Y/IA-165

Y-12

OAK RIDGE Y-12 PLANT

MARTIN MARIETTA

SEDIMENT ASSESSMENT AND INVENTORY
OF EXISTING CONTAMINATION AND BIOLOGICAL
DATA OF TWO OIL RETENTION PONDS
IN THE Y-12 PLANT
BEAR CREEK VALLEY WASTE DISPOSAL AREA

L. L. McCauley

January 31, 1984

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

#458

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Maintenance Division

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SEDIMENT ASSESSMENT AND INVENTORY OF EXISTING CONTAMINATION AND BIOLOGICAL DATA OF TWO OIL PONDS IN THE BEAR CREEK VALLEY WASTE DISPOSAL AREA

January 31, 1984

1. EXECUTIVE SUMMARY

This report provides data on the Bear Creek Valley Burial Ground Oil Ponds and thereby satisfies one of the conditions of the Memorandum of Understanding (MOU) established on May 26, 1983, between the U.S. Department of Energy, Environmental Protection Agency (EPA), and the State of Tennessee. The report also satisfies one of the conditions in the Complaint and Order issued by the Commissioner of the Tennessee Department of Health and Environment (TDHE).

A comparison of the data showing the chemical parameters of the sediments in and adjacent to the two oil retention ponds against values developed by the Tennessee Valley Authority as typical of the region reveals few instances where the oil retention pond data exceed the range of regional values. Because all values reported represent single measurements, additional sampling and analysis will be undertaken as part of the existing monitoring program as well as the monitoring program associated with the forthcoming remedial/closure plan.

The maximum organic priority pollutant concentration levels observed in sediment and surface water samples taken in the Burial Ground were 2.8 ppm and 1.2 ppm respectively. The highest concentration levels observed in sediment and water samples taken in Burial Ground Oil Pond 1 Stream 1A, just above where it discharges into Bear Creek, were 0.02 ppm and 1.03 ppm respectively.

The data indicate that polychlorinated biphenyls (PCBs) are below

EPA's action level of 12.5 ppb in water and below the EPA action level of 50 ppm in sediment, except in the oil floating on the surfaces of the ponds and in the sediment samples from the oily patches on the edges of the ponds. The data support the position that the oil retention ponds effectively serve their intended purpose of collecting oils that were seeping from the ends of the trenches, thereby reducing the contamination of the oil pond drainage streams.

Mercury concentration levels in sediment samples taken in the Burial Ground were no higher than 1.4 ppm, well below TDHE's action level of 12.0 ppm for mercury in soils. Mercury concentration levels in water samples taken in the Burial Ground were below EPA's drinking water standard of 2 ppb.

Fish and invertebrates were found in a survey of the biota in Bear Creek near the tributary that flows from Oil Retention Pond 1.

Water samples were collected at the inlet and outlet of Oil Retention Pond 1 and from Oil Retention Pond 2. The water was used in a five day survival test with bluegill sunfish. All fish remained alive and visibly unharmed after five days' exposure.

As a result of a limited study conducted by ORNL's Environmental Sciences Division, information was obtained on the aquatic biota in small streams in the vicinity of Oil Retention Ponds 1 and 2 in Bear Creek Valley. The results of the study reveal that:

1. Benthic invertebrates and fish are found in segments of the streams sampled.
2. Lower diversity and biomass exist closer to Oil Retention Pond 2 than elsewhere in the stream or than in comparable unaffected streams on the Reservation.

3. Fish reside in a section of Bear Creek 500 m downstream from a section of Bear Creek in which no fish were found in a 1974-75 study.

The investigators conclude that additional studies are needed to obtain and address additional data.

2. INTRODUCTION

2.1 GENERAL INFORMATION

The Oak Ridge Y-12 Plant was built for the U.S. Army Corps of Engineers in 1943 as part of the Manhattan Project. The original mission of the plant was to separate the fissile isotope of uranium (235U) from natural uranium by the electromagnetic process. Production of 235U by the electromagnetic process was discontinued after World War II in favor of the more economical gaseous diffusion process. Since then, the plant has developed into a highly sophisticated manufacturing, development, and engineering organization. The Y-12 Plant has been operated since 1947 by the Union Carbide Corporation Nuclear Division (UCC-ND) for the U.S. Department of Energy (DOE) and its antecedents.

In addition to the facilties required to serve its mission, the Y-12 site contains several large facilities dedicated to Oak Ridge National Laboratory (ORNL) functions that range from complex laboratory animal colonies to thermonuclear fusion experimental apparatuses for power generation, and 30 operating calutrons that separate appropriate elements into their stable isotopes for medical research. The site also houses the Nuclear Division president and his staff, parts of the Nuclear Division General Staff, site-support personnel from the centralized Engineering and Computer Sciences Divisions, some DOE personnel, and DOE's construction contractor (Rust Engineering Company). The Y-12 Plant has four principal missions: (1) producing nuclear weapons components and supporting DOE's weapons design laboratories, (2) processing special materials, (3) supporting other Oak Ridge and Paducah installations, and (4) supporting other government agencies. The plant's primary mission is producing nuclear weapons components and

subassemblies and providing support to DOE's weapons design laboratories. The major Y-12 production responsibilities involve the fabrication of various materials into components, the certification of the fabricated components, and the production of subassemblies from some of the components. Materials used typically include enriched uranium; depleted uranium and its alloys; lithium hydride and deuteride; aluminum alloys; tungsten-nickel-iron alloy; specialty steels; lead; some precious metals; and niobium, tantalum, and other refractory metals. Extensive facilities are available for recycling uranium-, lithium-, and deuterium-bearing scrap.

2.2 AREA ADDRESSED

The Y-12 Plant is located at the eastern end of Bear Creek Valley in the valley-and-ridge section of East Tennessee. It is within the corporate limits of the City of Oak Ridge and is separated from the populated area by Pine Ridge. The plant is located on a valley floor about 950 feet above sea level and is bounded on the northwest and southeast by parallel ridges that rise about 300 feet above the valley floor. The Y-12 industrial complex area is about 0.6 mile wide by 3.2 miles long and encompasses 811 acres, 600 acres of which are enclosed by a perimeter security fence. The plant and its fenced buffer area total about 4860 acre.

Since 1955, the Y-12 Plant has utilized land disposal facilities that are approximately one mile west of the main plant site in Bear Creek Valley. Although there are a number of subdivisions of the Bear Creek Valley disposal facilities, this report describes activities and investigations of the area referenced as the two man-made oil retention ponds contained within Burial Ground A. Burial Ground A has been used for the disposal of both solid

and liquid wastes generated at the Y-12 Plant.

2.3 MEMORANDUM OF UNDERSTANDING COMMITMENTS

The Memorandum of Understanding (MOU) refers to several facilities in the Bear Creek Valley which were formerly and/or are currently used for the disposal of wastes generated at the Y-12 Plant. This report addresses one of the MOU commitments that pertain to the Burial Ground Oil Ponds:

> DOE agrees to submit to EPA and TDHE on/or before January 31, 1984, a report to include:
>
> a. An inventory of waste deposited in the pond watershed;
>
> b. A sediment assessment and inventory of existing contamination together with biological information regarding this area.

This report provides an assessment of the sediments in the Bear Creek oil pond subwatershed. In addition, it contains available biological information regarding the oil pond subwatersheds as well as data on surface water/stream quality in the vicinity of the oil retention ponds.

3. BACKGROUND AND HISTORICAL DATA

Sections 3.1 and 3.2 are excerpts from Y/SUB/83-47936/1, "Results of Ground-Water Monitoring Studies," a report authored in September 1983 by Law Engineering Testing Company under UCC-ND Subcontract 85Y-47936C.

3.1 HYDROGEOLOGY OF BEAR CREEK VALLEY

The Rome Formation, the Knox Group and Conasauga Group comprise the major portions of the stratigraphic sequence in the site area (Table 3-1). Waste disposal areas in Bear Creek Valley are underlain by rocks of of the Conasauga Group and bordered by the Rome Formation and Knox Group to the northwest and southeast, respectively. These geologic units strike generally northeast-southwest (Figure 3-1) and have a dip of about 60 degrees toward the southeast.

The Rome Formation is composed mainly of shale and siltstone with small amounts of sandstone and localized thin layers of dolomite. Dolomite, where present, usually occurs in the lower portion with sandstones being more abundant in the upper part. A maroon coloration is characteristic, but green, tan and various shades of gray are also common. The upper boundary of the Rome Formation is gradational to shales and siltstones of the overlying Conasauga Group.

In the site area, the Conasauga Group consists of alternating layers and laminations composed mainly of shale and lesser amounts of siltstone, calcareous siltstone, and limestone. The Conasauga grades from shale and siltstone in the lower section to limestone in the upper section. Solutioning of the limestone along Bear Creek Valley provides an avenue for Bear Creek and tributaries and springs on the south side of the creek.

The principal divisions of the Conasauga along Bear Creek Valley include, in ascending order, the Pumpkin Valley shale, the Rutledge limestone, the Rogersville shale, the Maryville limestone, the Nolichucky shale, and the Maynardville limestone (Table 3-1). In this area, the Conasauga shales consist of light green, olive green, and dull purple shale with lenses of limestone. The shale weathers to a thin acidic soil with shale chips, except where limestone is present.

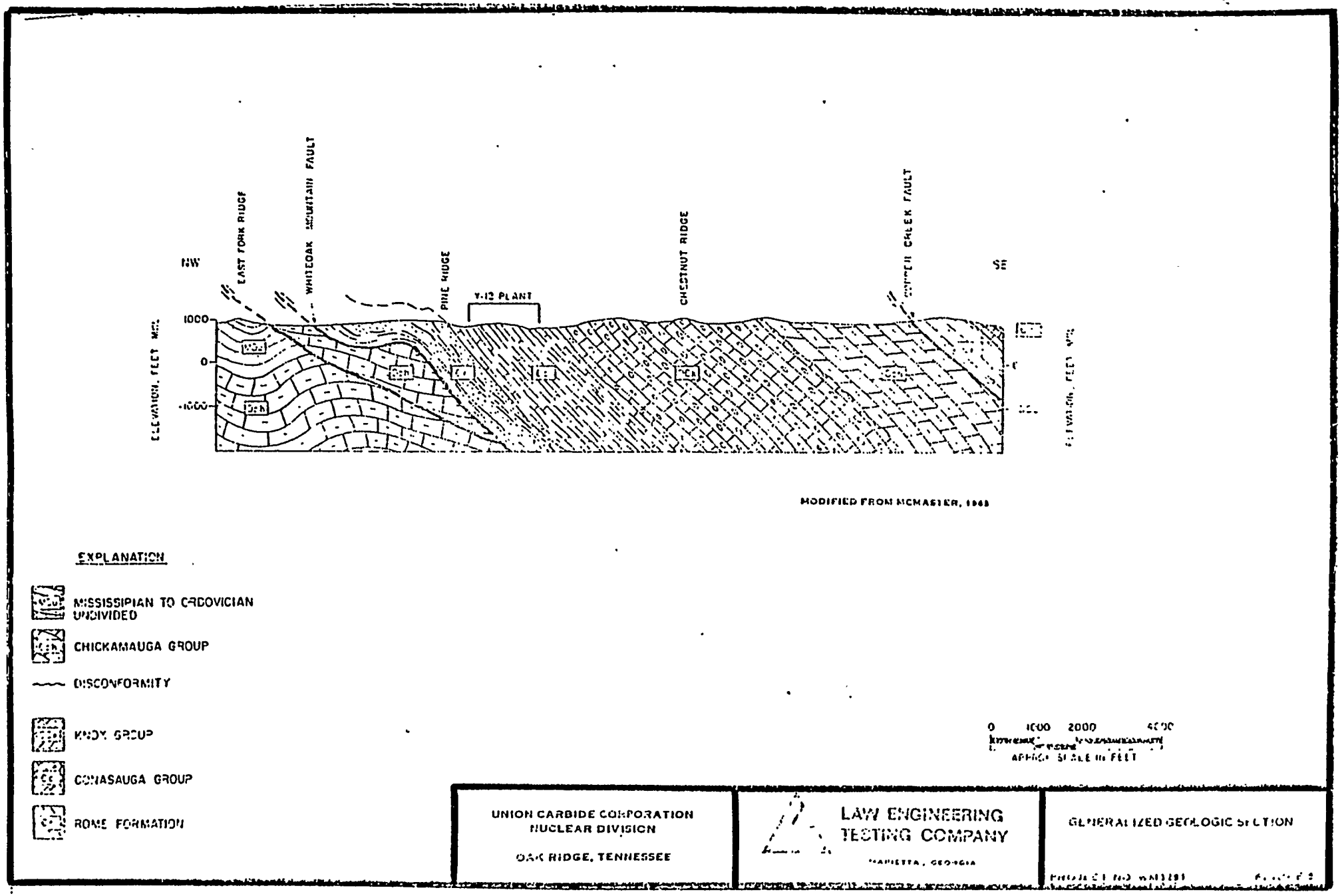
LAW
TABLE 5-1

TABLE 3-1

GEOLOGIC FORMATIONS IN EAST TENNESSEE

Era or system	Series	Group	Subdivisions				Thickness (feet)	Physical character	Water-bearing properties
Ordovician	Upper Ordovician		Sequatchie formation / Juniata formation				200–400	Sequatchie: Maroon and blue shaly limestone and shale. Juniata: Maroon siltstone and shale.	Yield small supplies to wells and springs.
	Middle Ordovician		Upper part of Chickamauga limestone	Reedsville shale	Chickamauga limestone Unit 4	Martinsburg shale	700–1,000	Upper part of Chickamauga: Blue, crystalline well-bedded limestone: upper part shaly limestone. Reedsville shale: Bluish calcareous shale. Martinsburg shale: Bluish calcareous shale.	Limestones yield small to moderate quantities of water to wells and springs. Where limestones are interbedded in shale, the limestone commonly contains well-developed solution cavities. Quality of water varies. Shale generally yields larger quantities of water to drilled wells than limestone. Quality of water varies.
			Lower and middle parts of Chickamauga limestone	Unit 3	Moccasin formation / Bays formation		700–1,000	Moccasin: Maroon limy shale and shaly limestone and blue flaggy limestone. Bays: Maroon siltstone and shale.	
				Unit 2	Ottosee shale	Sevier shale	2,500–4,000	Units of Chickamauga limestone: Blue generally well-bedded limestone, in part silty and shaly. Ottosee: Bluish calcareous shale containing crystalline limestone lenses. Holston: Red crystalline limestone (marble), quartzose crystalline limestone and limy sandstone. Lenoir: Blue nodular and massive limestone. Sevier: Blue calcareous shale with sandstone beds, blue limestone at base. Athens: Bluish calcareous shale and shaly limestone, blue limestone at base, some sandstone.	
				Unit 1	Holston formation				
					Lenoir limestone / Athens shale				
	Lower Ordovician	Knox	Newala, Longview and Chepultepec formations undivided	Newala formation	Mascot dolomite	Jonesboro limestone	400–600	Siliceous dolomite	Water occurs in joints and solution channels. Yield small to large supplies to wells. Water generally of good quality. Sandstone in Chepultepec dolomite [illegible] aquifers for small supplies. [illegible] marous large springs are found in these rocks.
					Kingsport formation		200	Siliceous dolomite, thick limestone near base.	
				Longview dolomite			250	Very siliceous dolomite, limestone beds near top.	
				Chepultepec dolomite (Oc)			700–750	Siliceous dolomite, sandstone beds near base.	Jonesboro limestone: Dark, blue weathering limestone
Cambrian	Upper Cambrian		Copper Ridge (Ccr) dolomite / Conococheague limestone				900–1,100	Copper Ridge: Dark crystalline siliceous dolomite. Conococheague: Limestone.	
		Conasauga	Upper Cambrian part of Conasauga shale or Conasauga group	Maynardville limestone member of Nolichucky shale (Cmn)			150–350	Limestone below, dolomite above.	Limestone and dolomite yield small to large quantities of water to springs and wells. Shale-limestone contacts produce springs at surface. In subsurface these contacts are frequently water bearing.
				Nolichucky shale (Cn)			400–750	Greenish shale.	
	Middle Cambrian		Middle Cambrian part of Conasauga shale or Conasauga group	Honaker dolomite	Maryville limestone (Cm)		250–650	Blue limestone, mostly ribboned with dolomite.	Shale yields small supplies to dug and drilled wells. Wells in shale near streams occasionally yield moderate to large quantities of water. Pumpkin Valley shale is very poor aquifer.
					Rogersville shale (Crg)		0–250	Light-green shale.	
					Rutledge limestone (Crt)		100–500	Blue limestone, mostly ribboned with dolomite.	
				Pumpkin Valley shale (Cpr)			200–400	Greenish silty shale.	
	Lower Cambrian		Rome formation (Cr)	Sandstone-bearing member			700	Varicolored shale, siltstone, and sandstone.	Yield small quantities of water to dug and drilled wells. Water occurs in closely spaced joints. Upper member of the Rome formation is a better aquifer than the lower member.
				Apison shale member				Bright-red and green shale.	
			Shady dolomite				1,000	Blue-gray and white dolomite.	Water occurs in joints and bedding planes.
		Chilhowee	Erwin formation	Helenmode member			1,000–1,500		Yield small to moderately large supplies to drilled wells and springs.
				Hesse sandstone				White sandstone.	
				Murray shale				Greenish silty shale.	
				Nebo sandstone				White sandstone.	
			Hampton formation	Nichols shale			500–2,500	Hampton: Greenish silty shale and siltstone with feldspathic sandstone layers. Nichols: Greenish silty shale.	
			Unicoi formation	Cochran conglomerate			1,000–5,000	Feldspathic sandstone and conglomerate.	

FROM: DEBUCHANANNE AND RICHARDSON, 1956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SE
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WHITEOAK MOUNTAIN FAULT
PINE RIDGE
Y-12 PLANT
CHESTNUT RIDGE
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ELEVATION, FEET MSL
MODIFIED FROM MCMASTER, 1965
EXPLANATION
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APPROX SCALE IN FEET
UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE
LAW ENGINEERING
TESTING COMPANY
MARIETTA, GEORGIA
GENERALIZED GEOLOGIC SECTION

FIGURE 3-1

The Knox Group overlies the Conasauga Group and is composed of dolomite and minor amounts of limestone. In the site area, the Knox Group includes the Copper Ridge dolomite and the Chepultepec dolomite. Nodules and thin discontinuous layers of chert occur in much of the Knox Group.

Ground water in the site area occurs in fractures in the rock, some of which have been enlarged by solutioning, particularly in the calcareous zones. The quantity of water available and general flow characteristics depend on the size and number of fractures encountered. In Bear Creek Valley, fractures are predominantly oriented in a northeast-southwest direction. Small streams draining into Bear Creek tend to follow these fracture patterns causing an evenly spaced series of small parallel tributaries along the north side of Bear Creek. This is particularly notable between the S-3 waste ponds and the western end of the burial ground disposal area.

Ground-water recharge in the area is from local precipitation. Rainfall measurements on site range from 2 inches in October to 7.8 inches in December, 1982. Recharge is most effective in those areas where the overburden soils are thin or permeable as found on steep ridges such as Pine Ridge and Chestnut Ridge.

Natural discharge of ground water is through streams, springs and evapotranspiration. Due to the frequent occurrence of streams in the area, especially north of Bear Creek, the ground-water travel distances are generally small and limited between topographic highs along the valley. Headwaters of these streams typically occur in the Maryville limestone. Where topographic slopes change abruptly, shallow ground water discharges on the ground surface as seeps or springs and eventually flow into Bear Creek, the principal discharge point for the valley. Deeper ground-water flow systems have longer travel distances and discharge into Bear Creek or possibly into adjacent valleys.

Movement of ground water is controlled by the piezometric gradients which can be variable with depth and by the degree of anisotropy of the aquifer. In general, ground-water movement in the Bear Creek Valley waste areas is moving in the direction of the slope of the potentiometric surface but in localized areas with strong anisotropic conditions flow may move along the major axis of permeability, making travel times faster than can be predicted by using the average hydraulic gradient through the area.

3.2 BURIAL GROUND DISPOSAL AREA

Ground-water flow in the burial ground disposal area is toward the southwest, parallel to streams draining the ridge area. The geologic formations through which the ground water is flowing represent the subdivisions of the Conasauga Group.

Potentiometric contours shown in Figure 3-2 indicate that ground-water flow is intercepted by streams. The strong convergence of the contours near the headwaters of these streams is an indication of short ground-water flow paths. Ground-water flow in the inter-stream areas moves toward Bear Creek following longer flow paths. The average hydraulic gradient in the interstream areas interpreted from the potentiometric surface is about 0.08 ft/ft.

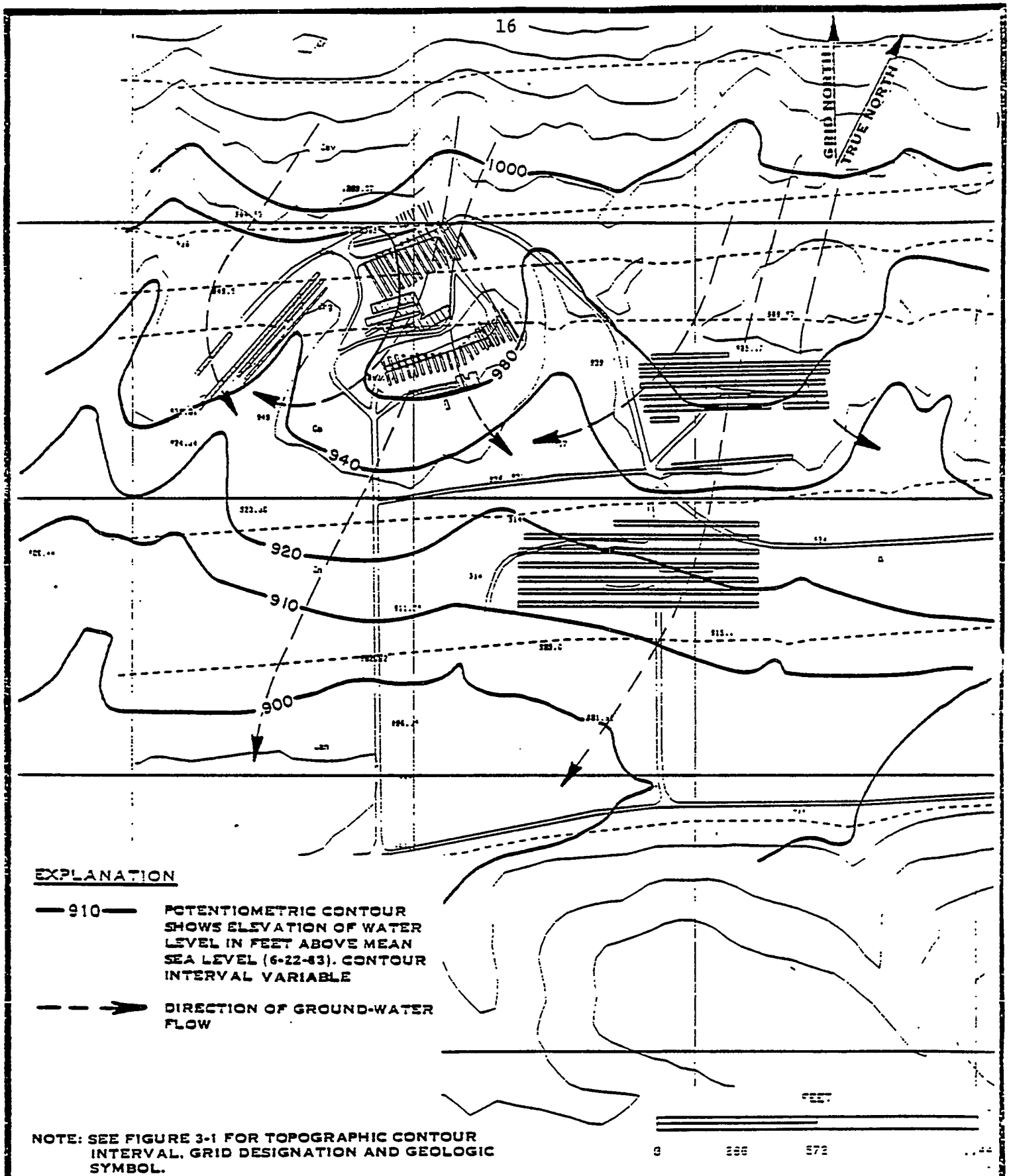
The locations of existing monitoring wells are adequate to construct the potentiometric surface map. The various construction characteristics of the wells did not affect our interpretation of water level elevations when considered for the overall site area.

3.3 SYNOPSIS OF LIQUID WASTE DISPOSAL PRACTICES AT Y-12

In 1955, the Y-12 Plant was authorized to dispose of certain types of solid waste in a land disposal facility generally referred to as Burial Ground A. In July 1959, the Y-12 Plant was authorized by the Atomic Energy Commission (AEC) to use these facilities as a disposal area for certain types of liquid wastes. The following is a synopsis of liquid waste disposal practices at the Y-12 Plant. Data detailing liquid disposal transactions at Y-12 are contained in a classified document that has also been prepared to fulfill a MOU commitment.

3.3.1 Mop Waters

Prior to 1959, the burial facilities at ORNL were used for the disposal the disposal of mop waters generated from floor cleaning operations in Y-12 shop areas. In July 1959, the Atomic Energy Commission authorized the Y-12



NOTE: SEE FIGURE 3-1 FOR TOPOGRAPHIC CONTOUR INTERVAL, GRID DESIGNATION AND GEOLOGIC SYMBOL.

UNION CARBIDE CORPORATION NUCLEAR DIVISION OAK RIDGE, TENNESSEE	LAW ENGINEERING TESTING COMPANY MARIETTA, GEORGIA	POTENTIOMETRIC SURFACE IN BURIAL GROUND DISPOSAL AREA PROJECT NO. WM3291 FIGURE 5-2

Plant to dispose of mop waters* in the Y-12 Burial Ground A. To facilitate the disposal of these liquid wastes, several vertical perforated pipes (generally referred to as standpipes) were sunk into trenches that had been used for solid waste disposals. Large rock (6" riprap) was backfilled around the pipes for support and to maximize the rate the liquids drained from the standpipes into the trenches. The liquids were transported from the plant to the burial ground in haul containers that were then drained into the standpipes. Available records show that an estimated 600,000 gallons of mop waters were transported annually to the standpipes, rock pits, or trenches in Burial Ground A from 1971 through 1978. Estimates of the quantities of mop waters disposed of prior to 1971 are very uncertain because of the inadequacy of the descriptive information and data recorded during that period.

In 1979, the practice of disposing of mop waters in the burial ground standpipes was terminated. Since 1979, mop waters have been disposed of in the S-3 ponds. These are four unlined, manmade ponds located on the west end of the plant and have been in operation since 1951. Each of the four ponds has an area of about one acre and a normal liquid depth of about 10 feet. The current plan calls for discontinuing the use of the S-3 ponds in the near future. As part of that plan, mop waters will be disposed of by other approved procedures.

3.3.2 Oils and Coolants

The primary method for disposing of oils and coolants prior to 1961 was to pour them into the unlined trenches in the Burial Ground along with the

---

* Water containing oils, detergents, traces of heavy metals, etc.

solid wastes. In 1961, a surface tank was placed in Burial Ground A to collect waste oils and coolants. Each week surface accumulations were burned. Oils and coolants that did not burn were drained into the adjacent trench. An estimated 180,000 gallons of liquid described as waste oils were handled by this disposal method. This practice was terminated in 1968 in order to comply with the new air pollution regulations. In January 1969, the plant adopted a new procedure that called for oils and coolants to be poured into trenches using the standpipes and rock pits.

During 1972, a method was developed for the Y-12 Plant which used natural soil microbial assimilatory processes to slowly degrade oily wastes. The process is called landfarming and involved application of waste oils and coolants to nutrient adjusted soils followed by frequent soil cultivation to maintain aerobic conditions. The area selected for the program is located north of the Y-12 Centralized Sanitary Landfill I in Bear Creek Valley and was designated as the Y-12 Plant Oil Landfarm.

Beginning in May 1973, waste oils and coolants were collected in tank trucks, distributed over the surface of the plots, and cultivated into the top three inches of soil. The plots were cultivated frequently between application periods. The application dates were selected to minimize impacts of precedent rainfall and forecasted antecedent rainfall. The Oil Landfarm was operated on a seasonal basis from April to October to take advantage of favorable conditions for soil microbial activity. By 1976, most liquids identified as waste oils or coolants were handled at the Oil Landfarm, although the Burial Ground Standpipe facilities continued to be used for overflow quantities of waste oil and coolant. Use of the Standpipe facilities for waste oil and coolant disposal was terminated in 1979. All waste

applications at the Oil Landfarm were discontinued in October 1982.

Approximately 260,000 gallons of waste oil and coolant were poured into the standpipes/rock pits in the southeast portion of Burial Ground A between 1969 and 1971. Approximately 132,000 gallons were poured into an area in the northeast portion of Burial Ground A between October 1971 and May 1972. Between 1972 and 1979, approximately 460,000 gallons were poured into a rock pit in the northwest portion of Burial Ground A. The latter area received most of the oil between 1972 and 1974 with decreasing disposal quantities thereafter following to the start-up of the Oil Landfarm.

3.3.3 Solvents

Prior to July 1970, waste solvents were transported from the Y-12 Plant and drained into a surface tank located in an area east of the Burial Ground. The liquids were burned in the open tank. In July 1970, the procedure for disposing of such wastes was changed to a "pour-out" practice using the southeast portion of Burial Ground A. This general area is called the Isolation Area and was used for the disposal of volatile liquids until October 1981. The Isolation Area was approximately 80 feet by 100 feet and is located above the eastern portions of two trenches previously filled with uranium contaminated solid wastes. The ground surface above the filled trench portion was covered with rock. Solvents were then poured onto the rock covered soil and waste filled trenches. During that time period, approximately 100,000 gallons of various waste solvents were delivered and poured onto the ground surface. A summary of the solvents handled at the Isolation Area is given in Table 3-2.

TABLE 3-2

SOLVENTS DISCHARGED INTO ISOLATION AREA
(IN GALLONS)

Solvent	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	12-YEAR TOTALS
Vythene	410	-	50	850	1,575	210	-	555	500	505	1,865	1,785	8,305
Varsol	245	410	1,000	720	490	650	615	1,000	900	560	810	661	8,061
Fuel and Water	450	500	700	110	15	680	1,165	2,500	400	250	790	205	7,765
Perchloroethylene	100	-	-	540	180	475	1,150	930	1,160	710	1,000	1,390	7,635
Freon	20	85	520	-	265	345	-	-	-	-	1,390	1,470	4,095
lchohol	25	25	550	490	280	210	20	290	600	200	410	169	3,269
Solvents from Bldg. 9208 (Benzene, Toluene, Xylene, Alchohol)	40	265	210	125	50	50	-	110	125	-	190	5	1,295
Trichloroethylene	-	75	50	-	220	-	-	-	110	225	-	55	735
MEK	-	-	160	-	120	-	-	-	75	175	-	-	530
Miscellaneous	6,910	10,640	6,760	4,165	1,605	1,880	2,900	4,615	5,130	2,850	7,240	2,730	57,425
Gallons Discharged	8,200	12,000	10,000	7,000	4,800	4,500	5,850	10,000	9,000	5,600	13,695	8,470	99,115

3.3.4 Oil Retention Ponds

As a result of the liquid disposal practices in the Burial Grounds, liquids (primarily oils) were observed seeping from the ends of some of the trenches. In May 1971, a pond (Pond 1) was constructed at the southwest corner of Burial Ground A to collect and contain oils observed seeping into a surface stream flowing along the west boundary of Burial Ground A. A diversion ditch was also constructed to divert surface water away from the pond, thereby minimizing the volume of water flowing into and through the pond and the chances of pond overflow. In May 1972, a smaller pond (Pond 2) was constructed at the northeast corner of Burial Ground A to collect and contain oils observed seeping into an intermittent stream along the east side of Burial Ground A. In 1974 and 1975, approximately 15,000 gallons of oil were skimmed and removed from the surfaces of the ponds and spread on plots in the Oil Landfarm. Oil accumulations of any significance on the surface of Pond 2 were not observed after 1975. Oil accumulations continued on Pond 1, and approximately 18,000 gallons were removed in 1979 and placed in a storage tank at the Y-12 Plant. Figures 3-3 and 3-4 are schematics of Oil Retention Pond 1. Oil Pond 2 was constructed with a single drain similar to that of Oil Pond 1.

3.3.5 Polychlorinated Biphenyls (PCBs)

As part of the program initiated in 1979 to remove oils from the surface of Pond 1, samples were collected and analyzed for various parameters. The analytical results confirmed the presence of PCBs. An investigation of previous disposal practices revealed that the electrical equipment and a machine coolant used in one of the shops were probably the sources of the PCBs detected in the oils removed from the two ponds. The records show that

approximately 2,000 gallons of these PCB-containing compounds were disposed of in the Burial Grounds between 1965 and 1973. Prior to 1972, the procedure for disposing of waste oils, including those from electrical equipment, did not require sampling and analysis prior to disposal. In 1972, however, the plant modified its procedures to provide for more rigorous controls of the disposal of waste oils identified as containing PCBs. Initially, PCB concentrations were monitored to levels of 500 mg/l in accordance with applicable standards. In 1979, the plant's action level was lowered to 50 mg/l to comply with federal regulations. An internal level of 5 mg/l was established to control the disposition of oils and coolants.

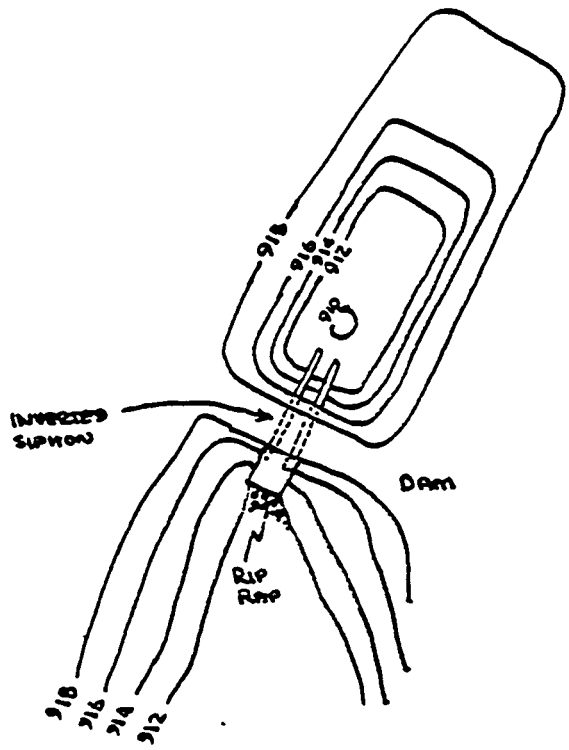


Figure 3-3

TOPOGRAPHIC VIEW OF OIL RETENTION POND 1

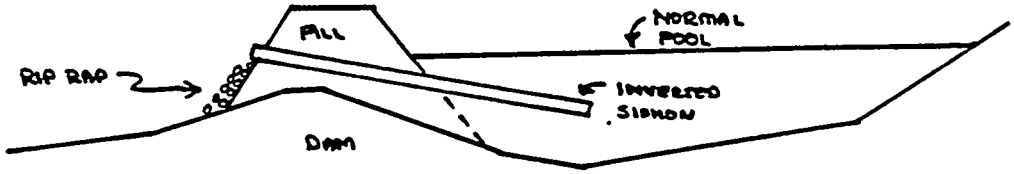


Figure 3-4

SIDE VIEW SECTION OF OIL RETENTION POND 1
THRU INVERTED SIPHON

4. RESULTS OF SAMPLING PROGRAM

4.1 METHODOLOGY

In response to a request by EPA and TDHE for characterization of the oil retention ponds, results of a sampling program are being reported in this document. Services of an independent contractor, Bechtel National, Inc., were secured to investigate conditions in the Burial Grounds in Bear Creek. Included in the Bechtel study was a characterization of sediments associated with the two ponds located in Burial Ground A. Figure 4-1 shows the locations of the oil retention ponds along with the waste disposal trenches. Although the data presented in this report are primarily those which characterize the oil retention ponds, data are also provided on the adjacent drainage streams, the diversion ditch, several stations in Bear Creek (upstream and downstream of the confluences of the drainage streams with Bear Creek), and background stations. Approximate positions of the sampling station locations for surface water and sediments are shown in Figure 4-2. Sampling station locations were selected by Bechtel to provide information regarding the potential transport of contaminants from the burial ground trenches.

4.1.1 Sediment Sampling Program

Sediment grab samples were collected by Bechtel personnel in Stream 1A, the diversion ditch, and Stream 2A. In addition, composite sediment samples were collected along the northern and southern edges of Pond 1 and along the southern edge of Pond 2. All samples were analyzed by IT Corporation, Stewart Laboratories Division, under subcontract to Bechtel. The samples were analyzed for:

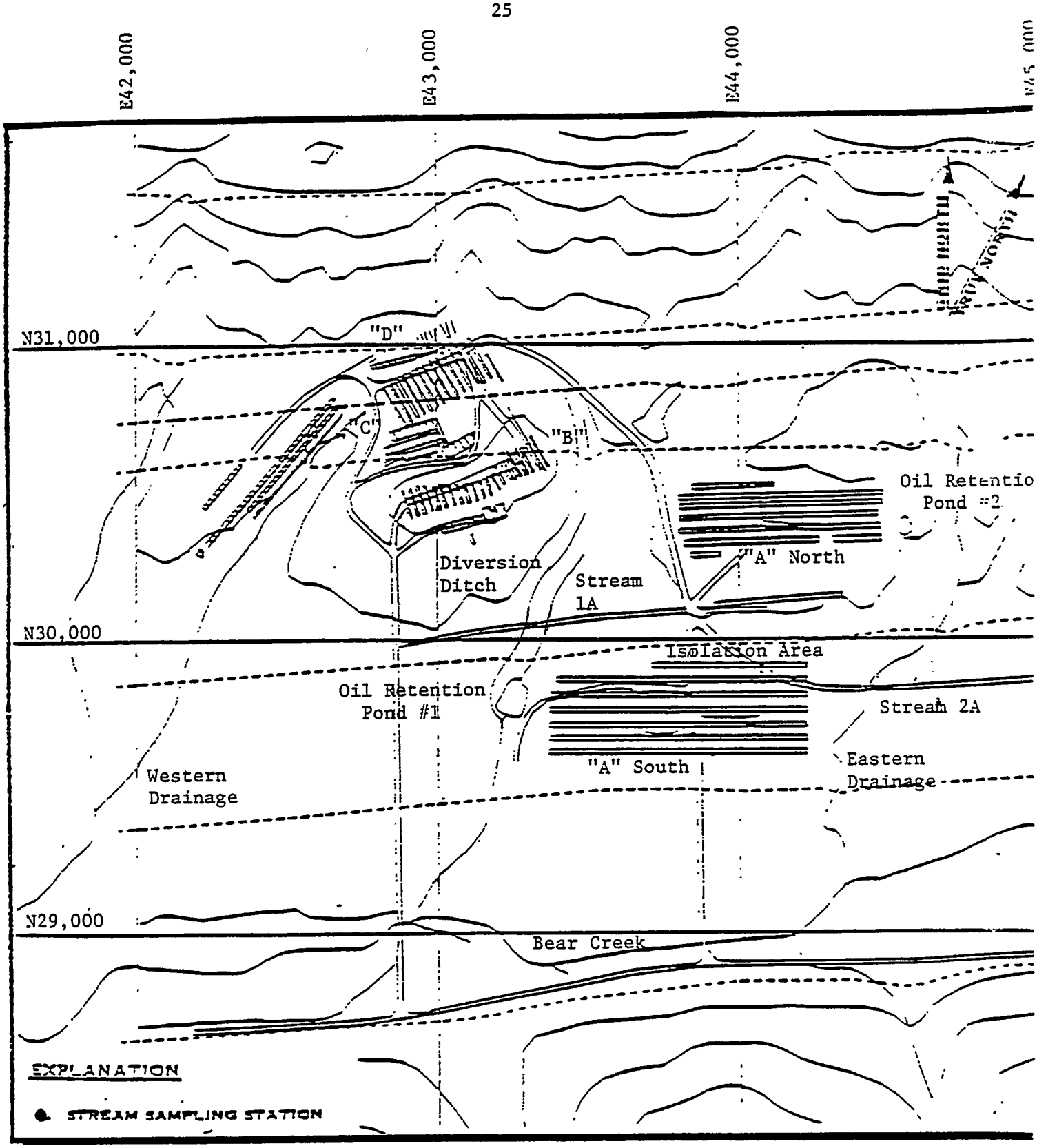


FIGURE 4-1

BEAR CREEK VALLEY BURIAL GROUNDS A-D

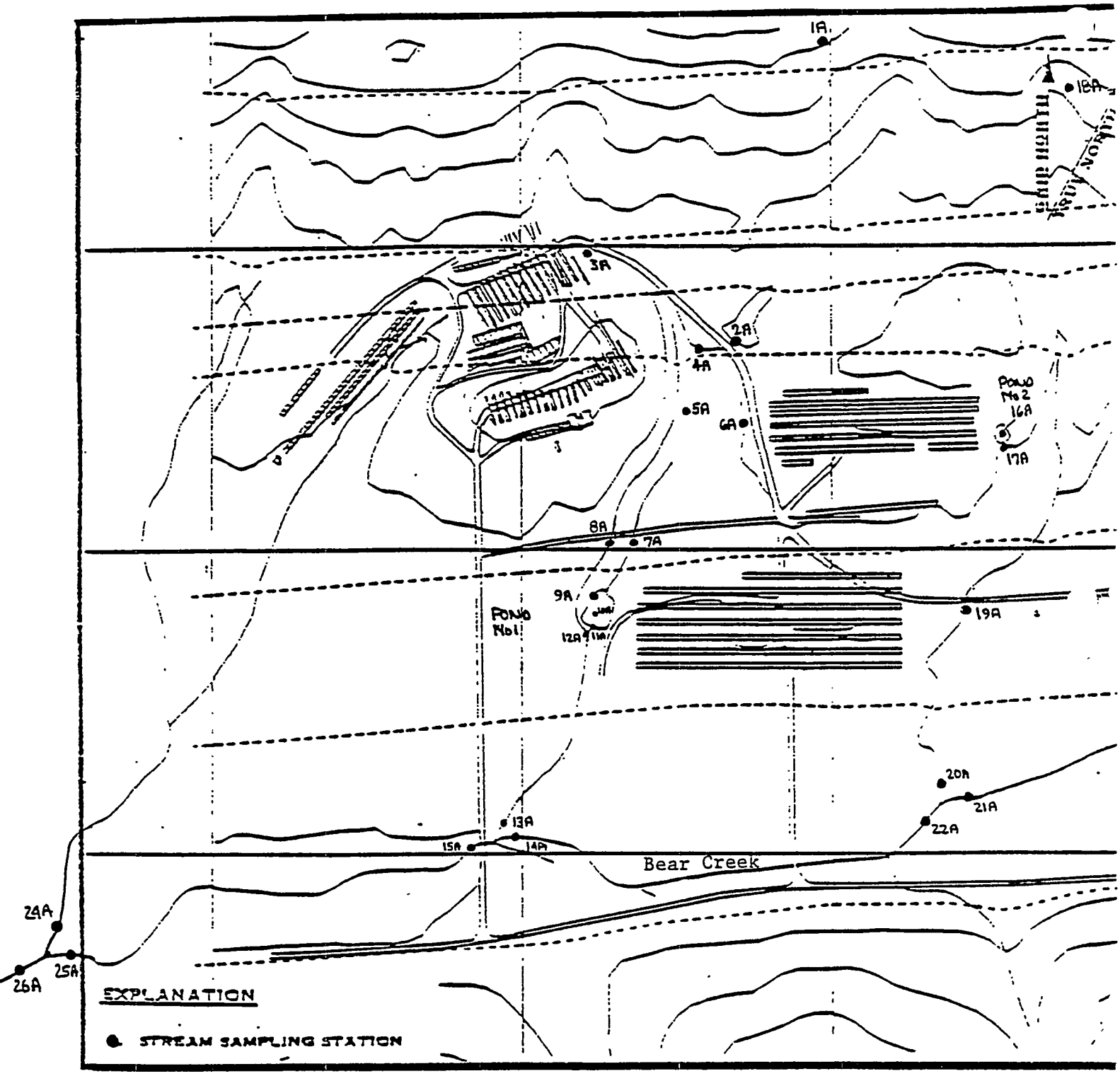


FIGURE 4-2

BEAR CREEK VALLEY BURIAL GROUND
SAMPLING STATIONS

- o Volatile Organics
- o PCBs
- o Metals, Cyanides, and Phenols
- o Various Conventional and Nonconventional Pollutants

4.1.2 Water Sampling Program

Water within the oil retention ponds was collected by Bechtel personnel from a depth of 1.1 meters (3.5 feet) and from the surface using a peristaltic pump. Samples were collected using a low pumping rate (<0.5 liter/minute) to avoid the loss of volatile organics. Water was pumped through Teflon tubing to reduce the possibility of contaminant leaching from tubing walls. Sample collection using the peristaltic pump was accomplished in accordance with EPA recommended method.[1] Surface and subsurface water was collected to determine if a thermal or chemical stratification was established which could affect pond discharge. In addition, oil, which was observed on the pond surface, was analyzed to assess the concentrations of nonpolar compounds such as PCBs that do not dissolve readily in water. All water samples, with the exception of those obtained from the ponds were

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(1) Ford, J., P. J. Turing, D. E. Seely. Characterization of Hazardous Waste Sites - A Methods Manual, Volume 2, Available Sampling Methods. Report Prepared by GCA Corporation for Lockheed Engineering and Management Services Co., Inc., Under EPA Contract 68-03-3050, September 1983.

collected by grab sampling. To be consistent with the National Pollutant Discharge Elimination System (NPDES) permitting requirements (40 CFR 122), IT Stewart Laboratories analyzed the water samples for:

- o Biochemical Oxygen (BOD 5 Day)
- o Chemical Oxygen Demand
- o Total Organic CarbonCarbon
- o Total Suspended Solids
- o Ammonia (as N)
- o Temperature
- o pH
- o Volatile Organics
- o Acid/Base Neutral Extractable Compounds (on selected samples)
- o PCBs
- o Metals, Cyanides, Phenols
- o Other Conventional and Nonconventional Pollutants

4.2 ANALYTICAL RESULTS

Tables 4-3 through 4-26 provide the analytical results for the Oil Pond 1 subwatershed. The analytical results for volatile and acid/base neutral extractable organics are presented in Tables 4-3 through 4-8. The

results of PCB analyses are shown in Tables 4-9 through 4-14, while those for metals, cyanide, and phenols are shown in Tables 4-15 through 4-22. Tables 4-23 through 4-26 indicate the results of miscellaneous conventional and nonconventional pollutant analysis. Tables 4-27 through 4-31 provide the analytical results for the Oil Pond 2 subwatershed.

