contact	6E-4	1E-8	NA	NA	0.005	3E-9
Surface Water						
Ingestion	0.003	6E-7	NA	NA	0.02	3E-6
Dermal Contact	3E-4	6E-8	NA	NA	0.003	2E-7
TOTAL	**0.01**	**2×10^{-6}**	**0.005**	**6E-7**	**0.1**	**9E-6**

Notes: -- = Not calculated. Potentially carcinogenic COPCs not detected in the data set
NA = Not Applicable
( ) = Risk value derived using dissolved inorganic results

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI) FOR BRIG EMPLOYEES AND BRIG PRISONERS - AREA A NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	Brig Prisoners		Brig Employees (Civilian)	
Pathway	HI	ICR	HI	ICR
Soil				
Ingestion	0.2	2E-6	0.15	2E-5
Dermal Contact	0.008	8E-8	0.006	7E-7
Sediment				
Ingestion	NA	NA	0.015	2E-6
Dermal Contact	NA	NA	0.001	2E-7
Surface Water				
Ingestion	NA	NA	0.005	9E-7
Dermal Contact	NA	NA	6E-4	9E-8
TOTAL	**0.2**	**2E-6**	**0.2**	**2E-5**

Notes: NA = Not Applicable

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI)
FOR FUTURE RESIDENTS - AREA A
NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	Adults		Children	
Pathway	HI	ICR	HI	ICR
Shallow Groundwater				
Ingestion	5.7 (5.0)	1E-2 (1E-2)	13 (12.0)	6E-3 (6E-3)
Dermal Contact	0.4 (0.4)	2E-4 (2E-4)	0.8 (0.8)	8E-5 (8E-5)
Inhalation	0.001	1E-5	0.02	4E-5
Deep Groundwater				
Ingestion	0.7 (0.6)	6E-4 (6E-4)	1.7 (1.0)	3E-4 (3E-4)
Dermal Contact	0.02 (0.02)	9E-6 (9E-6)	0.03 (0.03)	4E-6 (4E-6)
Inhalation	0.001	1E-5	0.02	3E-6
Soil				
Ingestion	0.4	5E-5	3.8	1E-4
Dermal Contact	0.02	3E-6	0.04	1E-6
Sediment				
Ingestion	0.04	6E-6	1.6	5E-5
Dermal Contact	0.002	3E-7	0.03	2E-8
Surface Water				
Ingestion	0.01	3E-6	0.3	1E-5
Dermal Contact	1E-7	2E-10	4E-6	1E-9
TOTAL (1)	**7 (6)**	**1E-2 (1E-2)**	**20 (19)**	**6E-3 (6E-3)**

Notes: ( ) = Risk value derived using dissolved (filtered) inorganic results
(1) Total result is derived by summing the ICR and HI values for each pathway using the more conservative results for shallow or deep groundwater.

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI) FOR SCHOOL CHILDREN AND ADULT SCHOOL EMPLOYEES - AREA B SCHOOL NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	School Employees		School Children K-5	
Pathway	HI	ICR	HI	ICR
Soil				
Ingestion	0.03	--	0.2	--
Dermal Contact	0.003	--	0.007	--
Sediment				
Ingestion	5E-5	--	0.002	--
Dermal Contact	2E-6	--	8E-5	--
Surface Water				
Ingestion	0.002	5E-7	0.06	3E-6
Dermal Contact	3E-4	5E-8	0.006	3E-7
TOTAL	**0.04**	**6E-7**	**0.3**	**3E-6**

Notes: -- = Not calculated. Potentially carcinogenic COPCs were not retained or detected in the respective data.

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI) FOR LOCAL ADULTS AND CHILDREN - AREA B POND NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors	
	Brig Employees	
Pathway	HI	ICR
Soil		
Ingestion	0.01	8E-7
Dermal Contact	0.002	8E-7
Sediment		
Ingestion	0.004	5E-7
Dermal Contact	3E-4	3E-8
Surface Water		
Ingestion	0.004	7E-7
Dermal Contact	0.001	4E-7
TOTAL	**0.02**	**3E-6**

INCREMENTAL LIFETIME CANCER RISKS (ICRs) AND HAZARD INDICES (HI) FOR FUTURE RESIDENTS - AREA B (SCHOOL AND POND AREAS) NORFOLK NAVAL BASE, NORFOLK, VIRGINIA

	Receptors			
	Adults		Children	
Pathway	HI	ICR	HI	ICR
Shallow Groundwater				
Ingestion	4.1 (2.6)	5E-3 (5E-3)	9.5 (6.0)	2E-3 (2E-3)
Dermal Contact	0.05 (0.04)	7E-5 (7E-5)	0.09 (0.08)	3E-5 (3E-5)
Inhalation	--	3E-4	--	3E-4
Deep Groundwater				
Ingestion	6.9 (0.1)	9E-4 (3E-4)	16.2 (0.3)	4E-4 (2E-4)
Dermal Contact	0.02 (0.004)	5E-6 (4E-6)	0.05 (0.007)	2E-6 (2E-6)
Inhalation	--	8E-5	--	8E-5
Soil*				
Ingestion	0.08	--	0.8	--
Dermal Contact	0.002	--	0.008	--
Sediment**				
Ingestion	0.01	2E-6	0.4	1E-5
Dermal Contact	0.005	6E-8	0.009	2E-7
Surface Water**				
Ingestion	0.01	2E-6	0.2	9E-6
Dermal Contact	0.002	1E-6	0.06	5E-6
TOTAL (1)	**4.3 (2.7)**	**5E-3 (5E-3)**	**11.0 (7.5)**	**2E-3 (2E-3)**

Notes: (1) Total result is derived by summing the ICR and HI values for each pathway, using the results for shallow groundwater because of the relatively higher ICR values.
* - Values represent Area B - School data.
** - Values represent Area B - Pond data.

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT
RISK CHARACTERIZATION

- Ecological
  - Areas A and B
    - Benthic Macroinvertebrates
    - Terrestrial Receptors

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

Summary of Risk Assessment Results

- Human Health
  - Area A - Current Potential Risks
  - Area B - Current Potential Risks
  - Area A - Future Potential Risks
  - Area B - Future Potential Risks
- Ecological
  - Aquatic and Terrestrial

TOTAL SITE ICR AND HI VALUES FOR CURRENT POTENTIAL HUMAN RECEPTORS, AREA A NORFOLK NAVAL BASE NORFOLK, VIRGINIA

Receptors	Total HI	Total ICR
Local Adults (1)	0.01	2E-6
Local Children (2)*	0.1	1E-5
Brig Employees (3)	0.2	2E-5
Brig Prisoners	0.2	2E-6

Notes:

(1) Local adults could potentially be exposed to COPCs by dermal contact and accidental ingestion of shallow groundwater, surface waters and sediments.

(2) Local children could potentially be exposed to surface waters, sediments and shallow groundwaters. Total site risk values represent potential exposure to surface waters and sediments by older children and total site risk values for younger children potentially exposed to COPCs in residential area shallow groundwater.

(3) Brig Employees (Civilian) could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments.

(4) Brig Prisoners could potentially be exposed to COPCs through dermal contact and accidental ingestion of soils. Prisoners do not generally gain access to the ditches.

* Total HI and ICR values derived by summing the HI and ICR values for younger children (ages 1 to 6 years) and older children (ages 6 to 15 years) potentially exposed to Area A ditch surface waters and sediments.

Rob Thomson - Do these numbers include VOC's ?
Rich Hoff - Yes includes inorganics, VOC's ETC (TOTAL)

TOTAL SITE ICR AND HI VALUES FOR CURRENT POTENTIAL HUMAN RECEPTORS, AREA B NORFOLK NAVAL BASE NORFOLK, VIRGINIA

Receptors	Total HI	Total ICR
Brig Employees(1)	0.02	3E-6
Elementary School Children (2)	0.2	3E-6
Elementary School Workers (3)	0.04	6E-7

Notes:

(1) Brig employees could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters, and sediments in Area B - pond during maintenance activities.

(2) Elementary School children (6 through 12) could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface water and sediments in Area B - School.

(3) Elementary School Workers could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments in Area B - School.

Lee Rosenberg - Is the Area B fenced security all the time?
Rich Hoff / T. Artman - yes, barrier fence was damaged last year and repaired shortly there after.

TOTAL SITE ICR AND HI VALUES FOR FUTURE POTENTIAL HUMAN RECEPTORS, AREA A NORFOLK NAVAL BASE NORFOLK, VIRGINIA

Receptors	Total HI	Total ICR
Resident Adults (1)	7 (6)	1E-2 (1E-2)
Resident Children (2)	20 (19)	6E-3 (6E-3)

Notes:

Values in parentheses represent risk values derived using dissolved inorganic constituent results for groundwaters.

(1) Future resident adults could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments. Potable use of shallow and deep groundwaters were also evaluated. Potential exposure pathways included ingestion, whole body dermal contact and inhalation of VOCs while showering.

(2) Future resident children could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments and by the potable use of shallow and deep groundwaters.

TOTAL SITE ICR AND HI VALUES FOR FUTURE POTENTIAL HUMAN RECEPTORS, AREA B NORFOLK NAVAL BASE NORFOLK, VIRGINIA

Receptors	Total HI	Total ICR
Resident Adults (1)	4.3 (2.7)	5E-3 (5E-3)
Resident Children (2)	11.0 (7.5)	2E-3 (2E-3)

Notes:

Values in parentheses represent risk values derived using dissolved inorganic constituent results for groundwaters.

(1) Future resident adults could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments. Potable use of shallow and deep groundwaters were also evaluated. Potential exposure pathways included ingestion, whole body dermal contact and inhalation of VOCs while showering.

(2) Future resident children could potentially be exposed to COPCs by dermal contact and accidental ingestion of soils, surface waters and sediments and by the potable use of shallow and deep groundwaters.

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

Chemicals and Environmental Media responsible for future potential human health risks include:

- Area A
  - Subsurface Soil - arsenic and cadmium
  - Sediment - arsenic
  - Shallow Groundwater - 1,2-dichloroethene, vinyl chloride, and trichloroethene
  - Deep Groundwater - 1,2-dichloroethene, vinyl chloride, and trichloroethene

CAMP ALLEN LANDFILL
BASELINE RISK ASSESSMENT

Chemicals and Environmental Media responsible for future potential human health risks include:

- Area B
  - Shallow Groundwater - 1,2-dichloroethene, vinyl chloride, and trichloroethene
  - Deep Groundwater - 1,2-dichloroethene and antimony

OVERVIEW OF AREA B REMOVAL ACTION

CAMP ALLEN LANDFILL
REMOVAL ACTION
AREA B

- Based on RI findings, a Non-time critical Removal Action is planned at Area B of the Camp Allen Landfill
  - Scope of Work
  - Generalized Figure
  - Tentative Schedule

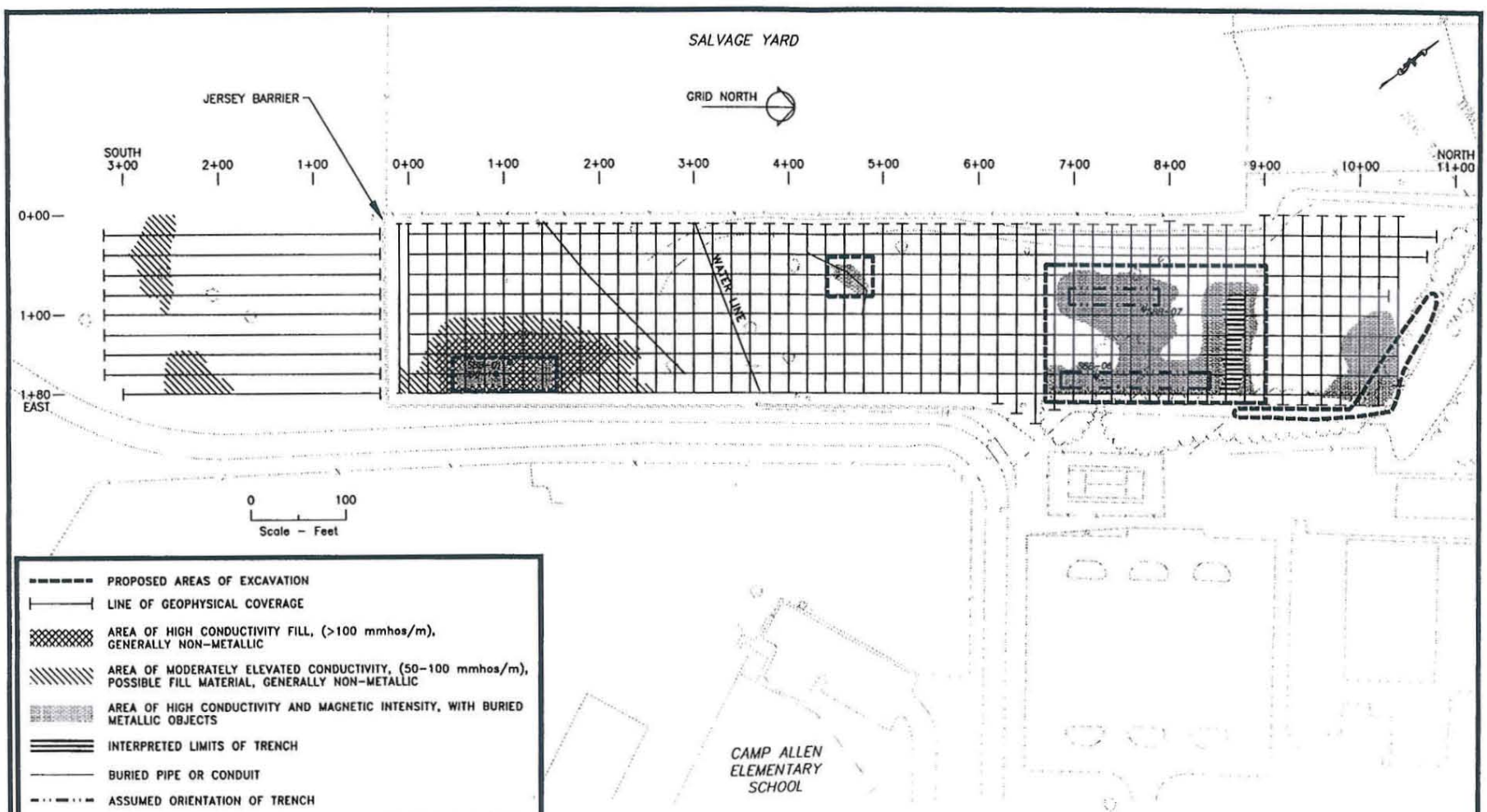
CAMP ALLEN LANDFILL
REMOVAL ACTION, AREA B

- Included in the Removal Action scope are the following items of work:
  - Temporary dewatering of the removal areas to lower the water table
  - Treatment of extracted groundwater and discharge to HRSD
  - Excavation of the soil/debris from the trenches plus over-excavation of visibly contaminated soil from excavation side walls/floor
  - Confirmation sampling and analysis, and additional excavation of material contaminated in excess of removal action endpoints
  - Transportation to and disposal at a RCRA Facility
  - Site Restoration

Lisa Ellis - Is area in NE corner only an estimate of Area to be addressed in Removal Action.

T. Artman - Yes. RAC contractor will over excavate and modify as needed.

OHM - RAC contractor

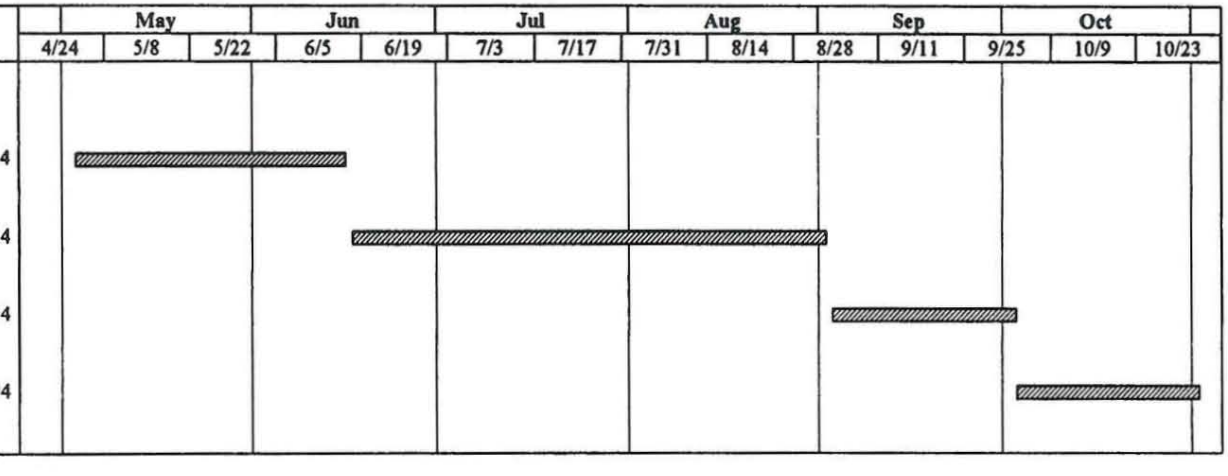


REVISIONS				
	DATE 4/93 SCALE GRAPHIC DRAWN GLB REVIEWED SJK S.O.# 19084 CADD# 176-016	GEOPHYSICAL INVESTIGATION CAMP ALLEN LANDFILL - AREA B NORFOLK, VIRGINIA PREPARED FOR BAKER ENVIRONMENTAL, INC WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Baker Baker Environmental, Inc. WESTON GEOPHYSICAL CORP. IS A WHOLLY OWNED SUBSIDIARY OF BAKER ENVIRONMENTAL, INC.	PROPOSED AREAS OF EXCAVATION AREA B SCALE GRAPHIC DATE 4/93	FIGURE 5-1

REMOVAL ACTION SCHEDULE FOR AREA B

Camp Allen Landfill, Naval Station, Norfolk, Virginia
Project Manager: Stephen Kretschman

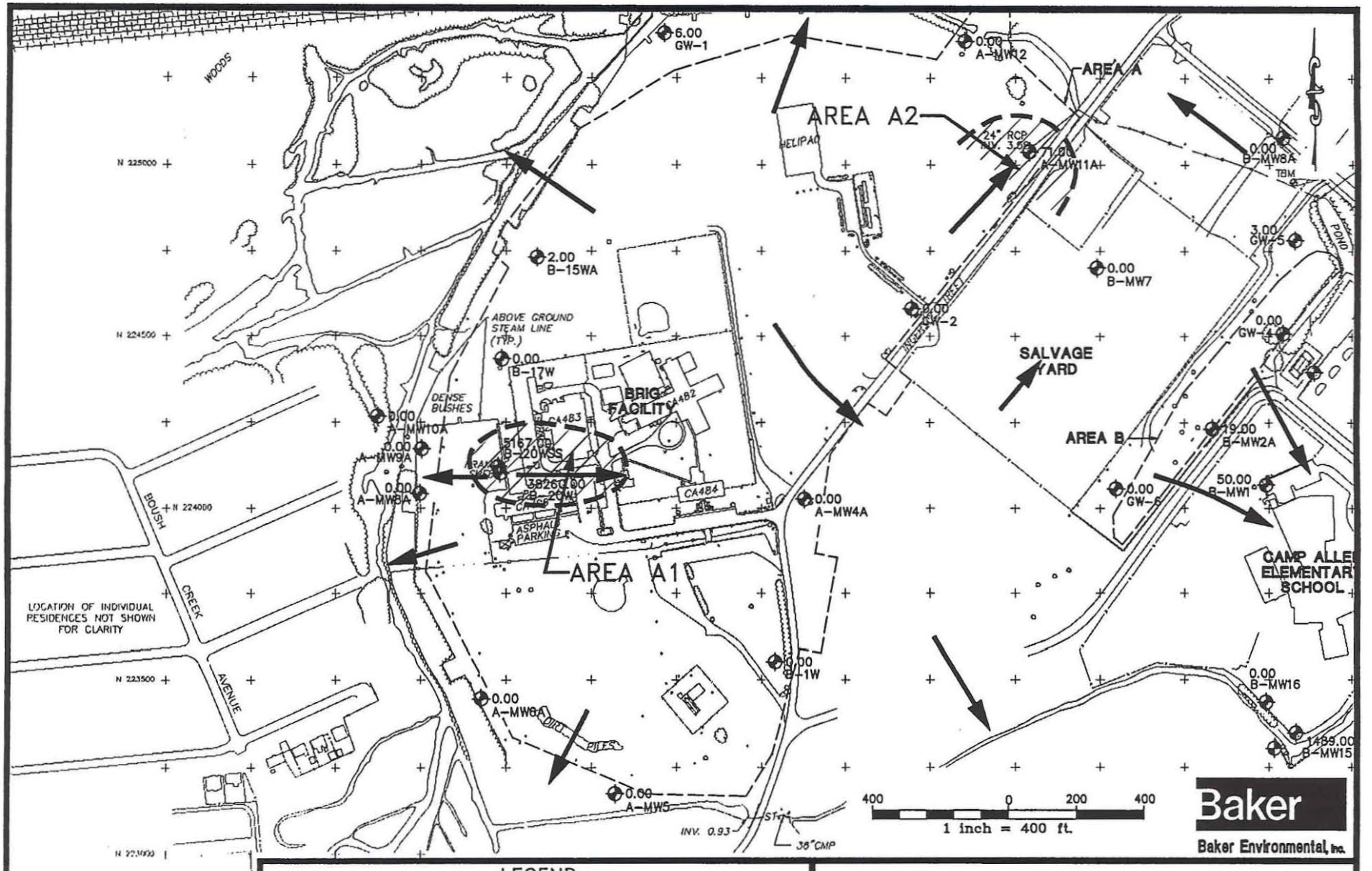
Task	Description	Days	Start	Finish
1.0	MOBILIZATION	44ed	5/3/94	6/16/94
2.0	REMOVAL	77ed	6/17/94	9/2/94
3.0	SITE RESTORATION	30ed	9/3/94	10/3/94
4.0	DEMOBILIZATION	30ed	10/3/94	11/2/94



SUMMARY OF FS RESULTS

FS PROCESS

- Unacceptable Risk
- Develop Remedial Action Objectives
- Develop General Response Actions
- Identify & Screen Technologies and Process Options
- Develop & Screen Alternatives
- Analyze Alternatives in Detail
- Compare Alternatives

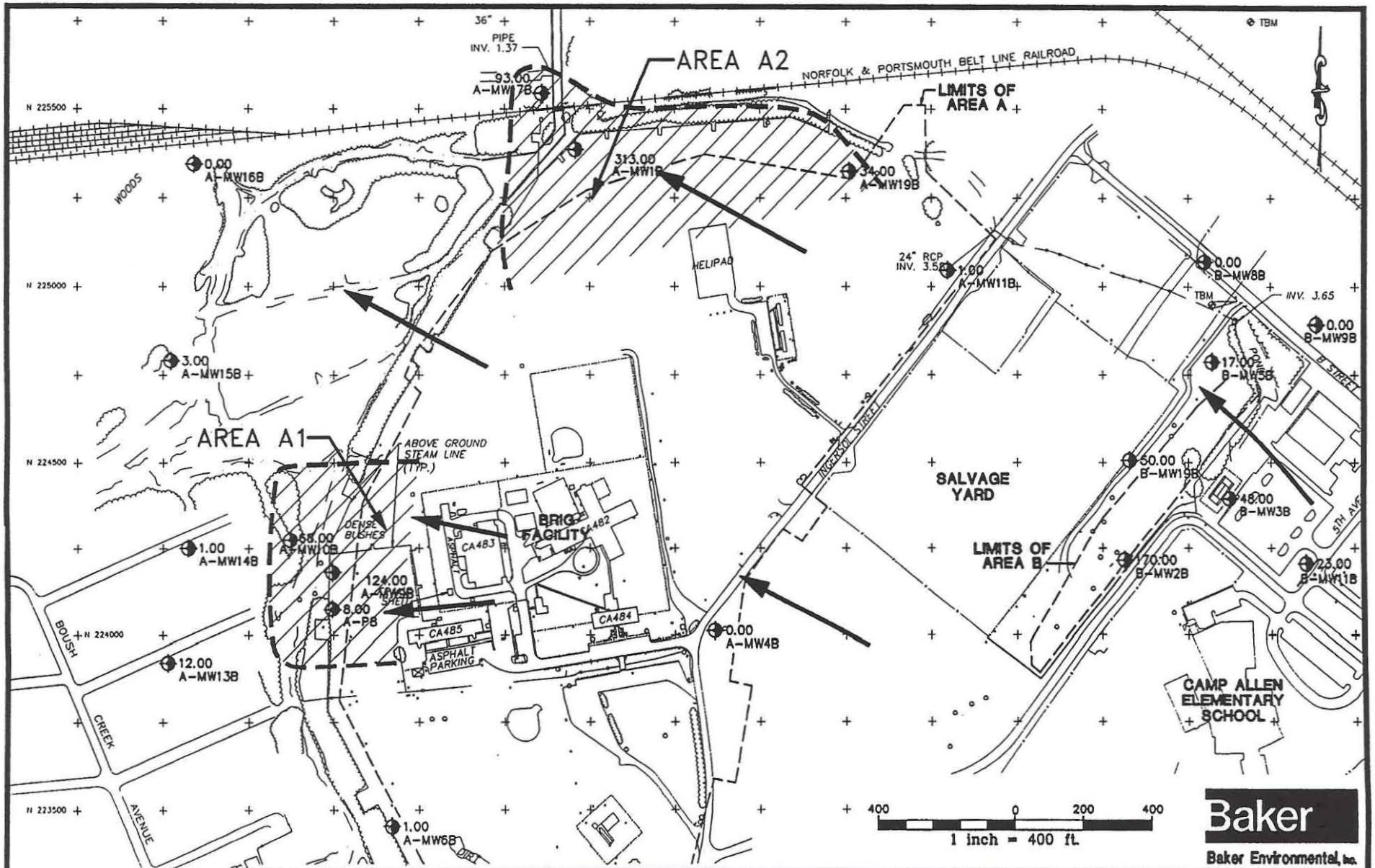


LEGEND

- ASSUMED DOWNGRADIENT EDGE OF CONTAINMENT PLUME
- GENERAL GROUNDWATER FLOW DIRECTION
- ASSUMED EXTENT OF GROUNDWATER CONTAMINATION
- 0.00 A-MW5 — SHALLOW MONITORING WELL WITH WELL NO. AND TOTAL VOC CONCENTRATION IN (μg/l)

084-768

FIGURE 2-1
ASSUMED EXTENTS OF SHALLOW GROUNDWATER CONTAMINATION IN AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

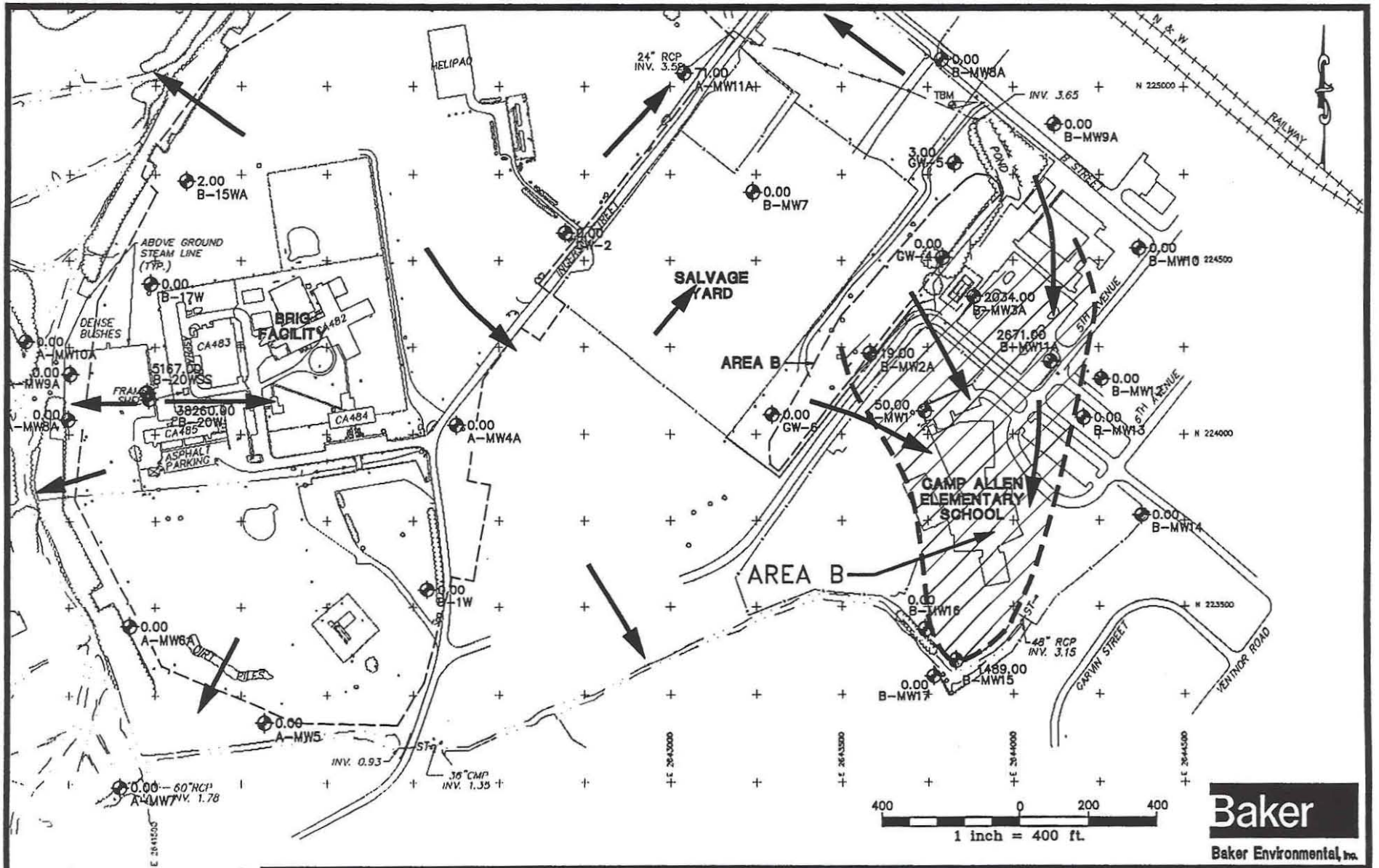
- - - - ASSUMED DOWNGRADIENT EDGE OF CONTAINMENT PLUME