Table 4-3

VOLATILE ORGANIC PRIORITY POLLUTANT ANALYSIS UNIT-PPL

FACILITY: BURIAL GROUND

LOCATION OF STATION 1A: ORIGIN OF STREAM 1A
LOCATION OF STATION 7A: STREAM 1A, NORTH OF OIL RETENTION POND 1

VOLATILE ORGANIC	STATION 1A 9/23/83		STATION 7A 9/20/83	
	WATER	SEDIMENT	WATER	SEDIMENT
ACROLEIN	N	N	N	N
ACRYLONITRILE	N	N	N	N
BENZENE	N	N	N	N
BROMOFORM	N	N	N	N
CARBON TETRACHLORIDE	N	N	N	N
CHLOROBENZENE	N	N	N	N
CHLORODIBROMOMETHANE	N	N	N	N
CHLOROETHANE	N	N	N	N
2-CHLOROETHYL VINYL ETHER	N	N	N	N
CHLOROFORM	N	N	N	N
DICHLOROBROMOMETHANE	N	N	N	N
DICHLORODIFLUOROMETHANE	N	N	N	N
1,1-DICHLOROETHANE	N	N	53	20
1,2-DICHLOROETHANE	N	N	N	N
1,1-DICHLOROETHYLENE	N	N	<10	N
1,2-DICHLOROPROPANE	N	N	N	N
CIS-1,3-DICHLOROPROPYLENE	N	N	N	N
TRANS-1,3-DICHLOROPROPYLENE	N	N	N	N
ETHYL BENZENE	N	N	N	N
METHYL BROMIDE	N	N	N	N
METHYL CHLORIDE	N	N	N	N
METHYLENE CHLORIDE	N	N	N	39
1,1,2,2-TETRACHLOROETHANE	N	N	N	N
TETRACHLOROETHYLENE	N	N	<10	N
TOLUENE	N	N	N	N
TRANS-1,2-DICHLOROETHYLENE	N	N	<10	<10
1,1,1-TRICHLOROETHANE	N	N	<10	N
1,1,2-TRICHLOROETHANE	N	N	N	N
TRICHLOROETHYLENE	N	N	<10	N
TRICHLOROFLUOROMETHANE	N	N	N	<10
VINYL CHLORIDE	N	N	N	N
METHYL ETHYL KETONE	<10	N	N	N

Table 4-4

VOLATILE ORGANIC PRIORITY POLLUTANT ANALYSIS UNIT-PPB

FACILITY: BURIAL GROUND

LOCATION OF STATION 8A: DIVERSION DITCH NORTH OF OIL RETENTION POND 1
LOCATION OF STATION 9A: NORTHWESTERN PORTION OF OIL RETENTION POND

VOLATILE ORGANIC	STATION 8A 9/21/83		STATION 9A 9/26/83
	WATER	SEDIMENT	SEDIMENT
ACROLEIN	N	N	N
ACRYLONITRILE	N	N	N
BENZENE	N	N	<10
BROMOFORM	N	N	N
CARBON TETRACHLORIDE	N	N	N
CHLOROBENZENE	N	N	N
CHLORODIBROMOMETHANE	N	N	N
CHLOROETHANE	N	N	<10
2-CHLOROETHYL VINYL ETHER	N	N	N
CHLOROFORM	N	N	N
DICHLOROBROMOMETHANE	N	N	N
DICHLORODIFLUOROMETHANE	N	N	N
1,1-DICHLOROETHANE	N	N	22
1,2-DICHLOROETHANE	N	N	N
1,1-DICHLOROETHYLENE	N	N	<10
1,2-DICHLOROPROPANE	N	N	N
CIS-1,3-DICHLOROPROPYLENE	N	N	N
TRANS-1,3-DICHLOROPROPYLENE	N	N	N
ETHYL BENZENE	N	N	N
METHYL BROMIDE	N	N	N
METHYL CHLORIDE	N	N	N
METHYLENE CHLORIDE	N	N	10
1,1,2,2-TETRACHLOROETHANE	N	N	N
TETRACHLOROETHYLENE	<10	N	52
TOLUENE	N	N	<10
TRANS-1,2-DICHLOROETHYLENE	<10	N	75
1,1,1-TRICHLOROETHANE	<10	N	N
1,1,2-TRICHLOROETHANE	N	N	N
TRICHLOROETHYLENE	<10	N	<10
TRICHLOROFLUOROMETHANE	N	N	N
VINYL CHLORIDE	N	N	<10
METHYL ETHYL KETONE	N	N	67

Table 4-5

VOLATILE ORGANIC PRIORITY POLLUTANT ANALYSIS UNIT=PPB

FACILITY: BURIAL GROUND

LOCATION OF STATION 10A: OIL RETENTION POND 1
LOCATION OF STATION 11A: SOUTHERN PORTION OF OIL RETENTION POND 1
LOCATION OF STATION 12A: DISCHARGE FROM OIL RETENTION POND 1

VOLATILE ORGANIC	STATION 10A 9/28/83		STATION 11A 9/26/83	STATION 12A 9/21/83	
	SUBSURFACE WATER	SURFACE WATER	SEDIMENT	WATER	SEDIMENT
ACROLEIN	N	N	N	N	N
ACRYLONITRILE	N	N	N	N	N
BENZENE	N	N	95	<10	240
BROMOFORM	N	N	N	N	N
CARBON TETRACHLORIDE	N	N	N	N	N
CHLOROBENZENE	N	N	<10	N	N
CHLORODIBROMOMETHANE	N	N	N	N	N
CHLOROETHANE	<10	N	26	N	210
2-CHLOROETHYL VINYL ETHER	N	N	N	N	N
CHLOROFORM	N	N	N	<10	55
DICHLOROBROMOMETHANE	N	N	N	N	N
DICHLORODIFLUOROMETHANE	N	N	N	N	N
1,1-DICHLOROETHANE	19	<10	2100	34	1200
1,2-DICHLOROETHANE	N	N	66	<10	96
1,1-DICHLOROETHYLENE	<10	N	46	<10	<10
1,2-DICHLOROPROPANE	N	N	N	N	N
CIS-1,3-DICHLOROPROPYLENE	N	N	N	N	N
TRANS-1,3-DICHLOROPROPYLENE	N	N	N	N	N
ETHYL BENZENE	N	N	19	N	N
METHYL BROMIDE	N	N	N	N	N
METHYL CHLORIDE	N	N	<10	N	N
METHYLENE CHLORIDE	N	N	17	<10	<10
1,1,2,2-TETRACHLOROETHANE	N	N	N	N	N
TETRACHLOROETHYLENE	21	<10	120	<10	160
TOLUENE	<10	N	220	N	38
TRANS-1,2-DICHLOROETHYLENE	40	13	150	284	96
1,1,1-TRICHLOROETHANE	<10	N	<10	16	280
1,1,2-TRICHLOROETHANE	N	N	<10	N	29
TRICHLOROETHYLENE	16	<10	30	<10	11
TRICHLOROFLUOROMETHANE	N	N	N	N	<10
VINYL CHLORIDE	23	<10	2800	61	24
METHYL ETHYL KETONE	N	N	56	N	57

Table 4-6

VOLATILE ORGANIC PRIORITY POLLUTANT ANALYSIS UNIT=PPB

FACILITY: BURIAL GROUND

LOCATION OF STATION 13A: STREAM 1A BEFORE DISCHARGE INTO BEAR CREEK
LOCATION OF STATION 14A: BEAR CREEK, UPSTREAM OF STREAM 1A DISCHARGE
LOCATION OF STATION 15A: BEAR CREEK, DOWNSTREAM OF STREAM 1A DISCHARGE

VOLATILE ORGANIC	STATION 13A 9/21/83		STATION 14A 9/23/83		STATION 15A 9/23/83	
	WATER	SEDIMENT	WATER	SEDIMENT	WATER	SEDIMENT
ACROLEIN	N	N	N	N	N	N
ACRYLONITRILE	N	N	N	N	N	N
BENZENE	17	N	N	<10	12	<10
BROMOFORM	N	N	N	N	N	N
CARBON TETRACHLORIDE	12	N	N	N	11	N
CHLOROBENZENE	N	N	N	N	N	N
CHLORODIBROMOMETHANE	N	N	N	N	N	N
CHLOROETHANE	N	N	N	N	<10	N
2-CHLOROETHYL VINYL ETHER	N	N	N	N	N	N
CHLOROFORM	24	<10	N	N	22	<10
DICHLOROBROMOMETHANE	N	N	N	N	N	N
DICHLORODIFLUOROMETHANE	N	N	N	N	N	N
1,1-DICHLOROETHANE	65	27	N	N	50	16
1,2-DICHLOROETHANE	<10	N	N	N	<10	<10
1,1-DICHLOROETHYLENE	19	N	N	N	21	12
1,2-DICHLOROPROPANE	N	N	N	N	N	N
CIS-1,3-DICHLOROPROPYLENE	N	N	N	N	N	N
TRANS-1,3-DICHLOROPROPYLENE	N	N	N	N	N	N
ETHYL BENZENE	N	N	N	N	N	N
METHYL BROMIDE	N	N	N	N	N	N
METHYL CHLORIDE	N	N	N	N	N	N
METHYLENE CHLORIDE	N	15	<10	<10	<10	N
1,1,2,2-TETRACHLOROETHANE	N	N	N	N	N	N
TETRACHLOROETHYLENE	126	24	N	N	102	270
TOLUENE	N	N	N	N	N	N
TRANS-1,2-DICHLOROETHYLENE	1027	11	N	N	831	330
1,1,1-TRICHLOROETHANE	73	<10	N	N	68	38
1,1,2-TRICHLOROETHANE	<10	N	N	N	<10	N
TRICHLOROETHYLENE	96	<10	N	N	82	59
TRICHLOROFLUOROMETHANE	N	N	N	N	<10	N
VINYL CHLORIDE	148	N	N	N	92	<10
METHYL ETHYL KETONE	N	20	<10	N	<10	20

TABLE 4-7
BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY POLLUTANTS
IN WATER
UNIT=PPB (PARTS PER BILLION)

OIL RETENTION POND DRAINAGE
WITHIN BURIAL GROUND AREAS

BASE-NEUTRAL EXTRACTABLE ORGANIC	STATION 6A WATER PHASE	6A OIL PHASE	10A SURFACE OIL PHASE
ACENAPHTHENE	N	N	N
ACENAPHTHYLENE	N	N	N
ANTHRACENE	N	N	N
BENZIDINE	N	N	N
BENZO(A)ANTHRACENE	N	N	N
BENZO(A)PYRENE	N	N	N
3,4-BENZOFLUORANTHENE*	N	N	N
BENZO(GHI)PERYLENE	N	N	N
BIS(2-CHLOROETHOXY)METHANE	N	N	N
BIS(2-CHLOROETHYL)ETHER	N	N	N
BIS(2-CHLOROISOPROPYL)ETHER	N	N	N
BIS(2-ETHYLHEXYL)PHTHALATE	120	370	580
4-BROMOPHENYL PHENYL ETHER	N	N	N
BUTYL BENZYLPHTHALATE	N	N	N
2-CHLORONAPHTHALENE	N	N	N
4-CHLORO-PHENYL PHENYL ETHER	N	N	N
CHRYSENE	N	N	N
DIBENZO(A,H)ANTHRACENE	N	N	N
1,2-DICHLOROBENZENE	N	N	N
1,3-DICHLOROBENZENE	N	N	N
1,4-DICHLOROBENZENE	N	N	N
3,3'-DICHLOROBENZIDINE	N	N	N
DIETHYLPHTHALATE	N	N	N
DIMETHYLPHTHALATE	N	N	N
DI-N-BUTYLPHTHALATE	N	N	N
2,4-DINITROTOLUENE	N	N	N
2,6-DINITROTOLUENE	N	N	N
DI-N-OCTYLPHTHALATE	N	N	N
1,2-DIPHENYLHYDRAZINE**	N	N	N
FLUORANTHENE	N	N	N
FLUORENE	N	N	N
HEXACHLOROBENZENE	N	N	N
HEXACHLOROBUTADIENE	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N
HEXACHLOROETHANE	N	N	N
INDENO(1,2,3-CD)PYRENE	N	N	N
ISOPHORONE	N	N	N
NAPHTHALENE	N	N	N
NITROBENZENE	N	N	N
N-NITROSODIMETHYLAMINE	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N
N-NITROSODIPHENYLAMINE***	N	N	N
PHENANTHRENE	N	N	N
PYRENE	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	N	N	N

* AND/OR BENZO(K)FLUORANTHENE - ISOMERIC PAIRS
** DETECTED AS AZOBENZENE
*** DETECTED AS DIPHENYLAMINE

TABLE 4-8
ACID EXTRACTABLE ORGANIC PRIORITY POLLUTANTS
IN WATER
UNIT=PPB (PARTS PER BILLION)

OIL RETENTION POND DRAINAGE
WITHIN BURIAL GROUND AREAS

ACID EXTRACTABLE ORGANIC	STATION 6A WATER PHASE	6A OIL PHASE	10A SURFACE OIL PHASE
2-CHLOROPHENOL	N	N	N
2,4-DICHLOROPHENOL	N	N	N
2,4-DIMETHYLPHENOL (M-XYLENOL)	23	N	N
4,6-DINITRO-O-CRESOL	N	N	N
2,4-DINITROPHENOL	N	N	N
2-NITROPHENOL	N	N	N
4-NITROPHENOL	N	N	N
P-CHLORO-M-CRESOL	N	N	N
PENTACHLOROPHENOL	N	N	N
PHENOL	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N

Table 4-9

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 1A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: ORIGIN OF STREAM 1A

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	<.1	<.1	<.05
AROCLOR 1254	<.3	<.3	<.05
AROCLOR 1260	<.3	<.3	<.05

STATION: 7A
DATE SAMPLED: 20 SEPTEMBER 1983

LOCATION: STREAM 1A, NORTH OF OIL RETENTION POND 1

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	1.4	<.1	2 1
AROCLOR 1254	<.3	<.3	3 1
AROCLOR 1260	<.3	<.3	5

Table 4-10

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 8A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: DIVERSION DITCH NORTH OF OIL RETENTION POND 1

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	<.1	<.1	<.05
AROCLOR 1254	<.3	<.3	<.05
AROCLOR 1260	<.3	<.3	<.05

STATION: 9A
DATE SAMPLED: 26 SEPTEMBER 1983

LOCATION: NORTHWESTERN PORTION OF OIL RETENTION POND

PCB	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	140
AROCLOR 1254	95
AROCLOR 1260	<20

Table 4-11

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 10A
DATE SAMPLED: 28 SEPTEMBER 1983

LOCATION: SUBSURFACE OF OIL RETENTION POND 1

PCB	IN SOLUTION
AROCLOR 1242/1248 AND/OR 1016	1.9
AROCLOR 1254	1.1
AROCLOR 1260	<.3

STATION: 10A
DATE SAMPLED: 28 SEPTEMBER 1983

LOCATION: SURFACE OF OIL RETENTION POND 1

PCB	IN WATER PHASE	IN OIL PHASE (PPM)
AROCLOR 1242/1248 AND/OR 1016	16	1100
AROCLOR 1254	23	1500
AROCLOR 1260	<2	<70

Table 4-12

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 11A
DATE SAMPLED: 26 SEPTEMBER 1983

LOCATION: SOUTHERN PORTION OF OIL RETENTION POND 1

PCB	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	220
AROCLOR 1254	90
AROCLOR 1260	<30

STATION: 12A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: DISCHARGE FROM OIL RETENTION POND 1

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	2.6	.5	2.8
AROCLOR 1254	3	1.1	4.6
AROCLOR 1260	.4	<.3	.8

Table 4-13

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 13A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: STREAM 1A BEFORE DISCHARGE INTO BEAR CREEK

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	.6	<.1	<4
AROCLOR 1254	.5	<.3	23
AROCLOR 1260	<.3	<.3	5.2

STATION: 14A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: BEAR CREEK, UPSTREAM OF STREAM 1A DISCHARGE

PCB	IN SOLUTION	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	<.1	< 05
AROCLOR 1254	<.3	<.05
AROCLOR 1260	< [illegible]	< 05

Table 4-14

PCB ANALYSIS UNIT=PPB
UNLESS OTHERWISE STATED
FACILITY: BURIAL GROUND
STATION: 15A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: BEAR CREEK, DOWNSTREAM OF STREAM 1A DISCHARGE

PCB	IN SOLUTION	SUSPENDED PARTICULATE	IN SEDIMENT (PPM)
AROCLOR 1242/1248 AND/OR 1016	.4	<.1	<.05
AROCLOR 1254	1.2	<.3	2.7
AROCLOR 1260	.4	<.3	.84

Table 4-15

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT-PPM

FACILITY: BURIAL GROUND
STATION 1A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: ORIGIN OF STREAM 1A

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	.23	< 05	28000
ANTIMONY	<.05	<.05	10
ARSENIC	<.2	<.2	80
BARIUM	.075	.063	240
BERYLLIUM	<.001	<.001	<2
BORON	<.01	<.01	5
CADMIUM	<.002	.002	2 3
CALCIUM	13	13	600
CHROMIUM	<.02	<.02	29
COBALT	<.01	<.01	6
COPPER	< 01	<.01	2
IRON	.27	.005	12000
LEAD	<.05	<.05	60
LITHIUM	<.1	<.1	10
MAGNESIUM	6 3	6 1	1600
MANGANESE	.012	.009	230
MOLYBDENUM	<.02	<.02	<2
NICKEL	<.02	<.01	11
SELENIUM	< 2	< 2	<20
SILICON	12	13.5	710
SILVER	< 01	< 01	<1
SODIUM	4 4	4.5	140
STRONTIUM	018	.016	18
THALLIUM	< 3	< 3	<50
TIN	.3	<.2	<50
TITANIUM	< 003	<.003	170
VANADIUM	<.01	.03	19
ZINC	<.01	<.01	56
CYANIDE	< 01		< 5
PHENOLS	<.01		05

Table 4-16

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 7A
DATE SAMPLED: 20 SEPTEMBER 1983

LOCATION: STREAM 1A, NORTH OF OIL RETENTION POND 1

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	<.05	<.05	44000
ANTIMONY	<.05	<.05	14
ARSENIC	<.2	<.2	130
BARIUM	.42	.38	190
BERYLLIUM	<.001	<.001	<1
BORON	.94	.97	2
CADMIUM	<.002	<.002	4.3
CALCIUM	137	139	3800
CHROMIUM	<.02	<.02	41
COBALT	<.01	<.01	11
COPPER	<.01	<.01	10
IRON	5.4	.02	27000
LEAD	<.05	<.05	80
LITHIUM	.2	<.1	30
MAGNESIUM	15	15	4900
MANGANESE	2.8	2.6	230
MOLYBDENUM	<.02	<.02	<2
NICKEL	<.02	<.02	17
SELENIUM	<.2	<.2	<20
SILICON	5.8	7.7	3300
SILVER	<.01	<.01	<1
SODIUM	19	19	1100
STRONTIUM	.17	.16	14
THALLIUM	<.3	<.3	<50
TIN	<.2	<.2	60
TITANIUM	.003	< 003	480
VANADIUM	<.01	.01	35
ZINC	<.01	<.01	37
CYANIDE	< 01		.24
PHENOLS	<.0		< 2

Table 4-17

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 8A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: DIVERSION DITCH NORTH OF OIL RETENTION POND 1

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	98	.05	34000
ANTIMONY	.1	<.05	20
ARSENIC	.3	<.2	100
BARIUM	1.2	.007	160
BERYLLIUM	.003	<.001	2
BORON	.24	.18	<2
CADMIUM	.012	<.002	4
CALCIUM	15	7.5	5000
CHROMIUM	.13	<.02	42
COBALT	.02	<.01	24
COPPER	.05	<.01	8
IRON	137	.06	30000
LEAD	.26	<.05	80
LITHIUM	<.1	<.1	40
MAGNESIUM	8.8	1.8	3800
MANGANESE	1	.011	1400
MOLYBDENUM	<.02	<.02	<2
NICKEL	.04	<.02	26
SELENIUM	<.2	<.2	<2
SILICON	26	1.6	2600
SILVER	.02	<.01	<1
SODIUM	1.2	1.2	170
STRONTIUM	.056	.009	13
THALLIUM	<.3	<.3	<50
TIN	.2	<.2	60
TITANIUM	.059	<.003	250
VANADIUM	.16	<.01	35
ZINC	.12	<.01	69
CYANIDE	<.01		.35
PHENOLS	<.01	—	.06

Table 4-18

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT-PPM

FACILITY: BURIAL GROUND

LOCATION OF STATION 9A: NORTHWESTERN PORTION OF OIL RETENTION POND
LOCATION OF STATION 10A: OIL RETENTION POND 1 DATE SAMPLED: 9/28/83
LOCATION OF STATION 11A: SOUTHERN PORTION OF OIL RETENTION POND 1

PARAMETER	STATION 9A 9/26/83 SEDIMENT	STATION 10A TOTAL IN SUBSURFACE WATER	STATION 10A TOTAL IN SURFACE WATER	STATION 11A 9/26/83 SEDIMENT
ALUMINUM	26000	<.05	<.05	30000
ANTIMONY	10	<.05	<.05	10
ARSENIC	50	<.2	<.2	70
BARIUM	140	.26	.28	140
BERYLLIUM	2	<.001	<.001	1
BORON	<2	.79	.93	<2
CADMIUM	2	<.002	<.002	2.3
CALCIUM	1800	101	104	1700
CHROMIUM	24	<.02	<.02	29
COBALT	7	<.01	<.01	8
COPPER	6	<.01	<.01	9
IRON	18000	2	1.8	15000
LEAD	50	<.05	<.05	50
LITHIUM	30	.1	<.1	40
MAGNESIUM	2600	13	13	2800
MANGANESE	180	1.6	2.1	150
MOLYBDENUM	<2	<.02	<.02	<2
NICKEL	11	<.02	<.02	13
SELENIUM	<20	<.2	<.2	<20
SILICON	<5	5	5.1	<5
SILVER	<1	<.01	<.01	<1
SODIUM	460	17	111	690
STRONTIUM	21	.14	.14	23
THALLIUM	<50	<.3	<.3	<50
TIN	<50	<.2	<.2	<50
TITANIUM	880	.007	<.003	970
VANADIUM	24	<.01	<.01	27
ZINC	26	<.01	<.01	35
CYANIDE		<.01	<.01	
PHENOLS			.02	

Table 4-19

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 12A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: DISCHARGE FROM OIL RETENTION POND 1

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	7.8	<.05	23000
ANTIMONY	<.05	<.05	10
ARSENIC	<.2	<.2	60
BARIUM	.26	.14	57
BERYLLIUM	<.001	<.001	1
BORON	.63	.68	<2
CADMIUM	<.002	.002	2
CALCIUM	76	74	790
CHROMIUM	< 02	<.02	17
COBALT	<.01	<.01	2
COPPER	<.01	<.01	2
IRON	12	.04	13000
LEAD	<.05	<.05	40
LITHIUM	< 1	<.1	20
MAGNESIUM	10	9.5	1700
MANGANESE	1.2	.4	430
MOLYBDENUM	<.02	<.02	<2
NICKEL	<.02	<.02	6
SELENIUM	<.2	<.2	<2
SILICON	3.4	4.3	3400
SILVER	<.01	<.01	<1
SODIUM	12	12	200
STRONTIUM	.1	.095	5 2
THALLIUM	<.3	<.3	<50
TIN	<.2	<.2	<50
TITANIUM	.028	<.003	300
VANADIUM	.01	< 01	16
ZINC	<.01	<.01	21
CYANIDE	< 01		.2
PHENOLS	< 01		.21

Table 4-20

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 13A
DATE SAMPLED: 21 SEPTEMBER 1983

LOCATION: STREAM 1A BEFORE DISCHARGE INTO BEAR CREEK

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	1	<.05	33000
ANTIMONY	<.05	<.05	20
ARSENIC	<.2	<.2	100
BARIUM	.15	.12	150
BERYLLIUM	<.001	<.001	3
BORON	.69	.64	<2
CADMIUM	<.002	<.002	3.8
CALCIUM	72	72	1600
CHROMIUM	<.02	<.02	48
COBALT	<.01	.01	20
COPPER	<.01	.01	2
IRON	2.4	.03	36000
LEAD	<.05	<.05	90
LITHIUM	.6	1	30
MAGNESIUM	9.6	9.3	3400
MANGANESE	1.5	1.2	950
MOLYBDENUM	<.02	<.02	<2
NICKEL	<.02	<.02	20
SELENIUM	<.2	<.2	<2
SILICON	5.3	5.2	1200
SILVER	<.01	<.01	<1
SODIUM	14	13	710
STRONTIUM	.095	.089	12
THALLIUM	<.3	<.3	<50
TIN	<.2	<.2	60
TITANIUM	.012	<.003	390
VANADIUM	<.01	<.01	33
ZINC	<.01	<.01	52
CYANIDE	<.01		.17
PHENOLS	<.01		.08

Table 4-21

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 14A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: BEAR CREEK, UPSTREAM OF STREAM 1A DISCHARGE

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	<.05	<.05	18000
ANTIMONY	<.05	<.05	<10
ARSENIC	<.2	<.2	40
BARIUM	.15	.14	120
BERYLLIUM	<.001	<.001	2
BORON	.14	.18	4
CADMIUM	<.002	<.002	8
CALCIUM	107	105	52000
CHROMIUM	<.02	<.02	29
COBALT	<.01	<.01	17
COPPER	<.01	<.01	7
IRON	.05	<.005	20000
LEAD	<.05	<.05	50
LITHIUM	<.1	<.1	30
MAGNESIUM	25	24	6700
MANGANESE	.004	.004	1200
MOLYBDENUM	<.02	< 02	<2
NICKEL	<.02	<.02	44
SELENIUM	< 2	<.2	<20
SILICON	3 2	4.1	220
SILVER	<.01	<.01	2
SODIUM	16	15	310
STRONTIUM	.13	.11	59
THALLIUM	< 3	<.3	<50
TIN	< 2	< 2	<50
TITANIUM	004	< 003	360
VANADIUM	< 01	.02	26
ZINC	<.01	<.01	31
CYANIDE	01		
PHENOLS	< 01		

Table 4-22

METALS (ICAP/AA ANALYSIS), CYANIDE & PHENOLS UNIT=PPM

FACILITY: BURIAL GROUND
STATION 15A
DATE SAMPLED: 23 SEPTEMBER 1983

LOCATION: BEAR CREEK, DOWNSTREAM OF STREAM 1A DISCHARGE

PARAMETER	TOTAL	DISSOLVED	IN SEDIMENT
ALUMINUM	<.05	<.05	15000
ANTIMONY	<.05	<.05	10
ARSENIC	<.2	<.2	50
BARIUM	.42	.16	110
BERYLLIUM	<.001	<.001	3
BORON	.42	.49	3
CADMIUM	<.002	<.002	11
CALCIUM	111	109	1300
CHROMIUM	<.02	<.02	23
COBALT	<.01	.01	19
COPPER	<.01	<.01	8
IRON	.48	.02	15000
LEAD	<.05	<.05	30
LITHIUM	1.4	2.6	60
MAGNESIUM	18	18	1200
MANGANESE	2	1.8	2300
MOLYBDENUM	<.02	<.02	2
NICKEL	.04	.03	68
SELENIUM	<.2	<.2	<20
SILICON	4.2	5.4	220
SILVER	<.01	<.01	1
SODIUM	22	20	240
STRONTIUM	.14	.12	5.4
THALLIUM	<.3	<.3	<50
TIN	<.2	< 2	80
TITANIUM	<.003	<.003	180
VANADIUM	<.01	<.01	17
ZINC	<.01	<.01	100
CYANIDE	.01		<.5
PHENOLS	< 01		1

Table 4-23

MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS AND RELATED PARAMETERS
UNIT=PPM UNLESS OTHERWISE STATED

FACILITY: BURIAL GROUND

LOCATION OF STATION 1A: ORIGIN OF STREAM 1A
LOCATION OF STATION 7A: STREAM 1A, NORTH OF OIL RETENTION POND 1

PARAMETER	STATION 1A 9/23/83	STATION 7A 9/20/83
TOTAL SUSPENDED SOLIDS	20	20
TOTAL DISSOLVED SOLIDS	100	780
METHYL ORANGE ALKALINITY (AS CACO3)	80	150
PHENOLTHALINE ALKALINITY (AS CACO3)	<1	<1
CONDUCTIVITY (IN UMHOS/CM)	121	1008
SULFATE	6	1
CHLORIDE	1	260
NITRATE - N	.03	.02
AMMONIA - N	.05	.51
TOTAL KJELDAHL NITROGEN	.14	.8
ORTHO PHOSPHATE - P	.06	<.01
FLUORIDE	<.1	.9
CHEMICAL OXYGEN DEMAND	<1	50
BIOCHEMICAL OXYGEN DEMAND	1	4
DISSOLVED ORGANIC CARBON	1	6
TOTAL ORGANIC CARBON	3	12
OIL & GREASE IN WATER	1	1.3
OIL & GREASE IN SEDIMENT	434	1200
MEAN PH (IN PH UNITS, N EQUALS 3)	7.61	6.93
DISSOLVED OXYGEN	9.2	4.2
MEAN REDOX (IN MV, N EQUALS 3)	231	73

Table 4-24

MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS AND RELATED PARAMETERS
UNIT=PPM UNLESS OTHERWISE STATED

FACILITY: BURIAL GROUND

LOCATION OF STATION 8A: DIVERSION DITCH NORTH OF OIL RETENTION POND 1
LOCATION OF STATION 12A: DISCHARGE FROM OIL RETENTION POND 1

PARAMETER	STATION 8A 9/21/83	STATION 12A 9/21/83
TOTAL SUSPENDED SOLIDS	3920	240
TOTAL DISSOLVED SOLIDS	140	430
METHYL ORANGE ALKALINITY (AS CACO3)	34	88
PHENOLTHALINE ALKALINITY (AS CACO3)	<1	<1
CONDUCTIVITY (IN UMHOS/CM)	66	610
SULFATE	25	7
CHLORIDE	2.5	145
NITRATE - N	.02	<.01
AMMONIA - N	.28	.15
TOTAL KJELDAHL NITROGEN	3.7	.95
ORTHO PHOSPHATE - P	<.01	<.01
FLUORIDE	.3	.33
CHEMICAL OXYGEN DEMAND	100	65
BIOCHEMICAL OXYGEN DEMAND	4	9
DISSOLVED ORGANIC CARBON	6	12
TOTAL ORGANIC CARBON	5	12
OIL & GREASE IN WATER	13	6 8
OIL & GREASE IN SEDIMENT	305	1156
MEAN PH (IN PH UNITS, N EQUALS 3)	7.64	6.63
DISSOLVED OXYGEN	8.8	8.2
MEAN REDOX (IN MV, N EQUALS 3)	183	113

Table 4-25

MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS AND RELATED PARAMETERS
UNIT=PPM UNLESS OTHERWISE STATED

FACILITY: BURIAL GROUND

LOCATION OF STATION 10A: OIL RETENTION POND 1
DATE SAMPLED: 28 SEPTEMBER 1983

PARAMETER	STATION 10A	
	SUBSURFACE WATER	SURFACE WATER
TOTAL SUSPENDED SOLIDS	14	1080
TOTAL DISSOLVED SOLIDS	620	370
METHYL ORANGE ALKALINITY (AS CACO3)	102	112
PHENOLTHALINE ALKALINITY (AS CACO3)	<1	<1
CONDUCTIVITY (IN UMHOS/CM)	716	832
SULFATE	5	5
CHLORIDE	210	3
NITRATE - N	.03	<.01
AMMONIA - N	.08	.2
TOTAL KJELDAHL NITROGEN	.58	2
ORTHO PHOSPHATE - P	.01	.06
FLUORIDE	.1	.5
CHEMICAL OXYGEN DEMAND	54	910
BIOCHEMICAL OXYGEN DEMAND	5	212
DISSOLVED ORGANIC CARBON	29	41
TOTAL ORGANIC CARBON	34	188
OIL & GREASE IN WATER		397
OIL & GREASE IN SEDIMENT		
MEAN PH (IN PH UNITS, N EQUALS 3)	7 3	
DISSOLVED OXYGEN		
MEAN REDOX (IN MV, N EQUALS 3)	282	

Table 4-26

MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS AND RELATED PARAMETERS
UNIT=PPM UNLESS OTHERWISE STATED

FACILITY: BURIAL GROUND
LOCATION OF STATION 13A: STREAM 1A BEFORE DISCHARGE INTO BEAR CREEK
LOCATION OF STATION 14A: BEAR CREEK, UPSTREAM OF STREAM 1A DISCHARGE
LOCATION OF STATION 15A: BEAR CREEK, DOWNSTREAM OF STREAM 1A DISCHARGE

PARAMETER	STATION 13A 9/21/83	STATION 14A 9/23/83	STATION 15A 9/23/83
TOTAL SUSPENDED SOLIDS	40	<1	12
TOTAL DISSOLVED SOLIDS	410	520	552
METHYL ORANGE ALKALINITY (AS CACO3)	100	266	212
PHENOLTHALINE ALKALINITY (AS CACO3)	<1	<1	<1
CONDUCTIVITY (IN UMHOS/CM)	590	711	812
SULFATE	21	24	37
CHLORIDE	120	27	120
NITRATE - N	08	58	22
AMMONIA - N	.14	.64	.18
TOTAL KJELDAHL NITROGEN	.7	.13	1
ORTHO PHOSPHATE - P	<.01	<.01	< 01
FLUORIDE	.2	.3	.2
CHEMICAL OXYGEN DEMAND	30	7	30
BIOCHEMICAL OXYGEN DEMAND	4	2	3
DISSOLVED ORGANIC CARBON	10	5	9
TOTAL ORGANIC CARBON	10	28	9
OIL & GREASE IN WATER	27	1	<1
OIL & GREASE IN SEDIMENT	1217		683
MEAN PH (IN PH UNITS, N EQUALS 3)	6 55	8 11	7 78
DISSOLVED OXYGEN	10 6	9 3	8 2
MEAN REDOX (IN MV, N EQUALS 3)	199	159	126

Table 4-27

PCBs
UNITS = PPB
POND 2 SUBWATERSHED

Station 16A	Surface and Subsurface of Oil Retention Pond No. 2
Station 17A	Perimeter of Oil Retention Pond No. 2
Station 19A	Stream 2A, Northeast of Isolation Area
Station 20A	Stream 2A, Before Discharge into Bear Creek

PCB In Sediment	16A Subsurface	16A Surface	17A	19A	20A
AROCLOR 1242/1248 AND/OR 1016	---	---	6.7	---	<0.05
AROCLOR 1254	---	---	1.7	---	<0.05
AROCLOR 1260	---	---	<0.4	---	<0.05
PCB In Solution					
AROCLOR 1242/1248 AND/OR 1016	5.2	390	---	<0.1	<0.1
AROCLOR 1254	2.8	210	---	<0.3	<0.3
AROCLOR 1260	<0.5	<30	---	<0.3	<0.3
PCB Suspended Particulate					
AROCLOR 1242/1248 AND/OR 1016	---	---	---	---	<0.1
AROCLOR 1254	---	---	---	---	<0.3
AROCLOR 1260	---	---	---	---	<0.3

Table 4-28

VOLATILE ORGANIC PRIORITY POLLUTANTS
IN SEDIMENT
UNIT = PPB (PARTS PER BILLION)
POND 2 SUBWATERSHED

Station 17A Perimeter of Oil Retention Pond No. 2

VOLATILE ORGANIC	Station 17A
ACROLEIN	N
ACRYLCNITRILE	N
BENZENE	N
BROMOFORM	N
CARBON TETRACHLORIDE	N
CHLOROBENZENE	N
CHLORODIBROMOMETHANE	N
CHLOROETHANE	N
2-CHLOROETHYL VINYL ETHER	N
CHLOROFORM	N
DICHLOROBROMOMETHANE	N
DICHLORODIFLUOROMETHANE	N
1,1-DICHLOROETHANE	13
1,2-DICHLOROETHANE	N
1,1-DICHLOROETHYLENE	N
1,2-DICHLOROPROPANE	N
CIS-1,3-DICHLOROPROPYLENE	N
TRANS-1,3-DICHLOROPROPYLENE	N
ETHYL BENZENE	N
MEHTYL BROMIDE	N
METHYL CHLORIDE	N
METHYLENE CHLORIDE	N
1,1,2,2-TETRACHLOROETHANE	N
TETRACHLOROETHYLENE	83
TOLUENE	43
TRANS-1,2-DICHLOROETHYLENE	110
1,1,1-TRICHLOROETHANE	N
1,1,2-TRICHLOROETHANE	N
TRICHLOROETHYLENE	30
TRICHLOROFLUOROMETHANE	N
VINYL CHLORIDE	10

Table 4-29

TOTAL METALS (DETERMINED BY ICAP/AA ANALYSIS),
TOTAL MERCURY, CYANIDE & PHENOLS IN SEDIMENT
UNIT = PPM (PARTS PER MILLION)
POND 2 SUBWATERSHED

Station 17A Perimeter of Oil Retention Pond No. 2
Station 20A Stream 2A, Before Discharge into Bear Creek

METAL	17A	20A
ALUMINUM	26000	21600
ANTIMONY	<10	<10
ARSENIC	70	80
BARIUM	170	220
BERYLLIUM	1	<1
BORON	<2	4
CADMIUM	1.9	3
CALCIUM	130	1350
CHROMIUM	20	24
COBALT	12	12
COPPER	3	19
IRON	13000.	16200
LEAD	30	75
LITHIUM	30	40
MAGNESIUM	2100	1860
MANGANESE	390	2030
MOLYBDENUM	<2	<2
NICKEL	10	19
SELENIUM	<20	<20
SILICON	290	34
SILVER	<1	<1
SODIUM	480	640
STRONTIUM	18	23
THALLIUM	<50	<50
TIN	<50	<50
TITANIUM	750	370
VANADIUM	24	26
ZINC	24	64
URANIUM	<200	372
CYANIDE	<0.5	
PHENOLS	3.2	
MERCURY		

Table 4-30

TOTAL METALS (DETERMINED BY ICAP/AA ANALYSIS),
CYANIDE & PHENOLS IN WATER
UNIT = PPM (PARTS PER MILLION)
POND 2 SUBWATERSHED

Station 16A Surface and Subsurface of Oil Retention Pond No. 2
Station 19A Stream 2A, Northeast of Isolation Area

METAL	Station 16A SUBSURFACE	Station 16A SURFACE	Station 19A
ALUMINUM	0.57	0.22	0.98
ANTIMONY	<0.05	<0.05	<0.05
ARSENIC	<0.2	<0.2	<0.2
BARIUM	0.017	0.017	0.15
BERYLLIUM	<0.001	<0.001	<0.001
BORON	0.04	0.02	1.6
CADMIUM	<0.002	<0.002	<0.002
CALCIUM	3.2	3.2	66
CHROMIUM	<0.02	<0.02	<0.02
COBALT	<0.01	<0.01	<0.01
COPPER	<0.01	<0.01	<0.01
IRON	2.5	2.6	1.5
LEAD	<0.05	<0.05	<0.05
LITHIUM	<0.1	<0.1	<0.1
MAGNESIUM	2.2	2.2	11
MANGANESE	0.54	0.55	0.38
MOLYBDENUM	<0.02	<0.02	<0.02
NICKEL	<0.02	<0.02	0.03
SELENIUM	<0.2	<0.2	<0.2
SILICON	2.5	2.1	1.6
SILVER	<0.01	<0.01	<0.01
SODIUM	14	14	50
STRONTIUM	0.0066	0.0068	0.079
THALLIUM	0.4	<0.3	<0.3
TIN	<0.2	<0.2	<0.2
TITANIUM	0.003	<0.003	0.005
VANADIUM	<0.01	<0.01	<0.01
ZINC	<0.01	<0.01	<0.01
URANIUM	<0.5	<0.5	4
CYANIDE	<0.01	<0.01	0.01
PHENOLS	0.01	0.02	<0.01

Table 4-31

VOLATILE ORGANIC PRIORITY POLLUTANTS
IN WATER
UNIT = PPB (PARTS PER BILLION)
PONE 2 SUBWATERSHED

Station 16A Surface and Subsurface of Oil Retention Pond No. 2
Station 19A Stream 2A, Northeast of Isolation Area
Station 20A Stream 2A, Before Discharge into Bear Creek

VOLATILE ORGANIC	16A SUBSURFACE	16A SURFACE	19A	20A
ACROLEIN	N	N	N	N
ACRYLONITRILE	N	N	N	N
BENZENE	N	<10	N	N
BROMOFORM	N	N	N	N
CARBON TETRACHLORIDE	N	N	N	N
CHLOROBENZENE	N	N	N	N
CHLORODIBROMOMETHANE	N	N	N	N
CHLOROETHANE	N	N	N	N
2-CHLOROETHYL VINYL ETHER	N	N	N	N
CHLOROFORM	N	N	N	N
DICHLOROBROMOMETHANE	N	N	N	N
DICHLORODIFLUOROMETHANE	N	N	N	N
1,1-DICHLOROETHANE	N	N	11	N
1,2-DICHLOROETHANE	N	N	N	N
1,1-DICHLOROETHYLENE	N	N	N	N
1,2-DICHLOROPROPRANE	N	N	N	N
CIS-1,3-DICHLOROPROPYLENE	N	N	N	N
TRANS-1,3-DICHLOROPROPYLENE	N	N	N	N
ETHYL BENZENE	N	N	N	N
METHYL BROMIDE	N	N	N	N
METHYL CHLORIDE	N	N	N	N
METHYLENE CHLORIDE	N	N	14	N
1,1,2,2-TETRACHLOROETHANE	N	N	N	N
TETRACHLOROETHYLENE	N	N	<10	N
TOLUENE	N	N	N	N
TRANS-1,2-DICHLOROETHYLENE	N	N	123	N
1,1,1-TRICHLOROETHANE	N	N	N	<10
1,1,2-TRICHLOROETHANE	N	N	N	N
TRICHLOROETHYLENE	N	N	22	N
TRICHLOROFLUOROMETHANE	N	N	N	N
VINYL CHLORIDE	N	N	24	N

ɔle 4-32

MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS
AND RELATED PARAMETERS
UNIT = PPM (PARTS PER MILLION) UNLESS OTHERWISE STATED
PONE 2 SUBWATERSHED

Station 16A Surface and Subsurface of Oil Retention Pond No. 2
17A Perimeter of Oil Retention Pond No. 2
19A Stream 2A, Northeast of Isolation Area
20A Stream 2A, Before Discharge into Bear Creek

PARAMETER	Station				
	16A SUBSURFACE	16A SURFACE	17A	19A	20A
TOTAL SUSPENDED SOLIDS	40	100		40	
TOTAL DISSOLVED SOLIDS	140	80		410	
METHYL ORANGE ALKALINITY (AS CACO3)	26	26		244	
PHENOLTHALINE ALKALINITY (AS CACO3)	<1	<1		<1	
CONDUCTIVITY (IN UMHOS/CM)	47	47		610	
SULFATE	<1	5		51	
CHLORIDE	190	180		30	
NITRATE - N	<0.01	<0.01		3.9	
AMMONIA - N	0.3	0.2		0.23	
TOTAL KJELDAHL NITROGEN	1.2	1		0.85	
ORTHO PHOSPHATE - P	0.02	0.02		0.02	
FLUORIDE	0.15	0.14		0.4	
CHEMICAL OXYGEN DEMAND	160	210		62	
BIOCHEMICAL OXYGEN DEMAND	12	3		2	
DISSOLVED ORGANIC CARBON	45	41		21	
TOTAL ORGANIC CARBON	41	41		23	
OIL & GREASE IN WATER	15	21		1	
OIL & GREASE IN SEDIMENT			29872		
PH (IN PH UNITS)	5.93*	6.17*		7.59*	6.7
DISSOLVED OXYGEN				7.2	7.9
REDOX (IN MV)	185*	219*		215*	242
WATER TEMP. (IN DEGREES CENTIGRADE)	17.7	19.9		19.2	13.6

*THIS VALUE REPRESENTS A MEAN, SAMPLE SIZE=3

5. APPLICABLE STANDARDS, GUIDELINES AND/OR CRITERIA

With few exceptions, there are few legislated standards that pertain to chemical parameters in sediments. Currently, standards exist only for PCBs (50 ppm) in sediments and Mercury (12 ppm) in soils. The concentrations of chemical parameters in the sediments in and around the two oil retention ponds may be compared against the data appearing in Table 5-1, "Criteria and Selected Data for Chemical Parameters in Sediment and Soil." This table was excerpted from a recent report prepared by the Tennessee Valley Authority for the Interagency Task Force.