← GENERAL GROUNDWATER FLOW DIRECTION

/// ASSUMED EXTENT OF GROUNDWATER CONTAMINATION

0.00 A-MW4B — DEEP MONITORING WELL WITH WELL NO. AND TOTAL VOC CONCENTRATION IN (µg/l)

FIGURE 2-2
ASSUMED EXTENTS OF DEEP GROUNDWATER CONTAMINATION IN AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

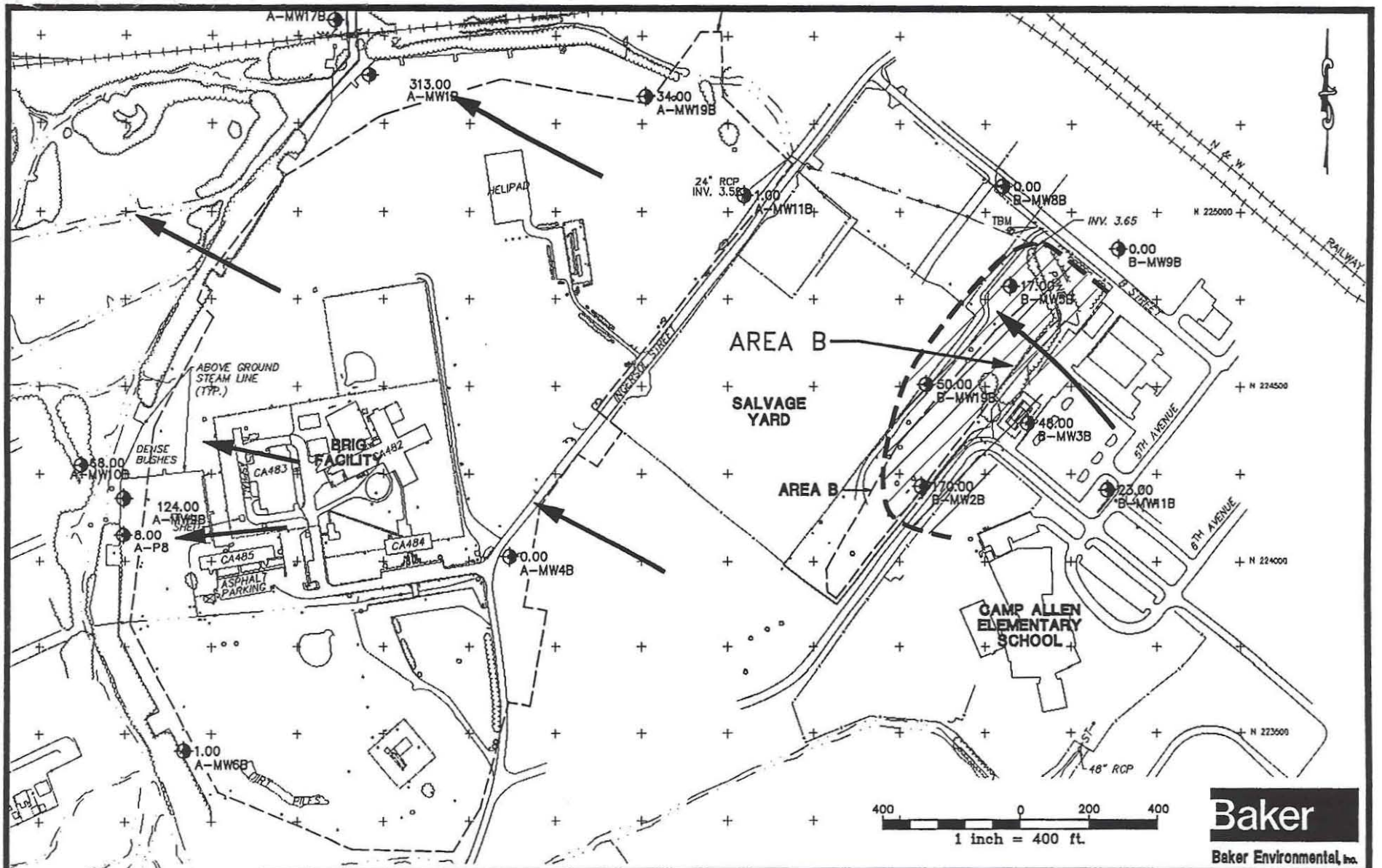


LEGEND

- ASSUMED DOWNGRADIENT EDGE OF CONTAINMENT PLUME
- GENERAL GROUNDWATER FLOW DIRECTION
- ASSUMED EXTENT OF GROUNDWATER CONTAMINATION
- 0.00 A-MW5 SHALLOW MONITORING WELL WITH WELL NO. AND TOTAL VOC CONCENTRATION IN (µg/l)

084-769

FIGURE 2-3
ASSUMED EXTENTS OF SHALLOW GROUNDWATER CONTAMINATION IN AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

- ASSUMED DOWNGRADIENT EDGE OF CONTAINMENT PLUME
- GENERAL GROUNDWATER FLOW DIRECTION
- ASSUMED EXTENT OF GROUNDWATER CONTAMINATION
- 0.00 A-MW4B — DEEP MONITORING WELL WITH WELL NO. AND TOTAL VOC CONCENTRATION IN (μg/l)

FIGURE 2-4
ASSUMED EXTENTS OF DEEP GROUNDWATER CONTAMINATION IN AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

Remedial Action Objectives - Groundwater

1a. Prevent exposure to (ingestion, inhalation, and dermal contact) groundwater exceeding drinking water standards

1b. Prevent exposure to (inhalation and dermal contact) groundwater exceeding nonpotable use cleanup levels

2a. Prevent further migration of contaminated groundwater in excess of drinking water standards

2b. Prevent further migration of contaminated groundwater in excess of nonpotable use cleanup levels

3a. Restore contaminated groundwater to drinking water standards

3b. Restore contaminated groundwater to nonpotable use cleanup levels

COMPARISON OF GROUNDWATER MAXIMUM CONTAMINANT CONCENTRATIONS TO CLEANUP LEVELS (µg/L)
CAMP ALLEN LANDFILL SITE, NORFOLK, VIRGINIA

Contaminants of Concern	Potable Use(1) Cleanup Levels	Nonpotable Use(2) Cleanup Levels	Water Table Aquifer Concen-trations(3) Area A	Yorktown Aquifer Concen-trations(3) Area A	Water Table Aquifer Concen-trations(3) Area B	Yorktown Aquifer Concen-trations(3) Area B
Vinyl Chloride	2	2	250	100	940	3
1,2-Dichloroethylene	70	220	6,100	540	1,600	16
1,2-Dichloroethane	5	40	3	38	180	450
Trichloroethylene	5	380	1,800	100	520	18
Tetrachloroethylene	5	70	620	4	10	--
Benzene	5	120	310	3	410	12
Toluene	1,000	130,000	5,400	1	--	1
Arsenic	50	2	309	64	94	194
Cadmium	5	37	46	6.5	18	31
Chromium	100	370	353	166	775	542

(1) Based on federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs), USEPA, May 1993.

(2) Based on incidental ingestion under a nonpotable use scenario and an incremental cancer risk of 1×10^{-6} for children.

(3) Concentrations represent maximum values detected during Rounds 2 and 3.

-- = Not detected

TABLE 3-5
SUMMARY OF GROUNDWATER TECHNOLOGY EVALUATION AND SCREENING
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

General Response Actions	Remedial Technology	Process Option	Screening Comments
No Action	None	Not Applicable	Retain for further consideration.
	Monitoring	Groundwater Monitoring	Retain for further consideration.
Institutional Controls	Alternate Water Supply Point-of-Use	Existing Water Supply	Retain for further consideration.
		New Water Supply	Eliminate as a representative process option in FS. More difficult and costly to implement than connection to existing public water supply.
		Individual Home Treatment Units	Eliminate as a representative process option in FS. More difficult and costly to implement than connection to existing public water supply.
	Land Use Controls	Base Master Plan	Retain for further consideration.
		Deed Restrictions	Retain for further consideration.
	Public Education	Meetings, Written Notices, etc.	Retain for further consideration.
Containment	Gradient Control	Extraction Wells	Retain for further consideration.
Collection/ Treatment/Discharge	Collection	Extraction Wells	Retain as a representative process option for groundwater collection.
		Interceptor Drains	Eliminate as a representative process option in FS. Retain for potential detailed design consideration.
	Aerobic Biological Treatment	Activated Sludge	Eliminate as a representative process option in FS. Not well proven for chlorinated organic contaminants of concern.
		Aerated Lagoon	Eliminate as a representative process option in FS. Not well proven for chlorinated organic contaminants of concern.
		Biological Towers	Eliminate as a representative process option in FS. Not well proven for chlorinated organic contaminants of concern.
	Chemical Treatment	Neutralization	Retain as a pretreatment process for metals removal.
		Oxidation with Hydrogen Peroxide	Eliminate as a representative process option in FS. Not well proven for chlorinated organic contaminants of concern.

Lisa Ellis - when a process option is eliminated then it and other similar options are eliminated

G.R. - Not necessarily, it depends upon the option.

TABLE 3-5
SUMMARY OF GROUNDWATER TECHNOLOGY EVALUATION AND SCREENING
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

General Response Actions	Remedial Technology	Process Option	Screening Comments
Collection/ Treatment/Discharge (continued)	Chemical Treatment (continued)	Ozonation	Eliminate as a representative process option in FS. Not well proven for chlorinated organic contaminants of concern.
		Oxidation with Potassium Permanganate	Retain as a pretreatment process for metals removal.
		Oxidation with UV Light/Ozonation	More costly to implement than air stripping and carbon adsorption.
		Oxidation with Hypochlorite	Eliminate as a representative process option in FS. Not well-proven for chlorinated organic contaminants of concern. More costly to implement than air stripping and carbon adsorption.
		Precipitation	Retain as a pretreatment process for metals removal.
	Physical Treatment	Activated Carbon	Retain for further consideration.
		Air Stripping	Retain for further consideration.
		Dewatering	Retain for dewatering of sludge generated during groundwater treatment.
		Clarification/ Sedimentation	Retain as a pretreatment process for metals removal.
		Coagulation/ Flocculation	Retain as a pretreatment process for metals removal.
		Dissolved Air Flotation	Eliminate as a representative process option in FS. Not well-proven for chlorinated organic contaminants of concern.
		Distillation	Eliminate as a representative process option in FS. Air stripping and carbon adsorption are more cost effective for contaminants of concern.
		Equalization	Retain as a pretreatment process for metals removal.
		Filtration	Retain as a pretreatment process for metals removal.

TABLE 3-5
SUMMARY OF GROUNDWATER TECHNOLOGY EVALUATION AND SCREENING
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

General Response Actions	Remedial Technology	Process Option	Screening Comments
Collection/ Treatment/Discharge (continued)	Physical Treatment (continued)	Ion Exchange	Eliminate as a representative process option in FS. Retain for potential detailed design consideration.
		Oil/water separation	Eliminate as a representative process option in FS. Free non-aqueous phase contamination not detected in groundwater.
		Reverse Osmosis	Eliminate as a representative process option in FS. More difficult to implement than air stripping and carbon adsorption.
		Steam Stripping	Eliminate as a representative process option in FS. Air stripping and carbon adsorption are more cost effective for contaminants of concern.
	Discharge	Surface Water	Retain for further consideration.
		Subsurface Discharge	Retain for further consideration.
		POTW	Eliminate as a representative process option in FS. Not implementable because local facility will not accept continuous groundwater discharge.
		Industrial Wastewater Treatment	Retain for further consideration.
In Situ Treatment	Biological Treatment	Aerobic Bioremediation	Eliminate as a representative process option in FS. Not well-proven for chlorinated organic contaminants of concern.
	Physical Treatment	Air Sparging	Eliminate as a representative process option in FS. Currently not well-proven for contaminants of concern. Could be considered at a later time to augment or replace shallow groundwater extraction and replacement system when more data become available.

TABLE 3-6

SUMMARY OF RETAINED GROUNDWATER TECHNOLOGIES AND REPRESENTATIVE PROCESS OPTIONS CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

GENERAL RESPONSE ACTION	TECHNOLOGY	REPRESENTATIVE PROCESS OPTION
No Action	Monitoring	Groundwater Monitoring
Institutional Controls	Land Use Control	Base Master Plan Deed Restrictions
	Alternate Water Supply	Connection to Public Water Supply
	Public Education	Public Meetings
Containment	Gradient Control	Extraction Wells
Collection/Treatment/ Discharge	Collection	Extraction Wells
	On-site Physical Treatment[1]	Air Stripping, Carbon Adsorption
	Treatment at IWTP[1]	Air Stripping, Carbon Adsorption
	Discharge	Surface Water, Subsurface

[1] The following process options were not selected as primary treatment components for the organic contaminants but were retained for pretreatment of groundwater for removal of metals and suspended solids: equalization, neutralization, oxidation with potassium permanganate, precipitation, coagulation/flocculation, clarification/sedimentation, filtration, and sludge dewatering.

Area A1 Groundwater Alternatives

- Alternative A1-GW1: No Action with Monitoring

- Alternative A1-GW2: Institutional Controls, Monitoring, and Alternate Water Supply

- Alternative A1-GW3a: Containment and On-site Treatment of Groundwater Exceeding Nonpotable Cleanup Levels, Institutional Controls, Monitoring, and Alternate Water Supply

Cherryl B- who would be supplied Alt. source of water? why?
Gordan- if containment system isn't 100% this Glenwood could possibly need system.
CFB- But they are on city water
Gordan- might no cost not for this alternative

- Alternative A1-GW3b: Containment and Treatment of Groundwater Exceeding Nonpotable Cleanup Levels Using IWTP, Institutional Controls, Monitoring, and Alternate Water Supply

Rob Thomson- I wouldn't include the Alternate water source if it isn't justified right now. Public concern could be unnecessarily generated.
G.R. - I think we will take that out of FS.

Area A1 Groundwater Alternatives (continued)

- Alternative A1-GW4a: Containment and On-site Treatment of Groundwater Exceeding Potable Cleanup Levels, Institutional Controls, Monitoring, and Alternate Water Supply

- Alternative A1-GW4b: Containment and Treatment of Groundwater Exceeding Potable Cleanup Levels Using IWTP, Institutional Controls, Monitoring, and Alternate Water Supply

Michele Monte – does this alternative (a) discharge to HRSD like ?

T. Artman/Gordan – no, discharge to Bowsch Creek or Aquifer through infiltration system.

Rob Thomson – We recommend a performance curve for system and compare it to discharge levels monitored.

Area A2 Groundwater Alternatives

- Alternative A2-GW1: No Action with Monitoring
- Alternative A2-GW2: Institutional Controls and Monitoring
- Alternative A2-GW3a: Containment and On-site Treatment of Groundwater Exceeding Nonpotable Cleanup Levels, Institutional Controls and Monitoring

Area A2 Groundwater Alternatives (continued)

- Alternative A2-GW3b: Containment and Treatment of Groundwater Exceeding Nonpotable Cleanup Levels Using IWTP, Institutional Controls and Monitoring

- Alternative A2-GW4a: Containment and On-site Treatment of Groundwater Exceeding Potable Cleanup Levels, Institutional Controls and Monitoring

- Alternative A2-GW4b: Containment and Treatment of Groundwater Exceeding Potable Cleanup Levels Using IWTP, Institutional Controls and Monitoring

Area B Groundwater Alternatives

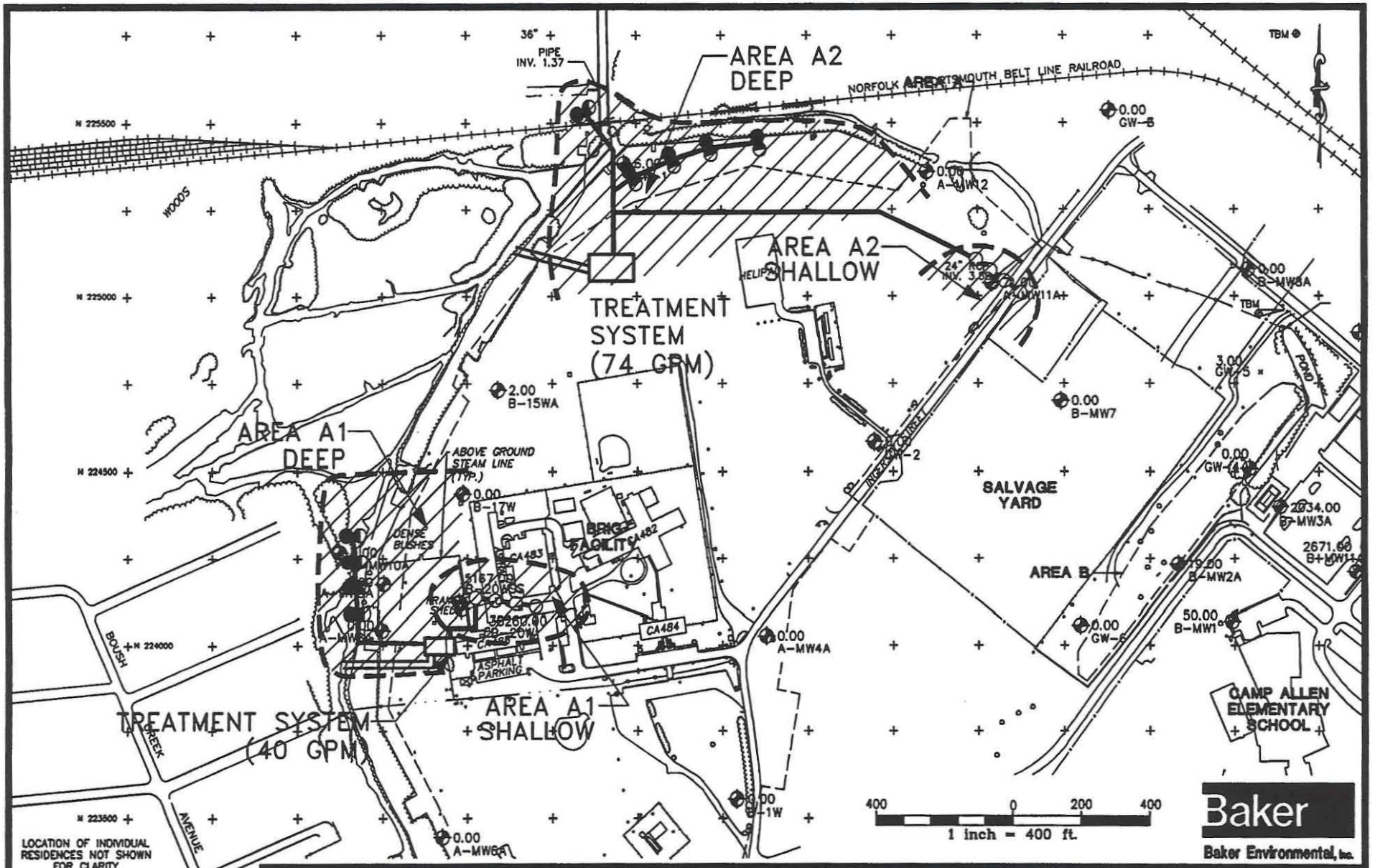
- Alternative B-GW1: No Action with Monitoring
- Alternative B-GW2: Institutional Controls and Monitoring
- Alternative B-GW3a: Containment and On-site Treatment of Groundwater Exceeding Nonpotable Cleanup Levels, Institutional Controls and Monitoring

Area B Groundwater Alternatives (continued)

- Alternative B-GW3b: Containment and Treatment of Groundwater Exceeding Nonpotable Cleanup Levels Using IWTP, Institutional Controls and Monitoring

- Alternative B-GW4a: Containment and On-site Treatment of Groundwater Exceeding Potable Cleanup Levels, Institutional Controls and Monitoring

- Alternative B-GW4b: Containment and Treatment of Groundwater Exceeding Potable Cleanup Levels Using IWTP, Institutional Controls and Monitoring



LEGEND

- ASSUMED DOWNGRADIENT EDGE OF CONTAINMENT PLUME
- INFLUENT PIPING
- EFFLUENT PIPING
- SHALLOW PUMPING WELL
- MID-DEPTH PUMPING WELL
- DEEP PUMPING WELL

FIGURE 6-1
CONCEPTUAL GROUNDWATER EXTRACTION AND TREATMENT SYSTEMS FOR AREAS A1 AND A2

CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VA

TABLE 6-1

AREA A1
GROUNDWATER EXTRACTION SYSTEM CHARACTERISTICS
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Aquifer	Plume Width (feet)	Number of Wells	Well Depth (feet)	Well Spacing (feet)	Well Pumping Rate (gpm)
Shallow (Watertable)	400	4	25	40	4
Deep (Yorktown)	550	4	60	53	3
		4	110	53	3

TABLE 6-2

AREA A2
GROUNDWATER EXTRACTION SYSTEM CHARACTERISTICS
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Aquifer	Plume Width (feet)	Number of Wells	Well Depth (feet)	Well Spacing (feet)	Well Pumping Rate (gpm)
Shallow (Watertable)	400	4	25	41.4	3.5
Deep (Yorktown)	1200	4	60	116	5.625
		4	110	116	5.625
	400	1	60	NA	7.5
		1	110	NA	7.5

Notes: NA - Not Applicable

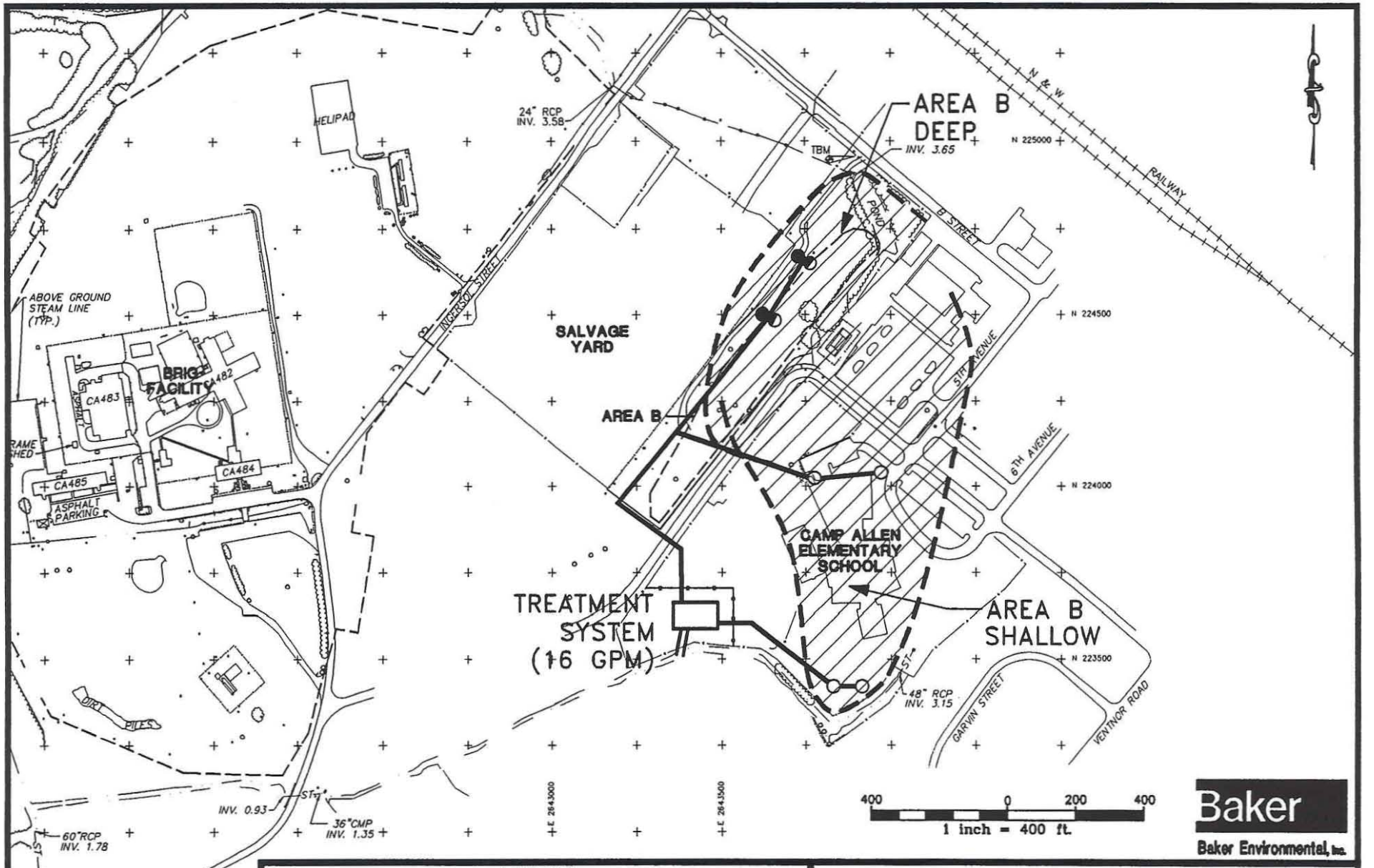


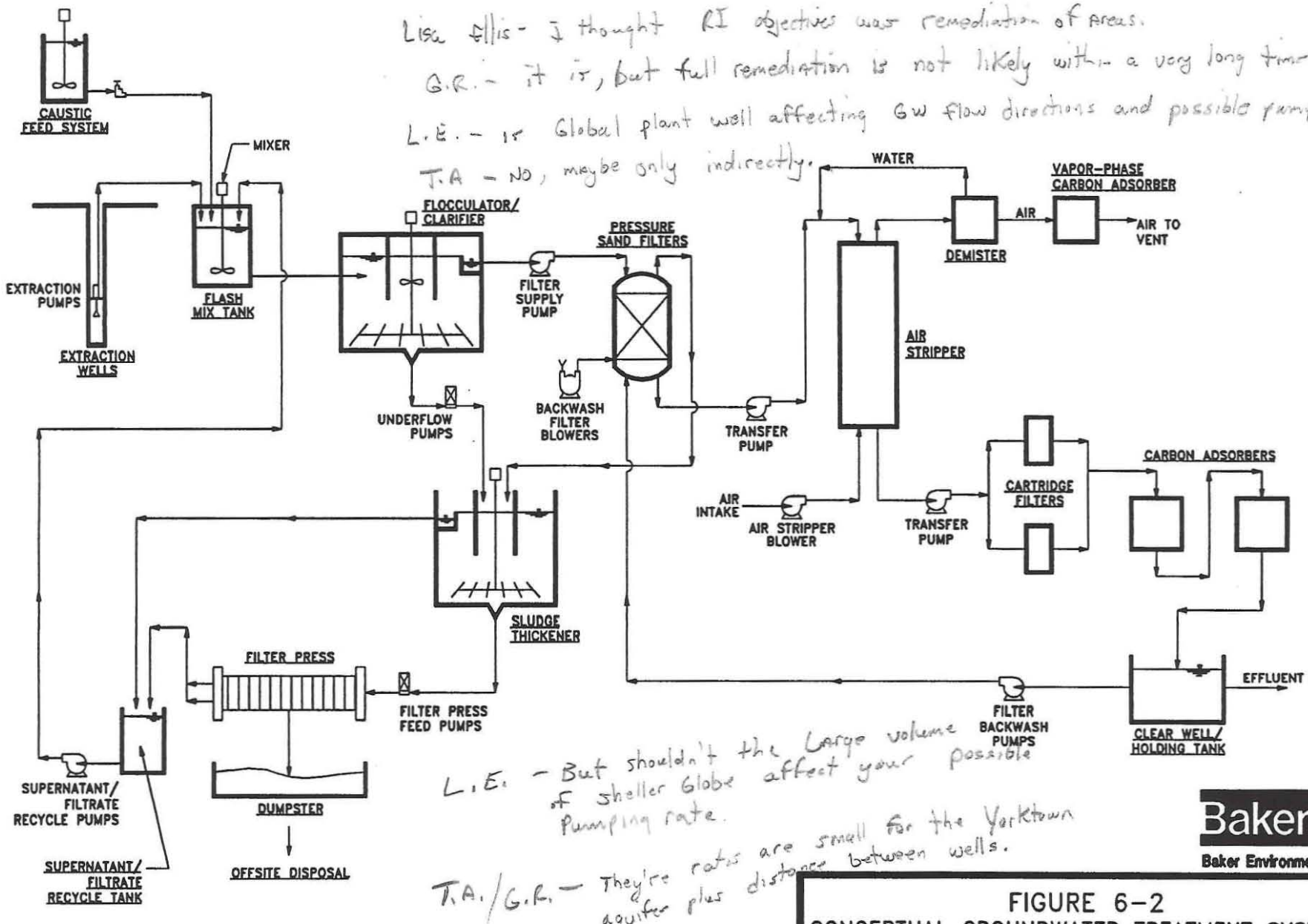
FIGURE 6-4
CONCEPTUAL GROUNDWATER EXTRACTION AND TREATMENT SYSTEMS FOR AREA B ALTERNATIVES B-GW3 AND B-GW4
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE, NORFOLK, VA

TABLE 6-3

AREA B
GROUNDWATER EXTRACTION SYSTEM CHARACTERISTICS
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Aquifer	Plume Width (feet)	Number of Wells	Well Depth (feet)	Well Spacing (feet)	Well Pumping Rate (gpm)
Shallow	800	2	25	212	0.75
(Watertable)	200	2	25	32	2.5
Deep	550	2	60	154	2.375
(Yorktown)		2	110	154	2.375

Lisa Ellis - I thought RI objectives was remediation of areas.
G.R. - it is, but full remediation is not likely within a very long time.
L.E. - is Global plant well affecting GW flow directions and possible pump rates
T.A - No, maybe only indirectly.



L.E. - But shouldn't the Large volume of sheller Globe affect your possible Pumping rate.

T.A./G.R. - They're rates are small for the Yorktown aquifer plus distance between wells.

Baker
Baker Environmental, Inc.