Table 5-2, "Drinking Water Regulations," is included in this report because it also contains data on the water quality in the oil retention ponds as well as in the streams near of the oil ponds.

Remedial/closure plan activities will also take into consideration Tennessee water quality criteria, a copy of which appears on the next five pages.

TENNESSEE WATER QUALITY CRITERIA

(Rules and Regulations of the State of Tennessee, Chapter 1200-4, Department of Health, Bureau of Environmental Health Services, Division of Water Quality, Rule 3 — General Water Quality Criteria for the Definition and Control of Pollution in the Waters of Tennessee; Adopted May 26, 1967; As last amended October 22, 1982)

1200-4-3-.01 Tennessee Water Quality Control Board

The Water Quality Control Act, Tennessee Code Annotated, Sections 70-324, et seq., makes it the duty of the Water Quality Control Board to study and investigate all problems concerned with the pollution of the waters of the State and with its prevention, abatement, and control and to establish such standards of quality for any waters of the State in relation to their reasonable and necessary use as the Board shall deem to be in the public interest and establish general policies relating to pollution as the Board shall deem necessary to accomplish the purpose of the Act. The following general considerations and criteria shall be used to determine the permissible conditions of waters with respect to pollution and the preventive or corrective measures required to control pollution in various waters or in different sections of the same waters.

1200-4-3-.02 General Considerations.

(1) Tennessee water quality standards shall consist of the general water quality criteria, 1200-4-3, the antidegradation statement, and the stream use classification found in Rule 1200-4-4.

(2) Waters have many uses which in the public interest are reasonable and necessary. Such uses include: sources of water supply for domestic and industrial purposes; propagation and maintenance of fish and other desirable aquatic life; recreational boating and fishing; the final disposal of municipal sewage and industrial waste following adequate treatment; stock watering and irrigation; navigation; generation of power; and the enjoyment of scenic and aesthetic qualities of the waters.

(3) The rigid application of uniform water quality is not desirable or reasonable because of the varying uses of such waters. The assimilative capacity of a stream for sewage and waste varies depending upon various factors including the following: volume of flow, depth of channel, the presence of falls or rapids, rate of flow, temperature, natural characteristics, and the nature of the stream. Also, the relative importance assigned to each use will differ to different waters and sections of waters.

(4) In order to permit the reasonable and necessary uses of the waters of the State, existing pollution should be corrected as rapidly as practicable, and future pollution prevented through the best available technology economically achievable or that greater level of technology necessary to meet water quality standards; i.e., treatment plants or other control measures. There is an economical balance between the cost of sewage and waste treatment and the benefits received inherent in the correction and prevention of present and future pollution.

(5) Sewage, industrial wastes, or other wastes as defined in the Water Quality Control Act, Tennessee Code Annotated, sections 70-324, et seq., shall not be discharged into or adjacent to streams or other surface waters in such quantity and of such character or under such conditions of discharge in relation to the receiving waters as will result in visual or olfactory nuisances, undue interference to other reasonable and necessary uses of the water, or appreciable damage to the natural processes of self-purification. In relation to the various qualities and the specific uses of the receiving waters, no sewage, industrial wastes, or other wastes discharged shall be responsible for conditions that fail to meet the water quality standards outlined herein. Bypassing or accidental spills may be permitted only where necessary to prevent loss of life or severe property damage, or where excessive storm drainage or runoff would damage treatment facilities, and where it is not a routine operation of the facility.

(6) Since all waters of the State are classified for more than one use, the most stringent criteria will be applicable.

1200-4-3-.03 Criteria for Water Conditions.

(1) Domestic Water Supply

(a) Dissolved Oxygen — There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.

(b) pH - The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Hardness or Mineral Compounds — The hardness of or the mineral compounds contained in the water shall not appreciably impair the usefulness of the water as a source of domestic water supply.

(d) Total Dissolved Solids — The total dissolved solids shall at no time exceed 500 mg/l.

(e) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character as may impair the usefulness of the water as a source of domestic water supply.

(f) Turbidity or Color — There shall be no turbidity or color in amounts or characteristics that cannot be reduced to acceptable concentrations by conventional water treatment processes.

(g) Temperature — The maximum water temperature change shall not exceed 3 degrees C relative to an upstream control point. The temperature of the water shall not exceed 30.5 degrees C and the maximum rate of change shall not exceed 2 degrees C per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.

(h) Coliform — The concentration of the fecal coliform group shall not exceed 1,000 per 100 ml, as the geometric mean based on a minimum of 10 samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purpose of determining the geometric mean, individual samples having a fecal coliform group concentration of less than 1 per 100 ml, shall be considered as having a concentration of 1 per 100 ml. In addition, the concentration of the fecal coliform group in any individual sample shall not exceed 5,000 per 100 ml.

(i) Taste or Ordor — The waters shall not contain substances which will result in taste or odor that prevent the production of potable water by conventional water treatment processes.

(j) Toxic Substances — The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man or animals, or impair the safety of conventionally treated water supplies. Available references to be used in determining such conditions shall include, but not be limited to: *Quality Criteria For Water* (Section 304(a) of PL 92-500); Federal Regulations under Section 307 of PL 92-500; and Federal Regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act (PL 93-523). Limits set for some of the most commonly occurring toxic substances are as follows:

Parameter	Criteria (ug/L)
Cadmium	10
Chromium (total)	50
Copper	1,000
Lead	50
Mercury	0.2
Nickel	100
Selenium	10
Silver	50
Zinc	5,000
Cyanide	200

(k) Other Pollutants — The waters shall not contain other pollutants shall not be in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply.

(2) Industrial Water Supply

(a) Dissolved Oxygen — There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.

(b) pH — The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Hardness or Mineral Compounds — The hardness or mineral compounds contained in the water shall not appreciably impair the usefulness of the water as a source of industrial water supply.

(d) Total Dissolved Solids — The total dissolved solids shall at no time exceed 500 mg/l.

(e) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character as may impair the usefulness of the water as a source of industrial water supply.

(f) Turbidity or Color — There shall be no turbidity or color in amounts or characteristics that cannot be reduced to acceptable concentrations by conventional water treatment processes.

(g) Temperature — The maximum water temperature change shall not exceed 3 degrees C relative to an upstream control point. The temperature of the water shall not exceed 30.5 degrees C and the maximum rate of change shall not exceed 2 degrees C per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.

(h) Taste or Odor — The waters shall not contain substances which will result in taste or odor that would prevent the use of the water for industrial processing.

(i) Toxic Substances — The waters shall not contain toxic substances whether alone or in combination with other substances, which will adversely affect industrial processing.

(j) Other Pollutants — The waters shall not contain other pollutants in quantities that may adversely affect the water for industrial processing.

(3) Fish and Aquatic Life

(a) Dissolved Oxygen — The dissolved oxygen shall be a minimum of 5.0 mg/l except in limited sections of streams where it can be clearly demonstrated that (i) the existing quality of the water due to irretrievable man-induced conditions cannot be restored to the desired minimum of 5.0 mg/l dissolved oxygen; (ii) the cost for application of effluent limitations more stringent than those defined through Section 301(b) of the Federal Water Pollution Control Act (PL 92-500) is economically prohibitive when compared with the benefits to be obtained; or (iii) the natural qualities of the

water are less than the desired minimum of 5.0 mg/l. Such exceptions shall be determined on an individual basis but in no instance shall the dissolved oxygen concentration be less than 3.0 mg/l. The dissolved oxygen concentration shall be measured at mid-depth in waters having a total depth of ten (10) feet or less and at a depth of five (5) feet in waters having a total depth of greater than ten (10) feet. The dissolved oxygen concentration of recognized trout streams shall not be less than 6.0 mg/l.

(b) pH — The pH value shall lie within the range of 6.5 to 8.5 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to fish and aquatic life.

(d) Turbidity or Color — There shall be no turbidity or color in such amounts or of such character that will materially affect fish and aquatic life.

(e) Temperature — The maximum water temperature change shall not exceed 3 degrees C relative to an upstream control point. The temperature of the water shall not exceed 30.5 degrees C and the maximum rate of change shall not exceed 2 degrees C per hour. The temperature of recognized trout waters shall not exceed 20 degrees C. There shall be no abnormal temperature changes that may affect aquatic life unless caused by natural conditions. The temperature of impoundments where stratification occurs will be measured at mid-depth in the epilimnion for warm water fisheries and mid-depth in the hypolimnion for cold water fisheries. In the case of large impoundments (100 acres or larger) subject to stratification and recognized as trout waters, the temperature of the hypolimion shall not exceed 20 degrees C. the temperature on flowing streams shall be measured at mid-depth.

(f) Taste or Odor — The waters shall not contain substances that will impart unpalatable flavor to fish or result in noticeable offensive odors in the vicinity of the water or otherwise interfere with fish or aquatic life.

(g) Toxic Substances — The waters shall not contain substances added whether alone or in combination with other substances that will adversely affect fish or aquatic life. The instream concentrations of toxic pollutants shall not exceed 1/10 of the 96-hour LC_{50} based upon available data using one or more of the most sensitive organisms significant to the aquatic community of the waters under consideration. Where there are substances that are toxic due to their cumulative characteristics, other limiting concentrations may be specified on a case-by-case basis within the discharge permit when factually justified and approved by the Commissioner of the Tennessee Department of Public Health. In no event shall the diversity or productivity of biota significant to the aquatic community of the receiving stream be decreased based upon a 96-hour LC_{50} criterion and the appropriate application factor. References to be used in determining toxicity limitations shall include, but not be limited to: *Quality Criteria for Water* (Section 304(a) of PL 92-500), Federal Regulations under Section 307 of PL 92-500, and Federal Regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act (PL 93-523). The use of such information should be limited to that part applicable to the aquatic community found within the receiving stream or waters under consideration.

(h) Other Pollutants — The waters shall not contain other pollutants shall not be added to the waters that will be detrimental to fish or aquatic life.

(i) Coliform — The concentration of the fecal coliform group shall not exceed 1,000 per 100 ml. as a geometric mean based on a minimum of 10 samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purpose of determining the geometric mean, individual samples having a fecal coliform group concentration of less than 1 per 100 ml. shall be considered as having a concentration of 1 per 100 ml. In addition, the concentration of the fecal coliform group in any individual sample shall not exceed 5,000 per 100 ml.

(4) Recreation

(a) Dissolved Oxygen — There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.

(b) pH — The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to recreation.

(d) Turbidity or Color — There shall be no turbidity or color added in such amounts or character that will result in any objectionable appearance to the water.

(e) Temperature — The maximum water temperature change shall not exceed 3 degrees C relative to an upstream control point. The temperature of the water shall not exceed 30.5 degrees C and the maximum rate of change shall not exceed 2 degrees C per hour. The termperature of impoundments where stratification occurs shall be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.

(f) Coliform — The concentration of the fecal coliform group shall not exceed 200 per 100 ml. as the geometric mean based on a minimum of 10 samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purpose of determining the geometric mean, individual samples having a fecal coliform group concentration of less than 1 per 100 ml. shall be considered as having a concentration of 1 per 100 ml. In addition, the concentration of the fecal coliform group in any individual sample shall not exceed 1,000 per 100 ml. Water areas in the vicinity of domestic wastewater treatment plant outfalls are not

considered suitable for body contact recreational purposes.

(g) Taste or Odor — The water shall not contain substances that will result in objectionable taste or odor.

(h) Toxic Substances— The water shall not contain toxic substances, whether alone or in combination with other substances, that will render the waters unsafe or unsuitable for water contact activities, or will propose toxic conditions that will adversely affect man or animal.

(i) Other Pollutants— The water shall not contain other pollutants to the water in quantities which may have a detrimental effect on recreation.

(5) Irrigation.

(a) Dissolved Oxygen — There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.

(b) pH — The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Hardness or Mineral Compounds — The hardness of or the mineral compounds contained in the water shall not impair its use for irrigation.

(d) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character as may impair the usefulness of the water for irrigation purposes.

(e) Temperature — The temperature of the water shall not be raised or lowered to such an extent as to interfere with its use for irrigation purposes.

(f) Toxic Substances — The waters shall not contain toxic substances to water that will produce toxic conditions that will affect the water for irrigation.

(g) Other Pollutants — The waters shall not contain other pollutants in quantities which may be detrimental to the waters used for irrigation.

(6) Livestock Watering and Wildlife.

(a) Dissolved Oxygen — There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.

(b) pH-The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.

(c) Hardness of Mineral Compounds — The hardness of or the mineral compounds contained in the water shall not impair its use for livestock watering and wildlife.

(d) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character as to interfere with livestock watering and wildlife.

(e) Temperature – The temperature of the water shall not be raised or lowered to such an extent as to interfere with its use for livestock watering and wildlife.

(f) Toxic Substances — The waters shall not contain substances, whether alone or in combination with other substances, that will produce toxic conditions that will affect the water for livestock watering and wildlife.

(g) Other Pollutants — The waters shall not contain other pollutants shall not be added to water in quantities which may be detrimental to the water for livestock watering and wildlife.

(7) Navigation.

(a) Solids, Floating Materials and Deposits — There shall be no distinctly visible solids, scum, foam, oily sleek, or the formation of slimes, bottom deposits or sludge banks of such size or character as to interfere with navigation.

(b) Other Pollutants — The waters shall not contain other pollutants in quantities which may be detrimental to the waters used for navigation.

1200-4-3-.04 Definitions

(1) Conventional Water Treatment — Conventional water treatment as referred to in the criteria denotes coagulation, sedimentation, filtration and chlorination.

(2) Mixing Zone — Mixing zone refers to that section of a flowing stream or impounded waters necessary for an effluent to become dispersed and mixed insofar as practical with the main flow or water body by appropriate methods at the discharge point. Such zones shall be restricted to as small an area and length as possible and shall not (i) prevent the free passage of fish or cause aquatic life mortality in the receiving waters; (ii) contain materials, that adequately represent the defined zone, in concentrations that exceed the 96-hour LC50 for biota significant to the aquatic community in the receiving waters; (iii) result in offensive conditions; (iv) produce undesirable aquatic life or result in dominance of a nuisance species; (v) endanger the public health or welfare; or (vi) adversely affect the reasonable and necessary uses of the area.

(3) Terminology not specifically defined herein shall be defined in accordance with the Tennessee Water Quality Control Act. (T.C.A., Sections 70-324 et seq.)

1200-4-3-.05 Interpretation of Criteria

(1) Interpretations of the above criteria shall conform to any rules and regulations or policies adopted by the Water Quality Control Board.

(2) Insofar as practicable, the effect of treated sewage or waste discharges on the receiving water shall be considered after they are mixed with the waters and beyond a reasonable zone of immediate effect. The extent to which this is practicable depends upon local conditions and the proximity and nature of other uses of the waters.

(3) The technical and economical feasibility of waste treatment, recovery, or adjustment of the method of discharge to provide correction shall be considered in determining the time to be allowed for the development of practicable methods and for the specified correction.

(4) The criteria set forth shall be applied on the basis of the following stream flows: unregulated streams — stream flows equal to or exceeding the 3-day minimum, 20-year recurrence interval; regulated streams — all flows in excess of the minimum critical flow occurring once in twenty (20) years as determined by an analysis of records of operation and approved by the Commissioner of the Tennessee Department of Public Health.

(5) In general, deviations from normal water conditions may be undesirable, but the rate and extent of the

deviations should be considered in interpreting the above criteria.

(6) The criteria and standards provide that all discharges of sewage, industrial waste, and other waste shall receive the degree of treatment or effluent reduction necessary to comply with water quality standards, or state or federal laws and regulations pursuant thereto, and where appropriate will comply with the "Standard of Performance" as required by the Tennessee Water Quality Control Act, (T.C.A., Sections 70-324, et seq.)

(7) Where naturally occurring or background water quality conditions are substantial impediments to attainment of the water quality standards, these natural or background conditions shall be taken into consideration in establishing any effluent limitations or restrictions on discharges to such waters.

1200-4-3-.06 Tennessee Antidegradation Statement.

(1) The purpose of the Water Quality Standards and Plan as adopted are to provide for the protection of existing water quality and/or the upgrading or "enhancement" of water quality in all waters within Tennessee. It is recognized that some waters may have existing quality better than established standards.

The latest edition of *Quality Criteria for Water* published by the Environmental Protection Agency pursuant to Section 304(a) of the Federal Water Pollution Control Act (PL 92-500), and other documents as specified by the Commissioner of the Tennessee Department of Public Health and the Water Quality Board shall be used as guides in interpreting the water quality criteria set out in these rules.

(2) The Tennessee Water Quality Standards shall not be construed as permitting the degradation of waters whose existing quality is better than the established standards unless and until it is affirmatively demonstrated to the Tennessee Water Quality Control Board that a change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to any assigned uses made of such waters. In no case will water quality be degraded below the base levels set forth in the criteria for the protection of the reasonable and necessary uses described herein. Additionally, no degradation shall be allowed in high quality waters which constitute an outstanding National resource, such as: waters of National and State parks and wildlife refuges, and waters of exceptional recreational or ecological significance.

(3) All discharges of municipal sewage, industrial waste, or other wastes shall receive the greatest degree of effluent reduction which the Commissioner of the Department of Public Health determines to be achievable through application of stringent effluent limitations and schedules of compliance either promulgated by the Water Quality Control Board: required to implement any applicable water quality standards, including where practicable, a standard permitting no discharge of pollutants: necessary to comply with a State Water Quality Plan: or necessary to comply with other State or Federal laws or regulations.

(4) In implementing the provisions of these rules as they relate to interstate streams, the Commissioner of the Tennessee Department of Public Health and the Tennessee Water Quality Control Board will cooperate with the appropriate Federal Agency in order to assist in carrying out responsibilities under the Federal Water Pollution Control Act, as amended.

TABLE 5-1

CRITERIA AND SELECTED DATA FOR*
CHEMICAL PARAMETERS IN SEDIMENT AND SOIL

Parameter[a] (ppm)	Proposed Virginia Criteria[b]	Average Earth's Crust[c]	Mean Concentrations of Upper Tennessee River[d]	Mean Concentrations of Tributary Streams to Upper Tennessee River[e]	Mean Concentrations of Clinch River[f]
Mercury	0.3	0.5	1.0 (<0.05-4.3)	0.25 (<0.05-0.98)	<0.16[g] (<0.05-0.41)
Cadmium	-	0.2	5.5 (0.4-12.0)	1.8 (<0.4-11.0)	1.4 (<0.4-3.7)
Chromium	-	200	48.0 (14.0-86.0)	19.7 (5.0-46.0)	19.3 (6.3-44.7)
Copper	-	70	38.0 (5.9-67.0)	47.6 (3.0-320.0[h])	18.2 (3.0-48.0)
Lead	-	16	59.7 (<10.0-99.0)	47.9 (<3.0-300.0)	31.6 (13.1-72.0)
Nickel	-	100	33.6 (5.8-57.0)	22.4 (<3.3-70.0)	30.0 (16.0-70.0)
Zinc	-	80	670 (85-1,600)	165 (20-940)	69.6 (31.6-140)
PCBs	-	-	-	-	-
Aluminum	-	81,000	25,590 (3,000-46,000)	8,684 (1,200-21,000)	7,453 (2,720-13,700)
Beryllium	-	6	1.9 (<0.3-4.0)	0.93 (<0.6-1.9)	<1.0 (<0.7-1.0)
Manganese	-	1,000	2,619 (670-5,300)	1,133 (150-14,000)	1,093 (442-3,100)

a. Concentrations given in mg/kg (ppm), dry weight, range in parenthesis.
b. State of Virginia proposed regulation for total mercury in freshwater river sediment.
c. After Y. M. Goldachmidt. Courtesy A. Muir, editor, and Clarendon Press, Oxford, publishers of "Geochemistry," average abundance of trace elements in the crust of the earth.
d. Average concentrations in river sediment for reach from Nickajack Dam to confluence of the Holston and French Broad Rivers, TRMs 424 to 652; 24 sampling locations - 1970 to 1983, TVA STORET data.
e. Average concentrations in river sediment for streams tributary to the Tennessee River between miles 424 and 652; 43 sampling locations 1970 to 1981, TVA STORET data.
f. Average concentrations in Clinch River sediment above Melton Hill Dam, CRM 22; 12 sampling locations - 1970 1981, TVA STORET data.
g. Seven of twelve samples below detection limits.
[illegible] downstream of Copperhill, Tennessee

TABLE 5-2

EPA DRINKING WATER REGULATIONS

Parameter	Maximum level (ppm)
Interim Primary Drinking Water Standards	
Maximum Contaminant Levels For Inorganic Chemicals Other Than Fluorides	
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate as Nitrogen	10
Selenium	0.01
Silver	0.05
Fluoride*	1.4 to 2.4
Maximum Contamination Levels For Organic Chemicals	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01
Total trihalomethanes	0.10
Other Maximum Contamination Levels	
Radium	5 pCi/l
Gross alpha	15 pCi/l
Gross beta	4 millirem/yr
Turbidity**	1/TU
Coliform bacteria	1/100 ml
Secondary Maximum Contamination Levels	
Chloride	250 mg/l
Color	15 color units
Copper	1 mg/l
Corrosibility	Noncorrosive
Foaming agents	0.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor number
pH	6.5-8.5
Sulfate	250 mg/l
Total dissolved solids	500 mg/l
Zinc	5 mg/l

*Depends on maximum air temperature of location

**Applicable only to surface-water supplies

6. ASSESSMENT OF SEDIMENT DATA

6.1 SEDIMENT DATA

Preliminary findings of the assessment include:

1. The following volatile organic priority pollutants were <u>not</u> detected in sediment samples taken in the Burial Ground (See Figures 6-1 through 6-12):

Acrolein	Dichlorobromomethane
Acrylonitrile	Dichlorodifluoromethane
Bromoform	Cis-1,3-Dichloropropylene
Carbon Tetrachloride	Trans-1,3-Dichloropropylene
Chlorodibromomethane	Methyl Bromide
2-Chloroethyl Vinyl Ether	1,1,2,2-Tetrachloroethane

2. The following volatile organic priority pollutants were detected (but not quantitified) at levels less than 10 ppb in sediment samples taken in the Burial Ground (See Figures 6-13 through 6-15):

   Chlorobenzene

   1,2-Dichloropropane

   Methyl Chloride

3. The following volatile organic priority pollutants were detected in sediment samples taken in the Burial Ground (See Figures 6-16 through 6-31):

Benzene	Tetrachloroethylene
Chloroethane	Toluene
Chloroform	Trans-1,2-Dichloroethylene
1,1-Dichloroethane	1,1,1-Trichloroethane

1,2-Dichloroethane	1,1,2-Trichloroethane
1,1-Dichloroethylene	Trichloroethylene Ethyl
Ethyl Benzene	Trichlorofluoromethane
Methylene Chloride	Vinyl Chloride

4. Mercury concentration levels in sediment samples taken in the Burial Ground were below Tennessee's action level of 12.0 ppm in soils (See Figure 6-32). Mercury concentration levels in water samples taken in the Burial Ground were below EPA's drinking water standard of 2 ppb (See Figure 6-33).

5. PCBs were detected at concentration levels less than 0.05 ppm in Burial Ground sediment samples as follows (See Figure 6-34):

Station	Station Location
1A	Background - near the headwaters of Stream 1A
2A	Diversion point of Stream 1A and Diversion Ditch
3A	Tributary stream to Diversion Ditch, northeast of Burial Ground D
5A	Stream 1A, west of nothern trenches in Burial Ground A
8A	Diversion Ditch, north of Oil Retention Pond 2
14A	Bear Creek, upstream of Stream 1A
20A	Stream 2A, before discharge into Bear Creek
21A	Bear Creek, upstream of 2A discharge into Bear Creek
22A	Bear Creek, downstream of 2A discharge into Bear Creek
24A	Stream draining Burial Grounds C and D before discharge into Bear Creek

6. PCBs were detected at concentration levels below EPA action levels (50 ppm) in Burial Ground sediment samples as follows (See Figure 6-34):

Station	Station Location
4A	Northernmost station in Diversion Ditch
7A	Stream 1A, north of Oil Retention Pond 1
12A	Discharge from Oil Retention Pond 1
13A	Stream 1A, before discharge into Bear Creek
15A	Bear Creek, downstream of Stream 1A discharge into Bear Creek
17A	Perimeter of Oil Retention Pond 2
25A	Bear Creek, upstream of stream (that drains Burial Grounds C and D) discharge into Bear Creek
26A	Bear Creek, downstream of stream (that drains Burial Grounds C and D) discharge into Bear Creek

7 PCBs were detected at concentration levels higher than EPA's permitted upper action level (50 ppm) in Burial Ground sediment samples as follows (See Figure 6-34):

Station	Station Location
9A	Northwest portion of Oil Retention Pond 1
11A	Southern portion of Oil Retention Pond 1

As expected, the surface water samples taken from the Oil Retention Ponds contained PCBs at concentration levels that exceed EPA's action level, as follows (See Figure 6-35):

Station	Station Location
6A	Stream 1A, oil seepage from northern trenches in Burial Ground A
10A	Surface and subsurface of Oil Retention Pond 1
16A	Surface and subsurface of Oil Retention Pond 2

All other water samples taken in the Burial Ground were well below EPA's action level of 12.5 ppb.

8. Concentration levels of metals in sediment samples taken from Pond 1 (Stations 9A and 11A), adjacent to Pond 1 (Station 12A) and adjacent to Pond 2 (Station 17A) were all within the range of concentrations in Tennessee River sediments cited by TVA in its report to the Interagency Task Force (See Figures 6-37 through 6-67).

6.2 MISCELLANEOUS CONVENTIONAL AND NONCONVENTIONAL POLLUTANTS OR RELATED PARAMETERS

Total suspended and dissolved solids from the tributary stream show a minor impact on existing conditions in the main stream of Bear Creek. Total suspended solids are below EPA published standards for drinking water. Methyl orange alkalinity does not impact the alkalinity of the main stream. Parameters such as phenolthaline alkalinity, ortho phosphates, and Kjeldahl nitrogen appear to offer no problems (See Figures 6-68 through 6-89).

Conductivity, sulfate, chlorides, fluorides, and inorganic nitrates data, as would be expected, are higher in the seep region. However, these parameters do not adversely affect existing conditions in the main stream. The COD and BOD values observed have trivial effects on the stream. The observed pH in the tributary may benignly influence the main stream. Dissolved oxygen is above state standards except for Station 7A. The 4.2 ppm value observed at Station 7A may be in a slower moving pool or stream as evidenced by its temperature of 19.5 degrees C compared a nominal 14.5 degrees C in the main stream. The oil and grease data, as expected, show the impact of oil seepage in the area.

6.3 ACID EXTRACTABLE ORGANIC PRIORITY POLLUTANTS IN WATER

1. Sediment samples taken from the Oil Retention Ponds in the Burial Grounds were not analyzed for acid extractable organic priority pollutants.
2. The only acid extractable organic priority pollutant detected in water samples taken in the Burial Ground was 2,4-Dimethylphenol (See Figure 6-90).
3. The following acid extractable organic priority pollutants were not detected in water samples taken in the Burial Ground (See Table 4-8).

2-Chlorophenol	4-Nitrophenol
2,4-Dichlorophenol	P-Chloro-M-Cresol
4,6-Dinitro-O-Cresol	Pentachlorophenol
2,4-Dinitrophenol	Phenol
2-Nitrophenol	2,4,6-Trichlorophenol

6.4 BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY POLLUTANTS IN WATER

1. Sediment samples taken from the Oil Retention Ponds in the Burial Grounds were not analyzed for base-neutral extractable organic priority pollutants.
2. The only base-neutral extractable organic priority pollutant detected in water samples taken in the Burial Grounds was Bis(2-Ethylhexyl) Phthalate (See Figure 6-91), a vinyl plasticizer.

3. The following base-neutral extractable organic priority pollutants were <u>not</u> detected in water samples taken in the Burial Grounds (See Table 4-7).

Acenaphthene	Di-N-Butylphthalate
Acenaphthylene	2,4-Dinitrotoluene
Anthracene	2,6-Dinitrotoluene
Benzidine	Di-N-Octylphthalate
Benzo(A)Anthracene	1,2-Diphenylhydrazine**
Benzo(A)Pyrene	Fluoranthene
3,4-Benzofluoranthene*	Fluorene
Benzo(GHI)Perylene	Hexachlorobenzene
Bis(2-Chloroethoxy)Methane	Hexachlorobutadiene
Bis(2-Chloroethyl)Ether	Hexachlorocyclopentadiene
Bis(2-Chloroisopropyl)Ether	Hexachloroethane
4-Bromophenyl Phenyl Ether	Ideno(1,2,3-CD)Pyrene
Butyl Benzylphthalate	Isophorone
2-Chloroanaphthalene	Naphthalene
4-Chloro-Phenyl Phenyl Ether	Nitrobenzene
Chrysene	N-Nitrosodimethylamine
Dibenzo(A,H)Anthracene	N-Nitrosodi-N-Propylamine

1,2-Dichlorobenzene

1,3-Dichlorobenzene

1,4-Dichlorobenzene

3,3'-Dichlorobenzidine

Diethylphthalate

Dimethylphthalate

N-Nitrosodiphenylamine***

Phenanthrene

Pyrene

1,2,4-Trichlorobenzene

2,3,7,8-Tetrachlorodibenzo-P-Dioxin

---

*And/or Benzo(K)Fluoranthrene - Isomeric Pairs

**Detected as Azobenzene

***Detected as Diphenylamine

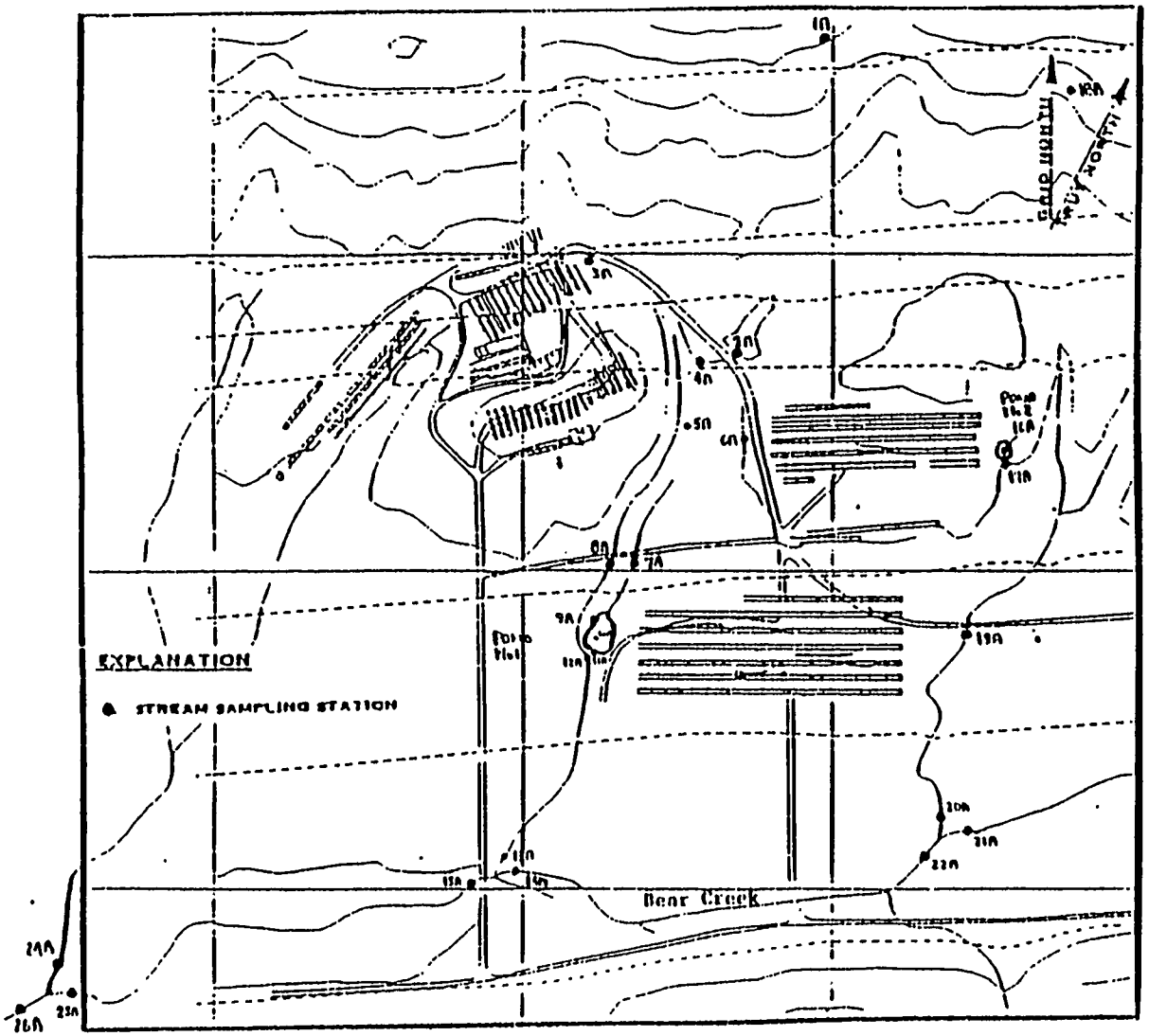


FIGURE 6-1
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	ACROLEIN
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

NOTE:

On all of the following figures:

N = NOT DETECTED

< INDICATES THAT A PARAMETER WAS DETECTED BUT AT A CONCENTRATION LESS THAN THE INDICATED VALUE

BLANK SPACE INDICATES THAT THE ANALYSIS HAS NOT BEEN COMPLETED OR THAT SAMPLES WERE NOT COLLECTED FOR ANALYSIS OF THIS PARAMETER

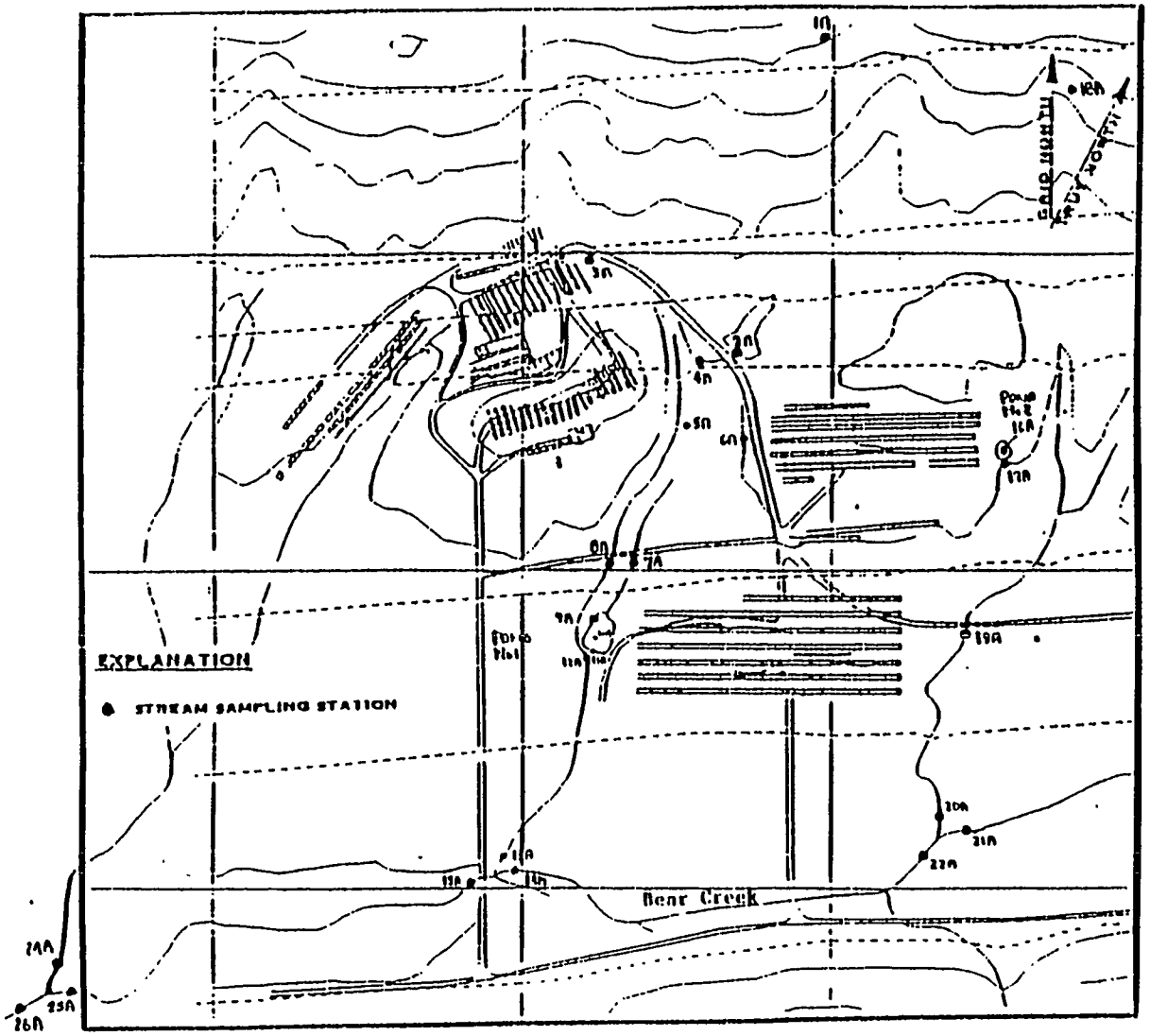


FIGURE 6-2
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	ACRYLONITRILE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

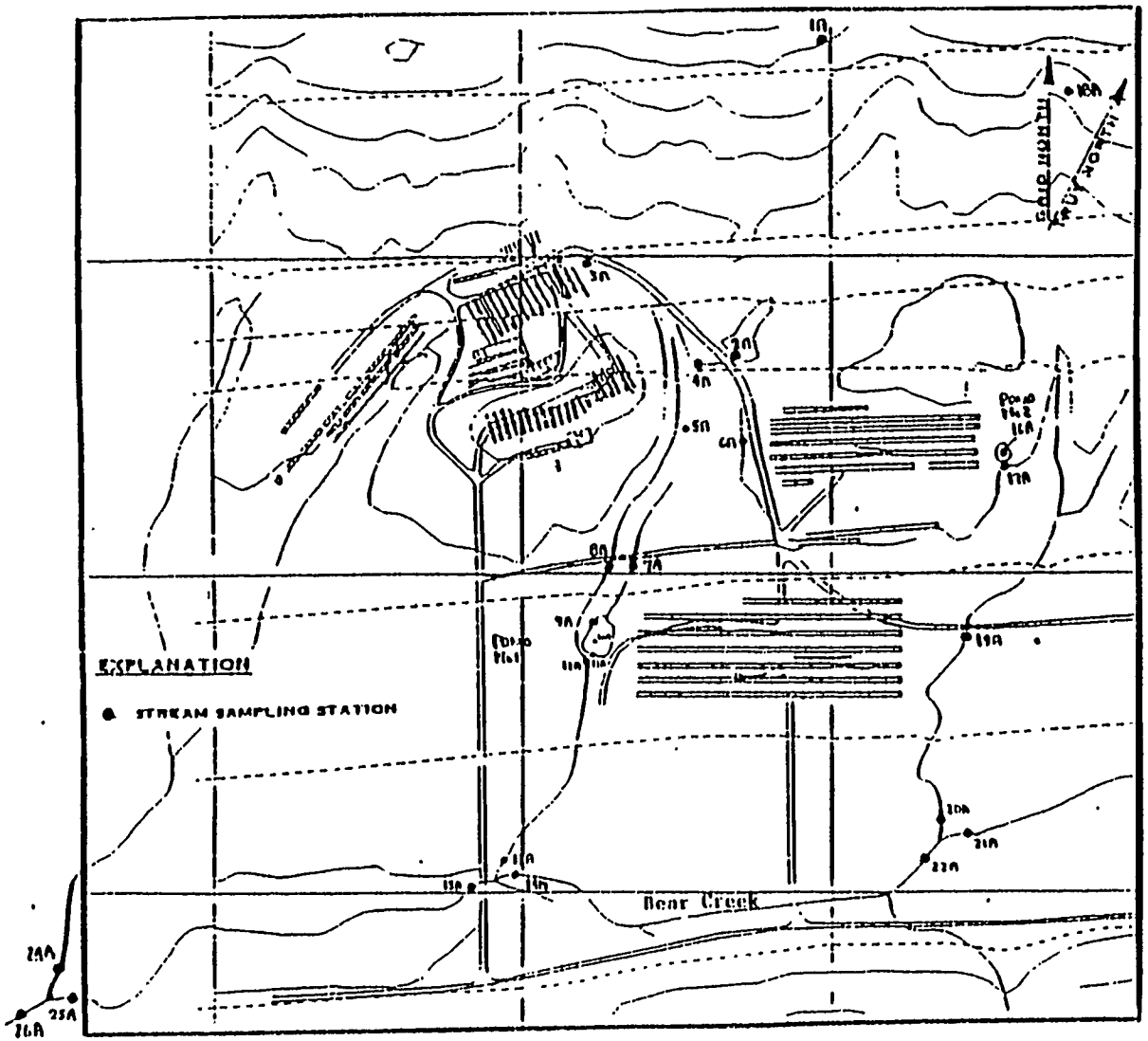


FIGURE 6-3
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	BROMOFORM
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

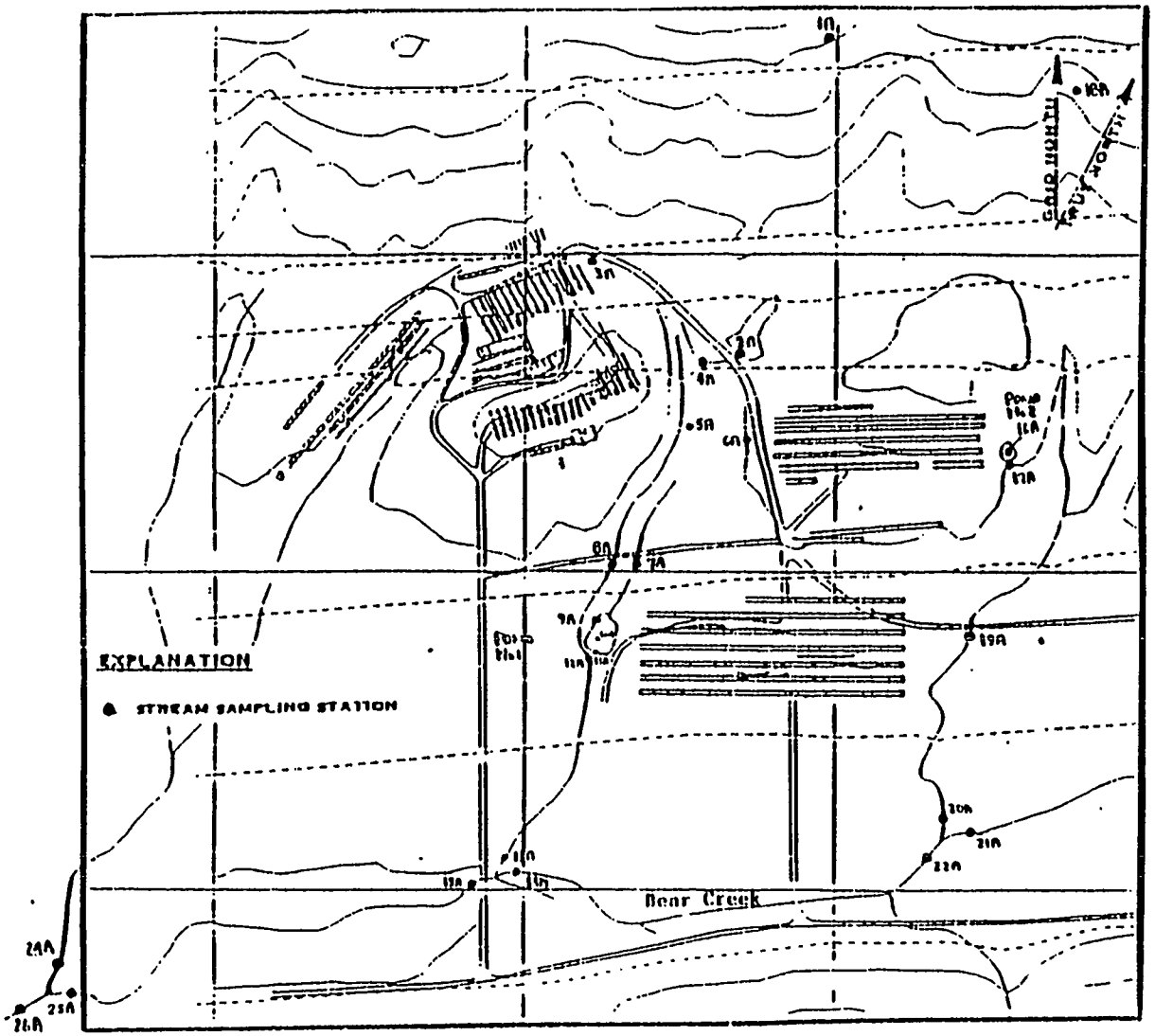


FIGURE 6-4
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CARBON TETRACHLORIDE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

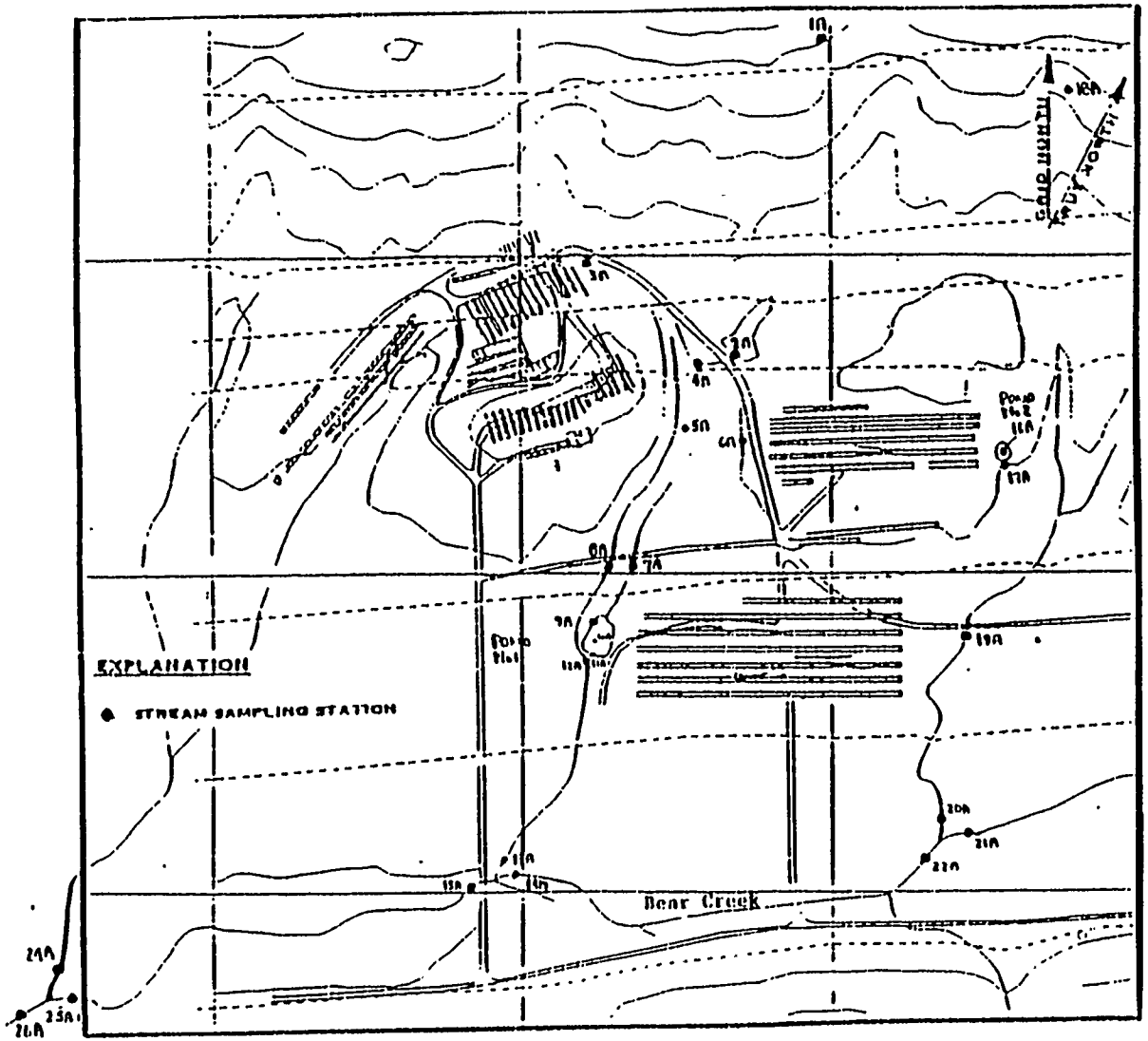


FIGURE 6-5
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CHLORODIBROMOMETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

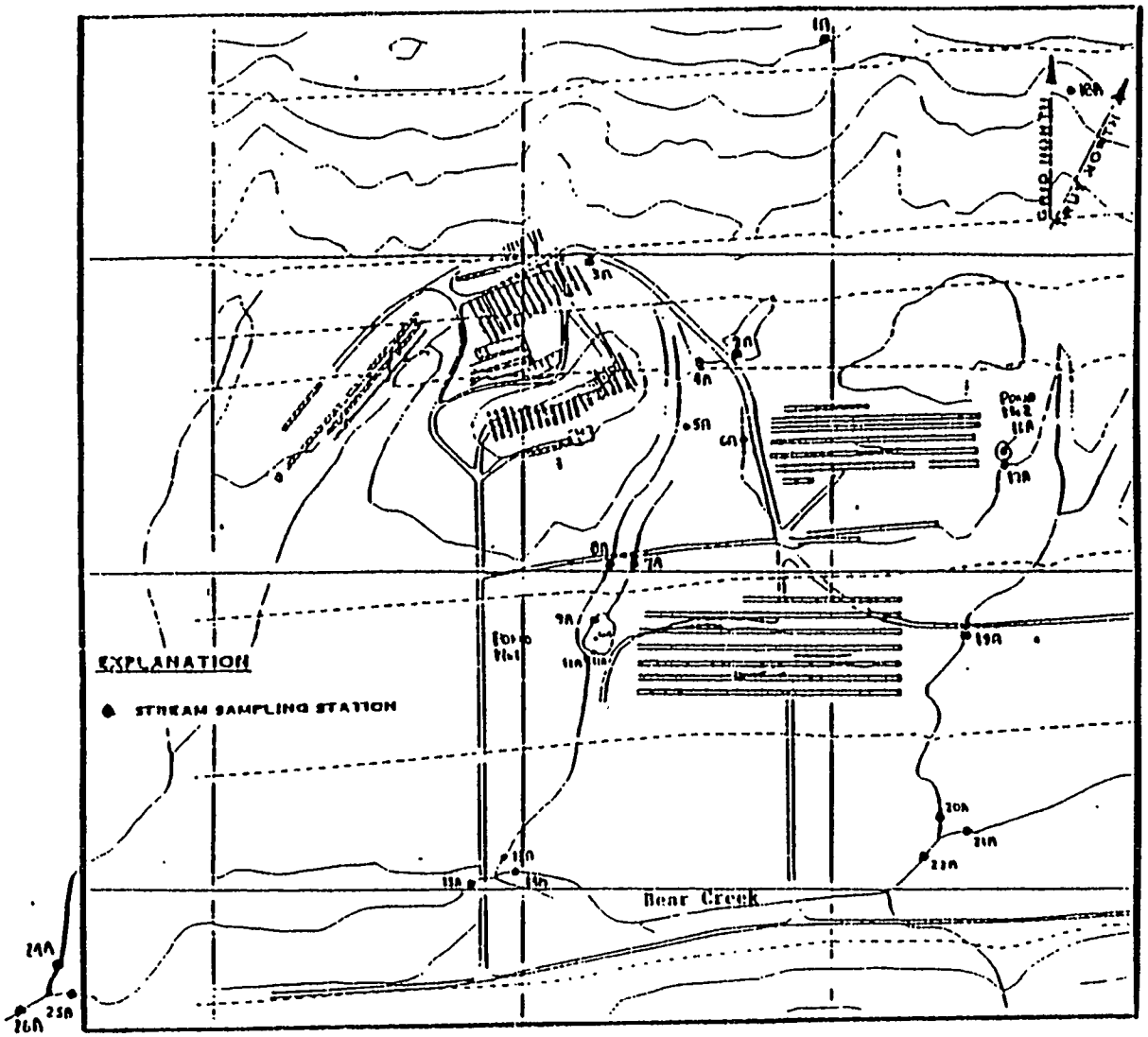


FIGURE 6-6
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	2-CHLOROETHYL VINYL ETHER
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

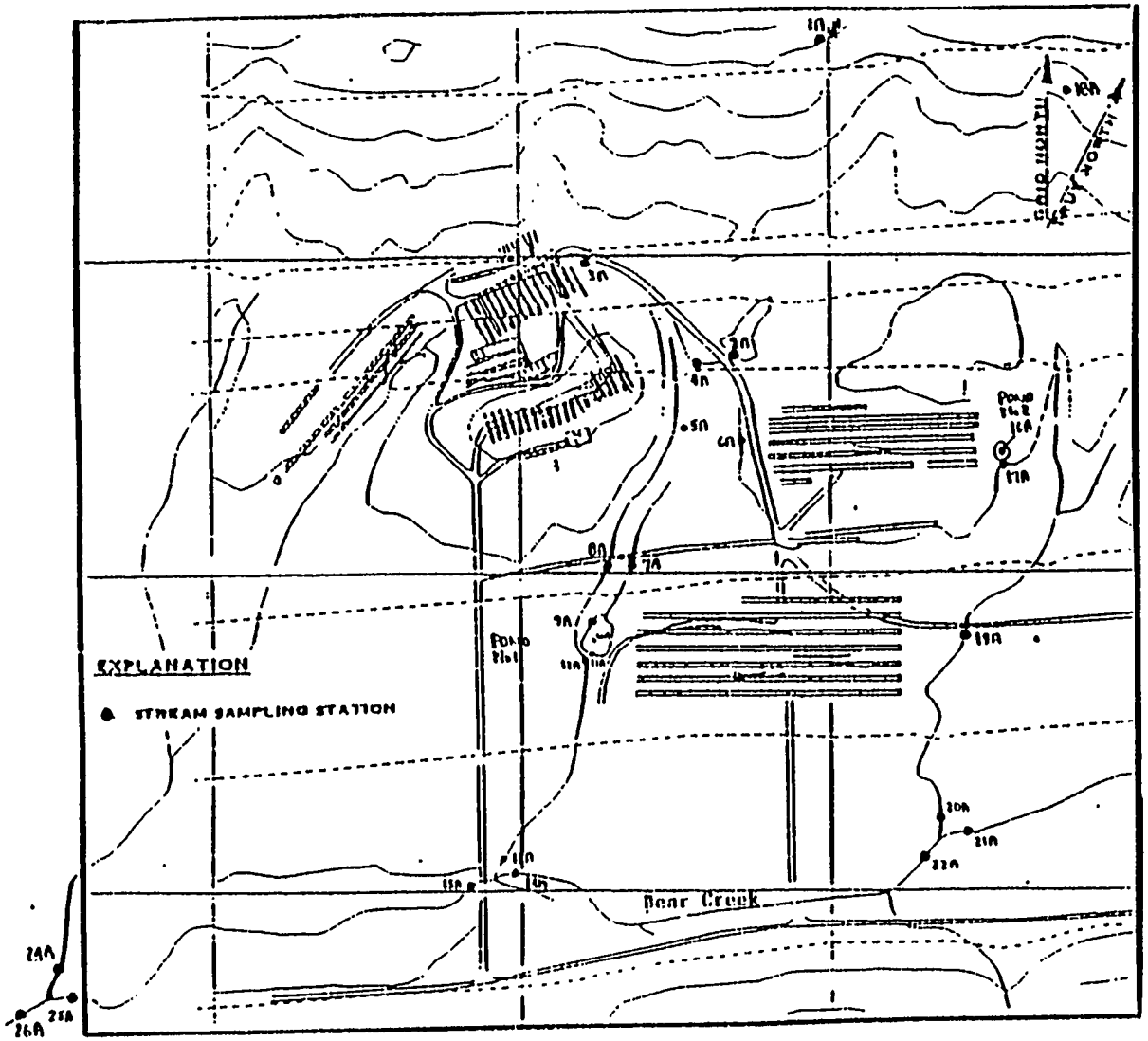


FIGURE 6-7
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	DICHLOROBROMOMETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

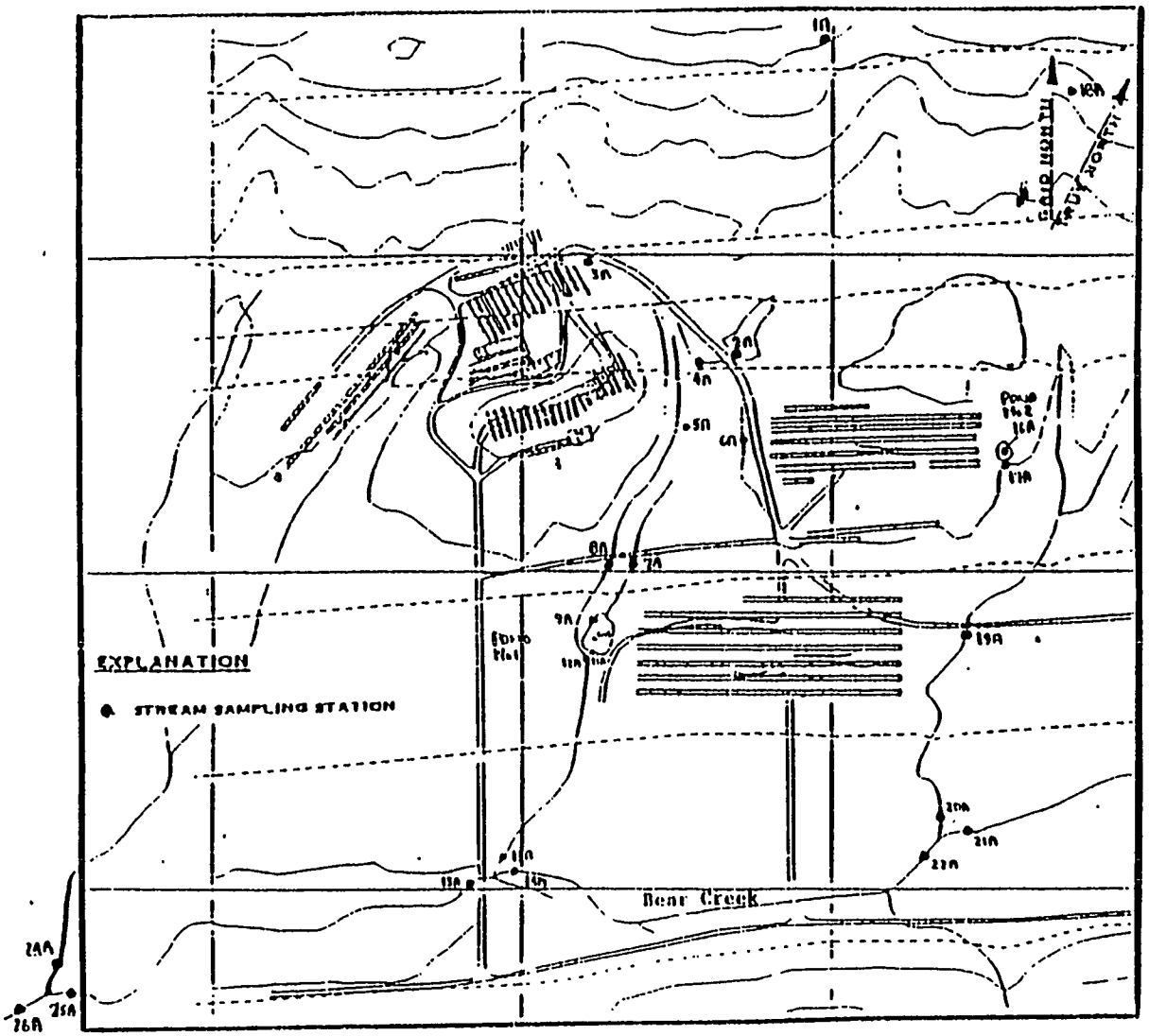


FIGURE 6-8
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	DICHLORODIFLUOROMETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

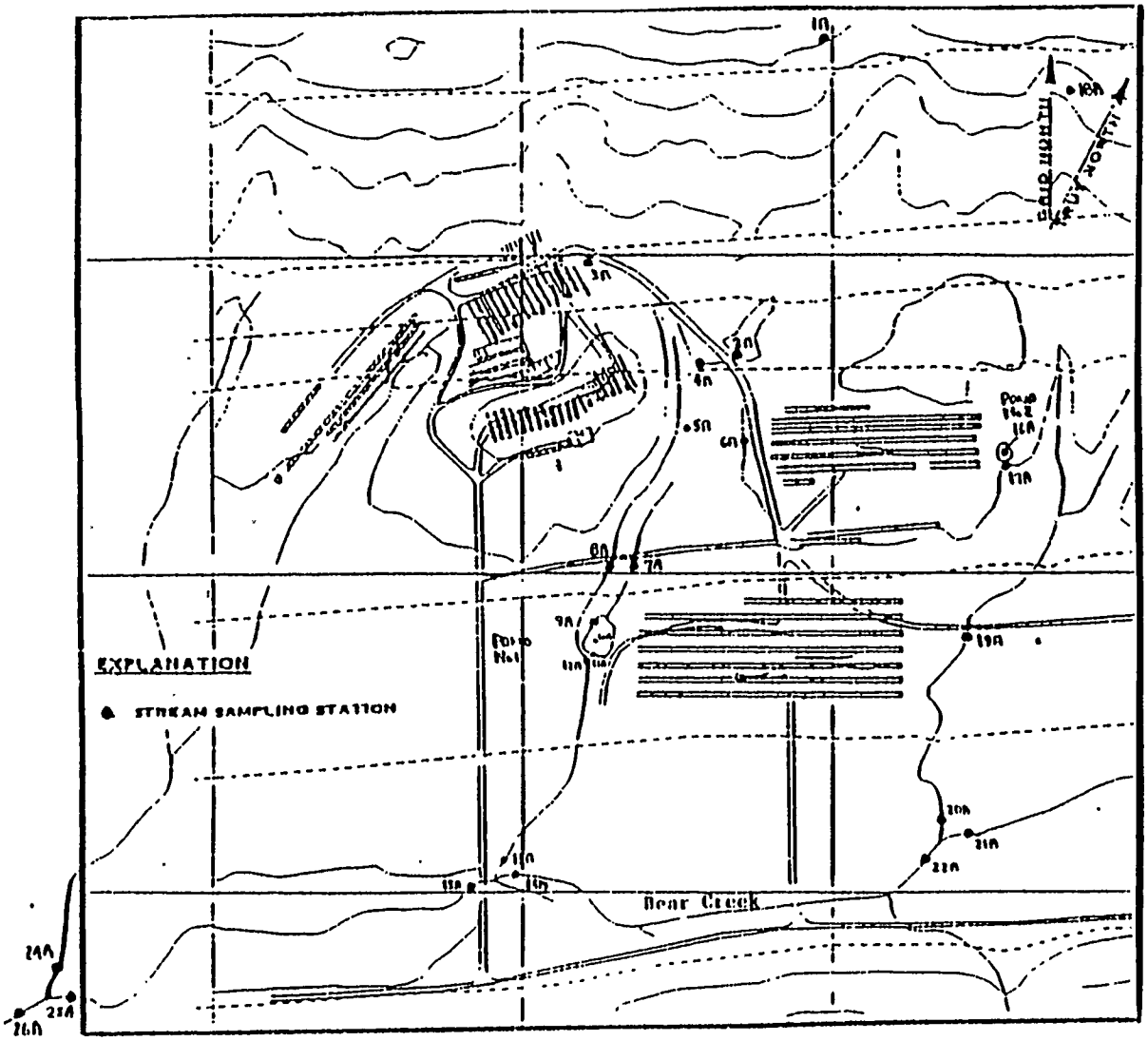


FIGURE 6-9
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CIS-1,3-DICHLOROPROPYLENE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

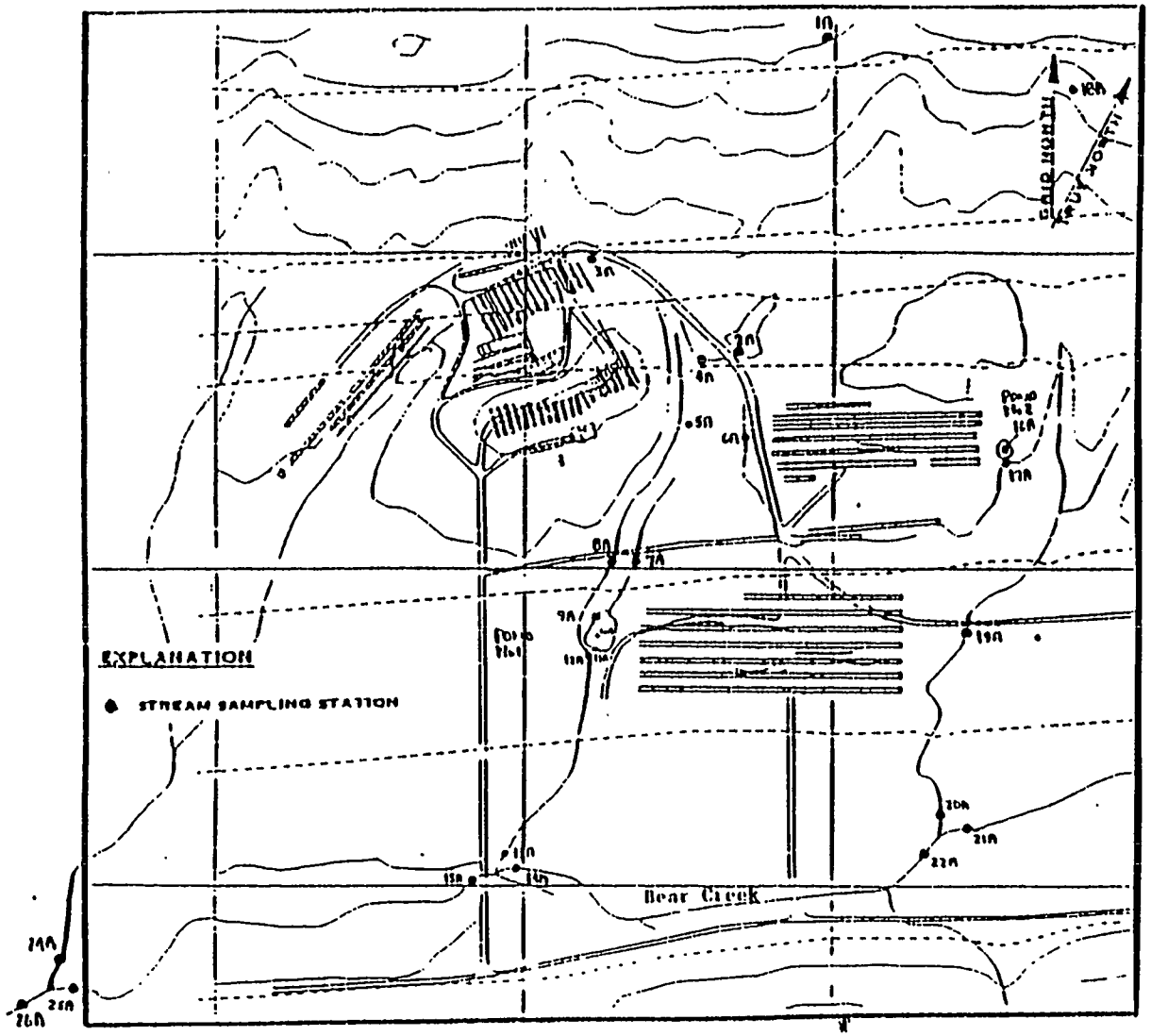


FIGURE 6-10
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TRANS-1,3-DICHLOROPROPYLENE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
13A	N
13A	N
14A	N
15A	N
17A	N

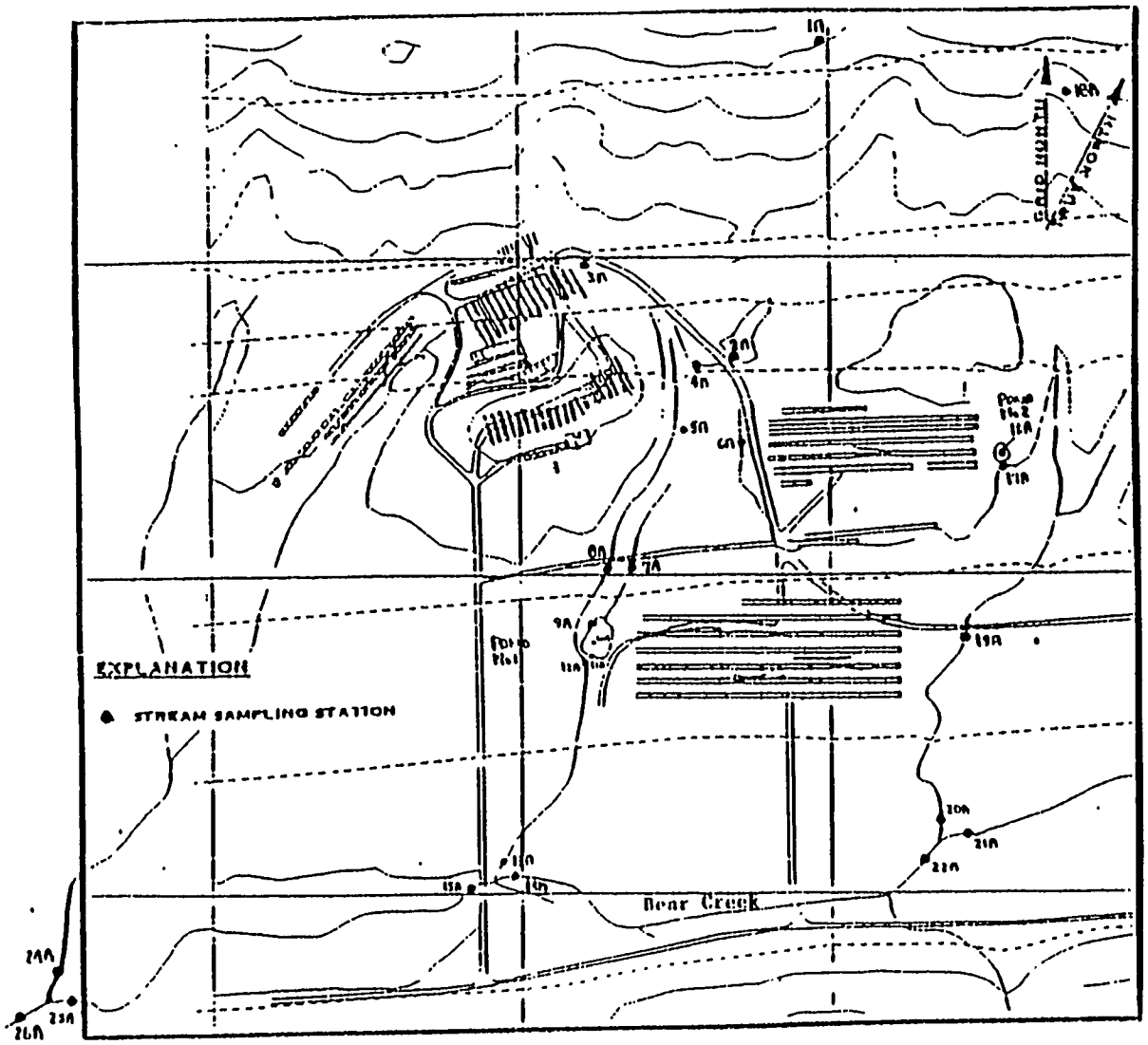


FIGURE 6-11
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	METHYL BROMIDE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

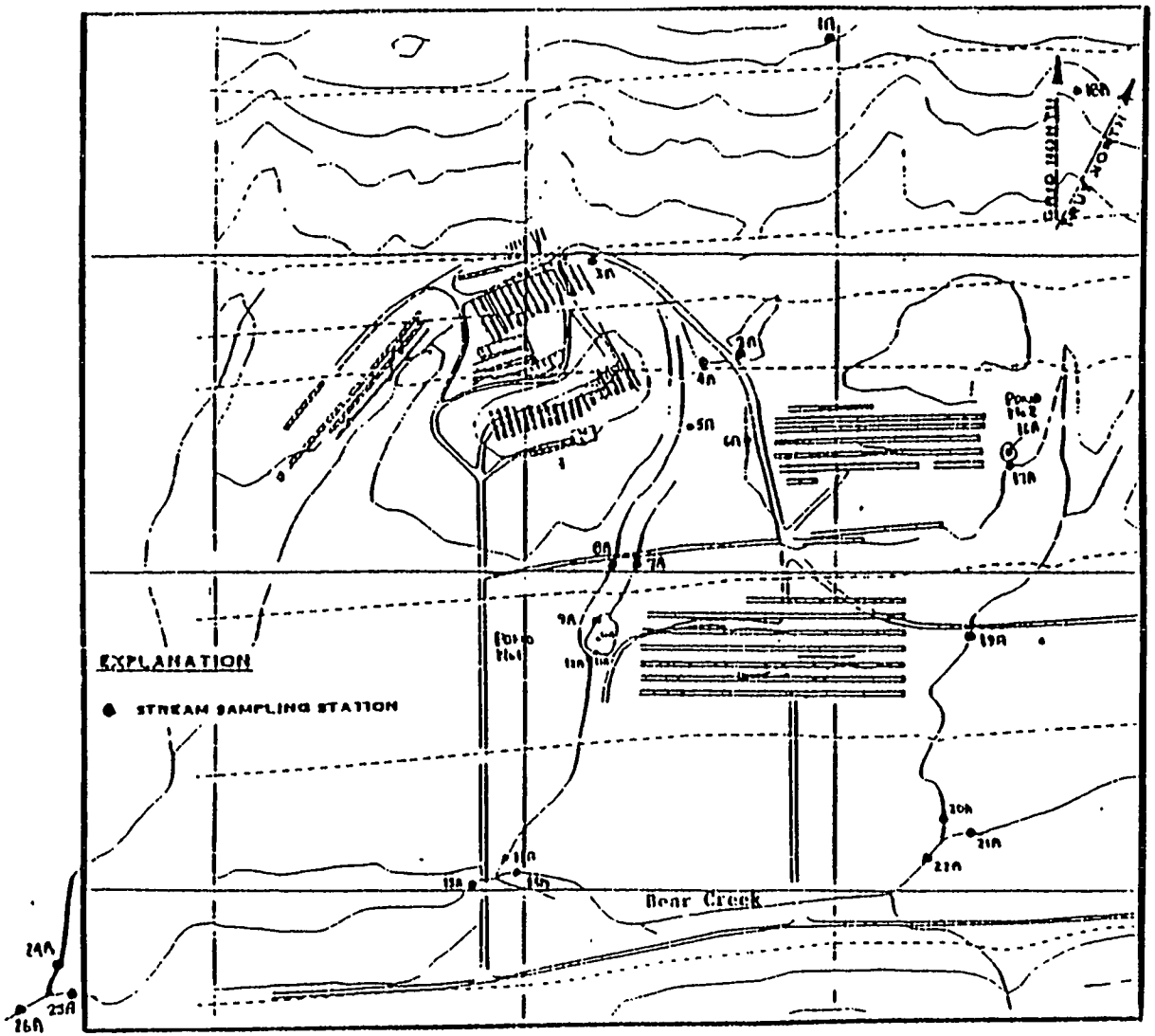


FIGURE 6-12
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,1,2,2-TETRACHLOROETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

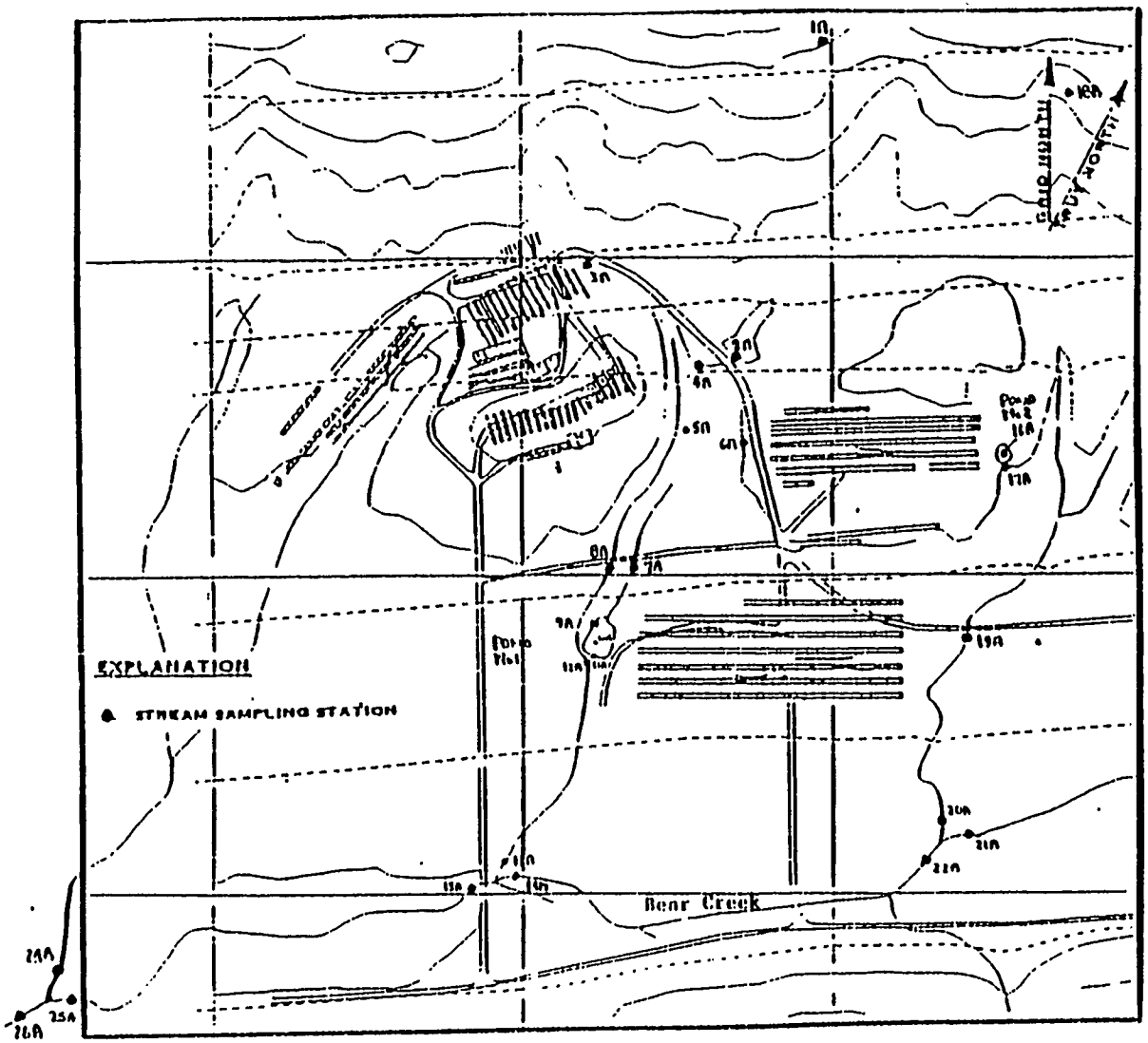


FIGURE 6-13
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CHLOROBENZENE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	<10
12A	N
13A	N
14A	N
15A	N
17A	N

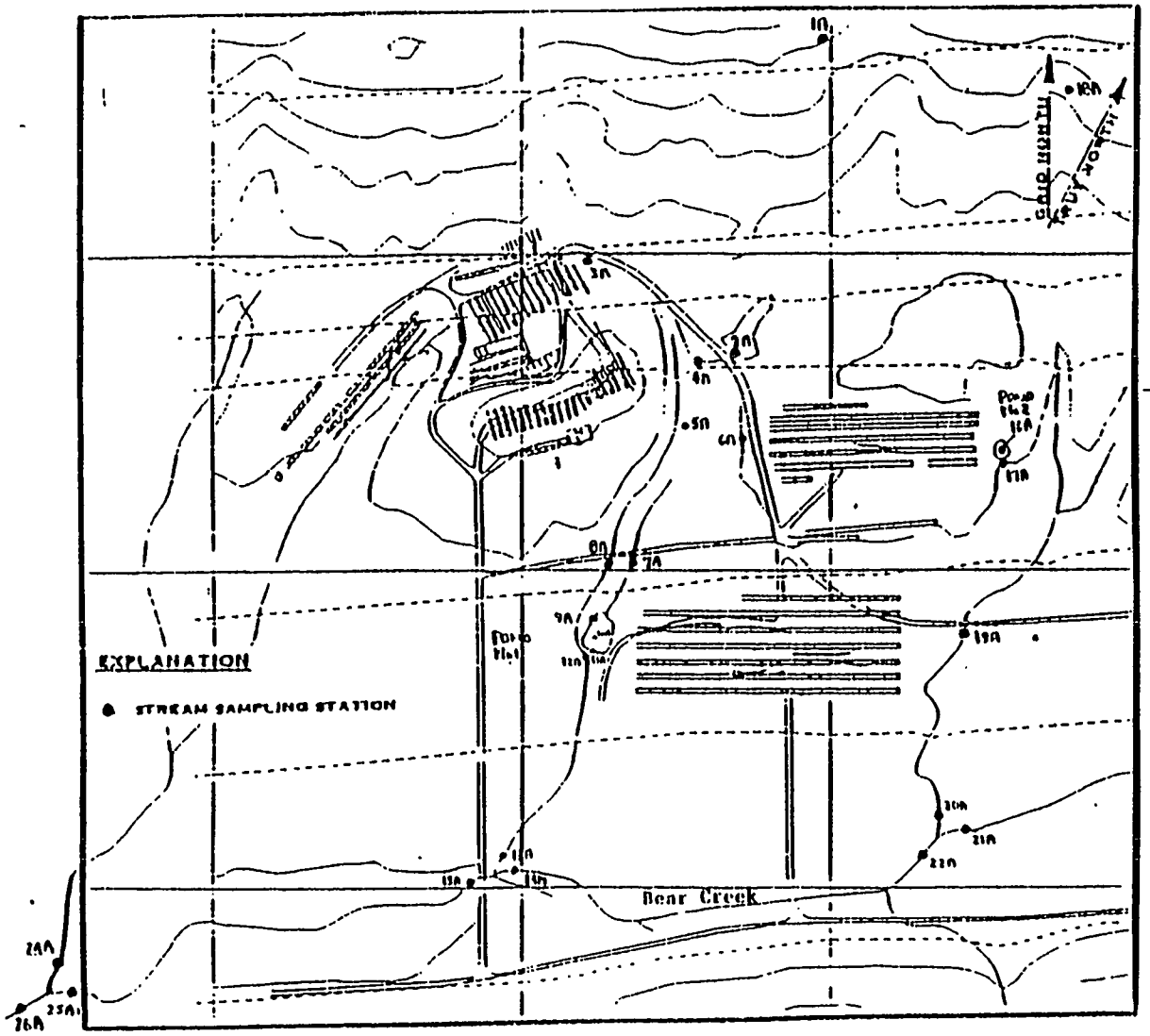


FIGURE 6-14
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,2-DICHLOROPROPANE
1A	N
2A	N
3A	<10
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	N
13A	N
14A	N
15A	N
17A	N

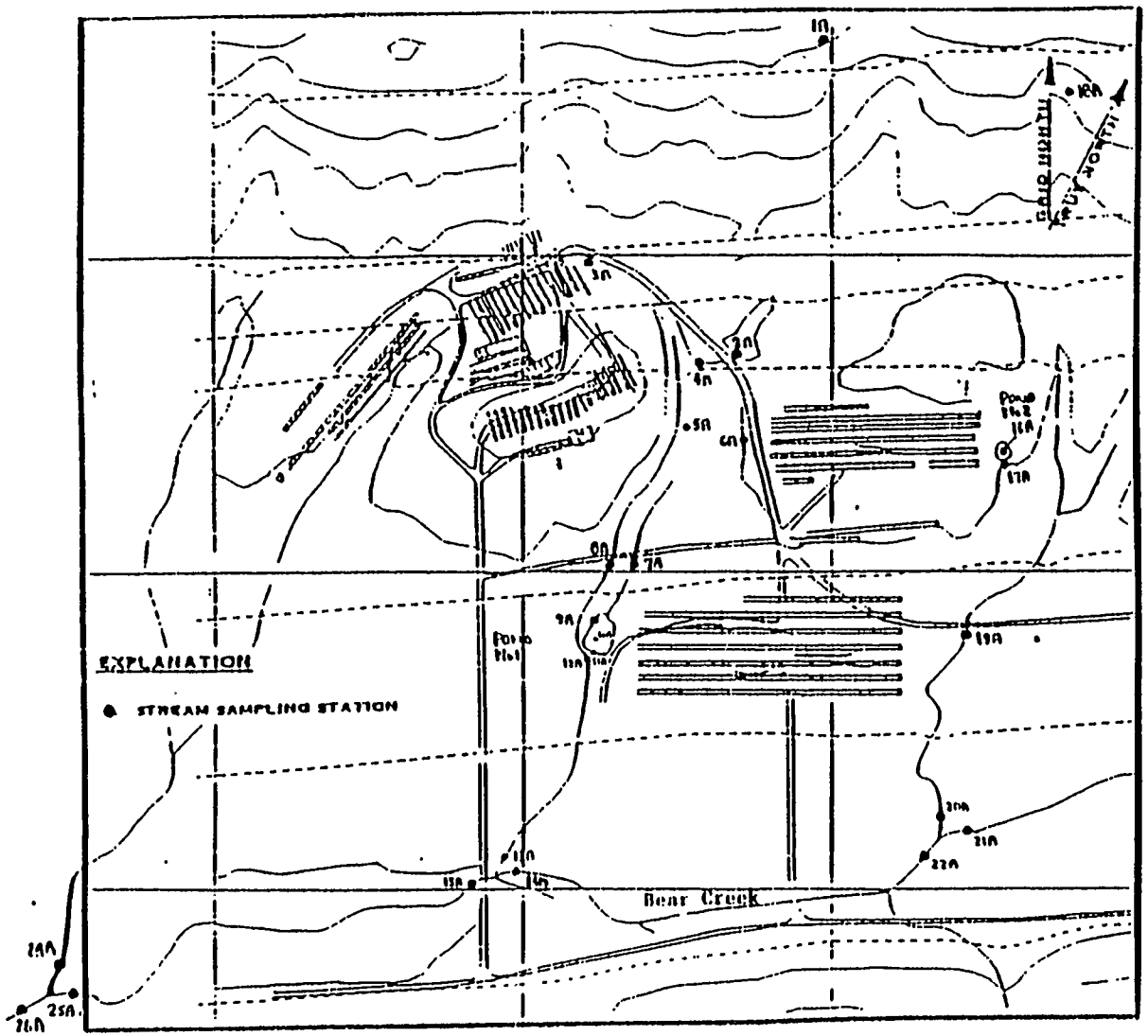


FIGURE 6-15
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	METHYL CHLORIDE
1A	N
2A	N
3A	N
4A	N
5A	<10
7A	N
8A	N
9A	N
11A	<10
12A	N
13A	N
14A	N
15A	N
17A	N