FIGURE 6-2
CONCEPTUAL GROUNDWATER TREATMENT SYSTEMS FOR AREAS A1, A2 AND B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084-762

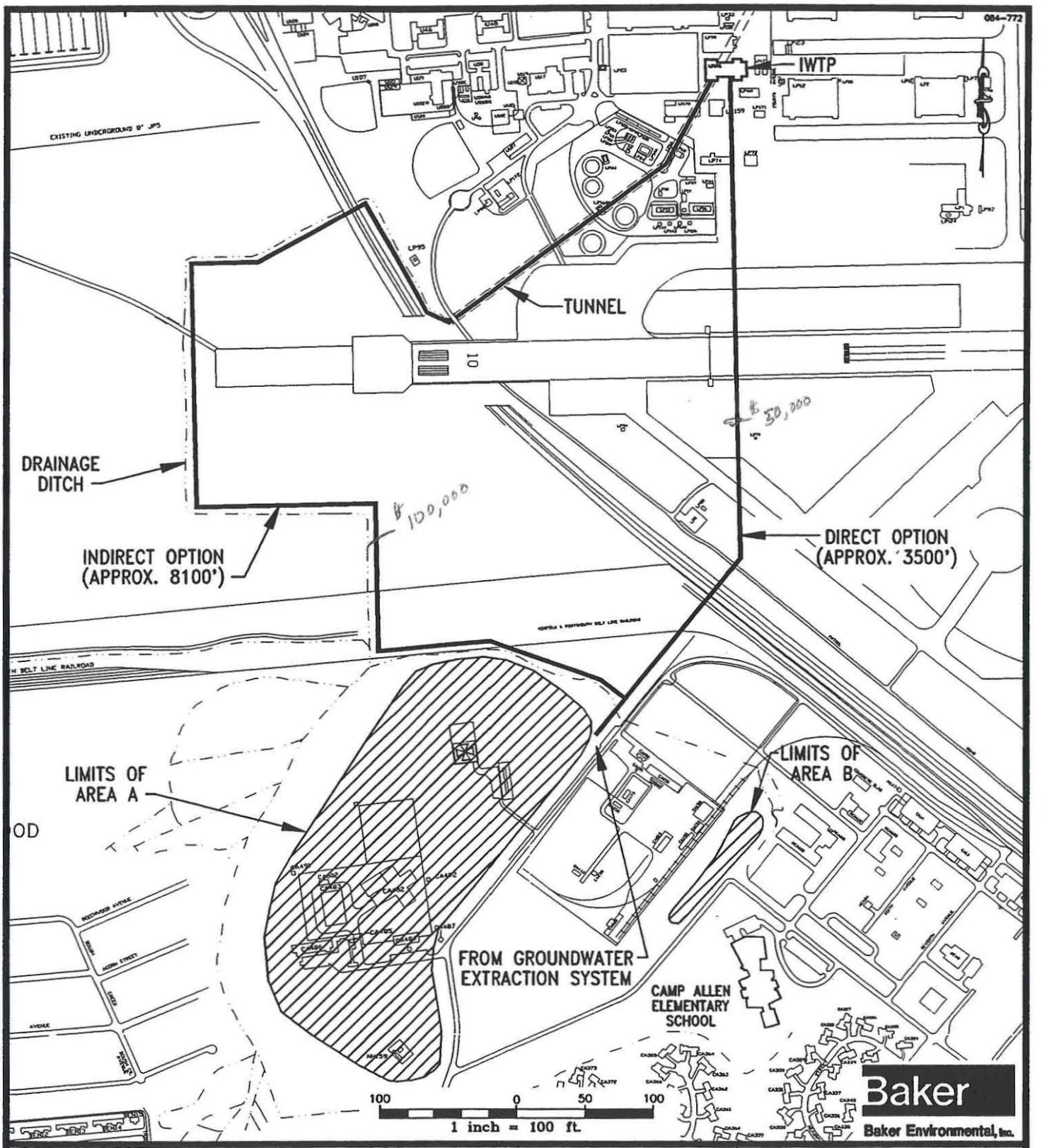


FIGURE 6-3
POTENTIAL PIPELINE OPTIONS FOR CONNECTION OF GROUNDWATER EXTRACTION SYSTEMS TO IWTP

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

SOURCE: LANTDIV OCT. 1991

TABLE 6-4

COMPARISON OF AREA A1 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A1-GW1 NO ACTION[1]	ALTERNATIVE A1-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A1-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A1-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
OVERALL PROTECTION TO HUMAN HEALTH AND THE ENVIRONMENT			
Would not contain or treat contaminated groundwater. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site.	Would not contain or treat contaminated groundwater. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site. If necessary in the future, institutional controls and provision of an alternate water supply would prevent potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above nonpotable levels. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination above potable levels but below nonpotable levels would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site. If necessary in the future, institutional controls and provision of an alternate water supply would prevent potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above potable levels. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. If necessary in the future, institutional controls and provision of an alternate water supply would prevent potable use and limit nonpotable use of contaminated groundwater.
COMPLIANCE WITH ARARS			
Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Groundwater would be contained and potentially restored to MCLs. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.

Pat McMurry - You are saying you would reach your MCL for Vinyl Chloride faster, what about TCE breaking down creating more Vinyl Chloride

G.F. - Possibily, usually TCE is in more abundance comparatively to Vinyl Chloride for this site versus other sites.

TABLE 6-4

COMPARISON OF AREA A1 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A1-GW1 NO ACTION[1]	ALTERNATIVE A1-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A1-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A1-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the deep aquifer but would exceed acceptable levels for the shallow aquifer. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the deep aquifer but would exceed acceptable levels for the shallow aquifer. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Potential future risks would be mitigated through institutional controls and alternate water supply. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the deep aquifer but would exceed acceptable levels for the shallow aquifer. Risks for on-site nonpotable use would be within acceptable levels following groundwater restoration. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Extraction system should prevent off-site migration of contamination above nonpotable levels. Potential future risks would be mitigated through institutional controls and alternate water supply. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the deep aquifer but would exceed acceptable levels for the shallow aquifer. Risks for on-site potable use would be within acceptable levels following groundwater restoration. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Extraction system should prevent off-site migration of contamination above potable levels. Potential future risks would be mitigated through institutional controls and alternate water supply. Periodic groundwater monitoring would effectively track potential contaminant migration.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME (TMV) THROUGH TREATMENT			
No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	Toxicity and volume reduced to nonpotable levels through extraction and treatment. Mobility reduced through extraction.	Toxicity and volume reduced to potable levels through extraction and treatment. Mobility reduced through extraction.

TABLE 6-4

COMPARISON OF AREA A1 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A1-GW1 NO ACTION[1]	ALTERNATIVE A1-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A1-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A1-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
SHORT-TERM EFFECTIVENESS			
No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	Air emissions from treatment system would be monitored to protect human health and the environment.	Air emissions from treatment system would be monitored to protect human health and the environment.
IMPLEMENTABILITY			
Groundwater monitoring could be readily implemented.	Groundwater monitoring could be readily implemented.	Treatment system components are demonstrated and commercially available.	Treatment system components are demonstrated and commercially available.
COST			
Capital: $157,000 O&M: $38,600 (years 1-10) $19,600 (years 11-20) $10,100 (years 21-30) $20,000 (every 5 years) NPW: $634,000	Capital: $157,000 O&M: $38,600 (years 1-10) $19,600 (years 11-20) $10,100 (years 21-30) $20,000 (every 5 years) NPW: $634,000	Capital: $1,394,000/$1,345,000[3] O&M: $285,400 (yrs 1-10) $266,400 (yrs 11-20) $256,900 (yrs 21-30) $20,000 (every 5 yrs) NPW: $5,664,000/$5,614,000[3]	Capital: $1,394,000/$1,345,000[3] O&M: $285,400 (yrs 1-10) $266,400 (yrs 11-20) $256,900 (yrs 21-30) $20,000 (every 5 yrs) NPW: $5,664,000/$5,614,000[3]

[1] Alternative includes groundwater monitoring.
[2] Alternative includes groundwater monitoring, institutional controls, and alternate water supply (if necessary in the future).
[3] Subalternative a/Subalternative b
O&M: Operation and maintenance.
NPW: Net present worth.

L.E - Would use of IWTP cause changes to be necessary to plant?
G.R. - Probably. The plant is a batch process plant & not designed to handle a continuous groundwater flow.

TABLE 6-5

COMPARISON OF AREA A2 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A2-GW1 NO ACTION[1]	ALTERNATIVE A2-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A2-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A2-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
OVERALL PROTECTION TO HUMAN HEALTH AND THE ENVIRONMENT			
Would not contain or treat contaminated groundwater. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site.	Would not contain or treat contaminated groundwater. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site. If necessary in the future, institutional controls would prevent potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above nonpotable levels. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. Deep groundwater contamination above potable levels but below nonpotable levels would continue to migrate off site. Shallow groundwater contamination does not appear to be migrating off site. If necessary in the future, institutional controls would prevent potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above potable levels. Groundwater on site not currently used for any purpose. Off-site shallow groundwater used for nonpotable residential use. Off-site deep groundwater used for industrial use. If necessary in the future, institutional controls would prevent potable use and limit nonpotable use of contaminated groundwater.
COMPLIANCE WITH ARARS			
Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Groundwater would be contained and potentially restored to MCLs. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.

R. Thom – Are the VOC hits in Glenwood Park? .... was it in residential wells?
G.R. – yes but TCE was just above MCL
T. Arim – it was in a Deep monitoring well?

TABLE 6-5

COMPARISON OF AREA A2 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A2-GW1 NO ACTION[1]	ALTERNATIVE A2-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A2-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A2-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the shallow and deep aquifers. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the shallow and deep aquifers. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the shallow and deep aquifers. Risks for on-site nonpotable use would be within acceptable levels following groundwater restoration. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Extraction system should prevent off-site migration of contamination above nonpotable levels. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of the shallow and deep aquifers. Risks for on-site potable use would be within acceptable levels following groundwater restoration. Currently no unacceptable off-site risks associated with nonpotable use of groundwater. Extraction system should prevent off-site migration of contamination above potable levels. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME (TMV) THROUGH TREATMENT			
No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	Toxicity and volume reduced to nonpotable levels through extraction and treatment. Mobility reduced through extraction.	Toxicity and volume reduced to potable levels through extraction and treatment. Mobility reduced through extraction.
SHORT-TERM EFFECTIVENESS			
No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	Air emissions from treatment system would be monitored to protect human health and the environment.	Air emissions from treatment system would be monitored to protect human health and the environment.

TABLE 6-5

COMPARISON OF AREA A2 GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A2-GW1 NO ACTION[1]	ALTERNATIVE A2-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE A2-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE A2-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
IMPLEMENTABILITY			
Groundwater monitoring could be readily implemented.	Groundwater monitoring could be readily implemented.	Treatment system components are demonstrated and commercially available.	Treatment system components are demonstrated and commercially available.
COST			
Capital: $157,000 O&M: $38,600 (years 1-10) $19,600 (years 11-20) $10,100 (years 21-30) $20,000 (every 5 years) NPW: $634,000	Capital: $157,000 O&M: $38,600 (years 1-10) $19,600 (years 11-20) $10,100 (years 21-30) $20,000 (every 5 years) NPW: $634,000	Capital: $1,508,000/$1,391,000[3] O&M: $324,000 (yrs 1-10) $305,800 (yrs 11-20) $296,300 (yrs 21-30) $20,000 (every 5 yrs) NPW: $6,384,000/$6,267,000[3]	Capital: $1,508,000/$1,391,000[3] O&M: $324,000 (yrs 1-10) $305,800 (yrs 11-20) $296,300 (yrs 21-30) $20,000 (every 5 yrs) NPW: $6,384,000/$6,267,000[3]

[1] Alternative includes groundwater monitoring.
[2] Alternative includes groundwater monitoring, institutional controls, and alternate water supply (if necessary in the future).
[3] Subalternative a/Subalternative b
O&M: Operation and maintenance.
NPW: Net present worth.

TABLE 6-6

COMPARISON OF AREA B GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE B-GW1 NO ACTION[1]	ALTERNATIVE B-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE B-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE B-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
OVERALL PROTECTION TO HUMAN HEALTH AND THE ENVIRONMENT			
Would not contain or treat contaminated groundwater, however, groundwater on site and immediately downgradient of contamination is not currently used for any purpose.	Would not contain or treat contaminated groundwater, however, groundwater on site and immediately downgradient of contamination is not currently used for any purpose. Institutional controls would prevent future potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above nonpotable levels. Contamination above potable levels but below nonpotable levels would continue to migrate off site. Groundwater on site and immediately downgradient of contamination is not currently used for any purpose. If necessary in the future, institutional controls would prevent potable use and limit nonpotable use of contaminated groundwater.	Would contain and treat contaminated groundwater above potable levels. Groundwater on site and immediately downgradient of contamination is not currently used for any purpose. If necessary in the future, institutional controls would prevent potable use and limit nonpotable use of contaminated groundwater.
COMPLIANCE WITH ARARS			
Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.	Shallow and deep contaminated groundwater exceeds State and Federal MCLs. Both aquifers, however, are not currently used for drinking water purposes. Groundwater would be contained and potentially restored to MCLs. Extracted groundwater and air emissions would comply with all local, State, and federal ARARs.

TABLE 6-6

COMPARISON OF AREA B GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE B-GW1 NO ACTION[1]	ALTERNATIVE B-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE B-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE B-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Risks would exceed acceptable levels if shallow or deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of both aquifers. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow or deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of both aquifers. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of both aquifers. Extraction system should prevent off-site migration of contamination above nonpotable levels. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.	Risks would exceed acceptable levels if shallow and deep aquifers were used for potable use on site. Risks would not exceed acceptable levels for on-site nonpotable use of both aquifers. Risks for on-site potable use would be within acceptable levels following groundwater restoration. Extraction system should prevent off-site migration of contamination above potable levels. Potential future risks would be mitigated through institutional controls. Periodic groundwater monitoring would effectively track potential contaminant migration.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME (TMV) THROUGH TREATMENT			
No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	No reduction in TMV through treatment. Possible reduction in toxicity over time through dilution and dispersion.	Toxicity and volume reduced to nonpotable levels through extraction and treatment. Mobility reduced through extraction.	Toxicity and volume reduced to potable levels through extraction and treatment. Mobility reduced through extraction.
SHORT-TERM EFFECTIVENESS			
No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	Air emissions from treatment system would be treated and monitored to protect human health and the environment.	Air emissions from treatment system would be treated and monitored to protect human health and the environment.

TABLE 6-6

COMPARISON OF AREA B GROUNDWATER ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE B-GW1 NO ACTION[1]	ALTERNATIVE B-GW2 INSTITUTIONAL CONTROLS[1]	ALTERNATIVE B-GW3 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING NONPOTABLE LEVELS[2]	ALTERNATIVE B-GW4 CONTAINMENT AND TREATMENT OF GROUNDWATER EXCEEDING POTABLE LEVELS[2]
IMPLEMENTABILITY			
Groundwater monitoring could be readily implemented.	Groundwater monitoring could be readily implemented.	Treatment system components are demonstrated and commercially available.	Treatment system components are demonstrated and commercially available.
COST			
Capital: $166,000 O&M: $40,300 (years 1-10) $20,500 (years 11-20) $10,600 (years 21-30) $20,000 (every 5 years) NPW: $660,400	Capital: $166,000 O&M: $40,300 (years 1-10) $20,500 (years 11-20) $10,600 (years 21-30) $20,000 (every 5 years) NPW: $660,400	Capital: $1,081,000/$1,084,000[3] O&M: $181,000 (years 1-10) $161,200 (years 11-20) $151,300 (years 21-30) $20,000 (every 5 years) NPW: $3,738,000/$3,741,000[1]	Capital: $1,081,000/$1,084,000[3] O&M: $181,000 (years 1-10) $161,200 (years 11-20) $151,300 (years 21-30) $20,000 (every 5 years) NPW: $3,738,000/$3,741,000[1]

[1] Alternative includes groundwater monitoring.
[2] Alternative includes groundwater monitoring and institutional controls.
[3] Subalternative a/Subalternative b
O&M: Operation and maintenance.
NPW: Net present worth.