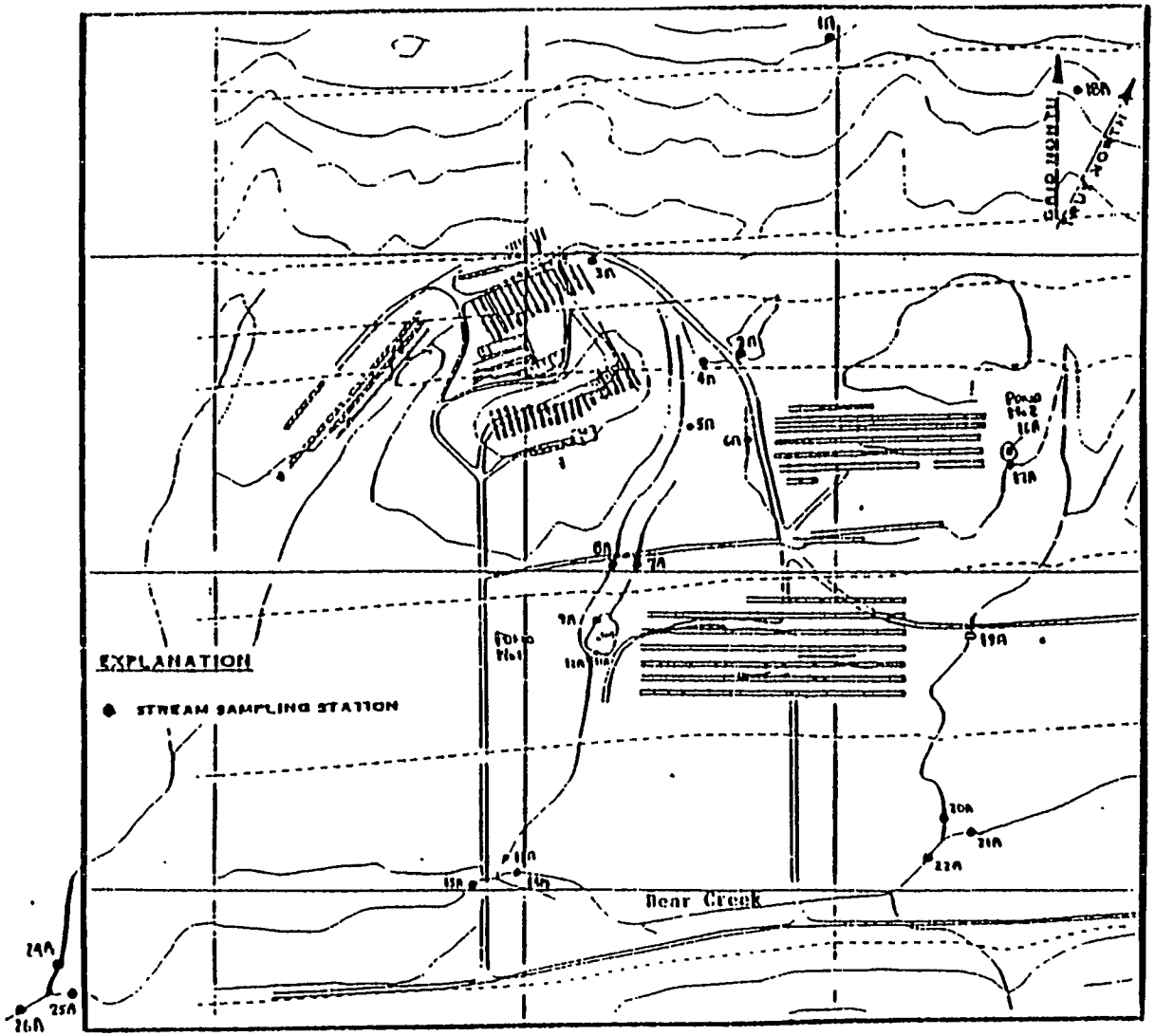


FIGURE 6-16
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	BENZENE
1A	N
2A	N
3A	N
4A	N
5A	<10
7A	N
8A	N
9A	<10
11A	95
12A	140
13A	N
14A	<10
15A	<10
17A	N

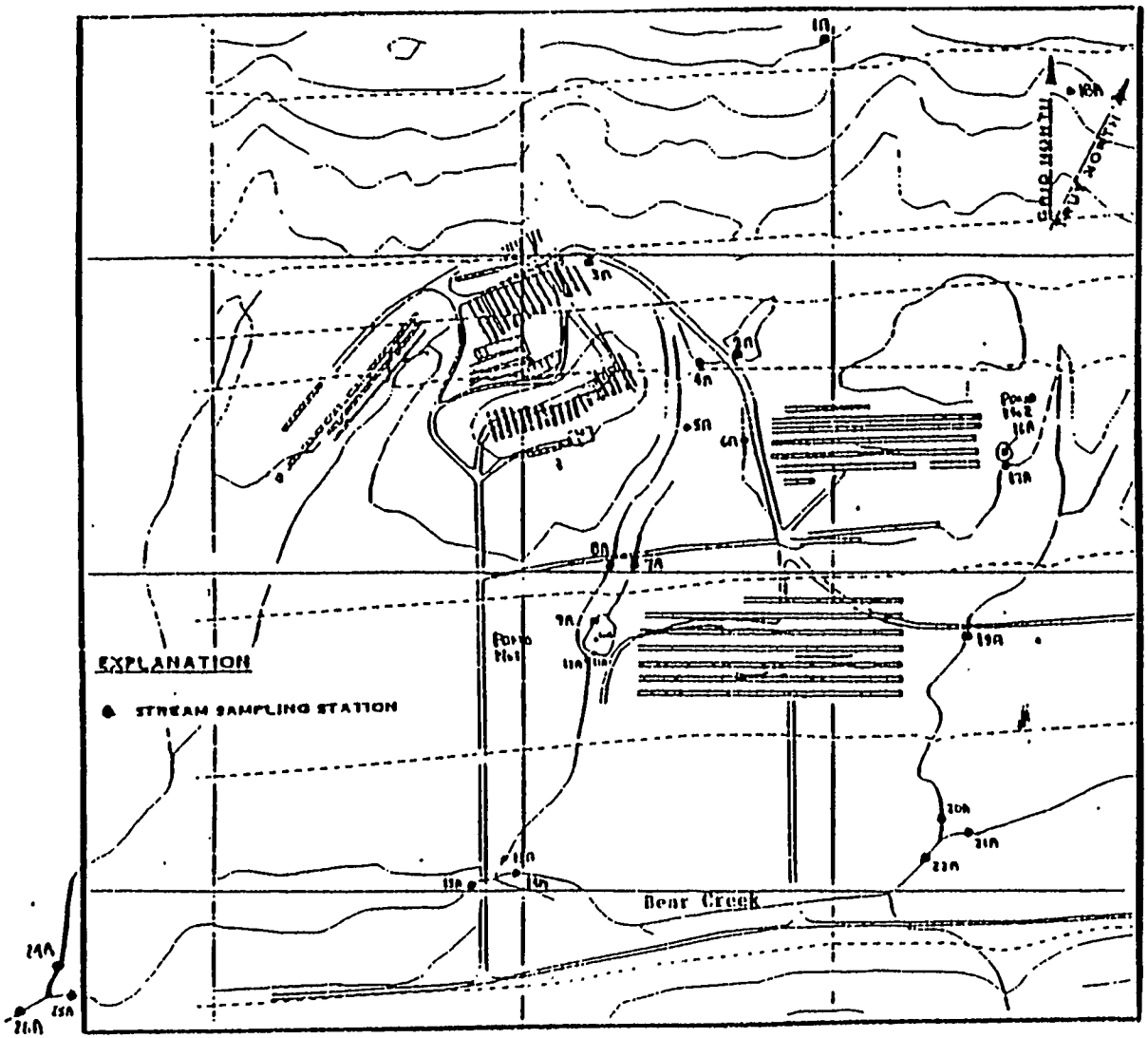


FIGURE 6-17
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CHLOROETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	<10
11A	26
12A	210
13A	N
14A	N
15A	N
17A	N

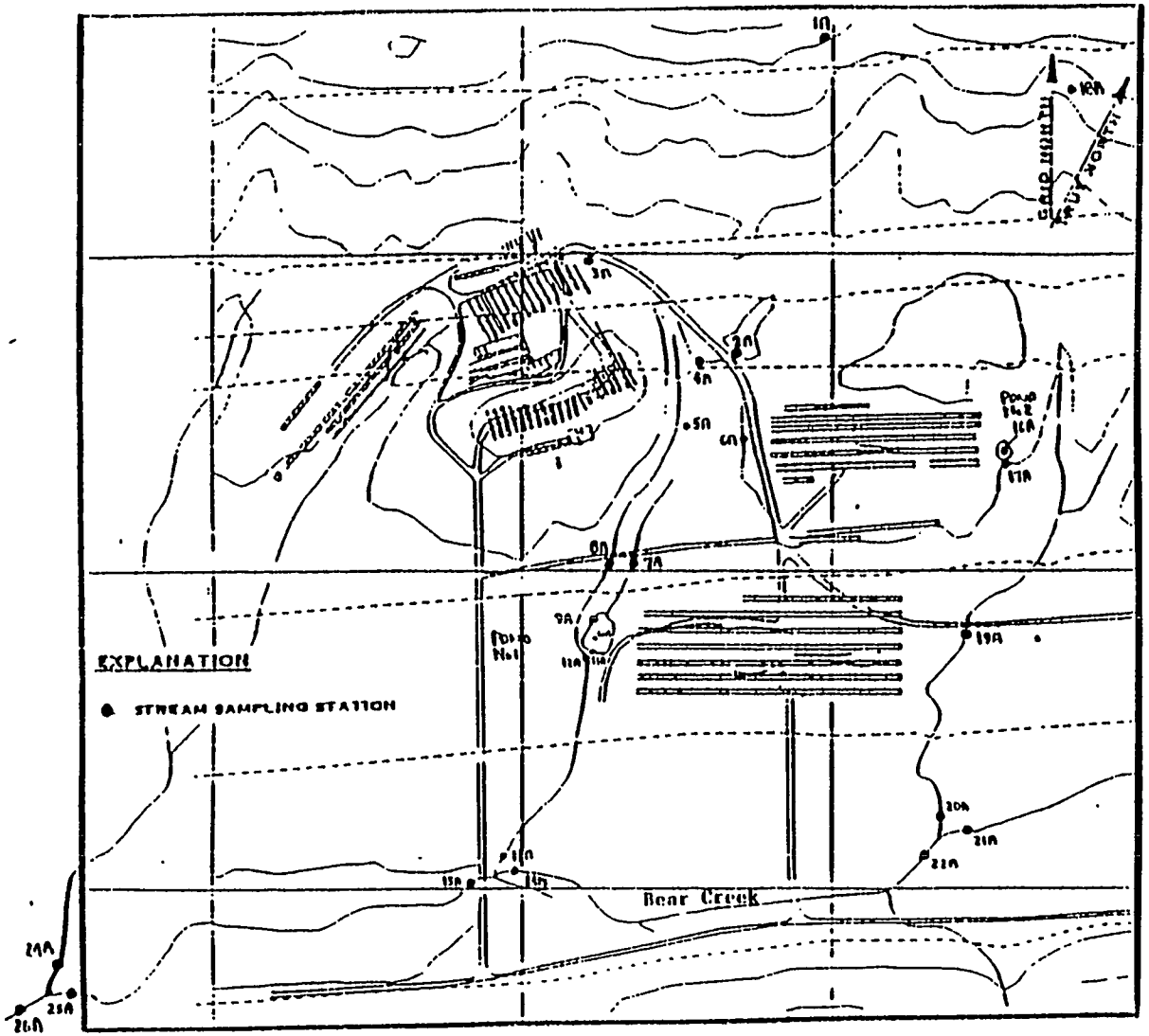


FIGURE 6-18
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	CHLOROFORM
1A	N
2A	N
3A	<10
4A	N
5A	N
7A	N
8A	N
9A	N
11A	N
12A	55
13A	<10
14A	N
15A	<10
17A	N

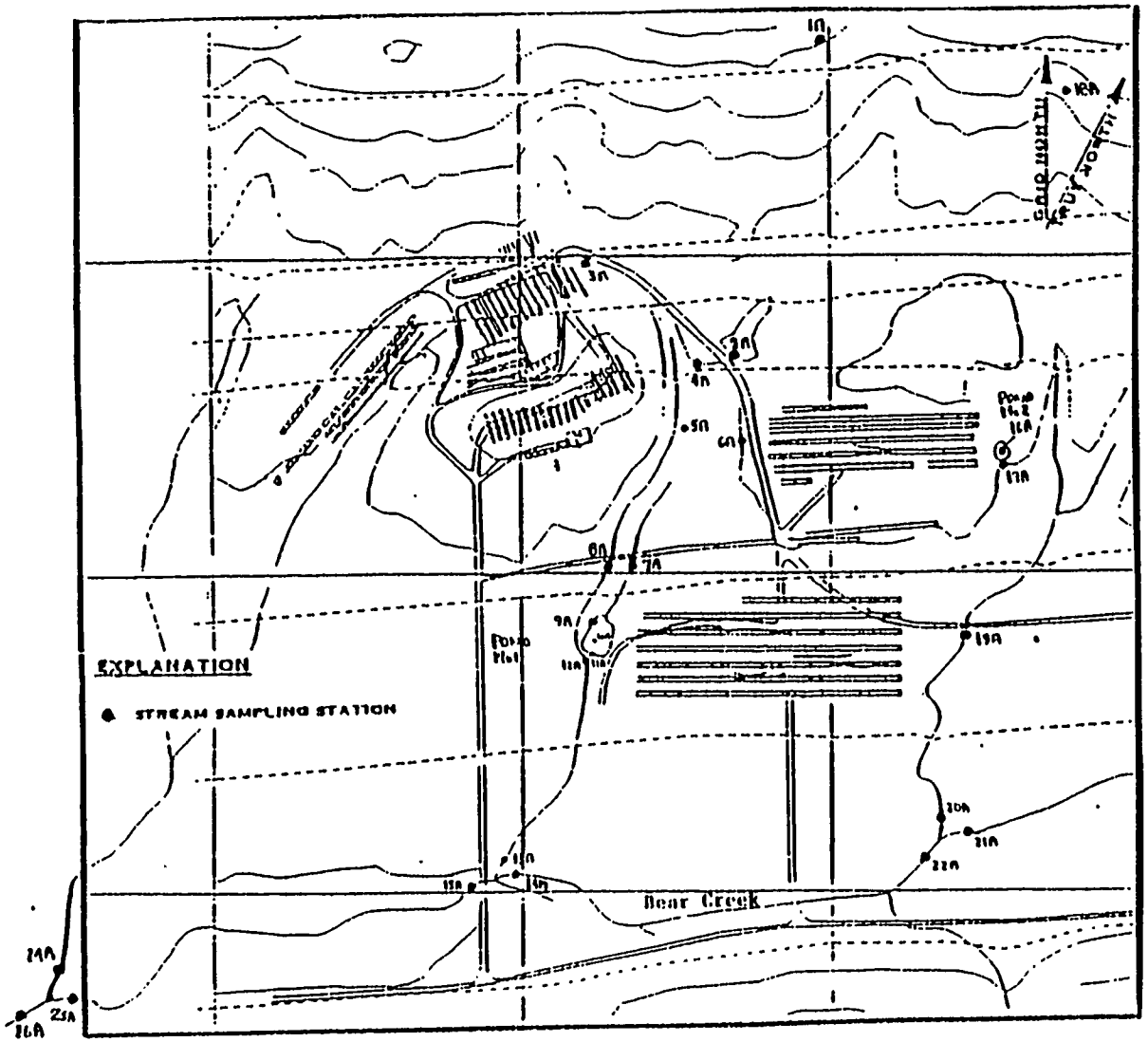


FIGURE 6-19
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,1-DICHLOROETHANE
1A	N
2A	N
3A	N
4A	N
5A	15
7A	20
8A	N
9A	22
11A	2100
12A	1200
13A	27
14A	N
15A	16
17A	13

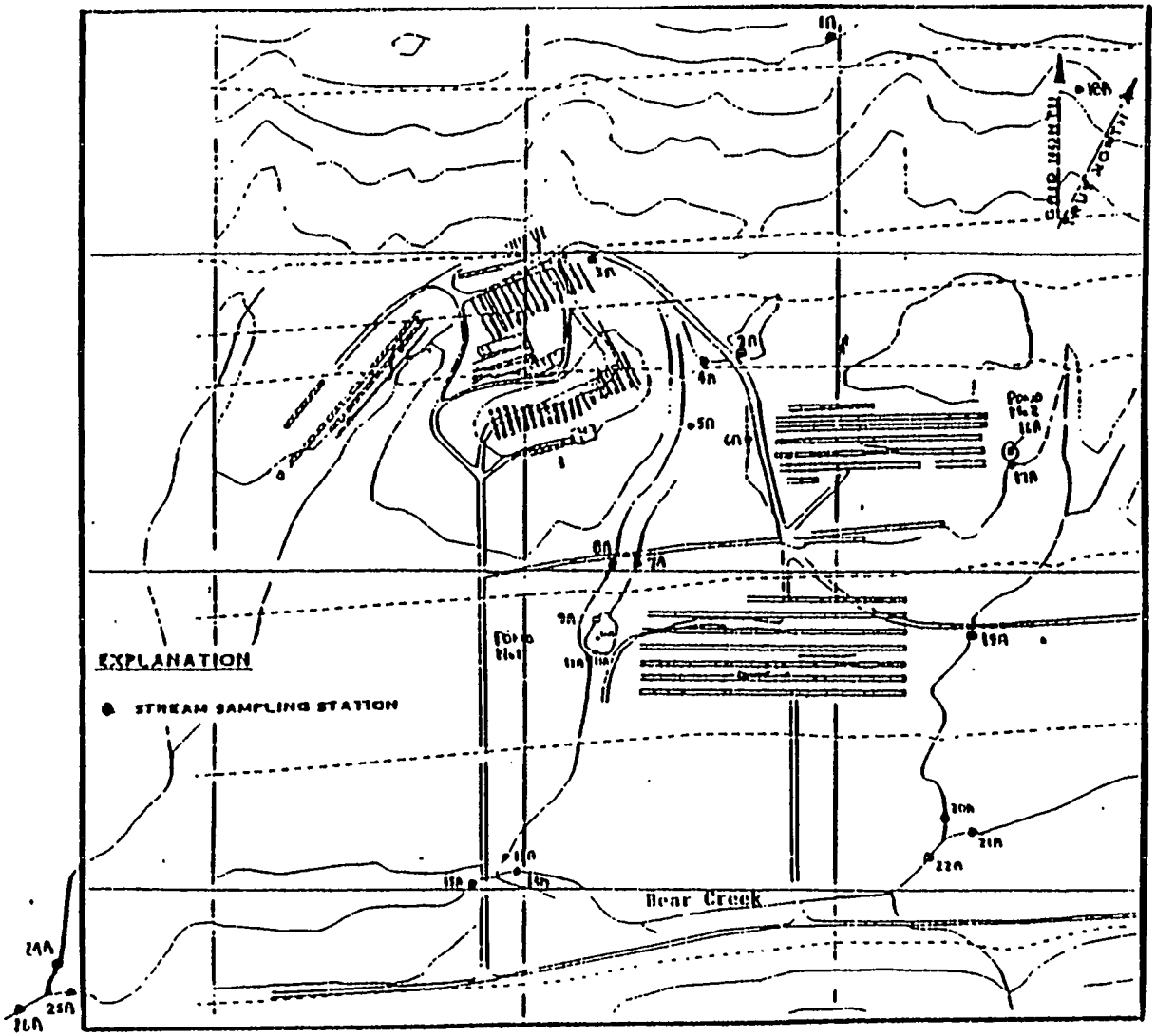


FIGURE 6-20
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,2-DICHLOROETHANE
1A	N
2A	N
3A	<10
4A	N
5A	N
7A	N
8A	N
9A	N
11A	64
12A	94
13A	N
14A	N
15A	<10
17A	N

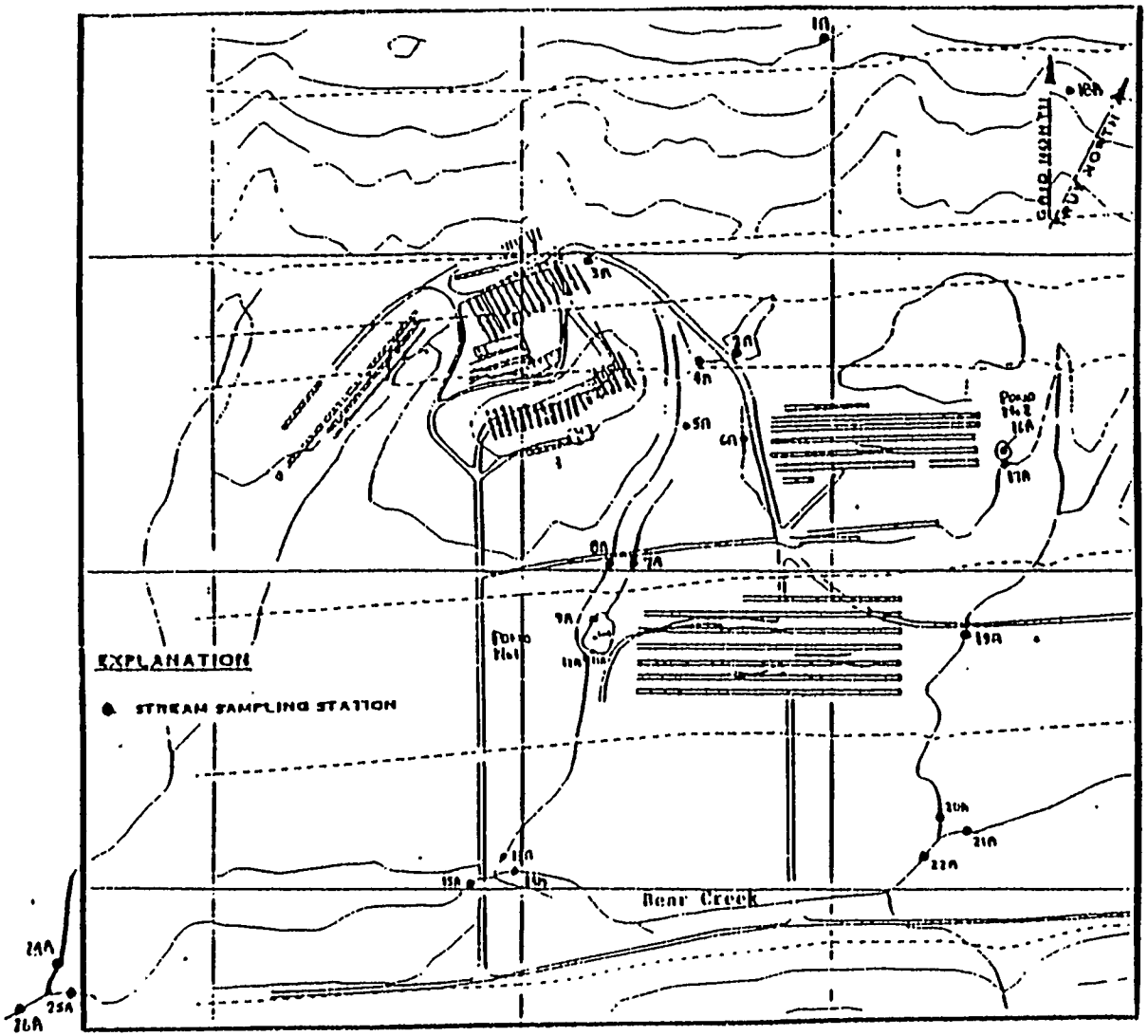


FIGURE 6-21
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,1-DICHLOROETHYLENE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	<10
11A	48
12A	<10
13A	N
14A	N
15A	12
17A	N

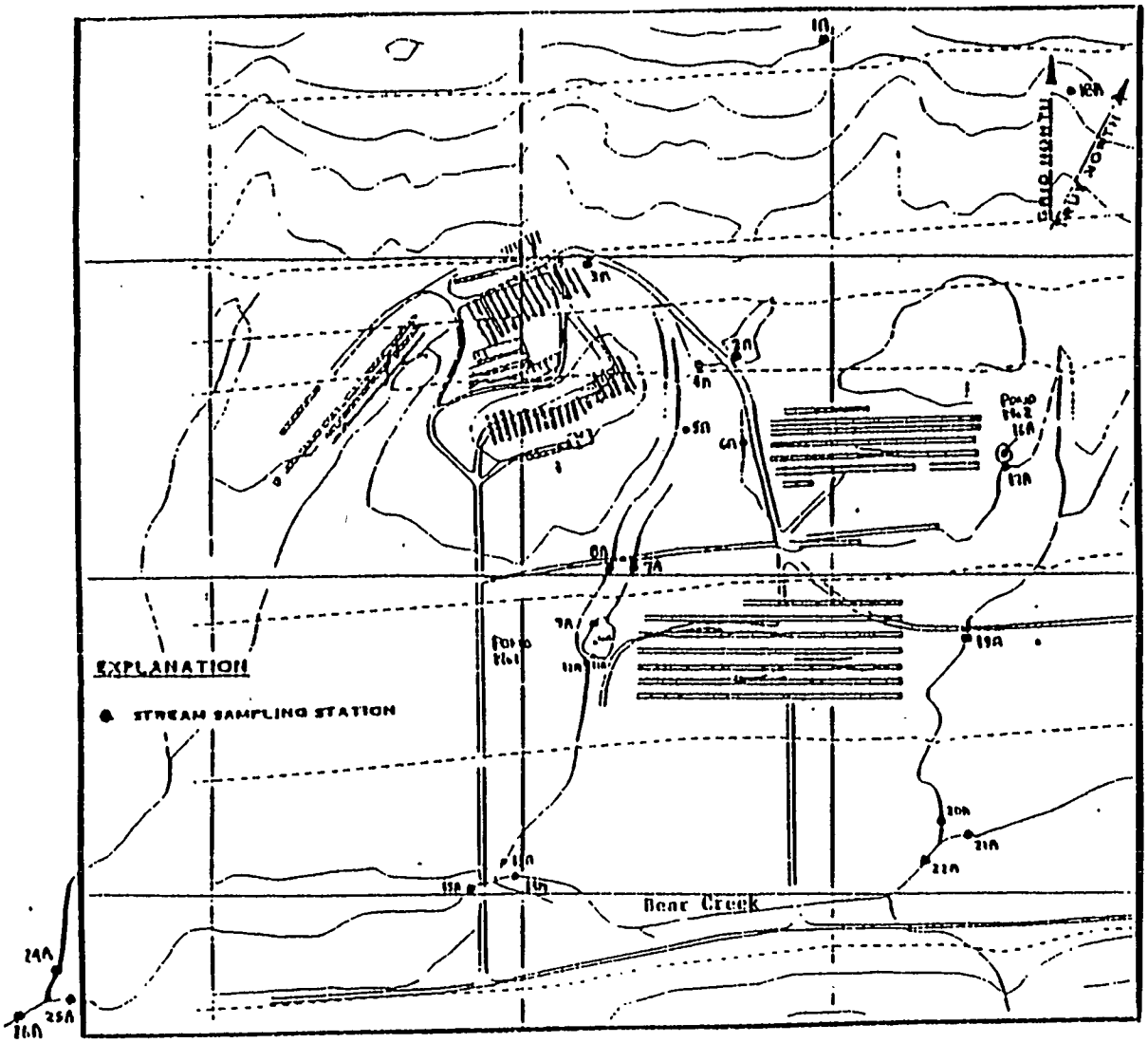


FIGURE 6-22
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	ETHYL BENZENE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	15
12A	N
13A	N
14A	N
15A	N
17A	N

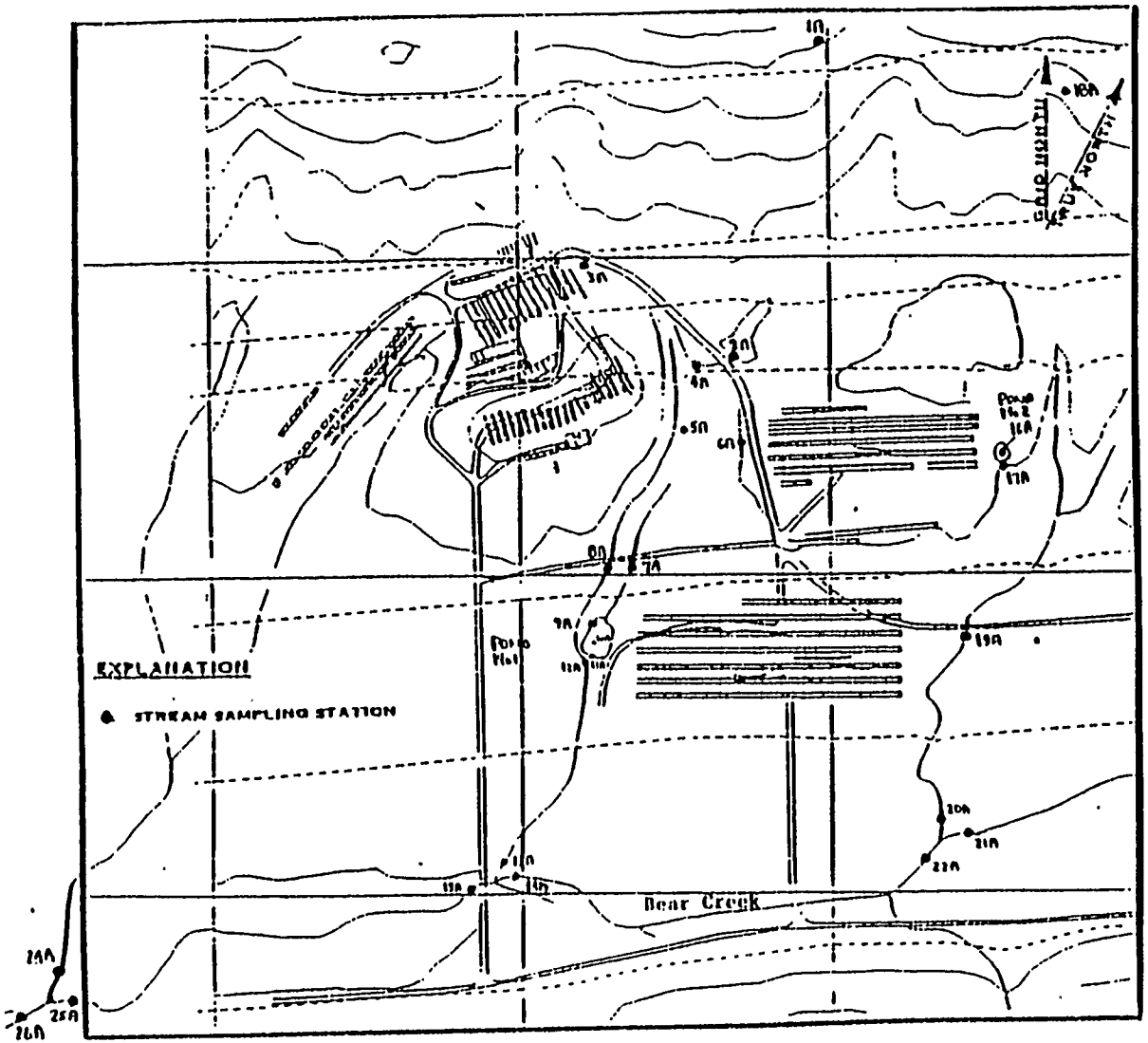


FIGURE 6-23
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	METHYLENE CHLORIDE
1A	N
2A	14
3A	330
4A	N
5A	92
7A	39
8A	N
9A	10
11A	17
12A	<10
13A	15
14A	<10
15A	N
17A	N

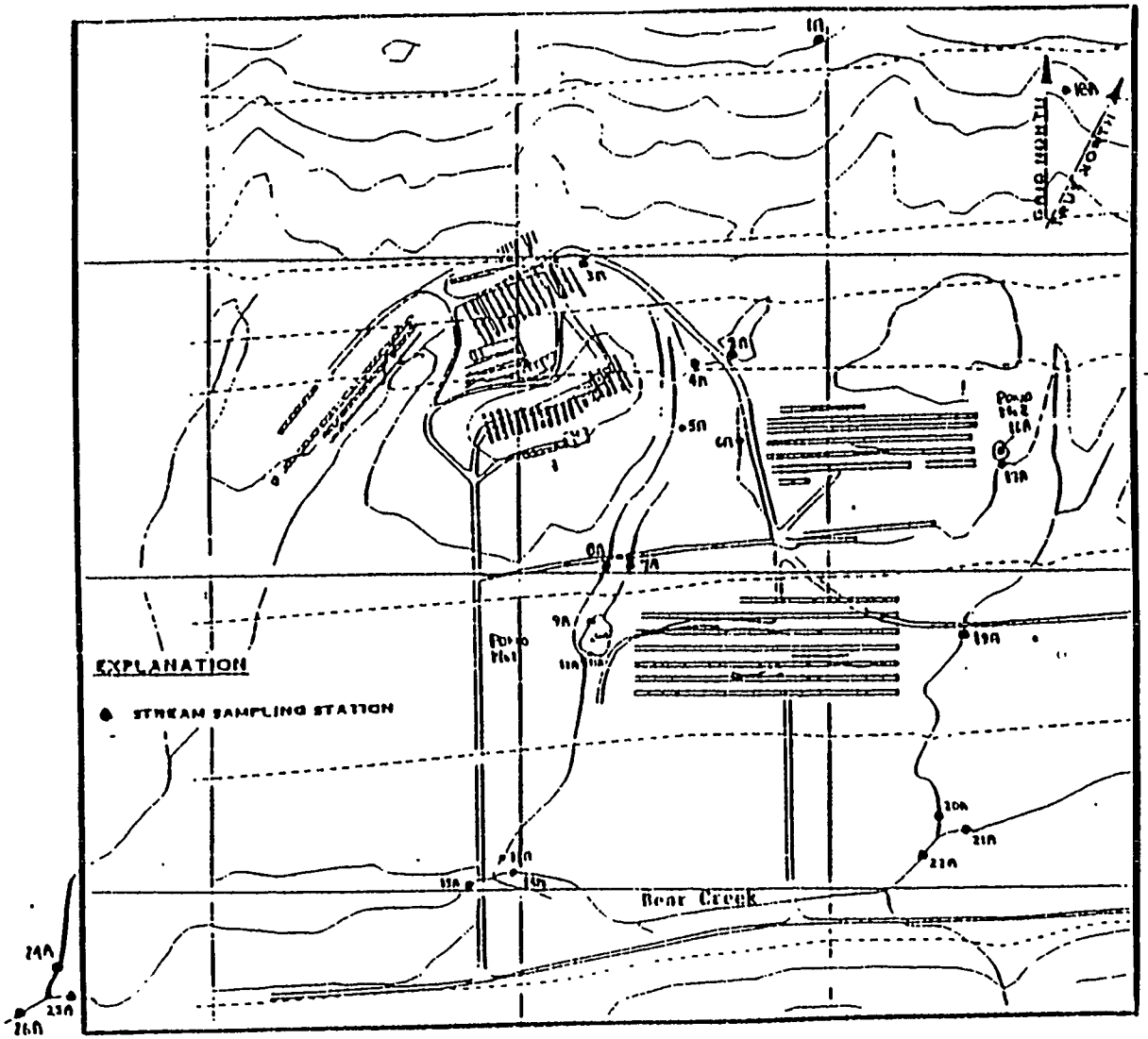


FIGURE 6-24
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TETRACHLOROETHYLENE
1A	N
2A	N
3A	N
4A	<10
5A	<10
7A	N
8A	N
9A	52
11A	120
12A	140
13A	14
14A	N
15A	170
17A	83

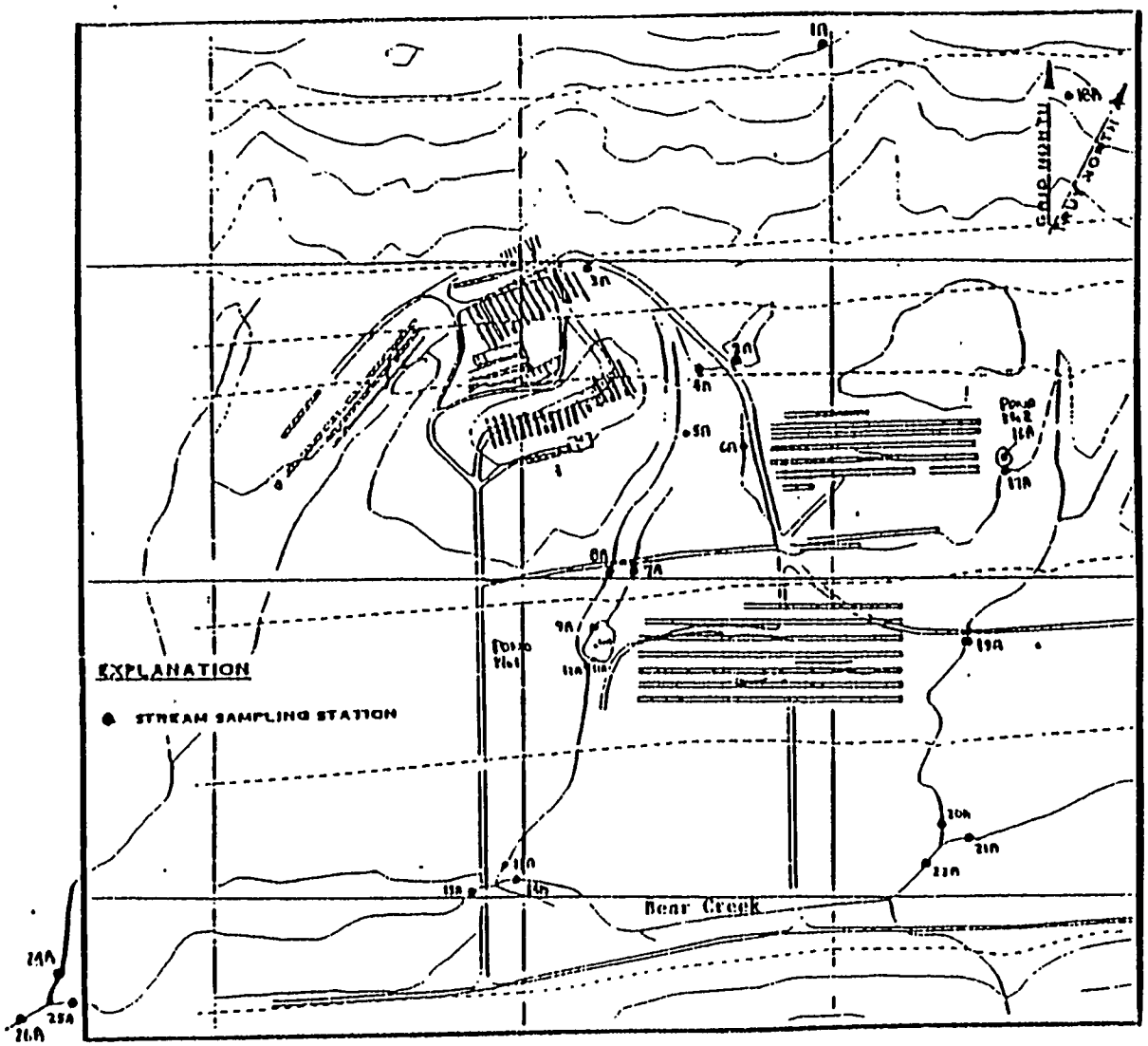


FIGURE 6-25
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TOLUENE
1A	N
2A	N
3A	N
4A	N
5A	<10
7A	N
8A	N
9A	<10
11A	120
12A	30
13A	N
14A	N
15A	N
17A	43

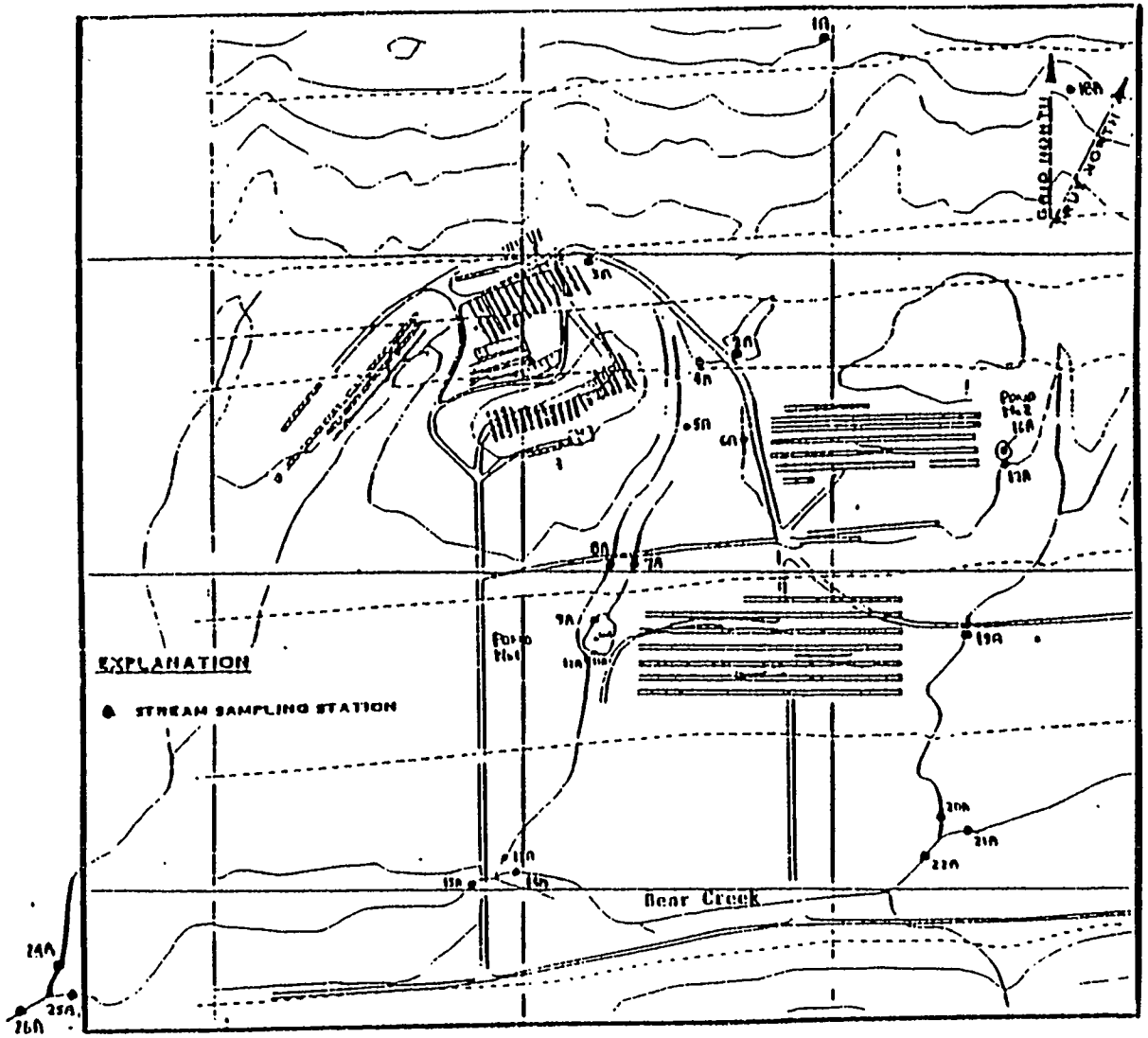


FIGURE 6-26
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TRANS-1,2-DICHLOROETHYLENE
1A	N
2A	N
3A	N
4A	N
5A	27
7A	[illegible]
8A	N
9A	75
11A	150
12A	94
13A	[illegible]
14A	N
15A	[illegible]
17A	[illegible]

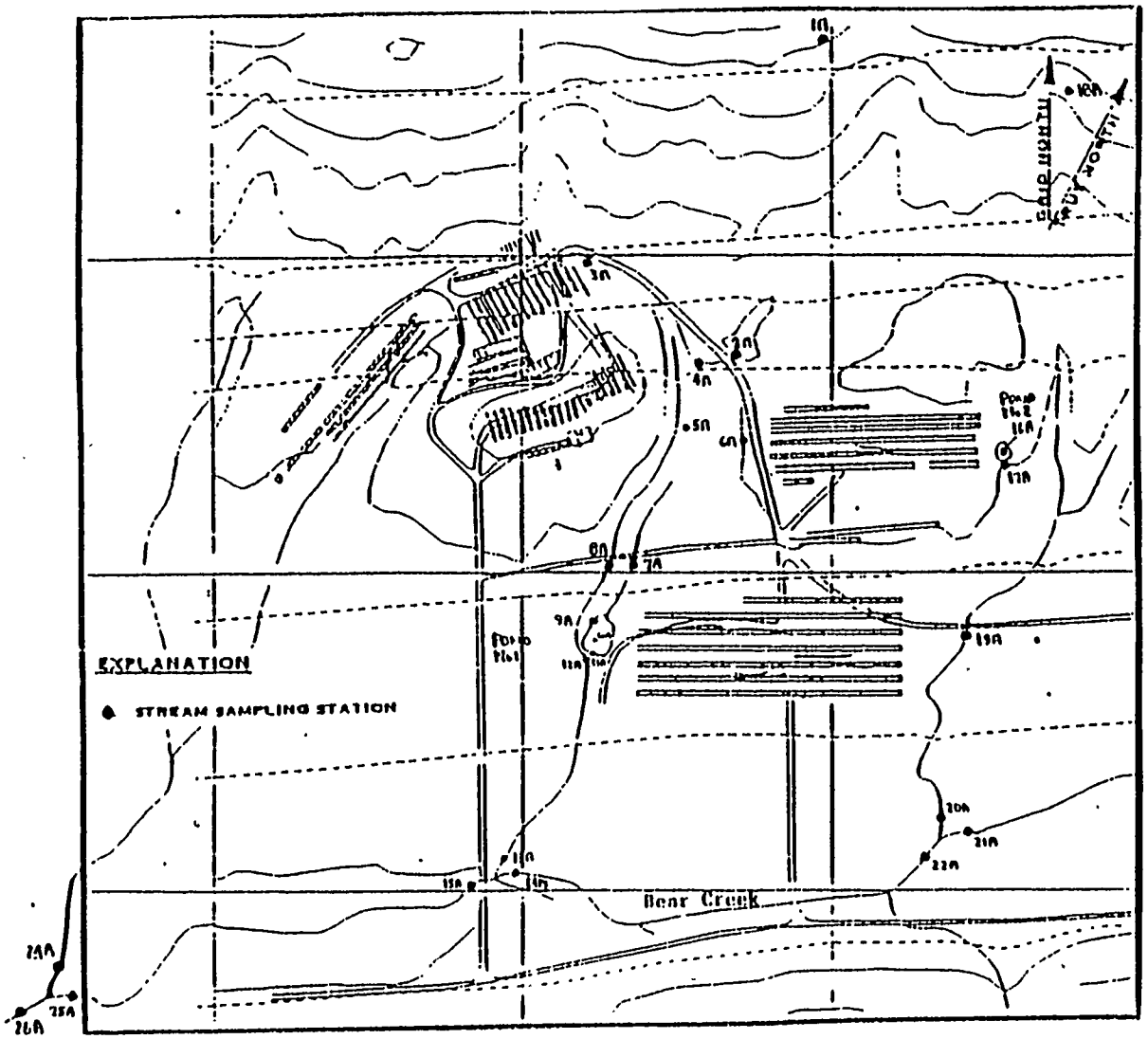


FIGURE 6-27
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1.1.1-TRICHLOROETHANE
1A	N
2A	N
3A	N
4A	<10
5A	N
7A	N
8A	N
9A	N
11A	<10
12A	280
13A	<10
14A	N
15A	38
17A	N

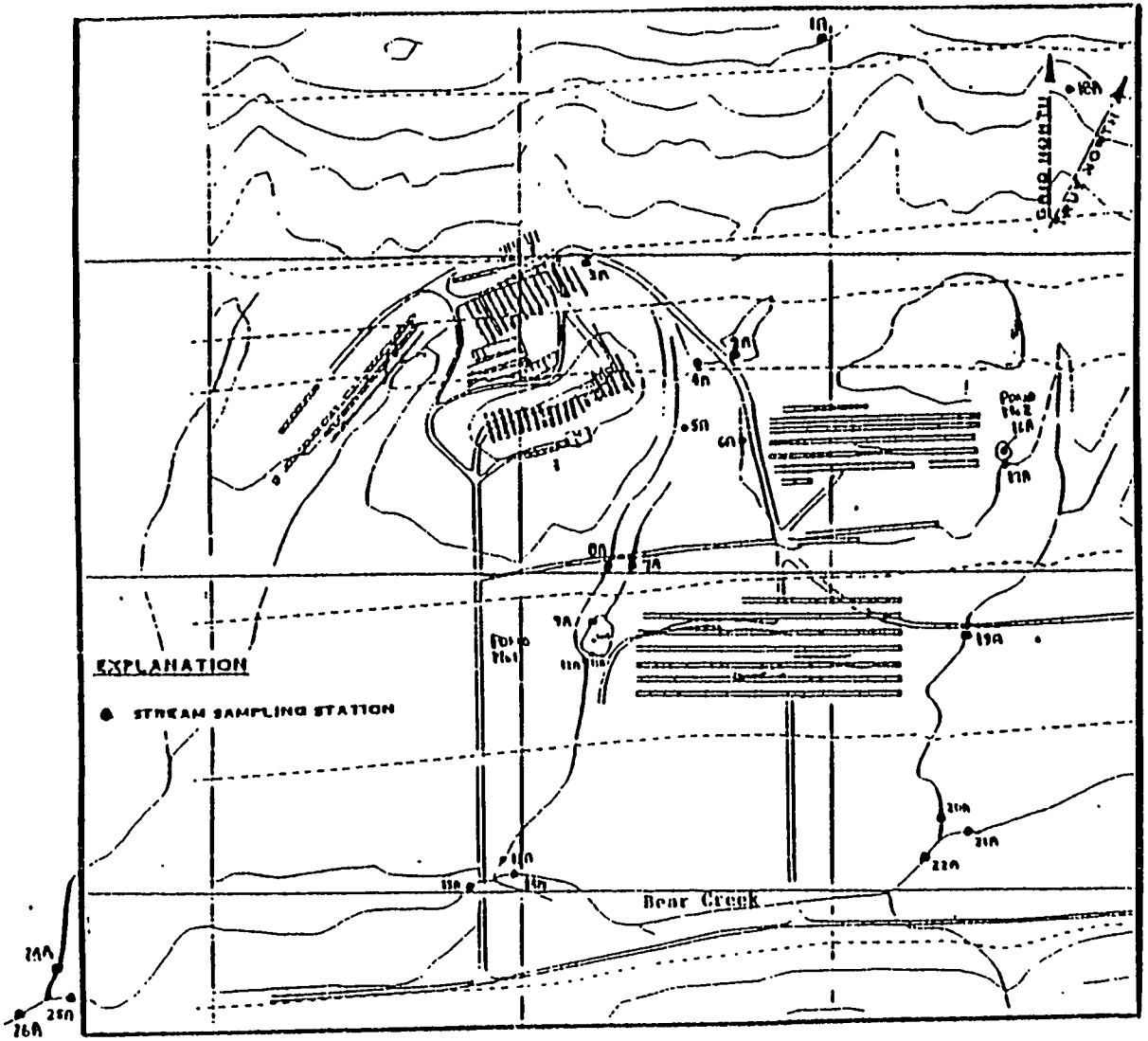


FIGURE 6-28
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,1,2-TRICHLOROETHANE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	N
11A	<10
12A	29
13A	N
14A	N
15A	N
17A	N

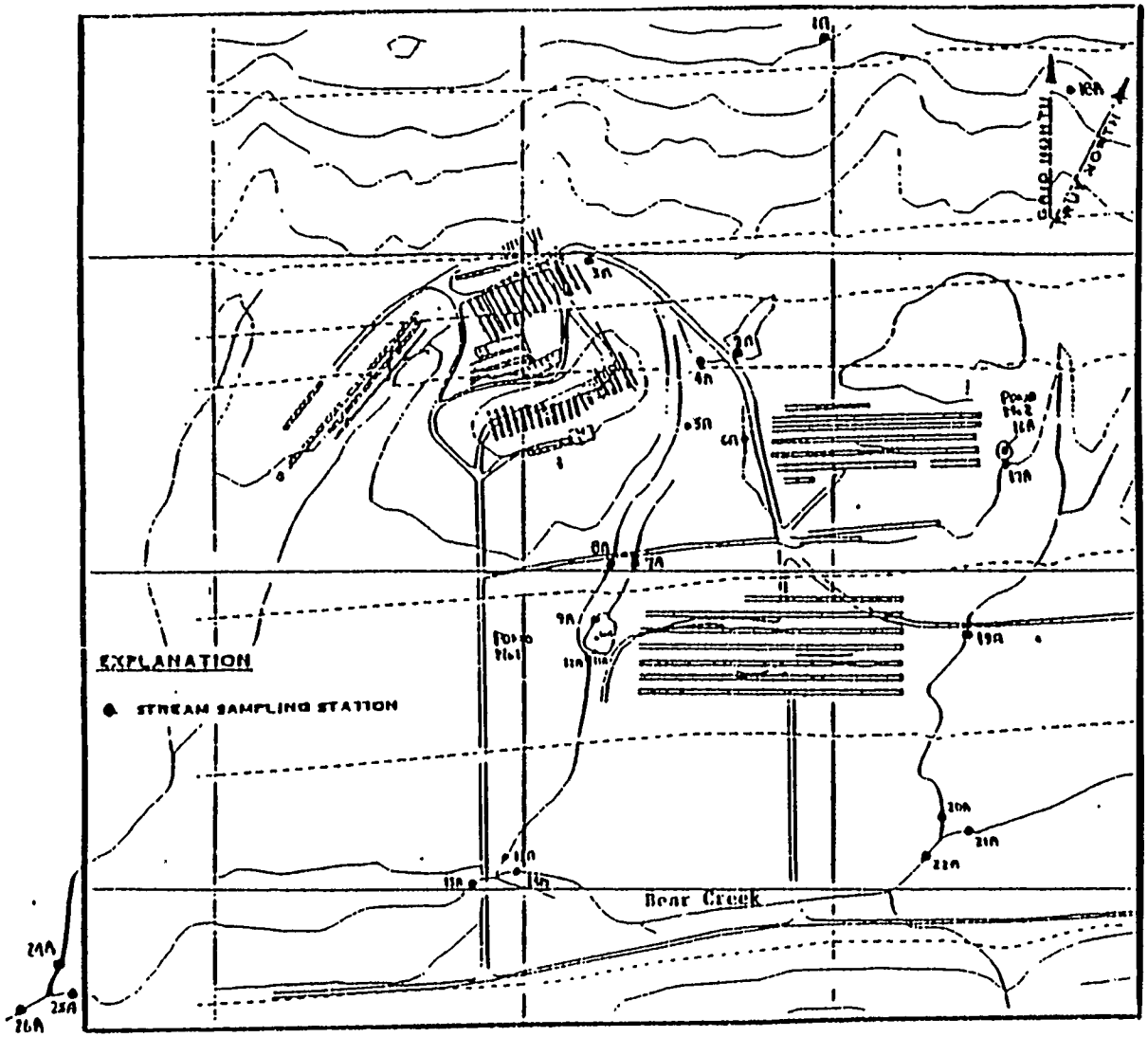


FIGURE 6-29
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TRICHLOROETHYLENE
1A	N
2A	N
3A	<10
4A	<10
5A	<10
7A	N
8A	N
9A	<10
11A	30
12A	11
13A	<10
14A	N
15A	55
17A	30

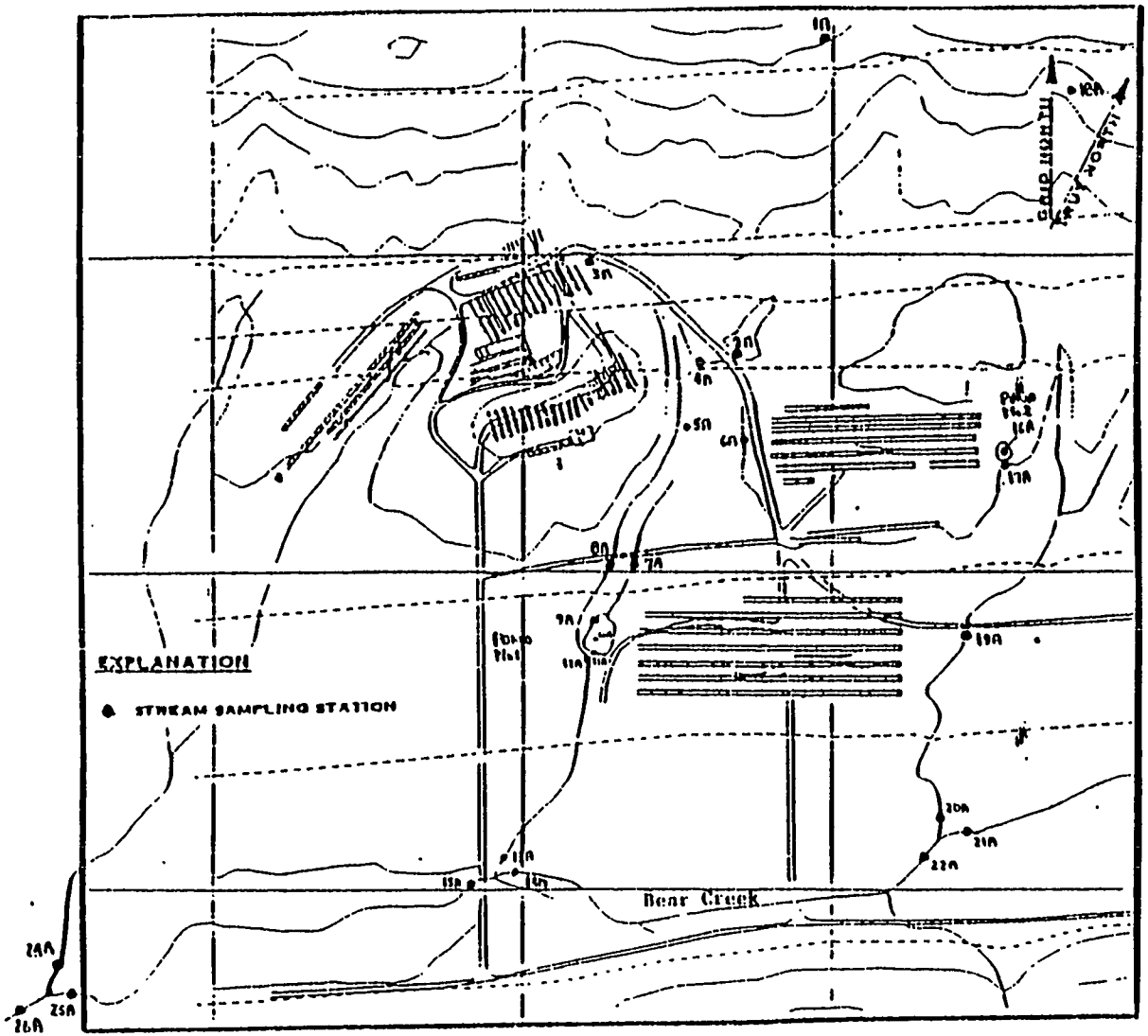


FIGURE 6-30
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	TRICHLOROFLUOROMETHANE
1A	N
2A	<10
3A	24
4A	N
5A	<10
7A	<10
8A	N
9A	N
11A	N
12A	<10
13A	N
14A	N
15A	N
17A	N

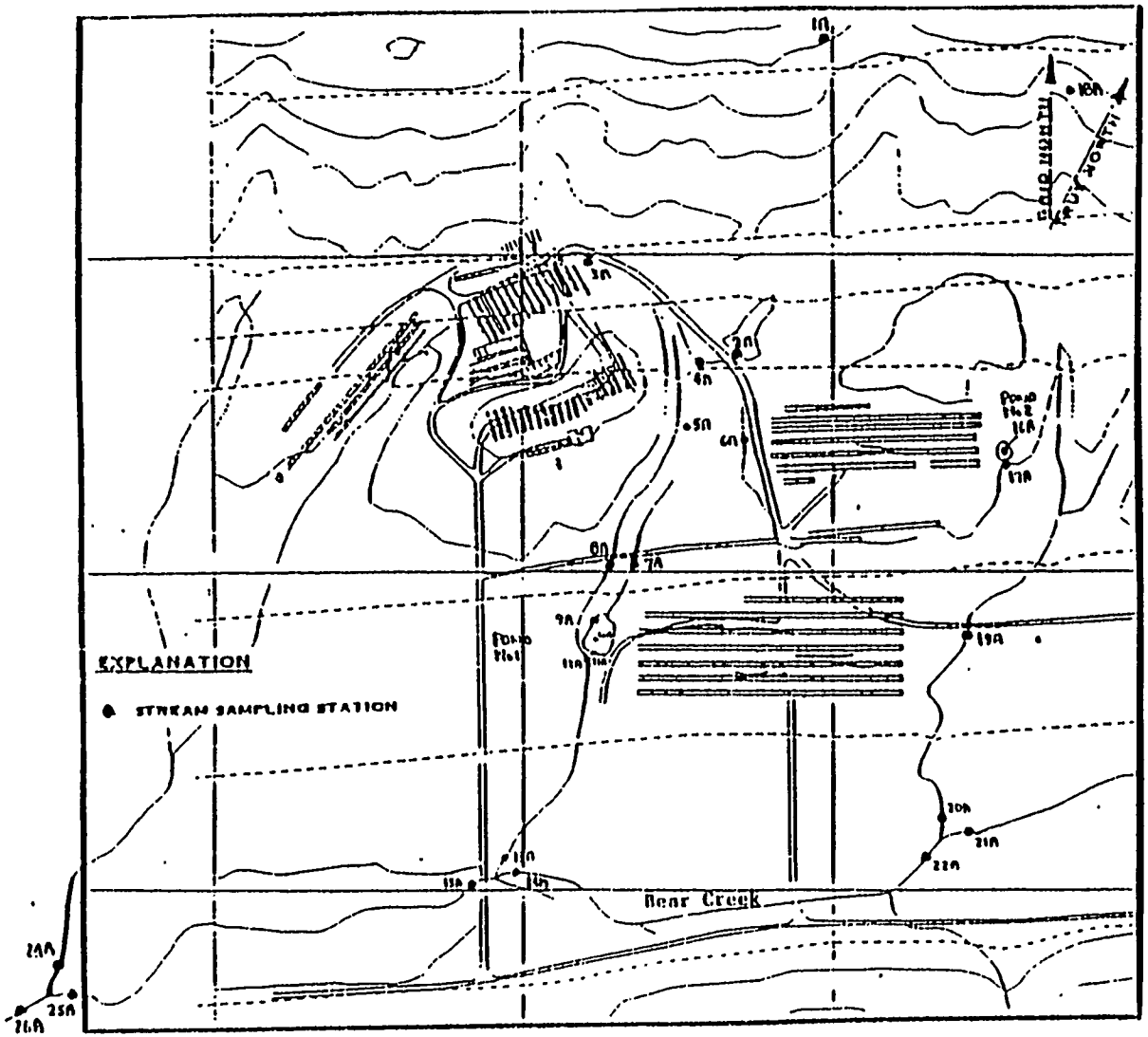
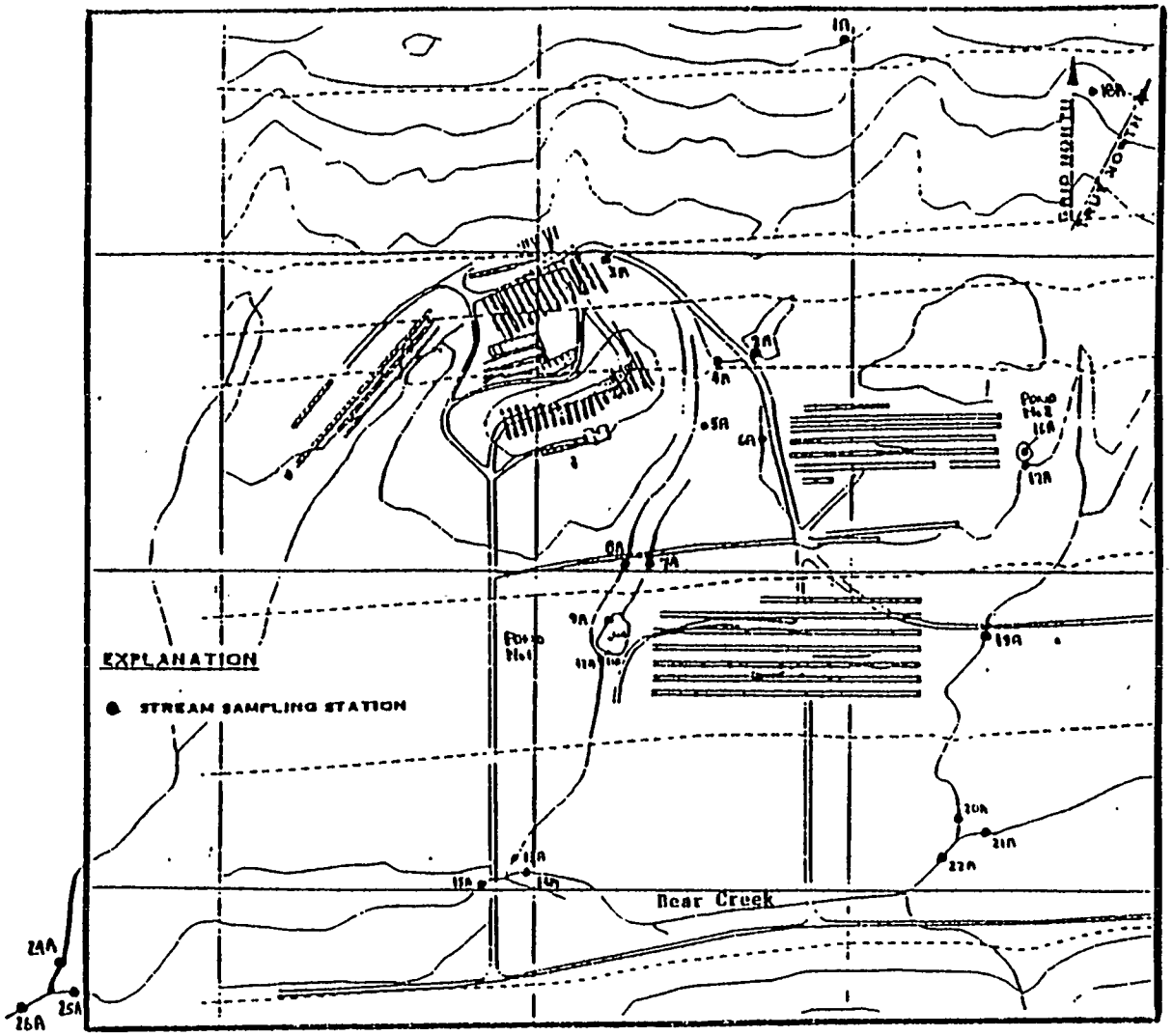


FIGURE 6-31
VOLATILE ORGANIC
PRIORITY POLLUTANT
IN SEDIMENT
UNIT=PPB (PARTS/BILLION)
BURIAL GROUNDS

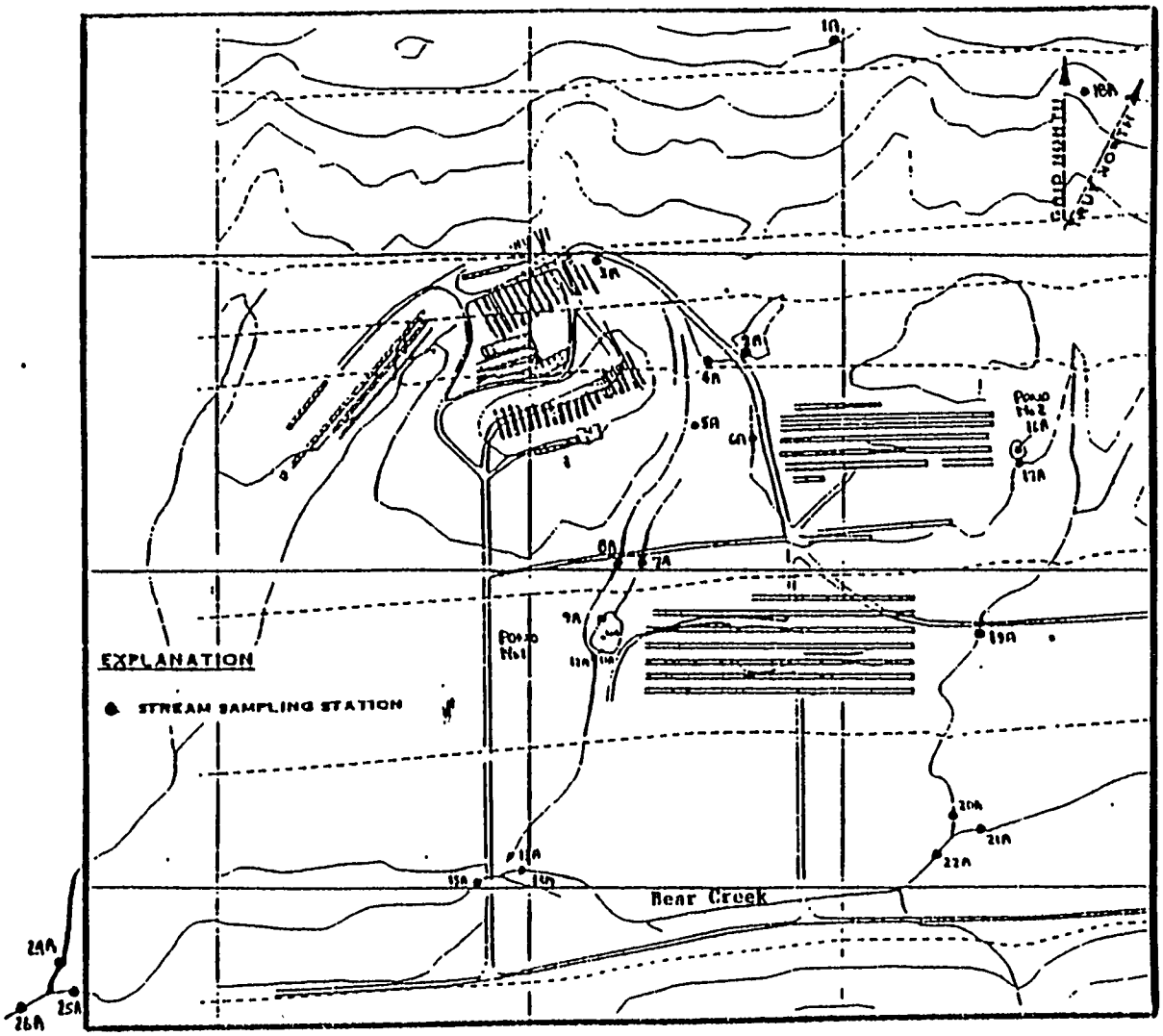
STATION	VINYL CHLORIDE
1A	N
2A	N
3A	N
4A	N
5A	N
7A	N
8A	N
9A	<10
11A	2800
12A	24
13A	N
14A	N
15A	<10
17A	10



Mercury in Sediment
(Units = ppm)

Station	Conc.
1A	
2A	
3A	<0.1
4A	<0.1
5A	
6A	
7A	0.7
8A	<0.2
9A	0.9
10A Sub.	
10A Sur.	
11A	1.4
12A	<0.1
13A	
14A	<0.1
15A	0.3
16A Sub.	
16A Sur.	
17A	<0.1
18A	
19A	
20A	1.1
21A	<0.1
22A	0.3
23A	
24A	<0.1
25A	0.1
26A	<0.1

FIGURE 6-32



Mercury in Water
(Units = ppm)

Station	Conc.
1A	<0.001
2A	<0.001
3A	
4A	
5A	0.001
6A	
7A	<0.001
8A	<0.001
9A	
10A Sub.	0.001
10A Sur.	
11A	
12A	<0.001
13A	
14A	
15A	
16A Sub.	<0.001
16A Sur.	
17A	
18A	
19A	
20A	
21A	<0.001
22A	<0.001
23A	
24A	<0.001
25A	<0.001
26A	<0.001

FIGURE 6-33

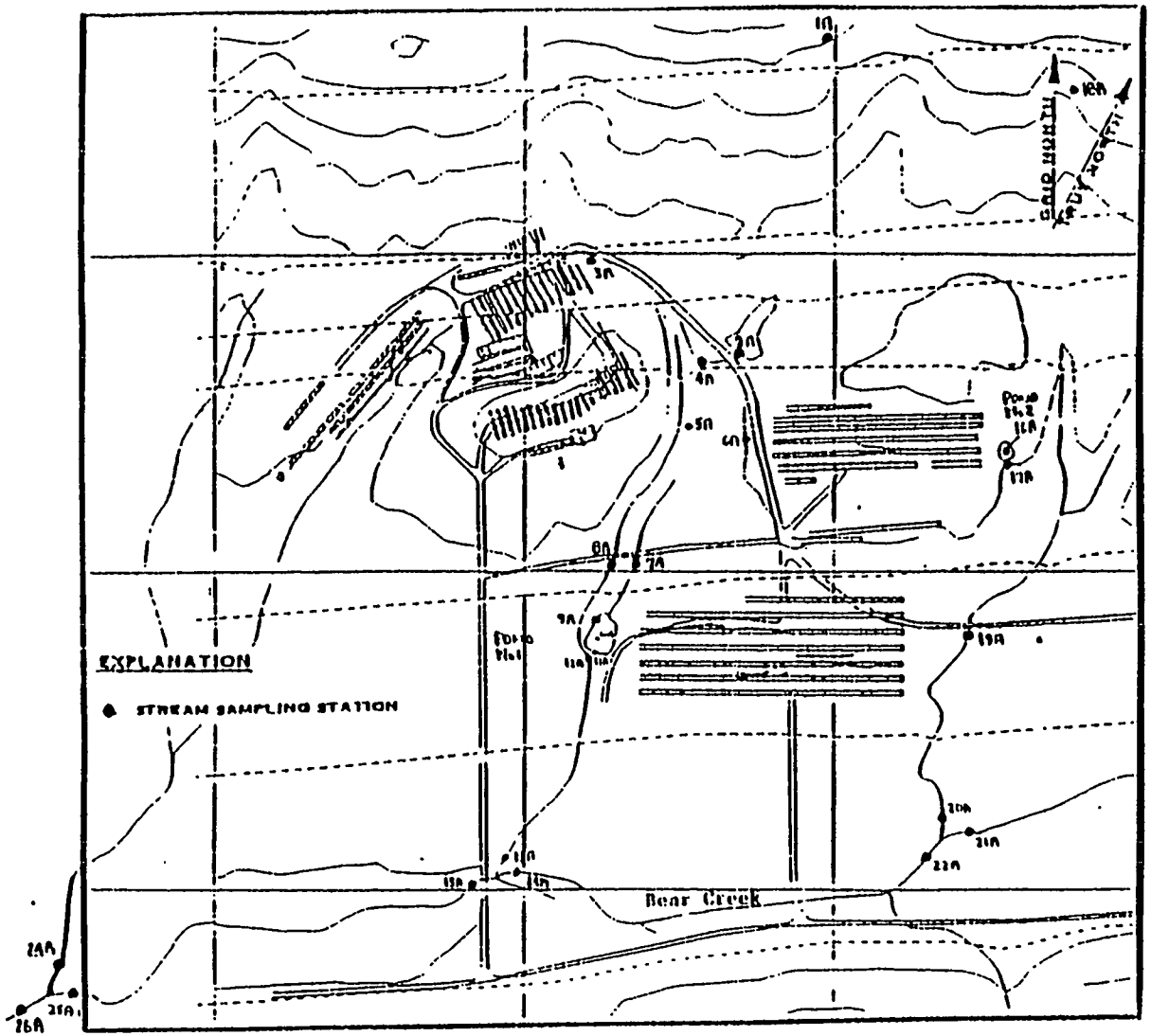


FIGURE 6.36
PCB IN SEDIMENT
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	AROCLOR 1242/1248 AND/OR 1016	AROCLOR 1254	AROCLOR 1260
1A	<0.05	<0.05	<0.05
2A	<0.05	<0.05	<0.05
3A	<0.05	<0.05	<0.05
4A	<0.05	0.11	<0.05
5A	<0.05	<0.05	<0.05
6A	3.4	3.1	0.3
7A	<0.05	<0.05	<0.05
8A	140	95	<20
9A	320	90	<30
10A	3.8	4.4	0.8
11A	<4	23	3.2
12A	<0.05	<0.05	<0.05
13A	<0.05	2.7	0.05
14A	4.7	1.7	<0.4
15A	<0.05	<0.05	<0.05
16A	<0.05	<0.05	<0.05
17A	<0.05	<0.05	<0.05
18A	<0.05	<0.05	<0.05
19A	<0.05	0.05	<0.05
20A	<0.05	0.13	0.06

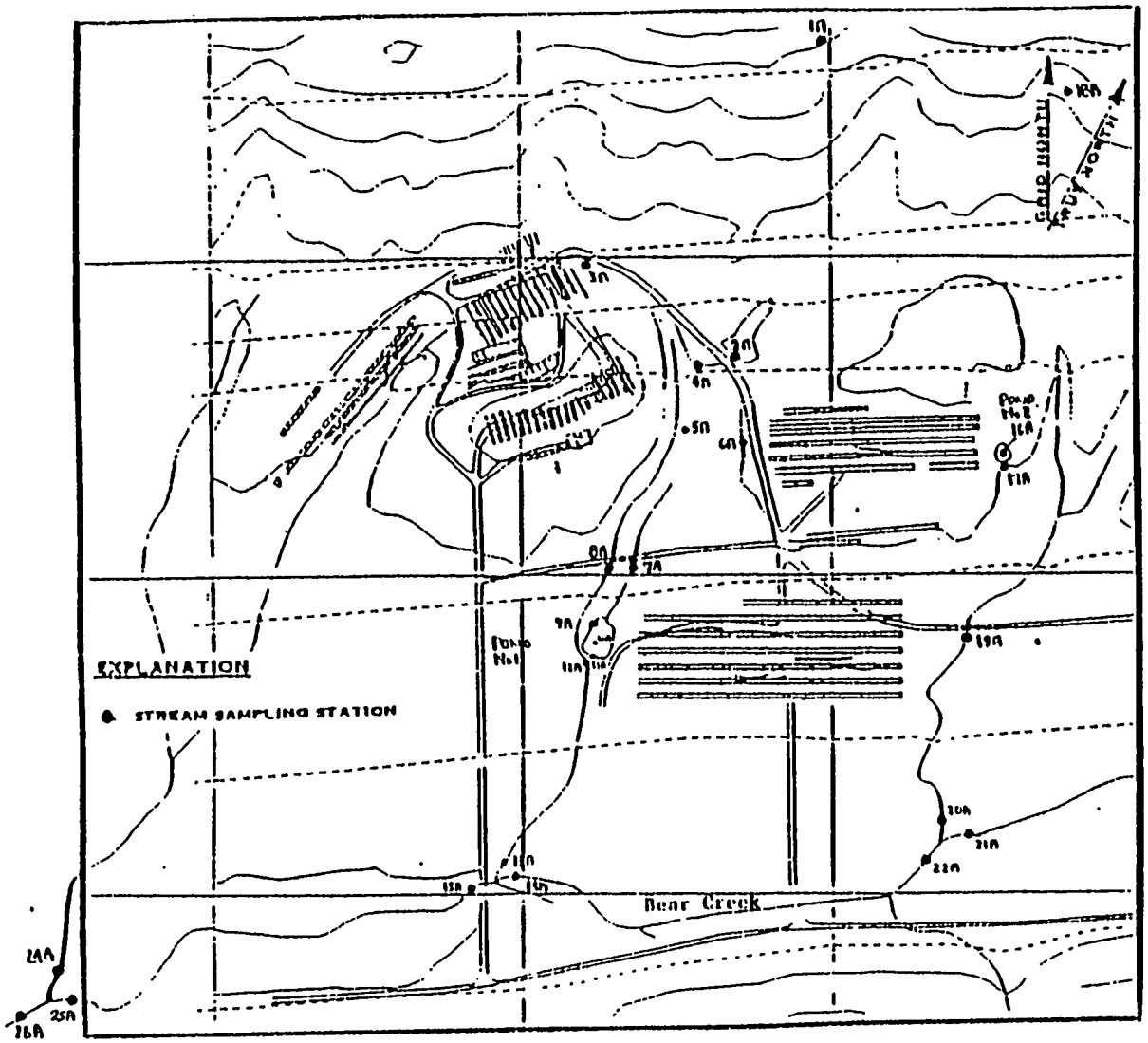


FIGURE 6-15
PCB III SECTION
UNIT-PPB (PARTS/BILLION)
BURSAL GROUNDS

STATION	AROCLOR 1242/1248 AND/OR 1016	AROCLOR 1254	AROCLOR 1260
1A	<0.1	<0.3	<0.3
2A	<0.1	<0.3	<0.3
3A	<0.1	<0.3	<0.3
5A	<0.1	<0.3	<0.3
4A WATER PHASE	840	300	<120
4A OIL PHASE	3000	2400	<480
7A	1.6	<0.3	<0.3
8A	<0.1	<0.3	<0.3
10A SUB-SURFACE	1.9	1.1	<0.3
10A SURFACE WATER PHASE	14	23	<1
10A SURFACE OIL PHASE	1100	1300	<70
13A	1.6	3	0.4
15A	0.6	3.5	<0.3
14A	<0.1	<0.3	<0.3
16A	0.6	1.3	0.4
16A SUB-SURFACE	3.3	3.0	<0.3
16A SURFACE	390	210	<30
17A	<0.1	<0.3	<0.3
18A	<0.1	<0.3	<0.3
19A	<0.1	<0.3	<0.3
22A	<0.1	<0.3	<0.3
20A	<0.1	<0.3	<0.3
21A	<0.1	<0.3	<0.3
24A	<0.1	<0.3	<0.3

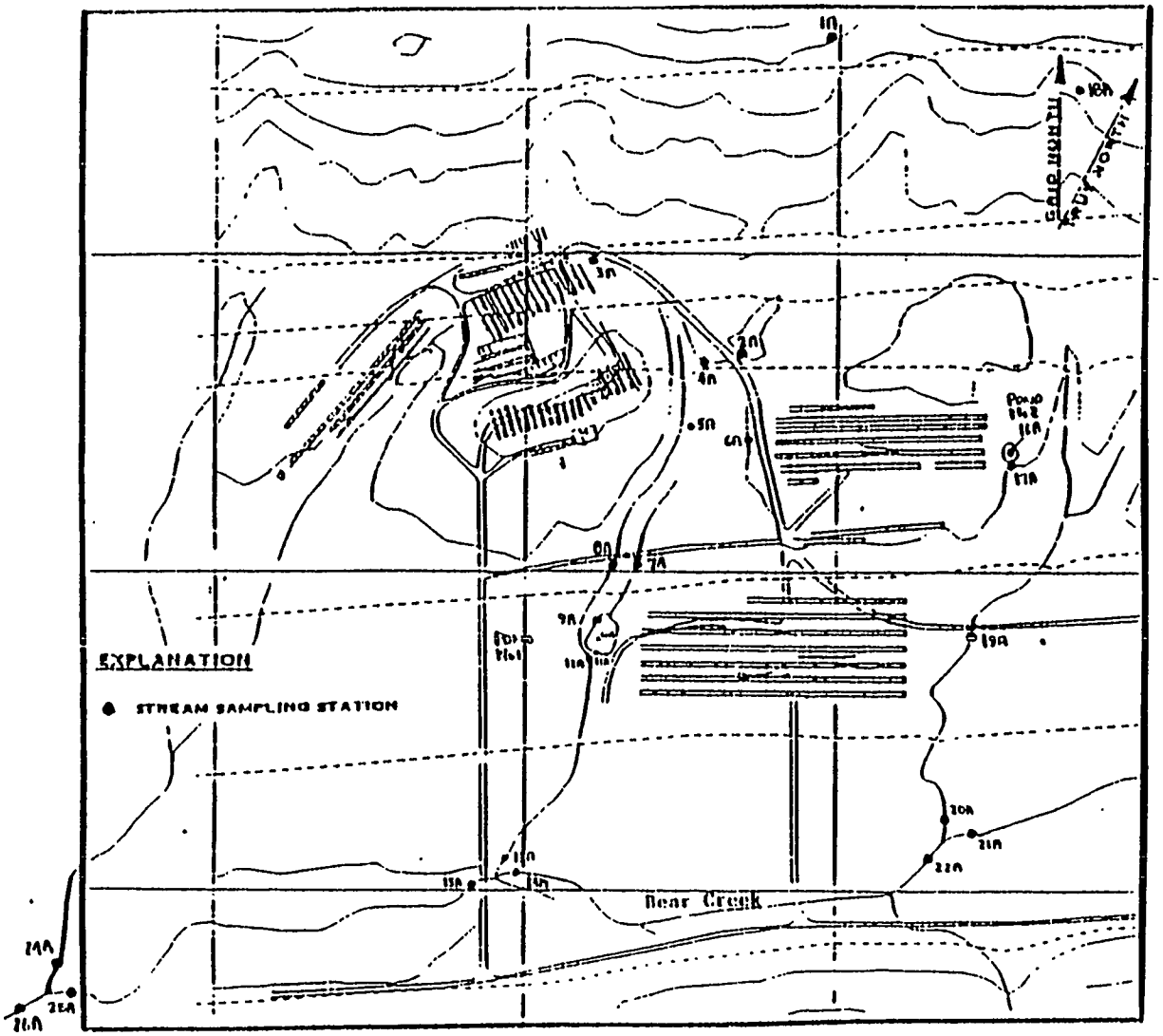


FIGURE 6 16
SUSPENDED PARTICULATE PCB
UNIT-PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	AROCLOR 1242/1248 AND/OR 1254	AROCLOR 1254	AROCLOR 1260
1A	<0.1	<0.3	<0.3
2A	<0.1	<0.3	<0.3
3A	<0.1	<0.3	<0.3
11A	0.5	1.1	<0.3
13A	<0.1	<0.3	<0.3
15A	<0.1	<0.3	<0.3
30A	<0.1	<0.3	<0.3
31A	<0.1	<0.3	<0.3
32A	<0.1	<0.3	<0.3
34A	<0.1	<0.3	<0.3
35A	<0.1	<0.3	<0.3
36A	<0.1	<0.3	<0.3

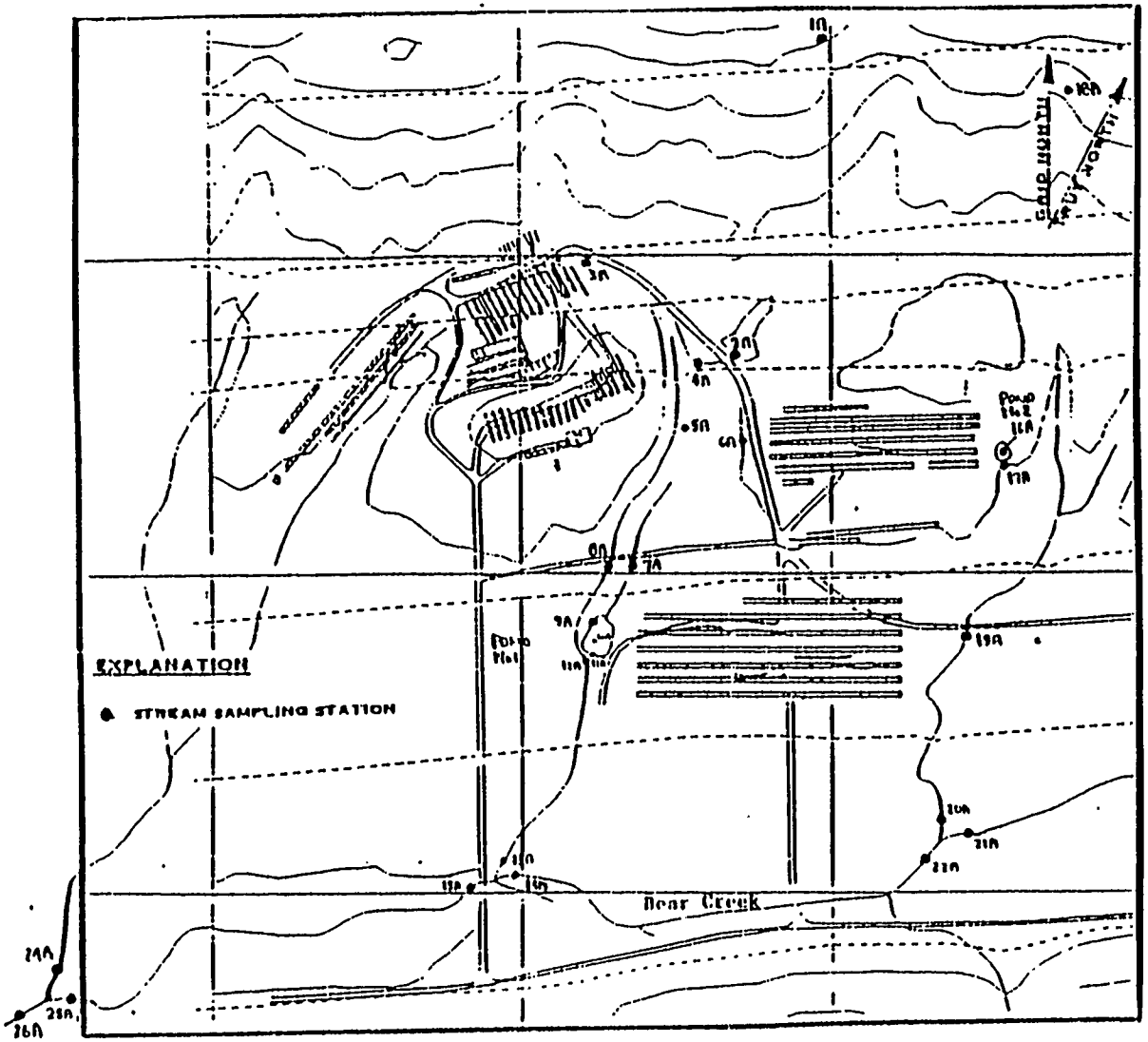


FIGURE 6-37
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL ALUMINUM IN WATER	DISSOLVED ALUMINUM	ALUMINUM IN SEDIMENT
1A	0.33	<0.05	20000
2A	[illegible]		21000
3A	1.5		31000
4A			17000
5A	1.6		15000
6A	0.1		
7A	<0.05	<0.05	44000
8A	0.0	0.05	24000
9A			24000
10A SUB-SURFACE	<0.05		
10A SURFACE	<0.05		
11A			30000
12A	7.0	<0.05	23000
13A	[illegible]	<0.05	33000
14A	<0.05	<0.05	18000
15A	<0.05	<0.05	15000
16A SUB-SURFACE	0.57		
16A SURFACE	0.22		14000
17A			
19A	0.10		31400
20A			19100
21A			19300
22A			