Michele Monti - costs don't reflect savings from using the existing IWTP?
G.R. - correct, this cost was a worst case scenario. Some savings
Pat McMurry - why are cost the same for the non and the potable cases.
G.R. - not enough information to accurately predict treatment ~~time~~ duration and cleanup levels.

Preferred Area A1 Groundwater Alternative

- Alternative A1-GW3b: Containment and Treatment of Groundwater Exceeding Nonpotable Cleanup Levels Using IWTP, Institutional Controls, Monitoring, and Alternate Water Supply

Contingency Area A1 Groundwater Alternative

- Alternative A1-GW3a: Containment and On-site Treatment of Groundwater Exceeding Nonpotable Cleanup Levels, Institutional Controls, Monitoring, and Alternate Water Supply

Rob Thomson - a non potable source cleanup as worded would not be acceptable as a superfund source. Should indicate cleanup to "beneficial use" or cleanup of organics.

CFB - so combining Alts 3 + 4 into one titled cleanup to beneficial use would be satisfactory?

Rob. T. - well not really, look @ language in NCP

Michele Monti - uses of upper aquifer could be a "beneficial use" with lower aquifer a drinking source.

Rob T - rewording wouldn't really change your scenario of GW cleanup.

G.R - yes it would .. becaure of the level to which we cleanup.

Rationale for Preferred Area A1 Groundwater Alternative

- Containment and treatment of groundwater exceeding nonpotable cleanup levels would protect off-Base groundwater for its current and future nonpotable use.
- Use of the IWTP to treat contaminated groundwater, if feasible, would be more cost-effective than constructing a new groundwater treatment system on site.
- Institutional controls would prevent nonpotable use of contaminated groundwater on-Base.

Rationale for Preferred Area A1 Groundwater Alternative (continued)

G.R.
To be removed

- Provision of an alternate water supply, if necessary, would prevent nonpotable use of contaminated groundwater off-Base.

- Groundwater monitoring would enable contaminant migration and the effectiveness of the groundwater containment system to be routinely evaluated.

CFB - installation of shallow gw monitoring wells might need to be installed in Glenwood to keep from having to potentially alarm public by continuously rechecking their wells.

Preferred Area A2 Groundwater Alternative

- Alternative A2-GW2: Institutional Controls and Monitoring

Rationale for Preferred Area A2 Groundwater Alternative

- Groundwater contamination in Area A2 is not migrating off Base.
- Institutional controls would prevent nonpotable use of contaminated groundwater on Base.
- Groundwater monitoring would enable contaminant migration to be routinely evaluated.

TOPIC - INSTITUTIONAL W/ MONITORING for A2

Rob T - Similiar TCE situation @ Toby-Hanna Army Base (Region III) where army didn't want to take action but was not agreed to by EPA

G.R - Fairchild AFB in Washington had same situation but with a long distance to receptors were and EPA Region 10 bought off on. Monitoring was continous for next 5 years.

Preferred Area B Groundwater Alternative

- Alternative B-GW3b: Containment and Treatment of Groundwater Exceeding Nonpotable Cleanup Levels Using IWTP, Institutional Controls and Monitoring

Contingency Area B Groundwater Alternative

- Alternative B-GW3a: Containment and On-site Treatment of Groundwater Exceeding Nonpotable Cleanup Levels, Institutional Controls and Monitoring

Rationale for Preferred Area B Groundwater Alternative

- Containment and treatment of groundwater exceeding nonpotable cleanup levels would prevent shallow contaminated groundwater from migrating towards the Camp Allen Elementary School and Capehart Housing Area and would prevent deep contaminated groundwater from migrating towards the Area A Landfill.

- Use of the IWTP to treat contaminated groundwater, if feasible, would be more cost-effective than constructing a new groundwater treatment system on site.

Rationale for Preferred Area B Groundwater Alternative (continued)

- Institutional controls would prevent nonpotable use of contaminated groundwater on Base.

- Groundwater monitoring would enable contaminant migration and the effectiveness of the groundwater containment system to be routinely evaluated.

Michele Monti - How long would it take to modify IWTP to treat GW

G.R. - on order of months

Michele M - has HRSD bought off on recieving IWTP discharge from Camp Allen

OMF/CFB - they are accepting short term GW treated but it has not been resolved yet. we plan to approach them once we have a more clear understanding of what we would be sending and how much.

Remedial Action Objectives - Soil

1. Prevent exposure to potential contaminants within subsurface soils and debris

2. Minimize movement of potential contaminants from subsurface soils and debris to groundwater and surface water

TABLE 3-2
SUMMARY OF SOIL TECHNOLOGY EVALUATION AND SCREENING
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

General Response Actions	Remedial Technology	Process Option	Screening Summary
No Action	None	Not Applicable	Retain for further consideration.
Institutional Controls	Access Restriction	Fencing	Retain for further consideration.
	Land Use Controls	Base Master Plan	Retain for further consideration.
		Deed Restrictions	Retain for further consideration.
Containment	Capping	Clay Cap	Eliminate as a representative process option in FS. Retain for possible detailed design consideration.
		Synthetic Membrane	Retain as a representative process option.
		Composite Cap	Retain as a representative process option.
		Asphalt Cap	Retain as a representative process option.
	Vertical Barriers	Slurry Wall	Eliminate from further consideration. Not implementable under site conditions.
		Sheet Piling	Eliminate from further consideration. Not implementable under site conditions.
Removal/Disposal	Excavation	Conventional Excavation Equipment	Retain for further consideration.
	Off-Site Disposal	RCRA Hazardous Waste Landfill	Retain for further consideration.
		Solid Waste Landfill	Eliminate from further consideration. Solid waste landfills would not accept soils contaminated with chlorinated contaminants of concern.
Removal/ Treatment/Disposal	Excavation	Conventional Excavation Equipment	Retain for further consideration.
	Physical Treatment	Soil Washing	Eliminate from further consideration. Effectiveness not well-proven in the field. More difficult to implement and more costly than low temperature thermal treatment.

Rob Thomson – Did you look at Horizontal wells as an option.
G.R. /T.A. – not really practical or proven for this area.

TABLE 3-2
SUMMARY OF SOIL TECHNOLOGY EVALUATION AND SCREENING
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

General Response Actions	Remedial Technology	Process Option	Screening Summary
Removal/ Treatment/Disposal (continued)	Biological Treatment	Land Treatment (Aerobic)	Eliminate from further consideration. Effectiveness not well-proven. Not commercially available at this time.
		Composting (Aerobic)	Eliminate from further consideration. Effectiveness not well-proven. Not commercially available at this time.
	Thermal	Incineration	Retain for further consideration. difficult and costly to implement than low temperature thermal treatment.
		Vitrification	Eliminate from further consideration. Not well proven in the field. More difficult and costly to implement than low temperature thermal treatment.
		Low Temperature Thermal Treatment	Retain for further consideration.
	Off-Site Treatment	Bioremediation Cell Facility	Eliminate from further consideration. Effectiveness not well-proven. Not commercially available at this time.
		Incineration	Retain for further consideration.
In Situ Treatment	Biological Treatment	Aerobic Bioremediation	Eliminate from further consideration. Effectiveness not well-proven. Not commercially available at this time.
	Physical Treatment	Soil Vapor Extraction	Retain for further consideration.
		Soil Flushing	Eliminate from further consideration. Not well-proven in the field . More difficult and costly to implement than vapor extraction.
	Thermal Treatment	In Situ Vitrification	Eliminate from further consideration. Not well-proven in the field. More difficult and costly to implement than vapor extraction.
		In Situ Heating	Eliminate from further consideration. Not commercially available. More difficult and costly to implement than vapor extraction.

TABLE 3-3

SUMMARY OF RETAINED SOIL TECHNOLOGIES AND REPRESENTATIVE PROCESS OPTIONS CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

GENERAL RESPONSE ACTION	TECHNOLOGY	REPRESENTATIVE PROCESS OPTION
No Action	None	None
Institutional Controls	Access Restrictions	Fencing
	Land Use Control	Base Master Plan, Deed Restrictions
Containment	Capping	Geosynthetic Cap/ Asphalt Cap
Removal/Disposal	Excavation	Conventional Equipment
	Off-site Disposal	RCRA Hazardous Waste Landfill
Removal/Treatment/ Disposal	On-site Treatment	Low Temperature Thermal
	Off-site Treatment	Incineration[1]
In situ Treatment	Physical Treatment	Vapor Extraction

[1] For purposes of alternative development, incineration and low temperature thermal treatment were combined into one "thermal treatment" alternative. A combination of these technologies could potentially be used for treatment of the "hot spot" area depending on the types of waste materials identified (e.g., contaminated soils, sludges, buried drums).

Area A Soil Alternatives

- Alternative A-SO1: No Action
- Alternative A-SO2: Institutional Controls with Fencing
- Alternative A-SO3: Asphalt/Geosynthetic Cap Over Brig Area with Institutional Controls
- Alternative A-SO4: Composite Cap Over Hot Spot Area with Institutional Controls
- Alternative A-SO5: In situ Treatment of Hot Spot Area Soils Using Vapor Extraction (SVE) with Institutional Controls
- Alternative A-SO6: Thermal Treatment of Hot Spot Area Soils with Institutional Controls
- Alternative A-SO7: Disposal of Hot Spot Area Soils in Off-site Hazardous Waste Landfill with Institutional Controls

Area B Soil Alternatives

- Alternative B-SO1: No Action
- Alternative B-SO2: Institutional Controls with Fencing
  (MASTER PLAN EXCLUSION OF CAMP ALLEN FOR RESIDENTIAL USE)

Lisa Ellis – Isn't this contingent upon good follow sampling and analysis after the removal action. Could this be premature without that sampling.

Tom Artman – good field results and Removal Action plan; we believe thoroughly addresses and concerns the Area B

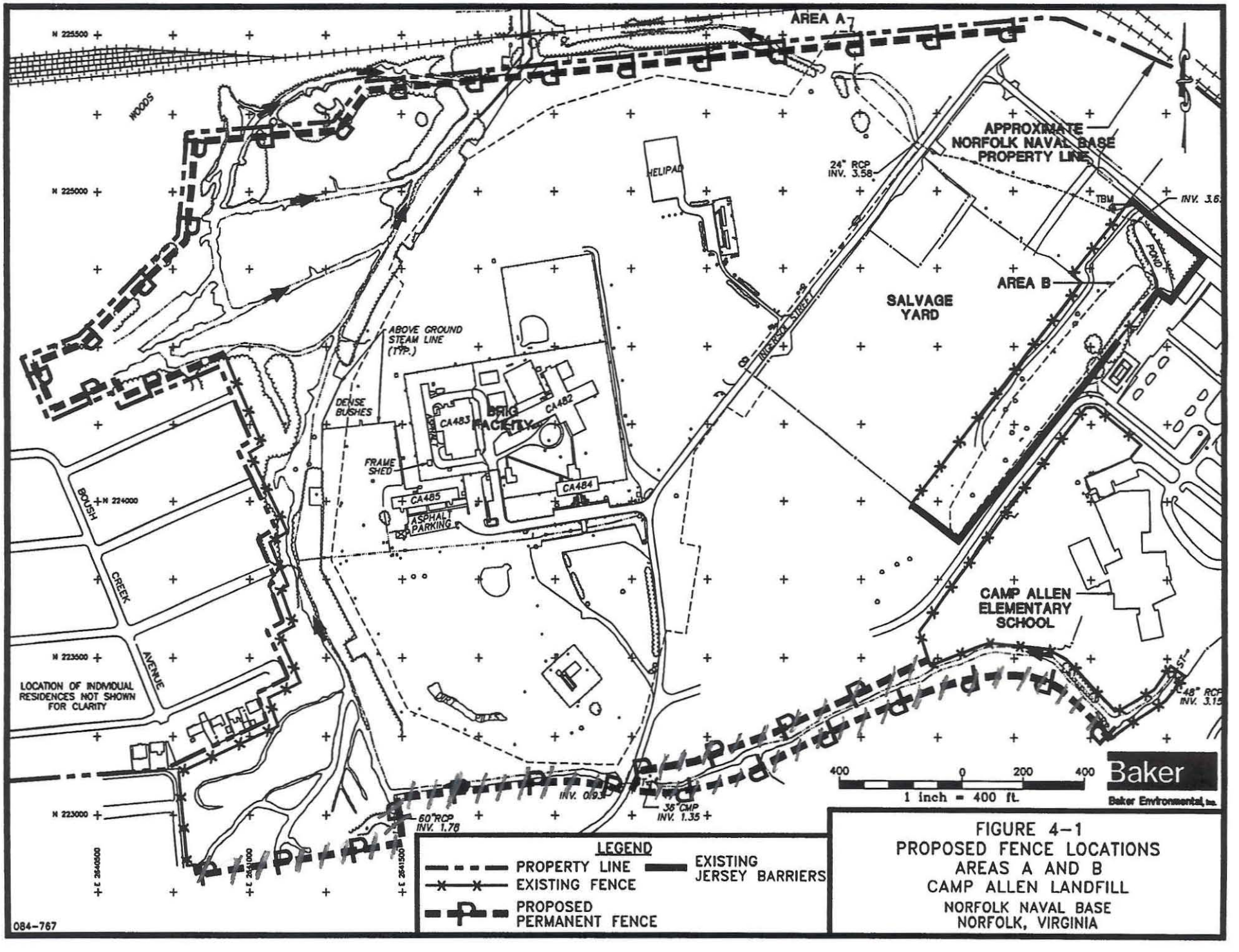
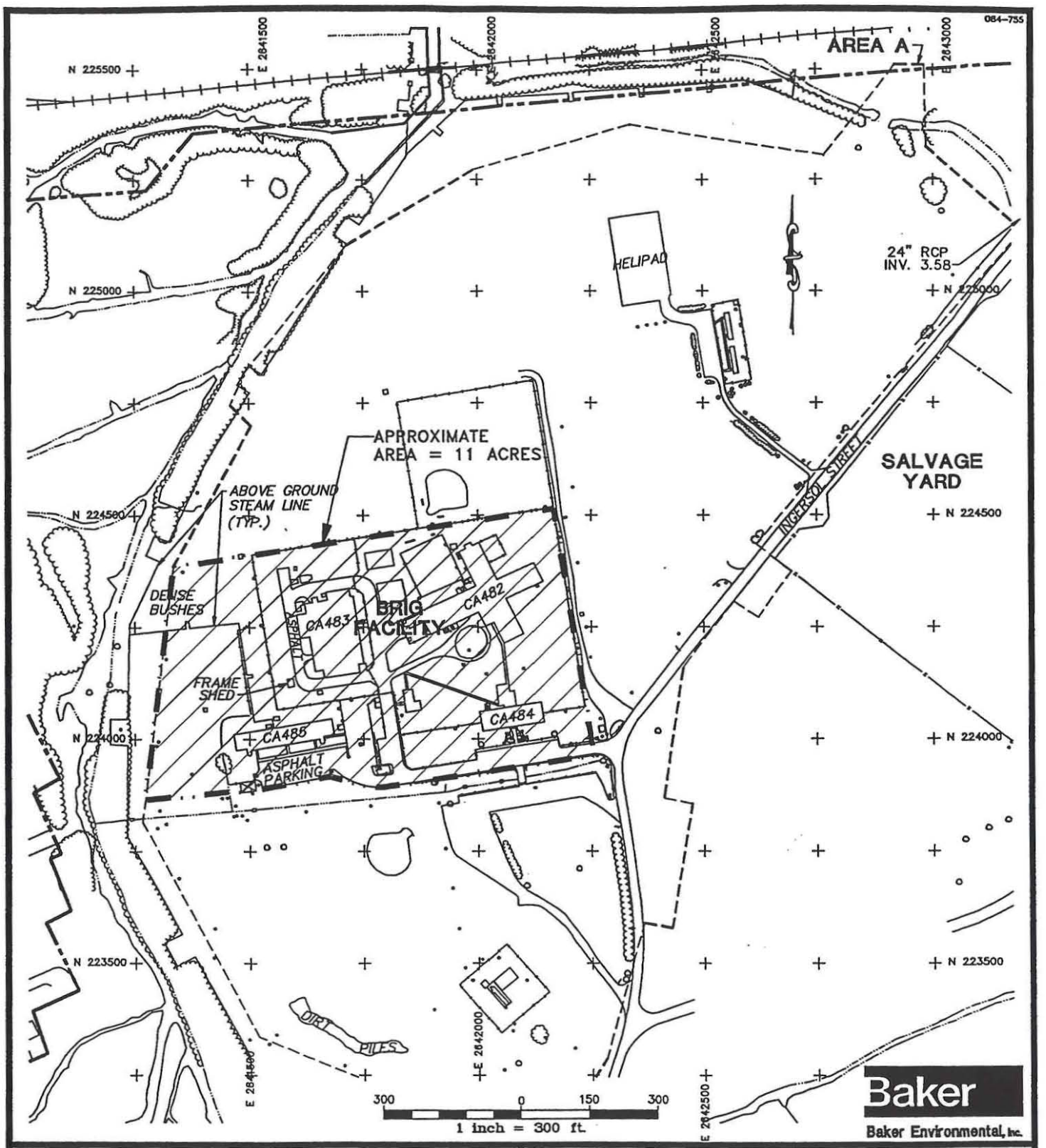


FIGURE 4-1
PROPOSED FENCE LOCATIONS
AREAS A AND B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

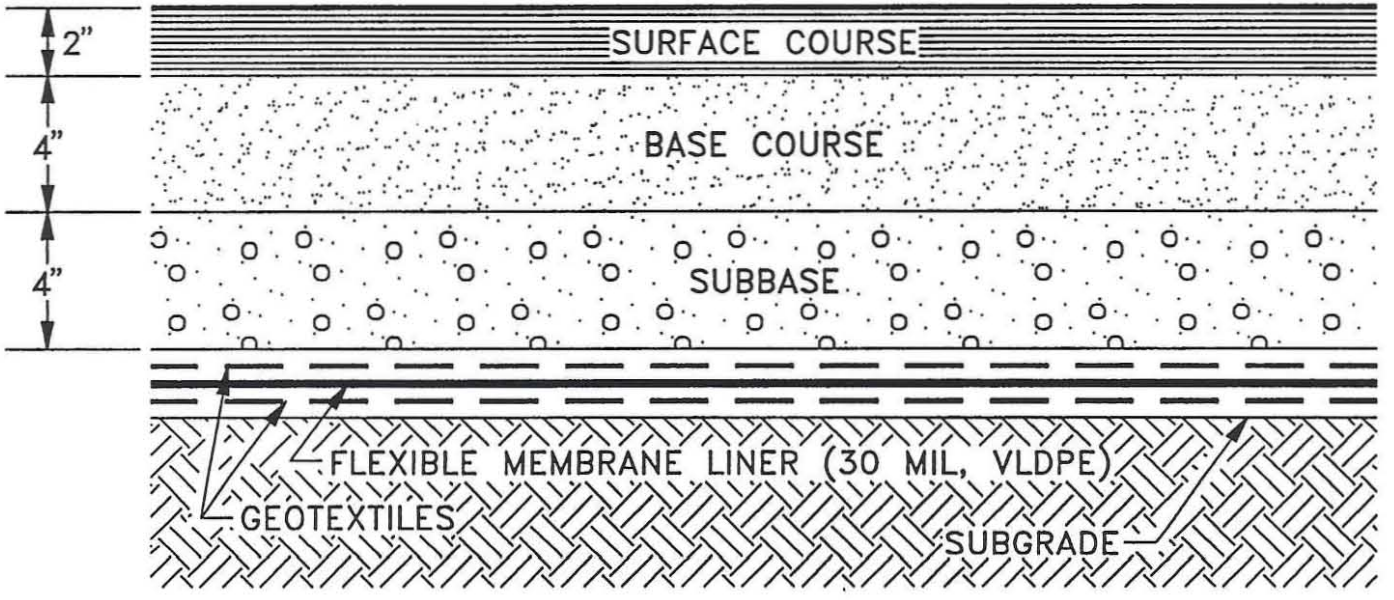


LEGEND

LIMITS OF PROPOSED ASPHALT CAP

SOURCE: 084-754

FIGURE 4-2
PROPOSED ASPHALT CAP LOCATION
ALTERNATIVE A-SO3
AREA A
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



REF.: AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES, 1986.

Baker
Baker Environmental, Inc.

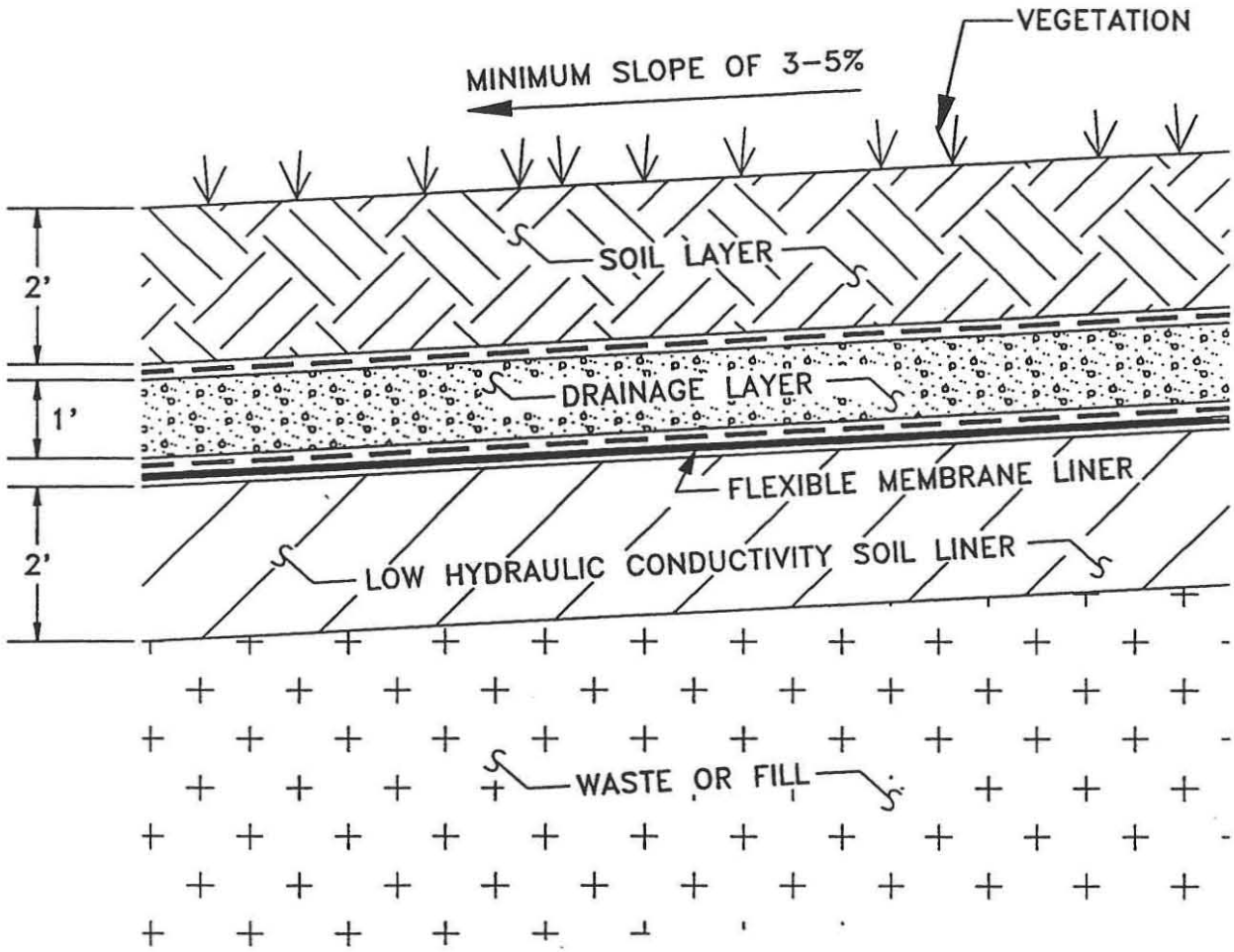
LEGEND

- SURFACE COURSE
- BASE COURSE
- SUBBASE
- GEOTEXTILE
- FLEXIBLE MEMBRANE LINER (30 MIL, VLDPE)
- SUBGRADE

FIGURE 4-3
ASPHALT CAP CROSS SECTION
ALTERNATIVE A-S03
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084-761

084-753



SOURCE: USEPA "DESIGN AND CONSTRUCTION OF RCRA/CERCLA FINAL COVERS," MAY 1991, EPA/625/4-91/025

Baker

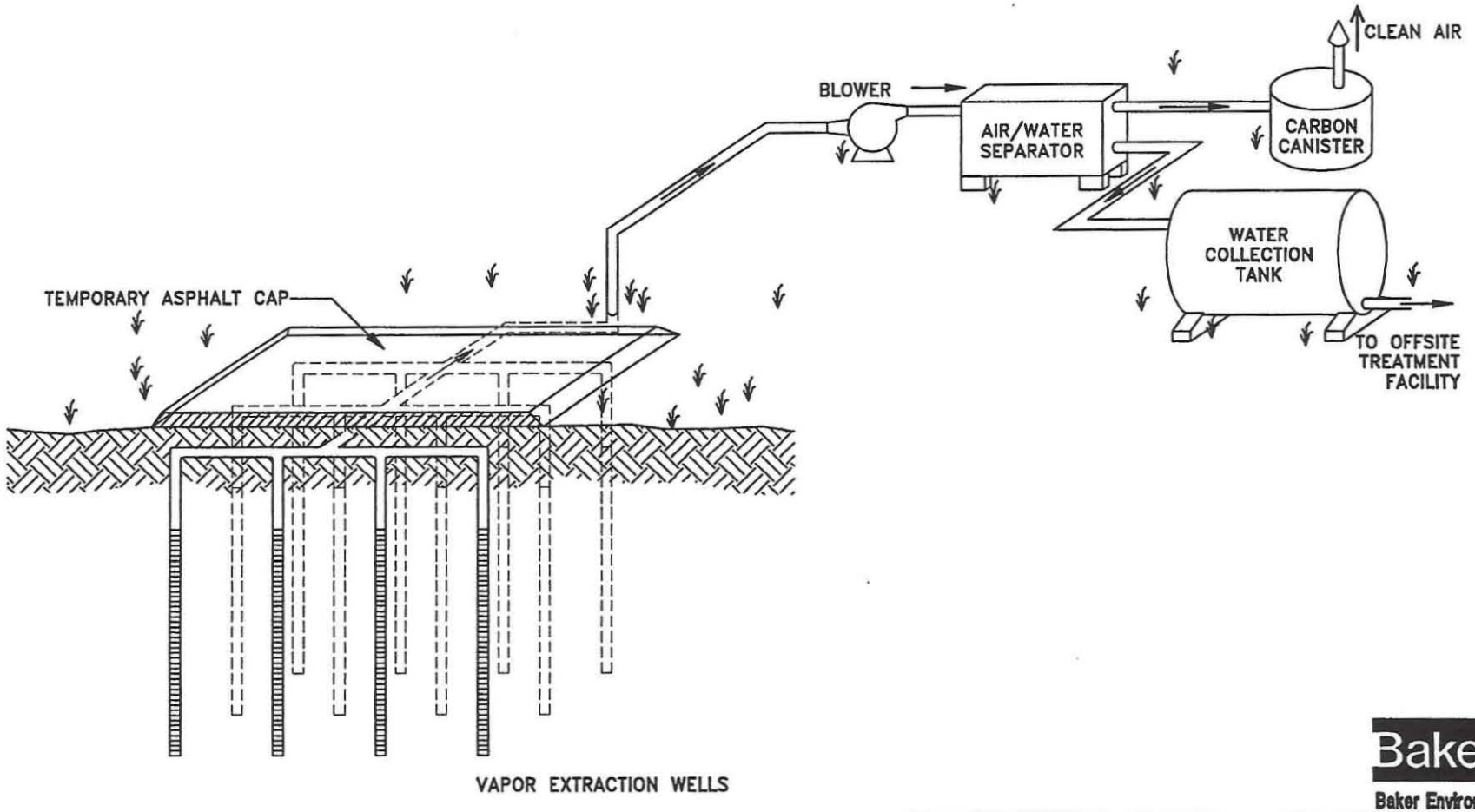
Baker Environmental, Inc.

LEGEND

- VEGETATION/SOIL LAYER
- GEOTEXTILE (FILTRATION OR FML PROTECTION)
- DRAINAGE LAYER – AGGREGATE $k \geq 1 \times 10^{-2}$ cm/sec
- FLEXIBLE MEMBRANE LINER (FML) 20 MIL MINIMUM
- LOW HYDRAULIC CONDUCTIVITY SOIL LAYER $k \leq 1 \times 10^{-7}$ cm/sec
- WASTE OR FILL

FIGURE 4-4
COMPOSITE COVER CROSS-SECTION
ALTERNATIVE A-S04
CAMP ALLEN LANDFILL

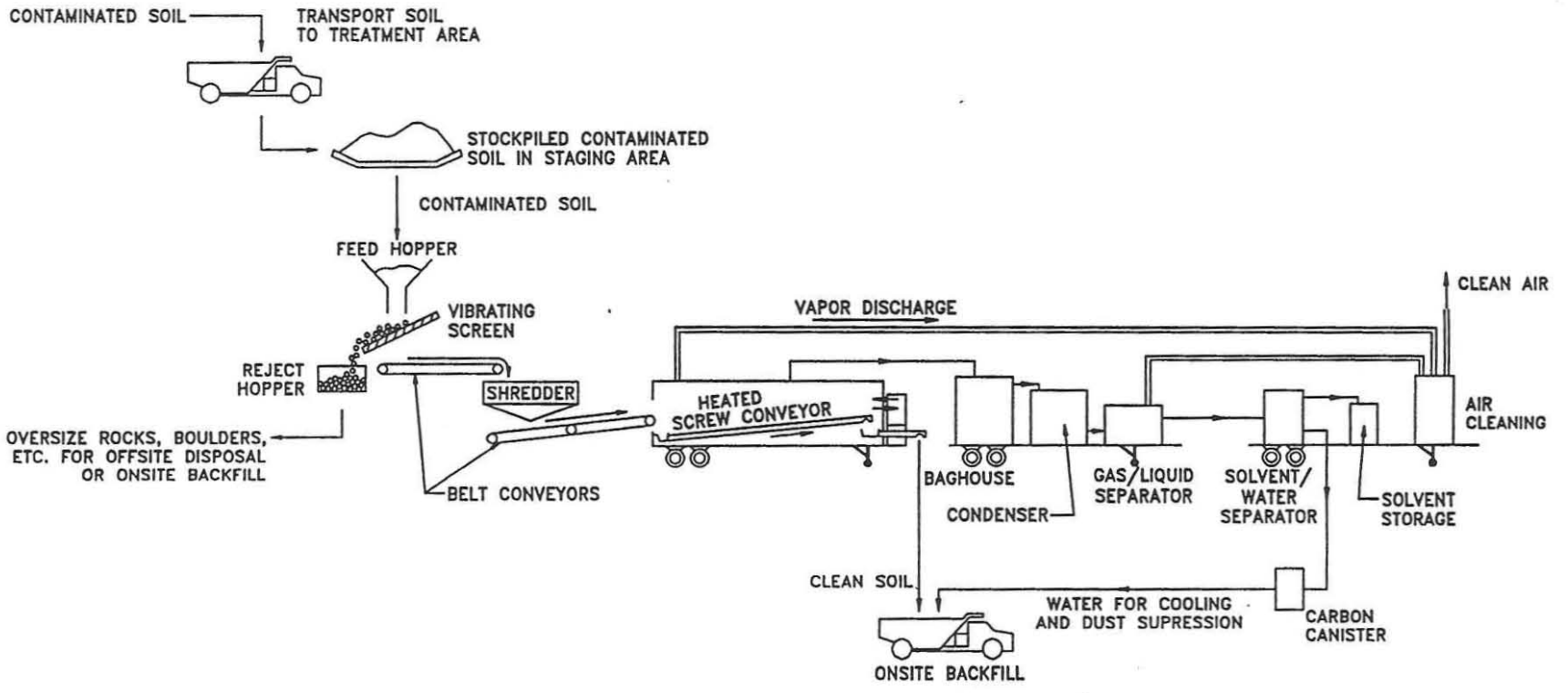
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



Baker
Baker Environmental, Inc.