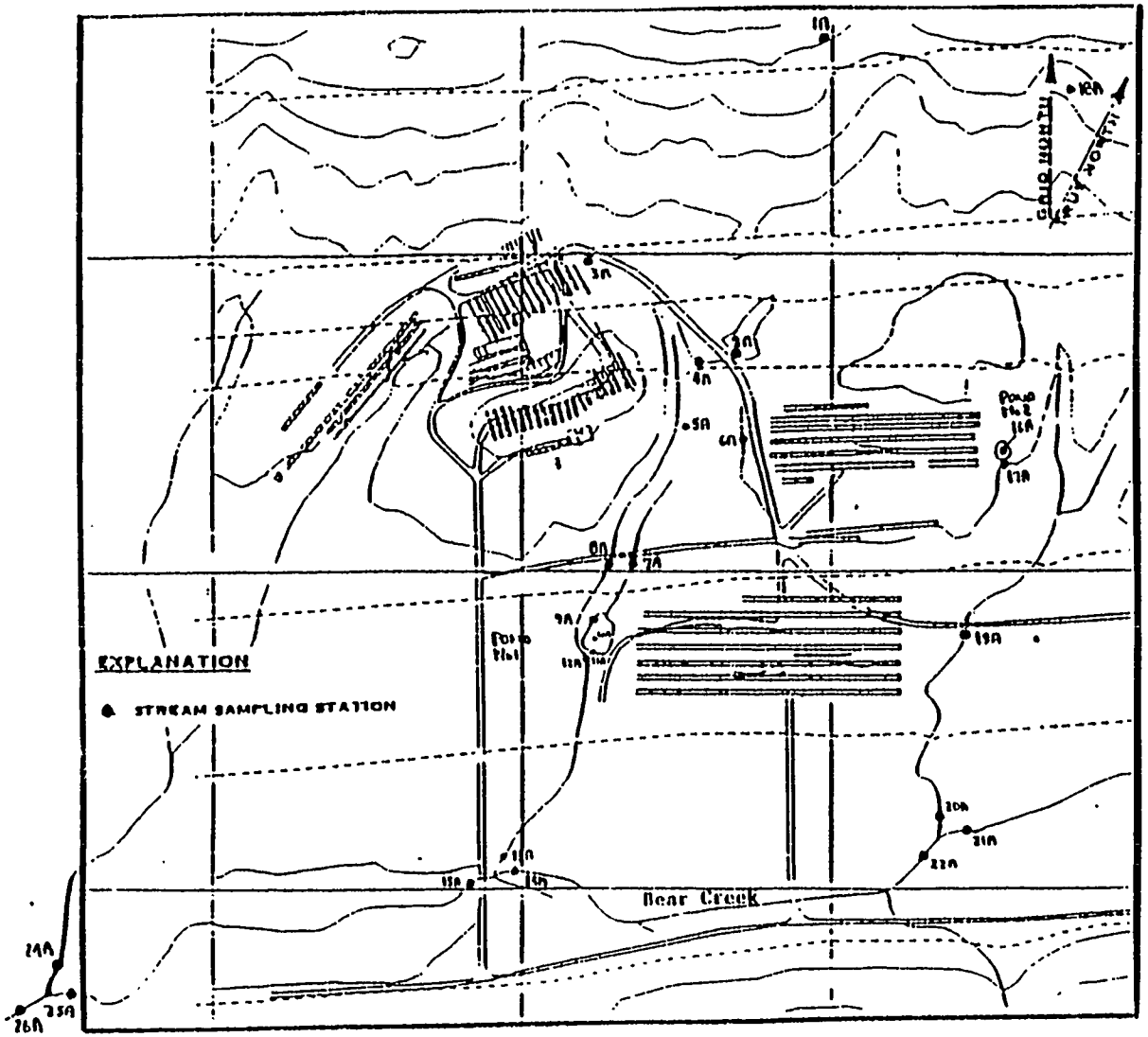


FIGURE 6 1B
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL ANTIMONY IN WATER	DISSOLVED ANTIMONY	ANTIMONY IN SEDIMENT
1A	<0.05	<0.05	10
2A	<0.05		15
3A	<0.05		<10
4A			20
5A	<0.05		10
6A	<0.05		
7A	<0.05	<0.05	14
8A	0.1	<0.05	20
9A			10
10A SUB-SURFACE	<0.05		
10A SURFACE	<0.05		
11A			10
12A	<0.05	<0.05	10
13A	<0.05	<0.05	20
14A	<0.05	<0.05	<10
15A	<0.05	<0.05	10
16A SUB-SURFACE	<0.05		
16A SURFACE	<0.05		
17A			<10
19A	<0.05		
20A			<10
21A			<10
22A			12

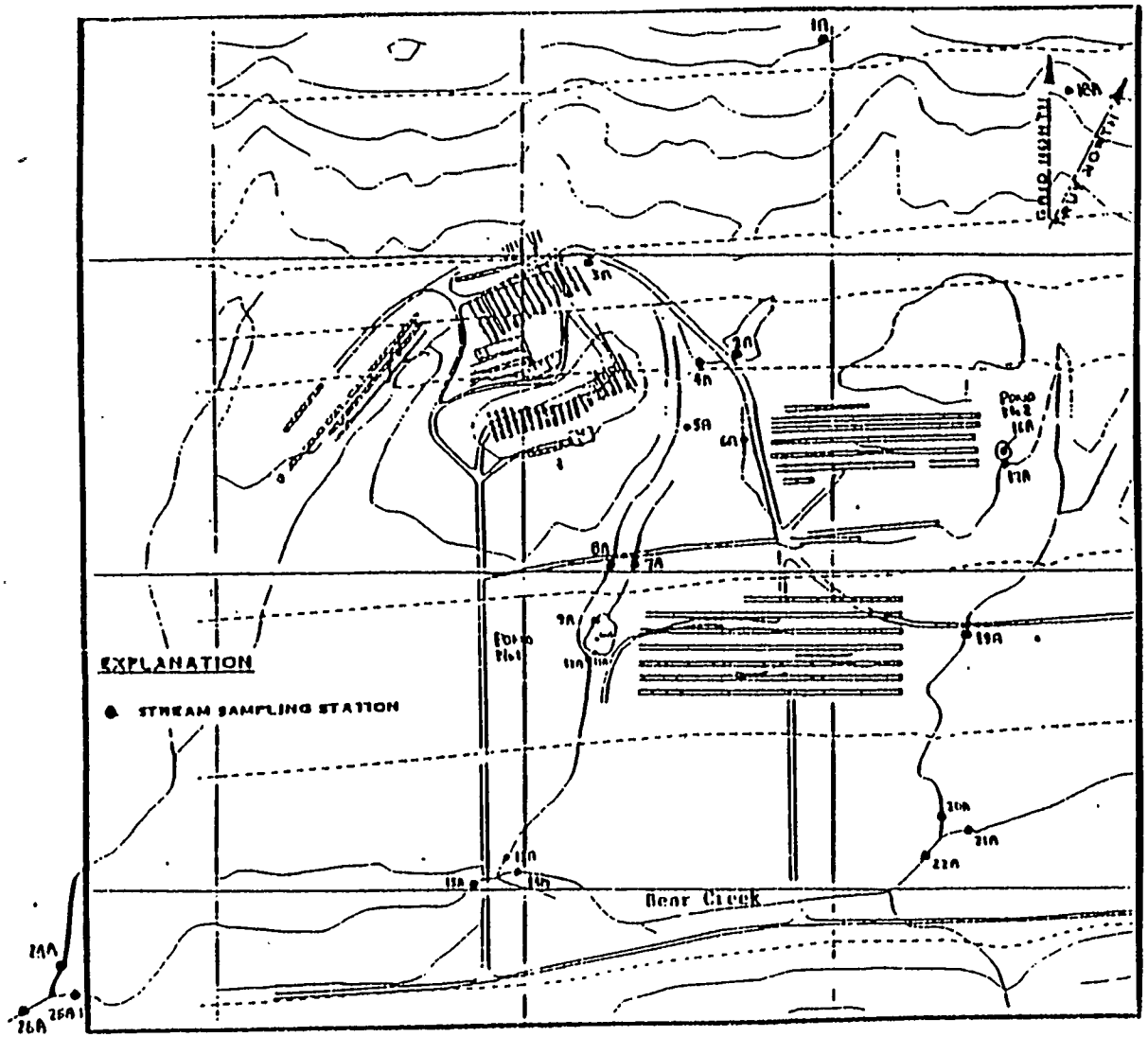


FIGURE 6-19
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNITS-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL ARSENIC IN WATER	DISSOLVED ARSENIC	ARSENIC IN SEDIMENT
1A	<0.2	<0.2	80
2A	<0.2		140
3A	<0.2		60
4A			80
5A	<0.2		30
6A	<0.2		
7A	<0.2	<0.2	130
8A	0.2	<0.2	100
9A			30
10A SUB-SURFACE	<0.2		
10A SURFACE	<0.2		
11A			70
12A	<0.2	<0.2	40
13A	<0.2	<0.2	100
14A	<0.2	<0.2	30
15A	<0.2	<0.2	30
16A SUB-SURFACE	<0.2		
16A SURFACE	<0.2		
17A			70
19A	<0.2		
20A			80
21A			30
22A			47

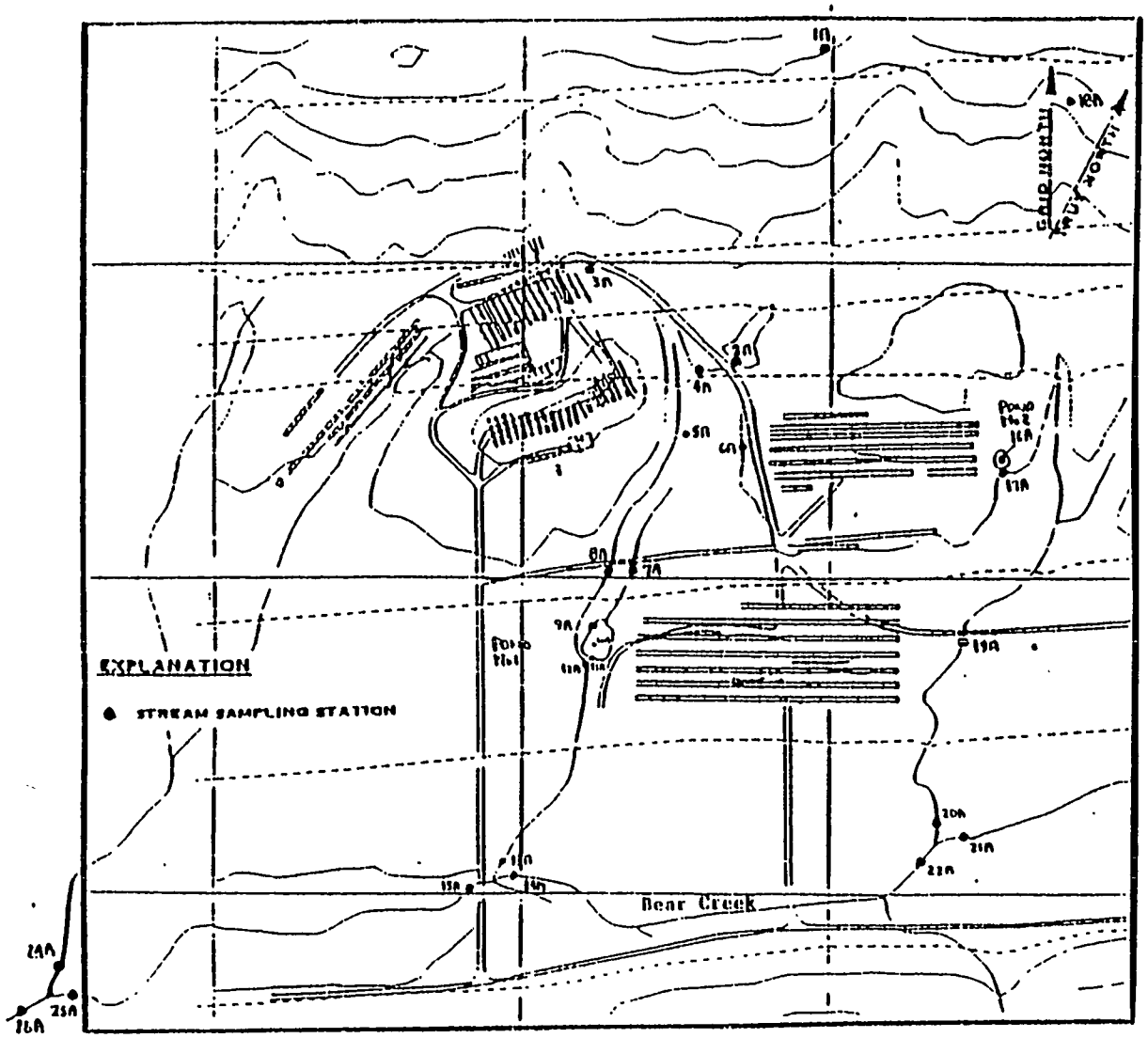


FIGURE 6.40
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL BARIUM IN WATER	DISSOLVED BARIUM	BARIUM IN SEDIMENT
1A	0.075	0.043	340
2A	0.15		310
3A	0.094		430
4A			190
5A	0.4		130
6A	2.1		
7A	0.43	0.30	170
8A	1.3	0.057	140
9A			140
10A SUB-SURFACE	0.24		
10A SURFACE	0.24		
11A			140
12A	0.26	0.14	37
13A	0.13	0.12	150
14A	0.15	0.14	120
15A	0.43	0.14	110
16A SUB-SURFACE	0.017		
16A SURFACE	0.017		
17A			170
18A	0.15		
19A			220
20A			107
22A			250

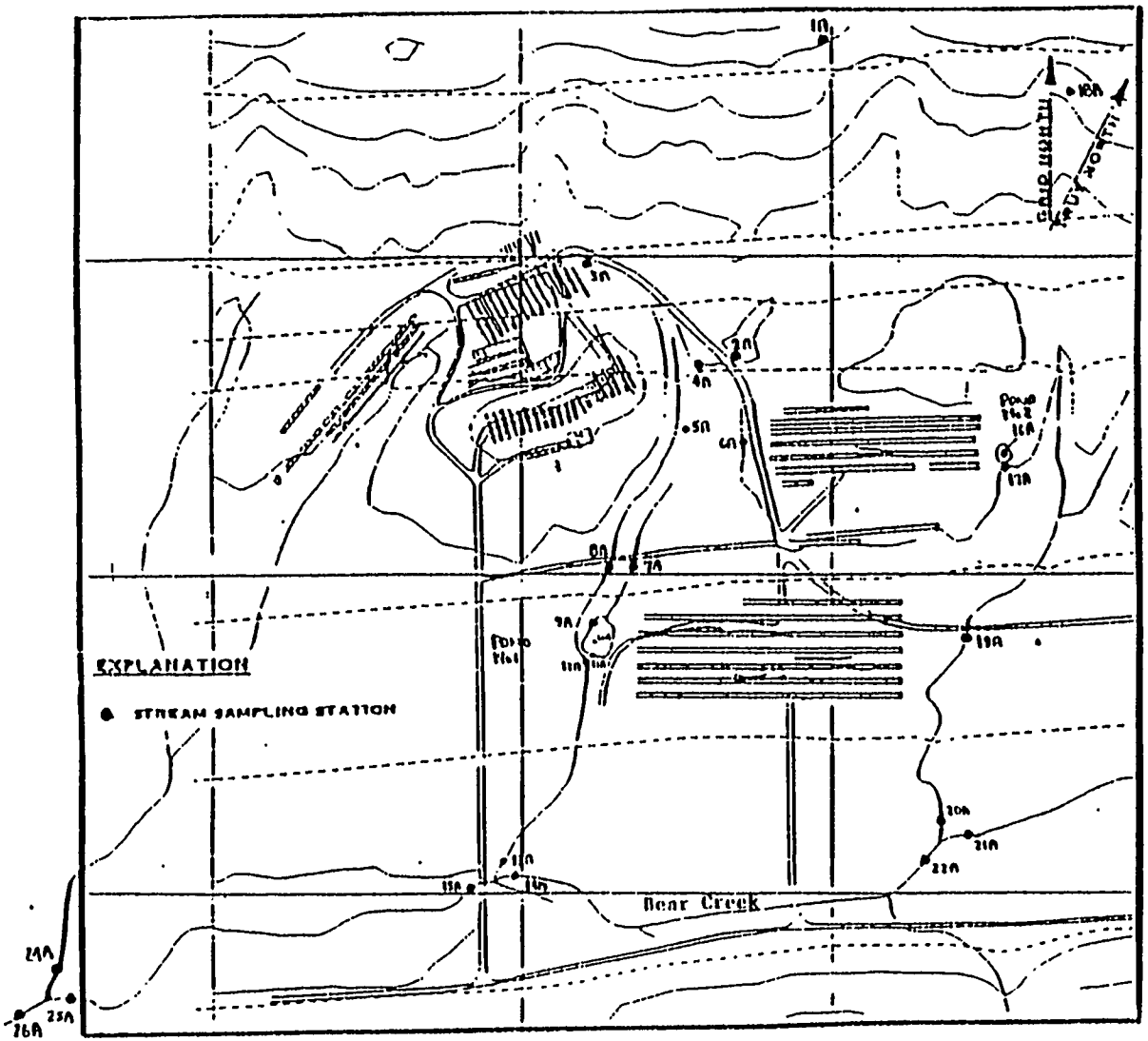


FIGURE 6.41
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL BERYLLIUM IN WATER	DISSOLVED BERYLLIUM	BERYLLIUM IN SEDIMENT
1A	<0.001	<0.001	<1
2A	<0.001		3
3A	<0.001		3
4A			3
5A	<0.001		<2
6A	<0.001		
7A	<0.001	<0.001	<1
8A	0.002	<0.001	3
9A			3
10A SUB-SURFACE	<0.001		
10A SURFACE	<0.001		
11A			1
12A	<0.001	<0.001	1
13A	<0.001	<0.001	3
14A	<0.001	<0.001	3
15A	<0.001	<0.001	3
16A SUB-SURFACE	<0.001		
16A SURFACE	<0.001		
17A			1
19A	<0.001		
20A			<1
21A			<1
22A			<1

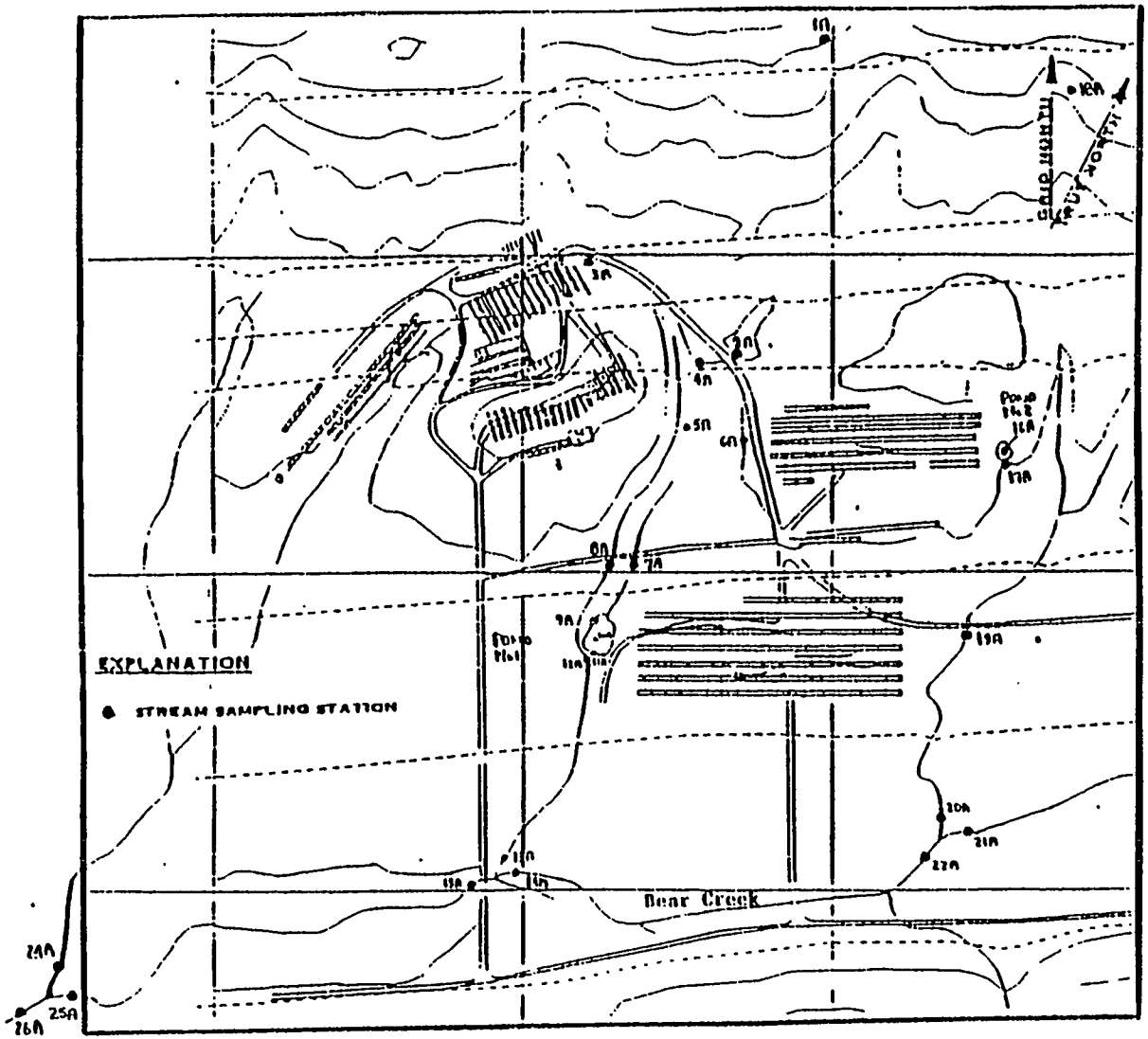


FIGURE 6.42
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL BORON IN WATER	DISSOLVED BORON	BORON IN SEDIMENT
1A	<0.01	<0.01	3
2A	<0.02		2
3A	<0.02		<2
4A			8
5A	1.6		<2
6A	.36		
7A	0.94	0.37	2
8A	0.24	0.10	<2
9A			<2
10A SUB-SURFACE	0.79		
10A SURFACE	0.93		
11A			<2
12A	0.43	0.40	<2
13A	0.49	0.44	<2
14A	0.14	0.10	4
15A	0.43	0.40	3
16A SUB-SURFACE	0.04		
16A SURFACE	0.02		
17A			<2
18A	1.6		
19A			4
20A			1.5
23A			12

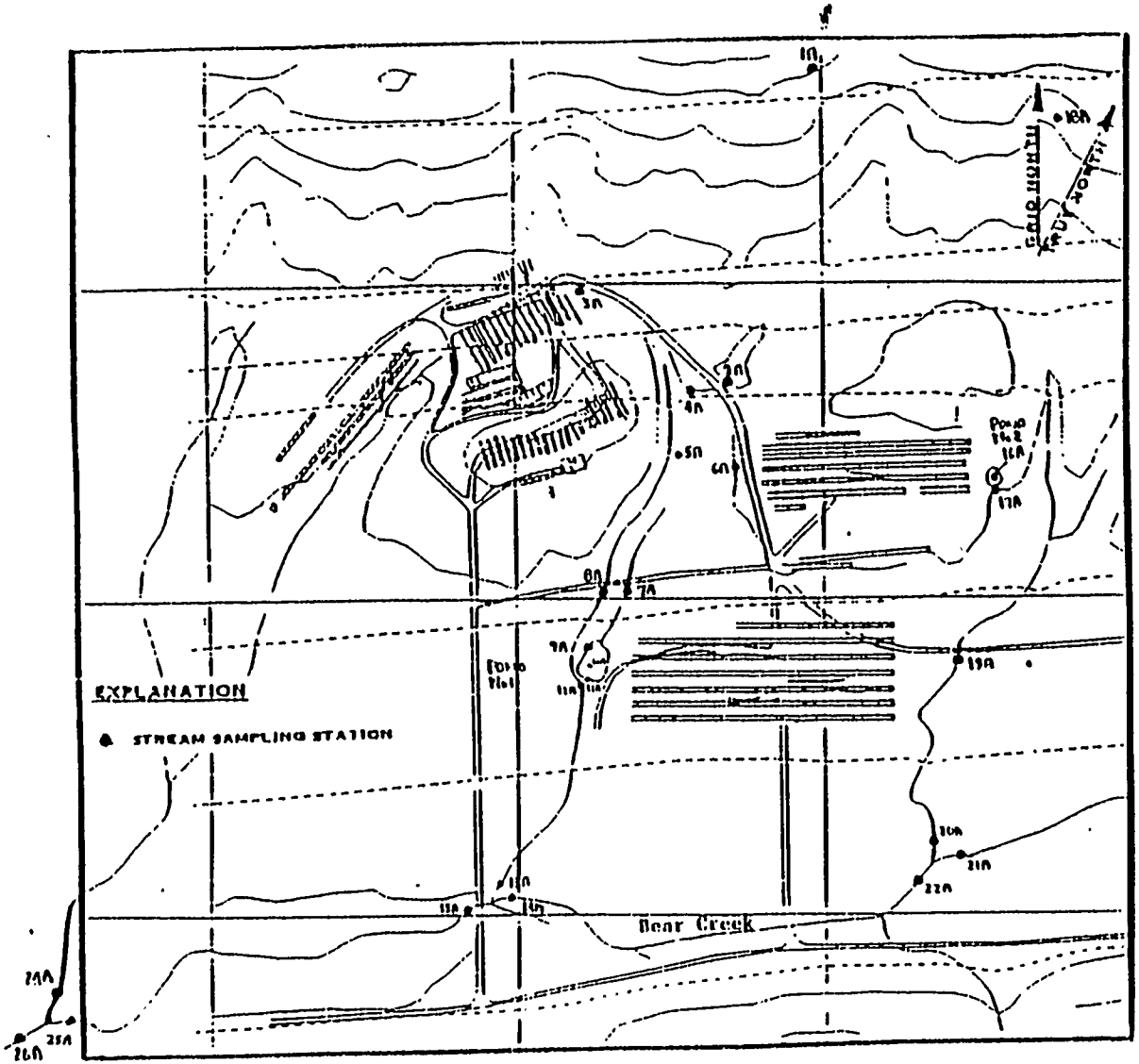


FIGURE 4.43
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL CADMIUM IN WATER	DISSOLVED CADMIUM	CADMIUM IN SEDIMENT
1A	<0.002	0.002	2.3
2A	<0.002		6.2
3A	<0.002		2.6
4A			3.7
5A	<0.002		1.4
6A	0.002		
7A	<0.002	<0.002	4.3
8A	0.012	<0.002	4
9A			3
10A SUB-SURFACE	<0.002		
10A SURFACE	<0.002		
11A			2.3
12A	<0.002	0.002	3
13A	<0.002	<0.002	3.0
14A	<0.002	<0.002	8
15A	<0.002	<0.002	11
16A SUB-SURFACE	<0.002		
16A SURFACE	<0.002		
17A			1.7
19A	<0.002		
20A			3
21A			16
22A			16

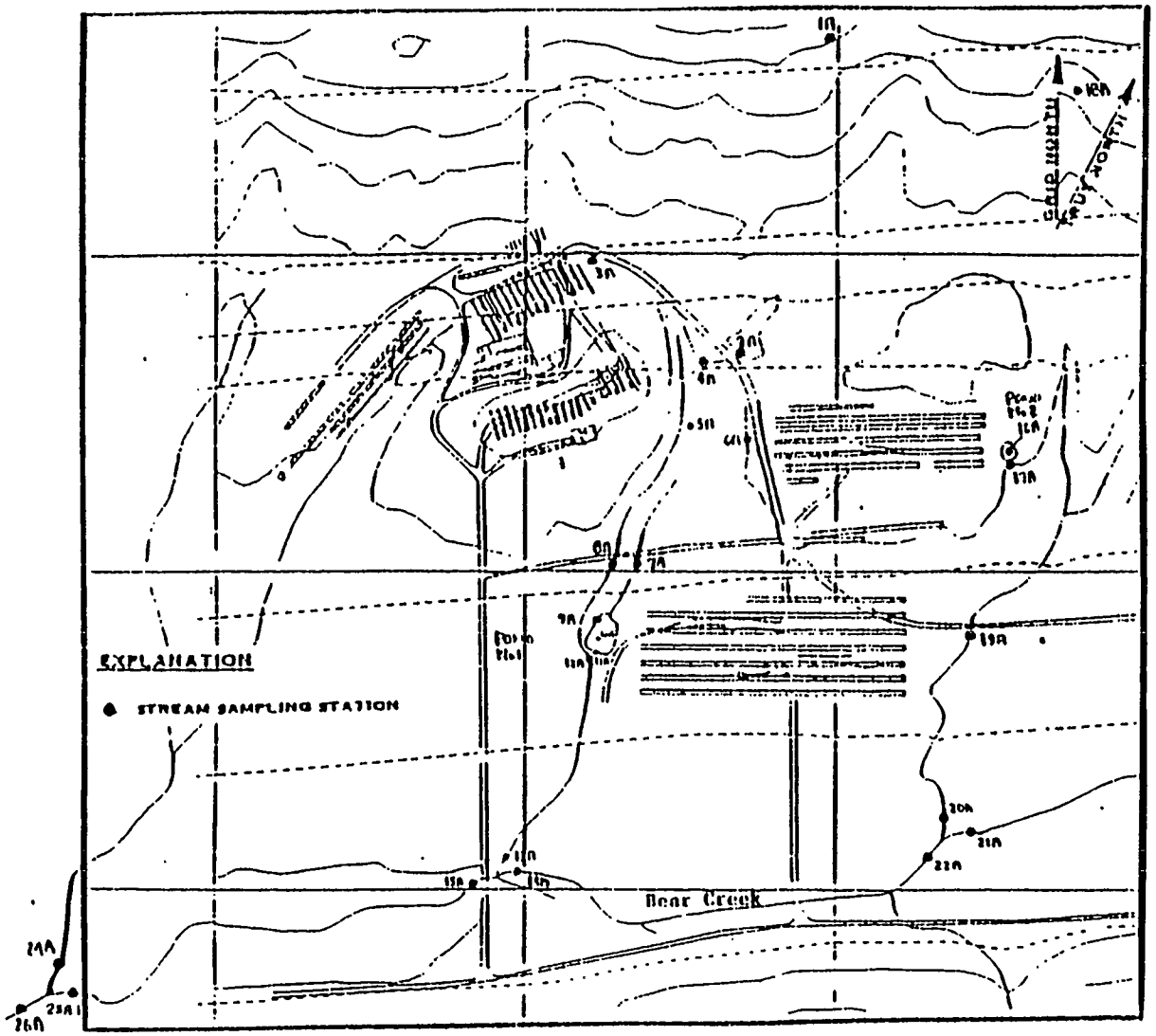


FIGURE 6-44
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL CALCIUM IN WATER	DISSOLVED CALCIUM	CALCIUM IN SEDIMENT
1A	13	13	600
2A	27		1940
3A	15		55000
4A			2000
5A	76		1100
6A	210		
7A	137	139	2000
8A	15	7.5	5000
9A			1800
10A SUB-SURFACE	101		
10A SURFACE	104		
11A			[illegible]
12A	76	74	770
13A	72	72	1400
14A	107	105	52000
15A	111	109	1300
16A SUB-SURFACE	3.2		
16A SURFACE	3.2		
17A			130
18A	66		
20A			1350
21A			1520
22A			930

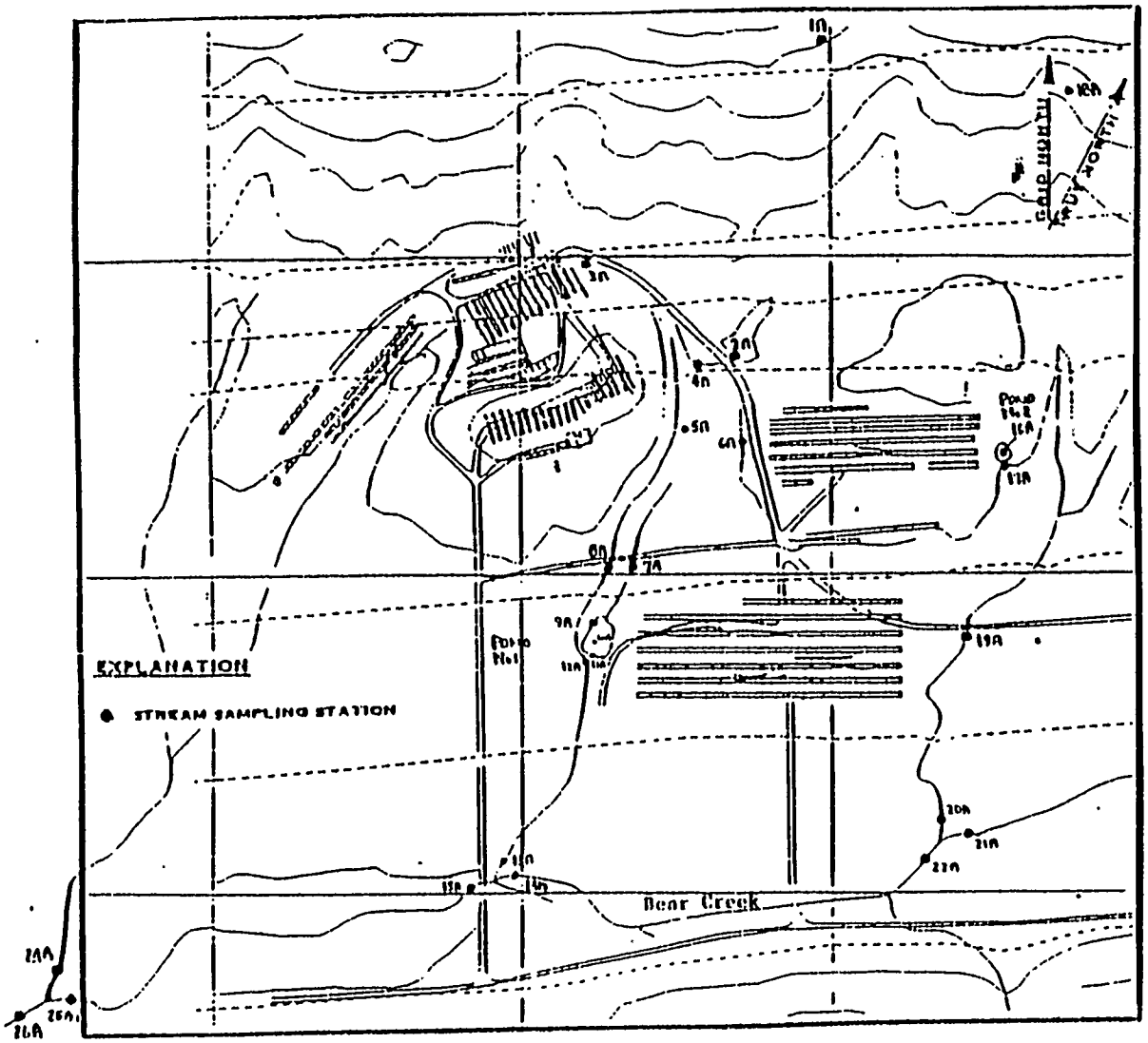


FIGURE A-45
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL CHROMIUM IN WATER	DISSOLVED CHROMIUM	CHROMIUM IN SEDIMENT
1A	<0.02	<0.02	29
2A	<0.02		50
3A	<0.02		37
4A			39
5A	<0.02		13
6A	<0.02		
7A	<0.02	<0.02	41
8A	0.13	<0.02	43
9A	—		34
10A SUB-SURFACE	<0.02		
10A SURFACE	<0.02		
11A			39
12A	<0.02	<0.02	12
13A	<0.02	<0.02	48
14A	<0.02	<0.02	15
15A	<0.02	<0.02	23
16A SUB-SURFACE	<0.02		
16A SURFACE	<0.02		
17A			20
19A	<0.02		
20A			24
21A			37
22A			24

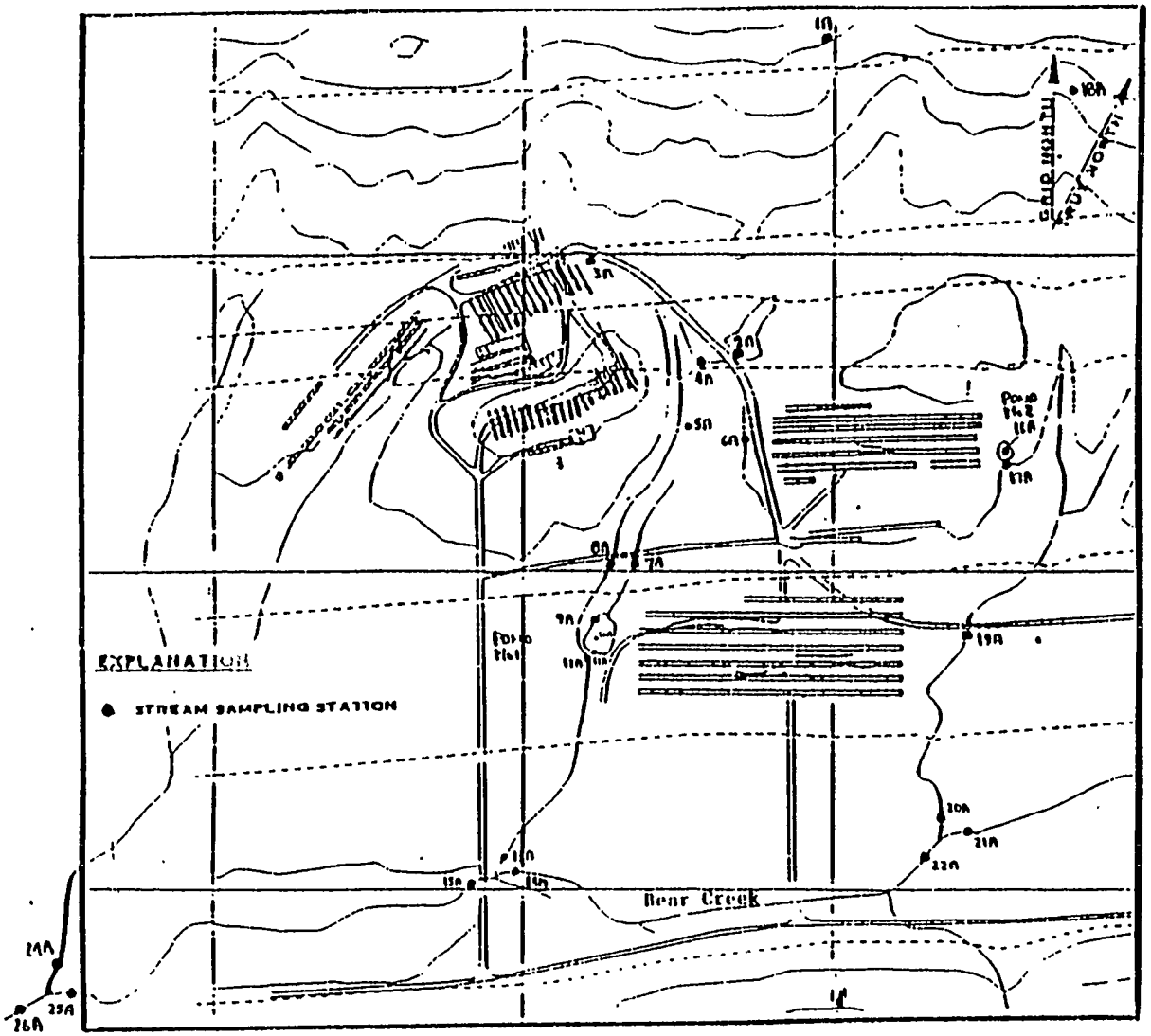


FIGURE 6.46
METAL (DETERMINED BY ICAP/AA ANALYSES)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL COBALT IN WATER	DISSOLVED COBALT	COBALT IN SEDIMENT
1A	<0.01	<0.01	4
2A	0.02		10
3A	<0.01		7
4A			14
5A	<0.01		8
6A	0.01		
7A	<0.01	<0.01	11
8A	0.02	<0.01	24
9A			7
10A SUB-SURFACE	<0.01		
10A SURFACE	<0.01		
12A			8
13A	<0.01	<0.01	5
13A	<0.01	0.01	20
14A	<0.01	<0.01	17
15A	<0.01	0.01	19
16A SUB-SURFACE	<0.01		
16A SURFACE	<0.01		
17A			13
19A	<0.01		
20A			15
21A			10
23A			32

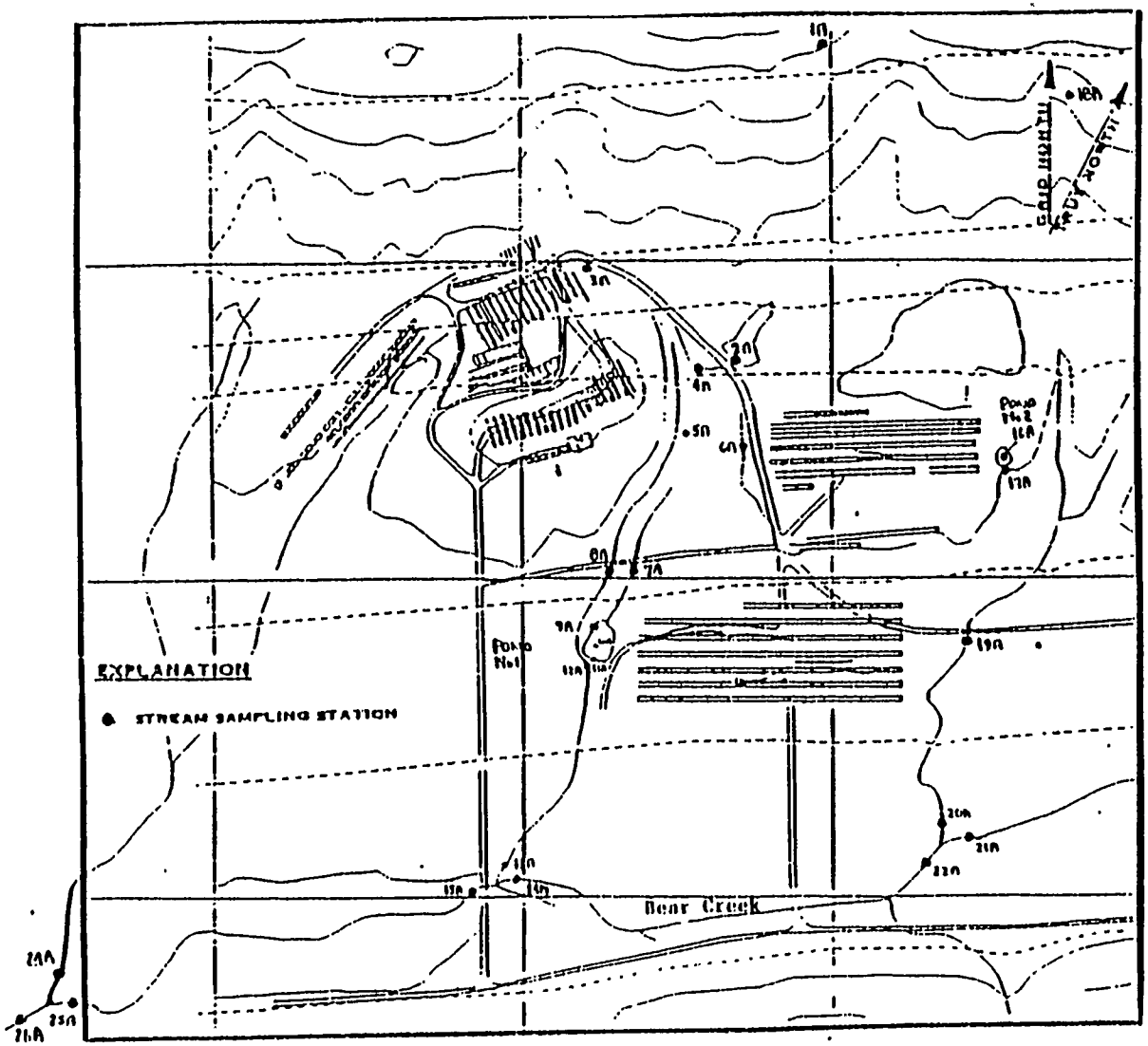


FIGURE 5-47
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL COPPER IN WATER	DISSOLVED COPPER	COPPER IN SEDIMENT
1A	<0.01	<0.01	1
2A	<0.01		7
3A	<0.01		8
4A			1
5A	<0.01		<1
6A	<0.01		
7A	<0.01	<0.01	10
8A	0.05	<0.01	8
9A			4
10A SUB-SURFACE	<0.01		
10A SURFACE	<0.01		
11A			9
12A	<0.01	<0.01	1
13A	<0.01	0.01	3
14A	<0.01	<0.01	7
15A	<0.01	<0.01	8
16A SUB-SURFACE	<0.01		
16A SURFACE	<0.01		
17A			3
18A	<0.01		
20A			9
21A			7
22A			4