FIGURE 4-5
IN SITU VAPOR EXTRACTION
ALTERNATIVE A-S05
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084-759



Baker

Baker Environmental, Inc.

FIGURE 4-6
ONSITE LOW TEMPERATURE THERMAL TREATMENT
ALTERNATIVE A-S06
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

084-758

TABLE 5-1

COMPARISON OF AREA A SOIL ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A-SO1 NO ACTION	ALTERNATIVE A-SO2 INSTITUTIONAL CONTROLS AND FENCING	ALTERNATIVE A-SO3 ASPHALT/ GEOSYNTHETIC CAP OVER BRIG AREA[1]	ALTERNATIVE A-SO4 COMPOSITE CAP OVER HOT SPOT AREAS[1]	ALTERNATIVE A-SO5 VAPOR EXTRACTION OF HOT SPOT AREAS[1]	ALTERNATIVE A-SO6 THERMAL TREATMENT OF HOT SPOT AREAS[1]	ALTERNATIVE A-S07 OFF-SITE DISPOSAL OF HOT SPOT AREAS[1]
OVERALL PROTECTION TO HUMAN HEALTH AND THE ENVIRONMENT						
No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for residential use. Potential risks from buried wastes. No additional protection from direct contact with potential soil contamination. No additional protection of groundwater.	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by additional fencing and institutional controls. No additional protection of groundwater.	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by institutional controls and cap. Partial protection of groundwater provided by cap over Brig area.	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by institutional controls and cap. Partial protection of groundwater provided by cap over hot spot area(s).	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by institutional controls. Protection of groundwater provided by in situ treatment of source(s).	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by institutional controls. Protection of groundwater provided by ex situ treatment of source(s).	No unacceptable risks from surface soils for industrial use. Marginal risk from surface soils for future residential use. Potential risks from buried wastes. Protection from direct contact provided by institutional controls. Protection of groundwater by off-site disposal.
COMPLIANCE WITH ARARS						
No contaminant-, location-, or action-specific ARARs.	No contaminant- or action-specific ARARs. Engineering controls used during fence installation would comply with State and federal wetland regulations.	No contaminant-specific ARARs. Cap designed in accordance with RCRA and State solid waste regulations.	No contaminant-specific ARARs. Cap designed in accordance with RCRA and State hazardous waste regulations.	No contaminant-specific ARARs. Air emissions would be treated to comply with State air pollution standards. Any hazardous materials would be handled/ disposed in accordance with RCRA and State hazardous waste regulations.	No contaminant-specific ARARs. Air emissions would be treated to comply with State air pollution standards. Any hazardous materials would be handled/disposed in accordance with RCRA and State hazardous waste regulations.	No contaminant-specific ARARs. Air emissions would be treated to comply with State air pollution standards. Any hazardous materials would be handled/disposed in accordance with RCRA and State hazardous waste regulations.

Michele Monti - ~~would~~ your soil cleanup should be risk based for a residential area not industrial.

G.R. - But a landfill used as residential is not feasible.

TABLE 5-1

COMPARISON OF AREA A SOIL ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A-SO1 NO ACTION	ALTERNATIVE A-SO2 INSTITUTIONAL CONTROLS AND FENCING	ALTERNATIVE A-SO3 ASPHALT/ GEOSYNTHETIC CAP OVER BRIG AREA[1]	ALTERNATIVE A-SO4 COMPOSITE CAP OVER HOT SPOT AREAS[1]	ALTERNATIVE A-SO5 VAPOR EXTRACTION OF HOT SPOT AREAS[1]	ALTERNATIVE A-SO6 THERMAL TREATMENT OF HOT SPOT AREAS[1]	ALTERNATIVE A-S07 OFF-SITE DISPOSAL OF HOT SPOT AREAS[1]
LONG-TERM EFFECTIVENESS AND PERMANENCE						
No remedial action would be taken. No reduction in risk levels, however, risks are acceptable under current use, and site is not used for residential use. No additional protection of groundwater.	Institutional actions would physically and administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. No additional protection of groundwater.	Institutional actions would administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. Partial long-term protection of groundwater provided by cap over potential source areas in vicinity of Brig.	Institutional actions would administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. Partial long-term protection of groundwater provided by cap over hot spot area(s).	Institutional actions would administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. Permanent long-term protection of groundwater provided by in situ treatment.	Institutional actions would administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. Permanent long-term protection of groundwater provided by ex situ treatment.	Institutional actions would administratively restrict access to site and limit future site use to nonresidential use. Risks are acceptable under current use, and site is not used for residential use. Permanent long-term protection of groundwater provided by off-site disposal.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME (TMV) THROUGH TREATMENT						
No reduction in TMV through treatment. Possible reduction in TMV through natural processes.	No reduction in TMV through treatment. Possible reduction in TMV through natural processes.	No reduction in TMV through treatment. Possible reduction in TMV through natural processes. Partial reduction in mobility through capping.	No reduction in TMV through treatment. Possible reduction in TMV through natural processes. Partial reduction in mobility through capping.	Reduction in TMV through in situ vapor extraction treatment. Effective removal of VOCs, partial removal of semi-VOCs.	Reduction in TMV through ex situ thermal treatment. Very effective removal of VOCs and effective removal of semi-VOCs.	No reduction in TMV through treatment. Reduction in mobility via disposal in secure off-site landfill.
SHORT-TERM EFFECTIVENESS						
No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	No risk to human health or environment during implementation.	Potential risks to human health and environment during operation would be controlled by air emission treatment/ monitoring. Several years required to achieve cleanup levels.	Potential risks to human health and environment during operation would be controlled by air emission treatment/ monitoring. Approx. 2 months required to complete remediation.	Potential risks to human health and environment during excavation would be controlled by dust controls. Approx. 2 months required to complete remediation.

TABLE 5-1

COMPARISON OF AREA A SOIL ALTERNATIVES
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

ALTERNATIVE A-SO1 NO ACTION	ALTERNATIVE A-SO2 INSTITUTIONAL CONTROLS AND FENCING	ALTERNATIVE A-SO3 ASPHALT/ GEOSYNTHETIC CAP OVER BRIG AREA[1]	ALTERNATIVE A-SO4 COMPOSITE CAP OVER HOT SPOT AREAS[1]	ALTERNATIVE A-SO5 VAPOR EXTRACTION OF HOT SPOT AREAS[1]	ALTERNATIVE A-SO6 THERMAL TREATMENT OF HOT SPOT AREAS[1]	ALTERNATIVE A-S07 OFF-SITE DISPOSAL OF HOT SPOT AREAS[1]
IMPLEMENTABILITY						
Readily implementable.	Straight-forward installation of fencing. Periodic inspection and maintenance of fenced required. Legal/administrative requirements for institutional controls.	Legal/administrative requirements for institutional controls. Capping technologies demonstrated and commercially available. Periodic inspection and maintenance of cap required.	Legal administrative requirements for institutional controls. Capping technologies demonstrated and commercially available. Periodic inspection and maintenance of cap required.	Administrative requirements for institutional controls. Technologies demonstrated and commercially available. Approx. 5-year operation of treatment system.	Administrative requirements for institutional controls. Technologies demonstrated and commercially available. Trial runs may be required. Potential public opposition. Approx. 2-month operation of treatment system.	Administrative requirements for institutional controls. Technologies demonstrated and commercially available.
COST						
Capital: $0 O&M: $20,000 (every 5 years) NPW: $55,600	Capital: $161,000 O&M: $840 (annually) $20,000 (every 5 years) NPW: $230,000	Capital: $1,274,000 O&M: $72,500 (every 5 years) NPW: $1,476,000	Capital: $422,000 O&M: $1,130 (annually) $20,000 (every 5 years) NPW: $495,000	Capital: $397,000 O&M: $97,400 (years 1-5) $20,000 (every 5 years) NPW: $874,000	Capital: $1,096,000 O&M: $20,000 (every 5 years) NPW: $1,152,000	Capital: $3,294,000 O&M: $20,000 (every 5 years) NPW: $3,349,000

[1] Alternative includes Institutional Controls
O&M: Operation and Maintenance
NPW: 30-year Net Present Worth

Preferred Area A Soil Alternative

- Alternative A-SO5: In situ Treatment of Hot Spot Area Soils Using Vapor Extraction with Institutional Controls

Contingency Area A Soil Alternatives

- Alternative A-SO6: Thermal Treatment of Hot Spot Area Soils with Institutional Controls
- Alternative A-SO7: Disposal of Hot Spot Area Soils in Off-site Hazardous Waste Landfill with Institutional Controls
- Alternative A-SO2: Institutional Controls with Fencing (if a source cannot be identified)

Rationale for Alternative A-SO5 Selection

- Institutional controls would protect human health by limiting site to nonresidential uses.
- SVE would protect groundwater by permanently removing volatile organic contaminants from the soil.
- SVE is more readily implementable than alternatives involving excavation (A-SO6 and A-SO7).
- SVE is more cost-effective than Alternatives A-SO6 and A-SO7.

Preferred Area B Soil Alternative

- Alternative B-SO2: Institutional Controls with Fencing

Rationale for Preferred Area B Soil Alternative

- Fencing would protect human health by maintaining existing barriers to restrict access to the Area B Landfill.
- Institutional controls would protect human health by limiting site to nonresidential uses.

Remedial Action Objective - Sediment

1. Prevent exposure to potential contaminants within the sediments

Area A Sediment Alternatives

- Alternative A-SD1: No Action
- Alternative A-SD2: Institutional Controls with Fencing

Preferred Area A Sediment Alternative

- Alternative A-SD2: Institutional Controls with Fencing

Rationale for Preferred Area A Sediment Alternative

- Fencing would protect human health by further restricting access to the drainage ditches.
- Institutional controls would protect human health by limiting site to nonresidential uses.

Area B Sediment Alternatives

- Alternative B-SD1: No Action
- Alternative B-SD2: Institutional Controls with Fencing

Preferred Area B Sediment Alternative

- Alternative B-SD2: Institutional Controls with Fencing

Rationale for Preferred Area B Sediment Alternative

- Fencing would protect human health by further restricting access to the drainage ditches.
- Institutional controls would protect human health by limiting site to nonresidential uses.

PREDESIGN ACTIVITIES

- Areas A1/A2 Source Delineation
- Areas A1/A2/B Groundwater Confirmation Monitoring
- Areas A1/A2 Groundwater Pilot Tests
- Percolation Tests
- IWTP Engineering Analysis

PREDESIGN ACTIVITIES

- Areas A1/A2 Source Delineation

  - In situ sampling and on-site analysis of approximately 20 hydraulic drive points to further delineate extent of shallow groundwater contamination in each area and help further define potential source areas.

  - Installation and sampling of 12 test pits in each suspected source area.

PREDESIGN ACTIVITIES
(continued)

- Areas A1/A2/B Groundwater Confirmation Monitoring
  - Installation and sampling of a total of 11 new shallow and 11 new deep wells.
  - Sampling of a total of 28 shallow and 24 deep existing wells.

PREDESIGN ACTIVITIES
(continued)

- Areas A1/B Groundwater Pilot Tests

  - Performance of a total of four 3-day pilot tests (Area A1 shallow & deep aquifers, Area B shallow & deep aquifers) to determine groundwater chemical and hydraulic characteristics to support design efforts.

PREDESIGN ACTIVITIES (continued)

- Percolation Tests
  - Performance of up to four percolation tests in potential areas where treated groundwater could be reinfiltrated back into the aquifer.

Michele Monti - Guidance out now looks at each nozzle on a re infiltration system as a separate reinjection point to the aquifer. ∴ Each would have to not be a hazardous waste per state regs.

IWTP ENGINEERING ANALYSIS

- Evaluate feasibility of using existing IWTP treatment system to treat contaminated groundwater.
- Evaluate feasibility of using existing building adjacent to IWTP to house a new groundwater treatment system.
- Evaluate feasibility of constructing pipeline to IWTP via both direct and indirect routes.
- Evaluate groundwater discharge options of infiltration (onsite treatment scenario), discharge to surface water (onsite treatment and IWTP scenarios), and reuse scenario for NAS washracks.

RI/FS/RD PROJECT SUMMARY

TASK	START	FINISH
• Finalize RI/FS Reports	10/93	11/93
• RAP/ROD Activities	1/94	6/94
• Remedial Design Work Plan S.O.W. of Predesign	9/93	2/94
• IWTP Engineering Analysis	10/93 — DRAFT IN DEC/93 —	1/94
• On-site Predesign Activities	11/93	12/93
• Sample Analysis/Validation	11/93	1/94
• Groundwater & Soil Remedial Designs	2/94	7/94

Summary of Questions

- Remove Alt. water source from F.S. (Action)
- Address barium in Risk Assessment (Action)

- Not Action on Area A2 Groundwater with monitoring would be hard for Region III to accept.
- IS Area "8" secured All the time to prevent exposures?
- Concern over lead and how it was reviewed as a potential chemical of concern
- IF An NPL site, containment of Groundwater in lieu of cleanup would not be acceptable.
- ~~Surface~~ aquifier could be addressed for cleanup for "beneficial use"
- deep " would need to be addressed as a drinking water source.
- IS "No ACTION" on soil at area B premature with confirmatory sampling
- Should the Risks in Area A and Area B be additive?
- EPA Risk screening guidance should be 1st not 4th in screening hierarchy.
- Will Area near Pond be addressed in Removal Action?
- Have modeled the Shellar Globe & GW well enough to know if our treatment system would be affected by Shellar?
- Treatment system "goals" such as "Vinyl Chloride" could be cleaned up without all of TCE being removed?
- Are VOC hits in Glenwood Park.
- Has HRSD bought off on discharge through IWTP