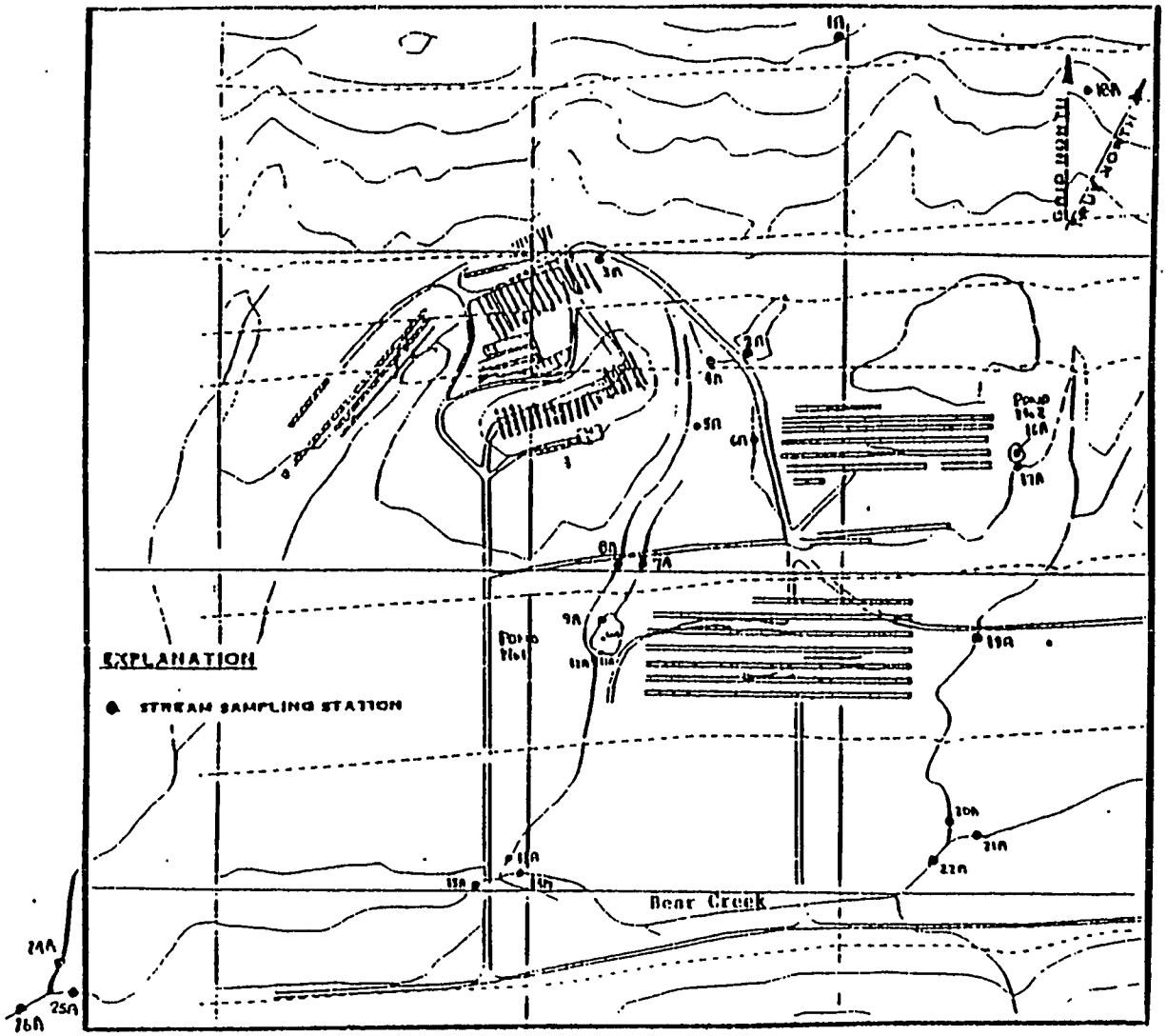


FIGURE 6.48
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL IRON IN WATER	DISSOLVED IRON	IRON IN SEDIMENT
1A	0.27	0.003	13000
2A	23		40000
3A	7.8		23000
4A			33000
5A	12		19000
6A	56		
7A	5.4	0.02	27000
8A	137	0.04	30000
9A			10000
10A SUB-SURFACE	2		
10A SURFACE	1.8		
11A			13000
12A	12	0.04	13000
13A	1.4	0.03	34000
14A	0.05	<0.005	26000
15A	0.40	0.02	15000
16A SUB-SURFACE	2.5		
16A SURFACE	2.6		
17A			13000
19A	1.5		
20A			16200
21A			12000
22A			32100

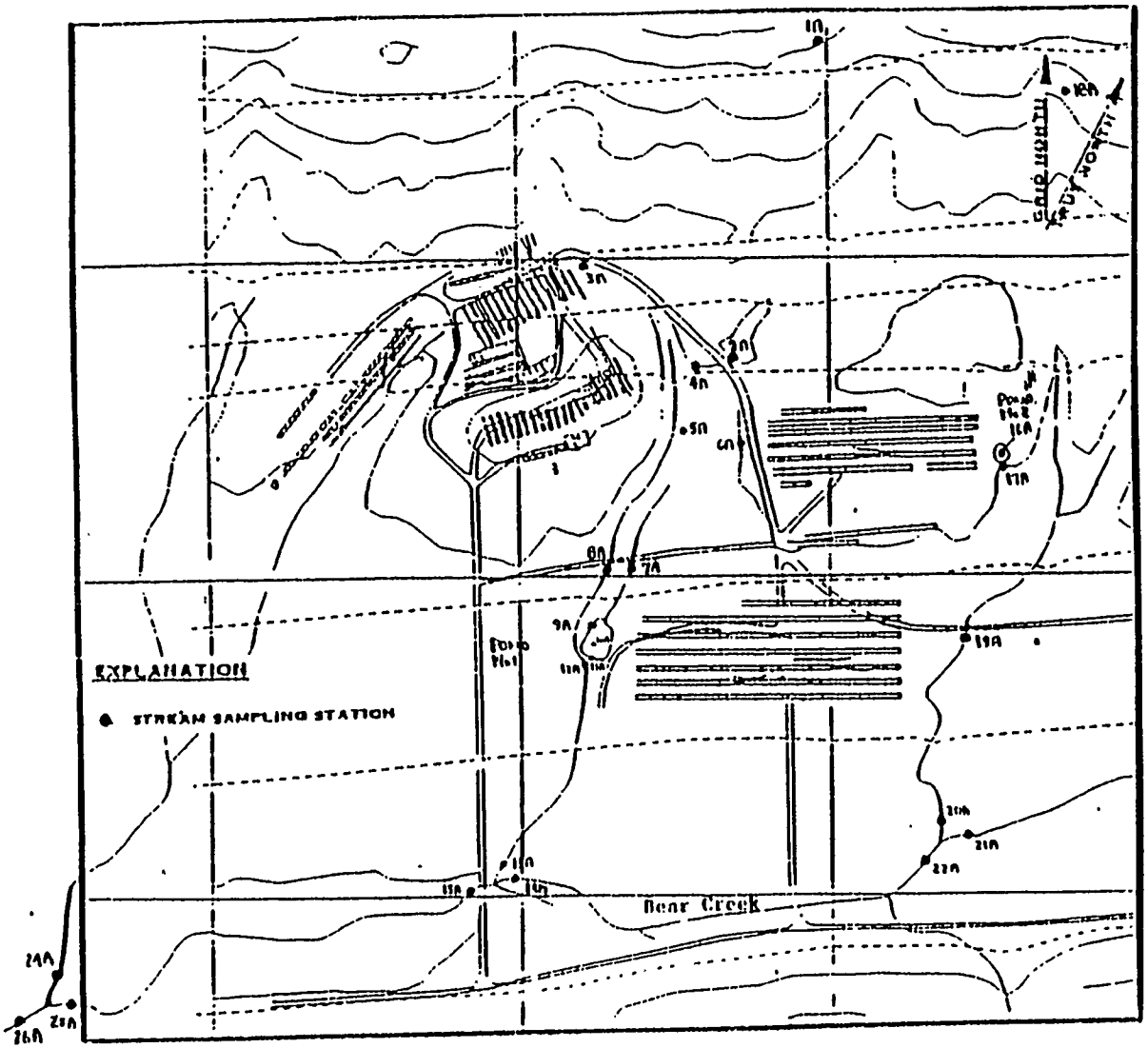


FIGURE 6.49
METAL (DETERMINED BY ICAP/AA ANALYSES)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL LEAD IN WATER	DISSOLVED LEAD	LEAD IN SEDIMENT
1A	<0.05	<0.05	60
2A	<0.05		100
3A	<0.05		70
4A			65
5A	<0.05		35
6A	<0.05		
7A	<0.05	<0.05	60
8A	0.16	<0.05	60
9A			50
10A SUB-SURFACE	<0.05		
10A SURFACE	<0.05		30
11A			40
12A	<0.05	<0.05	30
13A	<0.05	<0.05	20
14A	<0.05	<0.05	30
15A	<0.05	<0.05	
16A SUB-SURFACE	<0.05		
16A SURFACE	<0.05		30
17A			
18A	<0.05		25
19A			20
20A			45
21A			
22A			

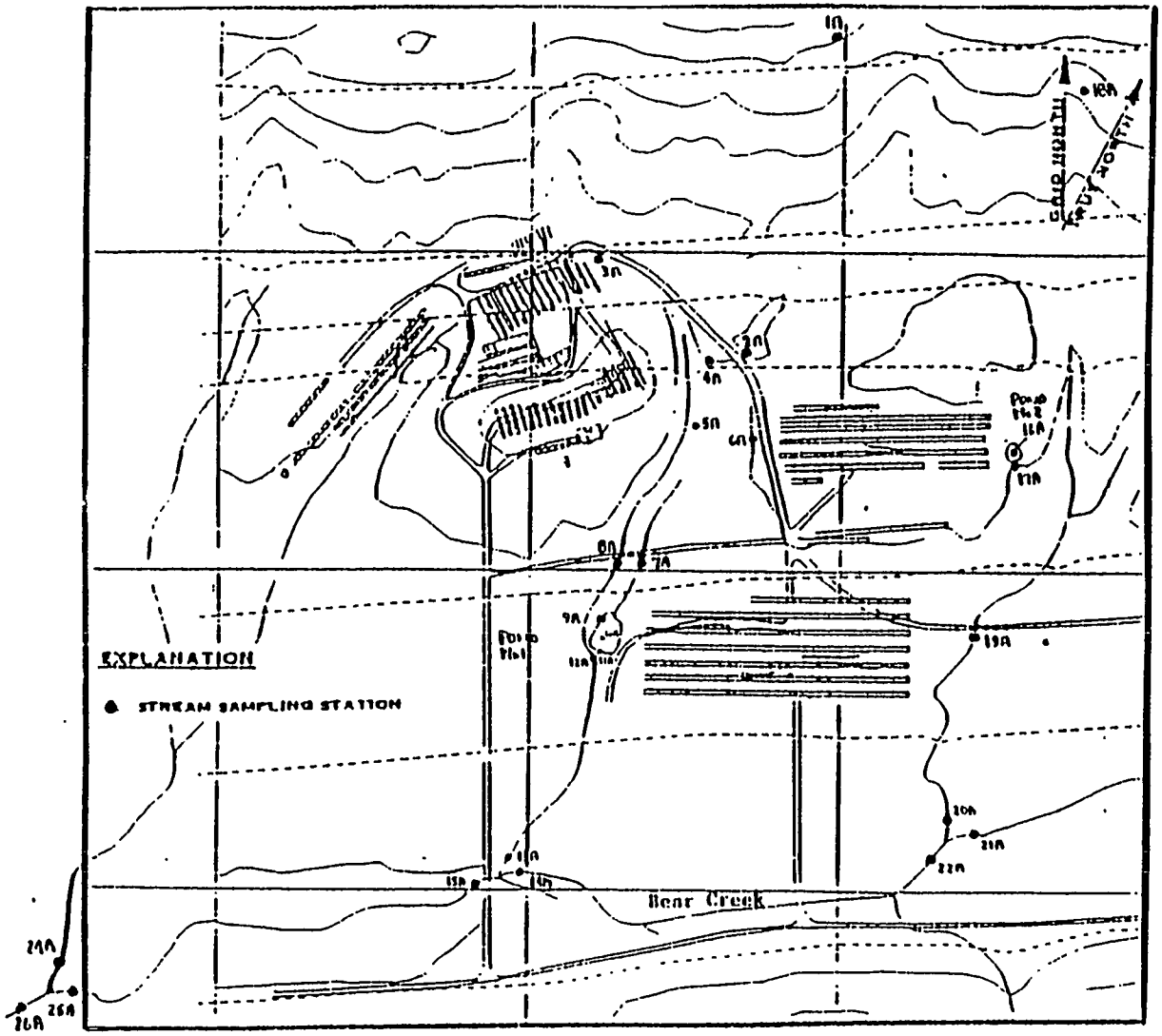


FIGURE 6.30
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPB (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL LITHIUM IN WATER	DISSOLVED LITHIUM	LITHIUM IN SEDIMENT
1A	<0.1	<0.1	10
2A	<0.1		40
3A	<0.1		40
4A			40
5A	<0.1		30
6A	1.4		
7A	0.3	<0.1	30
8A	<0.1	<0.1	40
9A			30
10A SUB-SURFACE	0.1		
10A SURFACE	<0.1		
11A			40
12A	<0.1	<0.1	30
13A	0.4	<0.1	30
14A	<0.1	<0.1	30
15A	1.0	1.4	40
16A SUB-SURFACE	<0.1		
16A SURFACE	<0.1		
17A			30
19A	<0.1		
20A			40
21A			33
22A			47

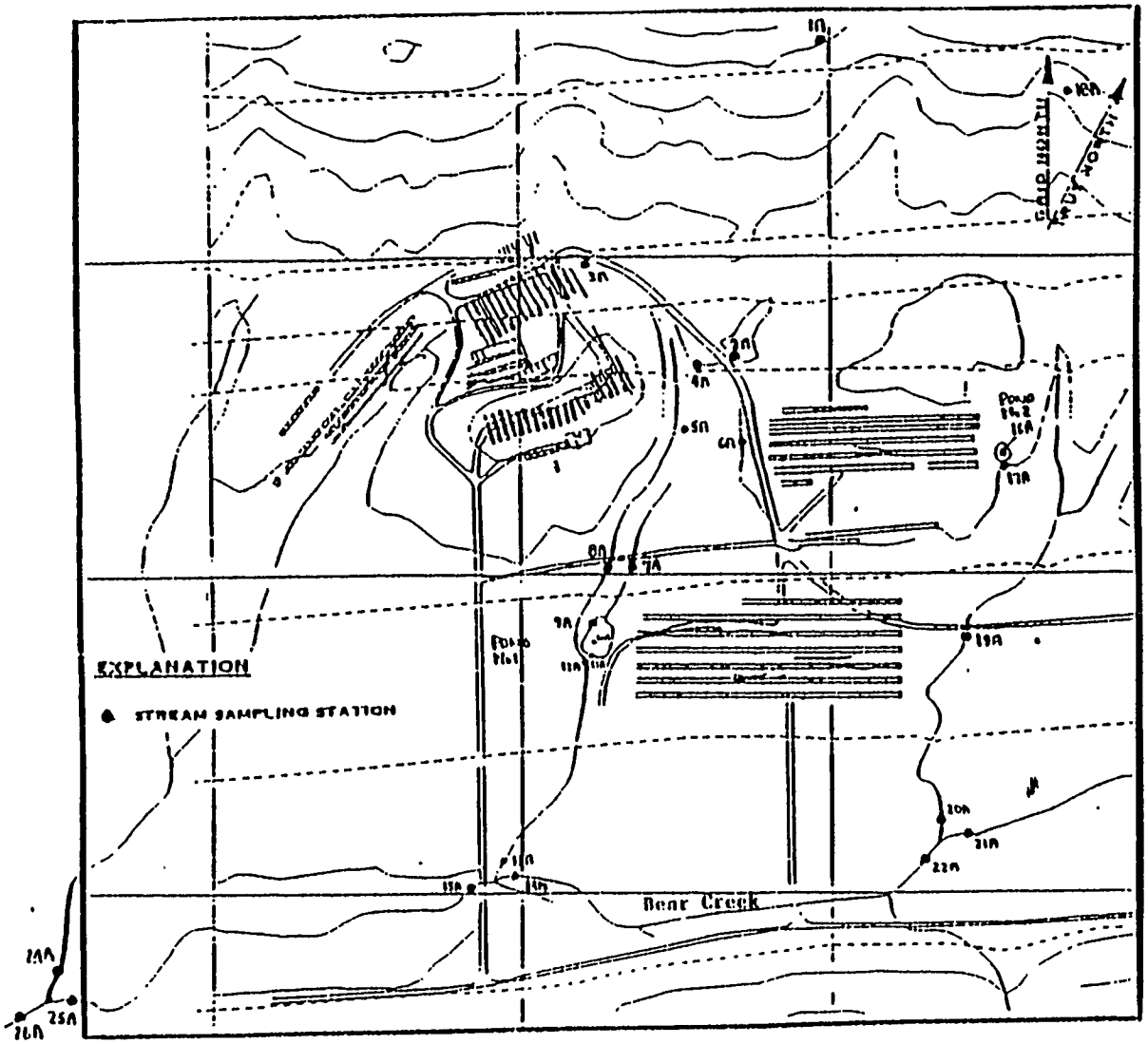


FIGURE 6-51
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL MAGNESIUM IN WATER	DISSOLVED MAGNESIUM	MAGNESIUM IN SEDIMENT
1A	4.3	4.1	1400
2A	4.0		3100
3A	5.3		17000
4A			3000
5A	14		1100
6A	39		
7A	15	15	4900
8A	8.8	1.8	3000
9A			2463
10A SUB-SURFACE	13		
10A SURFACE	13		3000
11A			1700
12A	10	9.3	3400
13A	9.4	9.3	4700
14A	35	34	1300
15A	10	10	
16A SUB-SURFACE	2.2		
16A SURFACE	2.2		3100
17A			
18A	11		1040
19A			1440
20A			1970
21A			

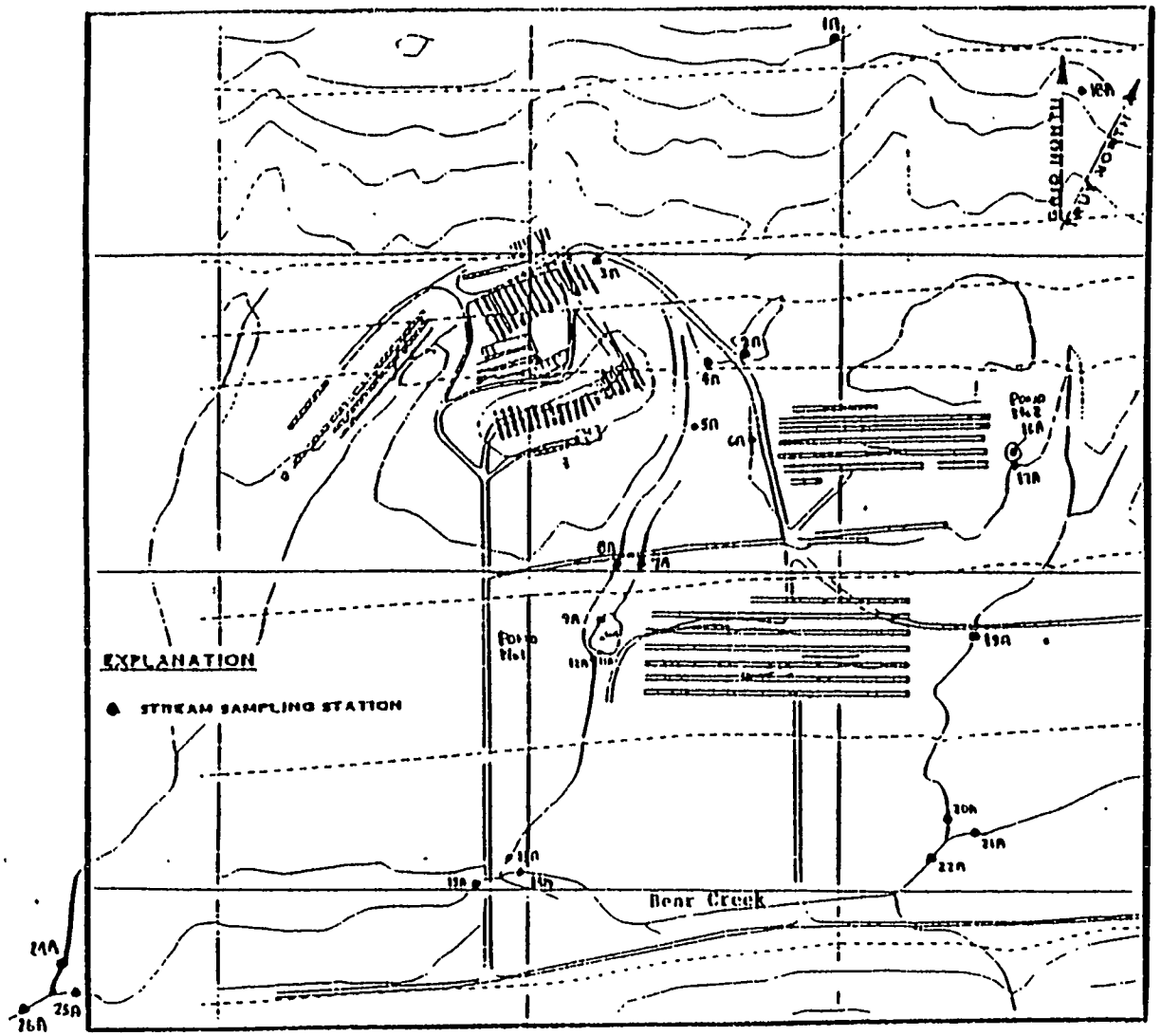
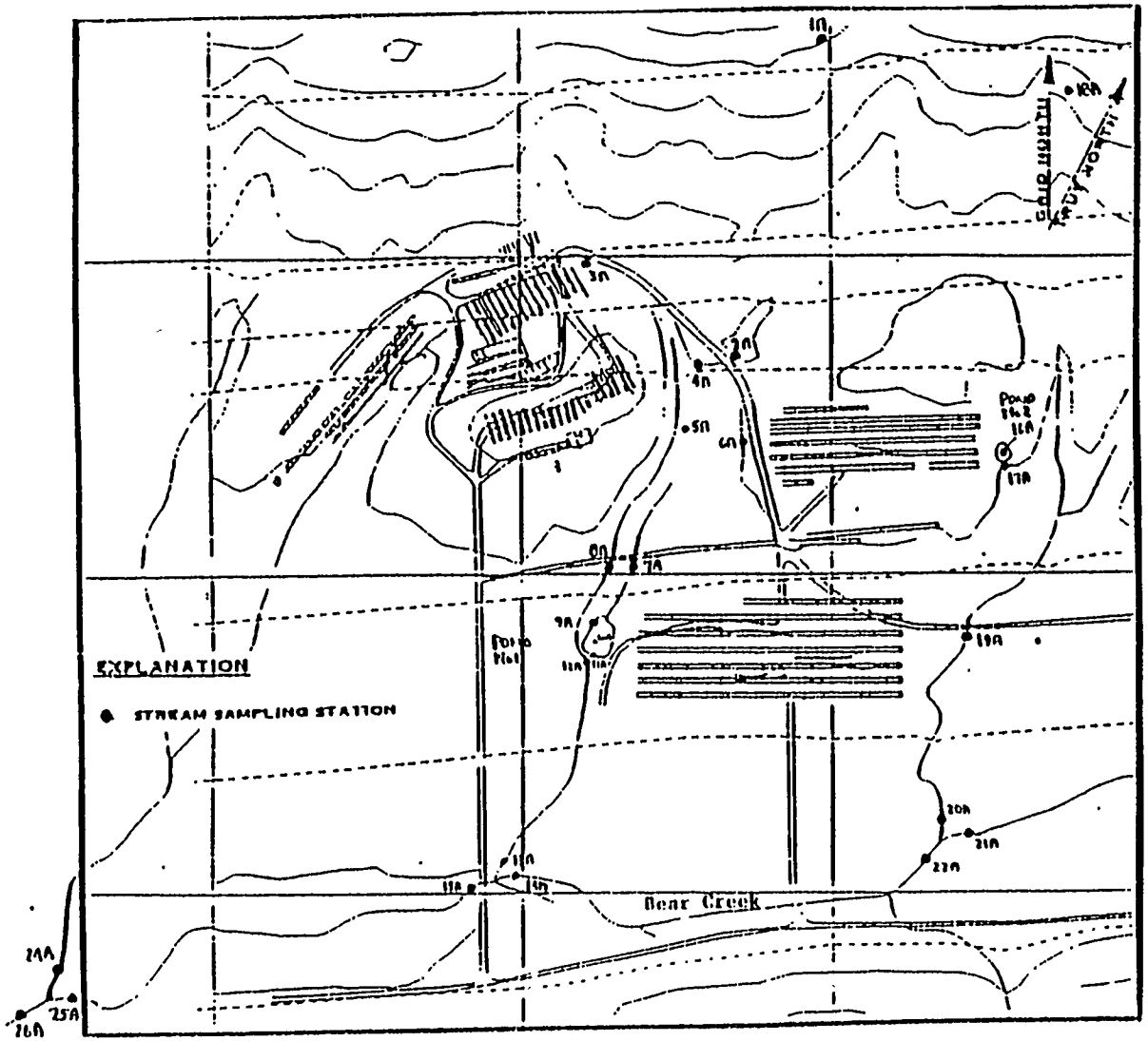


FIGURE 6.52
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL MANGANESE IN WATER	DISSOLVED MANGANESE	MANGANESE IN SEDIMENT
1A	0.013	0.009	330
2A	7.1		560
3A	1.0		400
4A			5100
5A	3.0		170
6A	34		
7A	3.5	3.4	350
8A	1	0.014	1400
9A			100
10A SUB-SURFACE	1.4		
10A SURFACE	2.1		
11A			150
12A	0.2	0.0	430
13A	1.5	1.3	950
14A	0.004	0.004	1100
15A	1	1.0	2300
16A SUB-SURFACE	0.34		
16A SURFACE	0.55		
17A			390
18A	0.30		
20A			2030
21A			2430
22A			3570



METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL MOLYBDENUM IN WATER	DISSOLVED MOLYBDENUM	MOLYBDENUM IN SEDIMENT
1A	<0.02	<0.02	<2
2A	<0.02		<2
3A	<0.02		<2
4A			<2
5A	<0.02		<2
6A	<0.02		
7A	<0.02	<0.02	<2
8A	<0.02	<0.02	<2
9A			<2
10A SUB-SURFACE	<0.02		
10A SURFACE	<0.02		
11A			<2
12A	<0.02	<0.02	<2
13A	<0.02	<0.02	<2
14A	<0.02	<0.02	<2
15A	<0.02	<0.02	3
16A SUB-SURFACE	<0.02		
16A SURFACE	<0.02		
17A			<2
19A	<0.02		<2
20A			3
21A			3
22A			

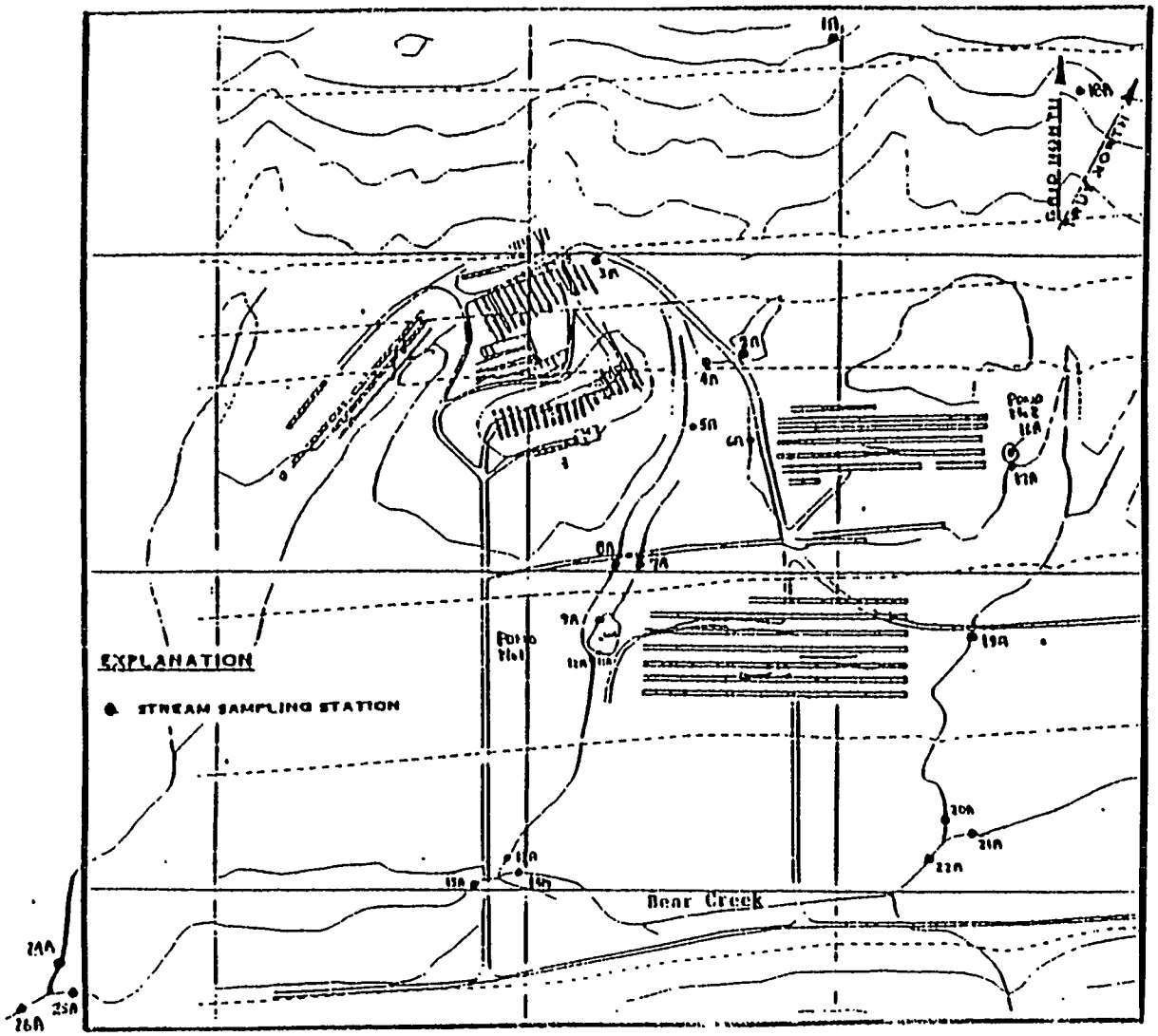


FIGURE 6-54
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL NICKEL IN WATER	DISSOLVED NICKEL	NICKEL IN SEDIMENT
1A	<0.02	<0.01	15
2A	<0.02		14
3A	<0.02		13
4A			10
5A	0.03		8
6A	0.59		
7A	<0.03	<0.02	17
8A	0.04	<0.02	24
9A			11
10A SUB-SURFACE	<0.02		
10A SURFACE	<0.02		
11A			13
12A	<0.02	<0.01	4
13A	<0.02	<0.02	20
14A	<0.02	<0.02	44
15A	0.04	0.03	40
16A SUB-SURFACE	<0.02		
16A SURFACE	<0.02		
17A			10
18A	0.03		
19A			19
20A			95
21A			55
22A			

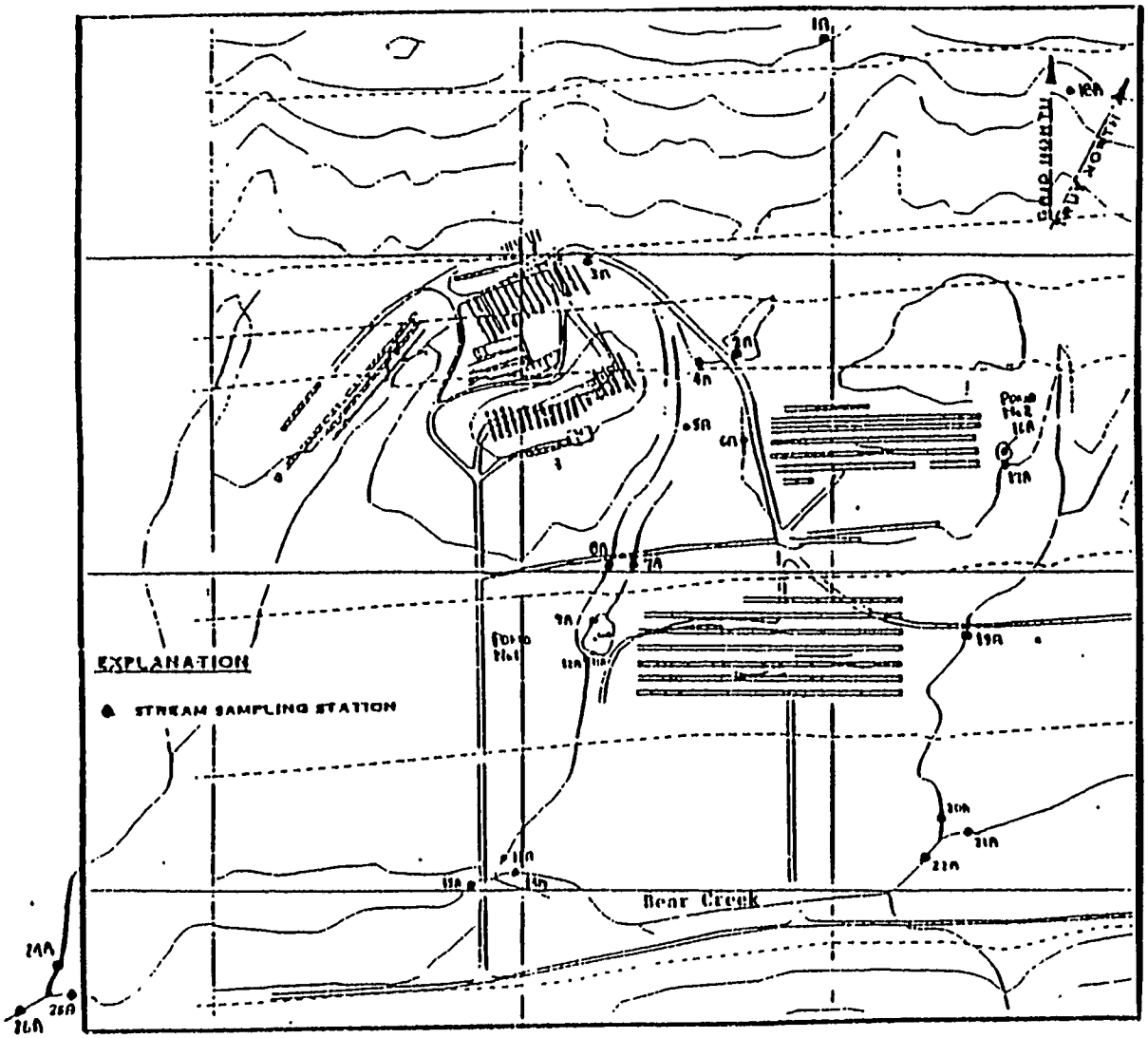


FIGURE 6 >>
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL SELENIUM IN WATER	DISSOLVED SELENIUM	SELENIUM IN SEDIMENT
1A	<0.1	<0.1	<10
2A	<0.1		<10
3A	<0.1		<10
4A			<10
5A	<0.1		<10
6A	<0.1		
7A	<0.1	<0.1	<10
8A	<0.1	<0.1	<1
9A			<10
10A SUB-SURFACE	<0.1		
10A SURFACE	<0.1		
11A			<10
12A	<0.1	<0.1	<1
13A	<0.1	<0.1	<1
14A	<0.1	<0.1	<10
15A	<0.1	<0.1	<10
16A SUB-SURFACE	<0.1		
16A SURFACE	<0.1		
17A			<10
19A	<0.1		
20A			<10
21A			<10
22A			<10

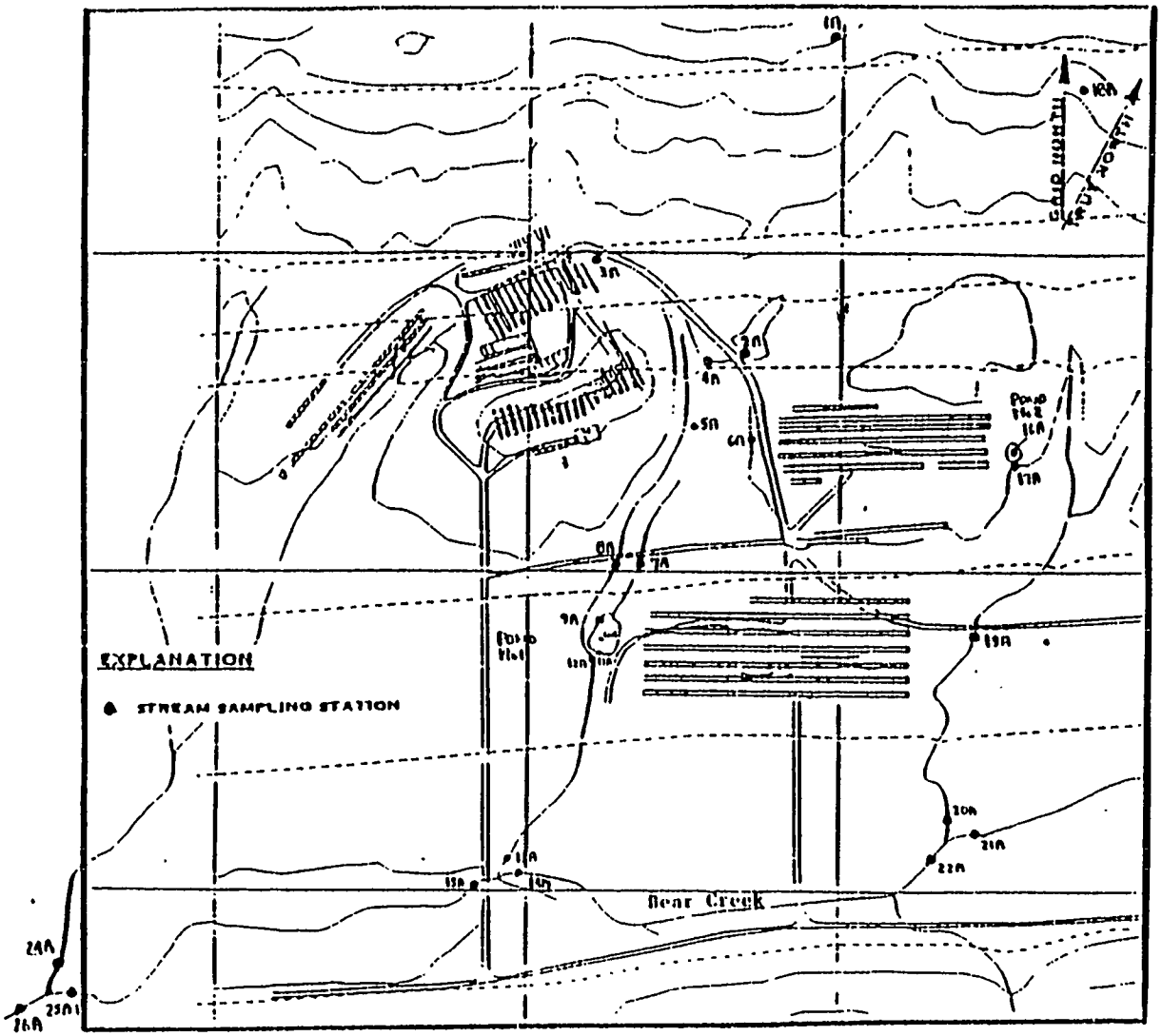


FIGURE 6.56
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL SILICON IN WATER	DISSOLVED SILICON	SILICON IN SEDIMENT
1A	12	13.5	710
2A	6.7		1700
3A	7.0		1400
4A			900
5A	7.3		<5
6A	1.1		
7A	5.0	7.7	3500
8A	26	1.6	3400
9A			<5
10A SUB-SURFACE	5		
10A SURFACE	5.1		
11A			<5
12A	2.4	4.3	3400
13A	5.3	5.2	1500
14A	3.1	4.1	330
15A	4.2	5.4	330
16A SUB-SURFACE	3.5		
16A SURFACE	2.1		
17A			290
19A	1.6		
20A			34
21A			310
22A			440

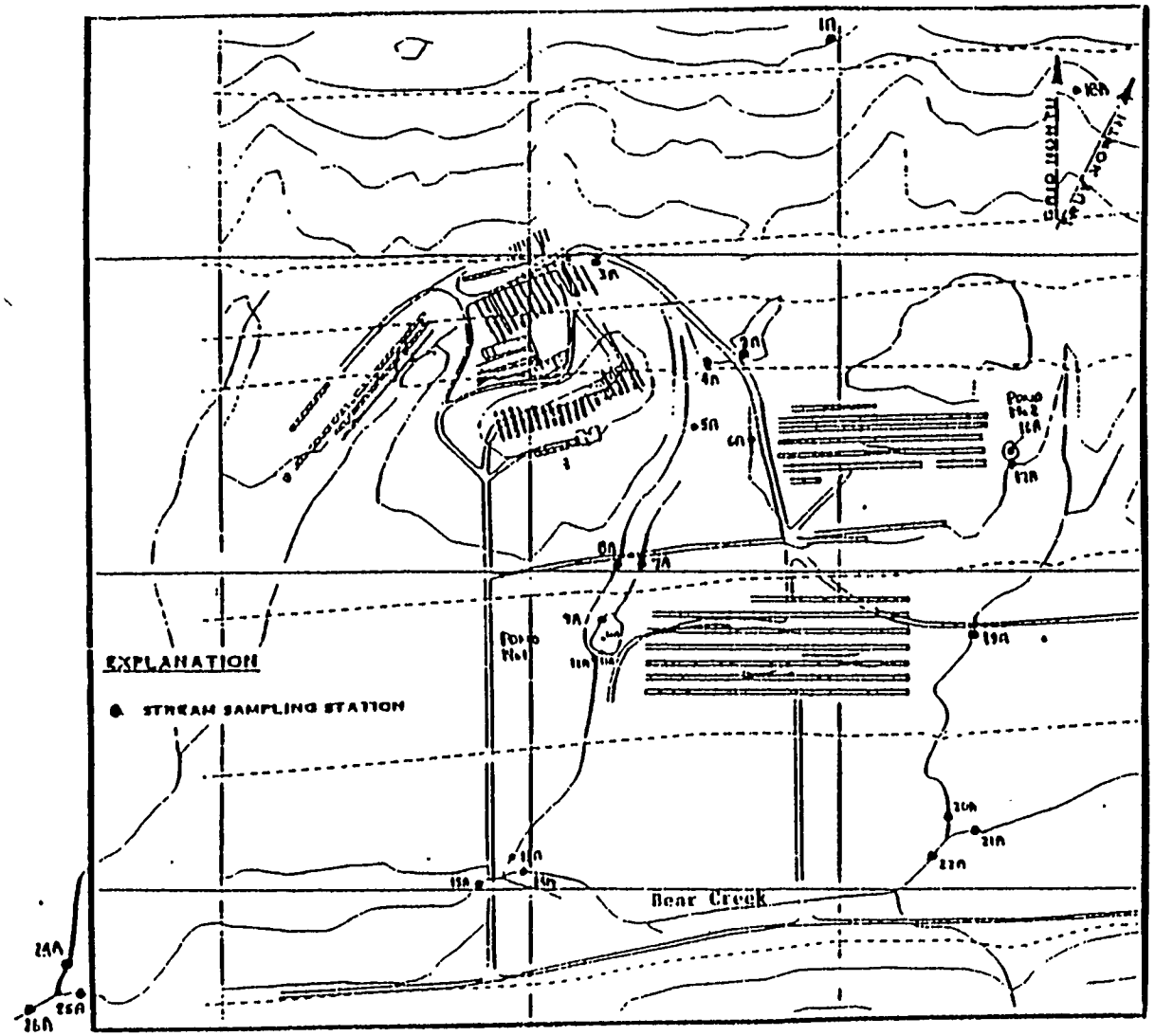


TABLE 6-57
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL SILVER IN WATER	DISSOLVED SILVER	SILVER IN SEDIMENT
1A	<0.01	<0.01	<1
2A	<0.01		<1
3A	<0.01		<1
4A			<1
5A	<0.01		<1
6A	<0.01		
7A	<0.01	<0.01	<1
8A	0.02	<0.01	<1
9A			<1
10A SUB-SURFACE	<0.01		
10A SURFACE	<0.01		
11A			<1
12A	<0.01	<0.01	<1
13A	<0.01	<0.01	<1
14A	<0.01	<0.01	2
15A	<0.01	<0.01	1
16A SUB-SURFACE	<0.01		
16A SURFACE	<0.01		
17A			<1
19A	<0.01		<1
20A			<1
21A			<1
22A			

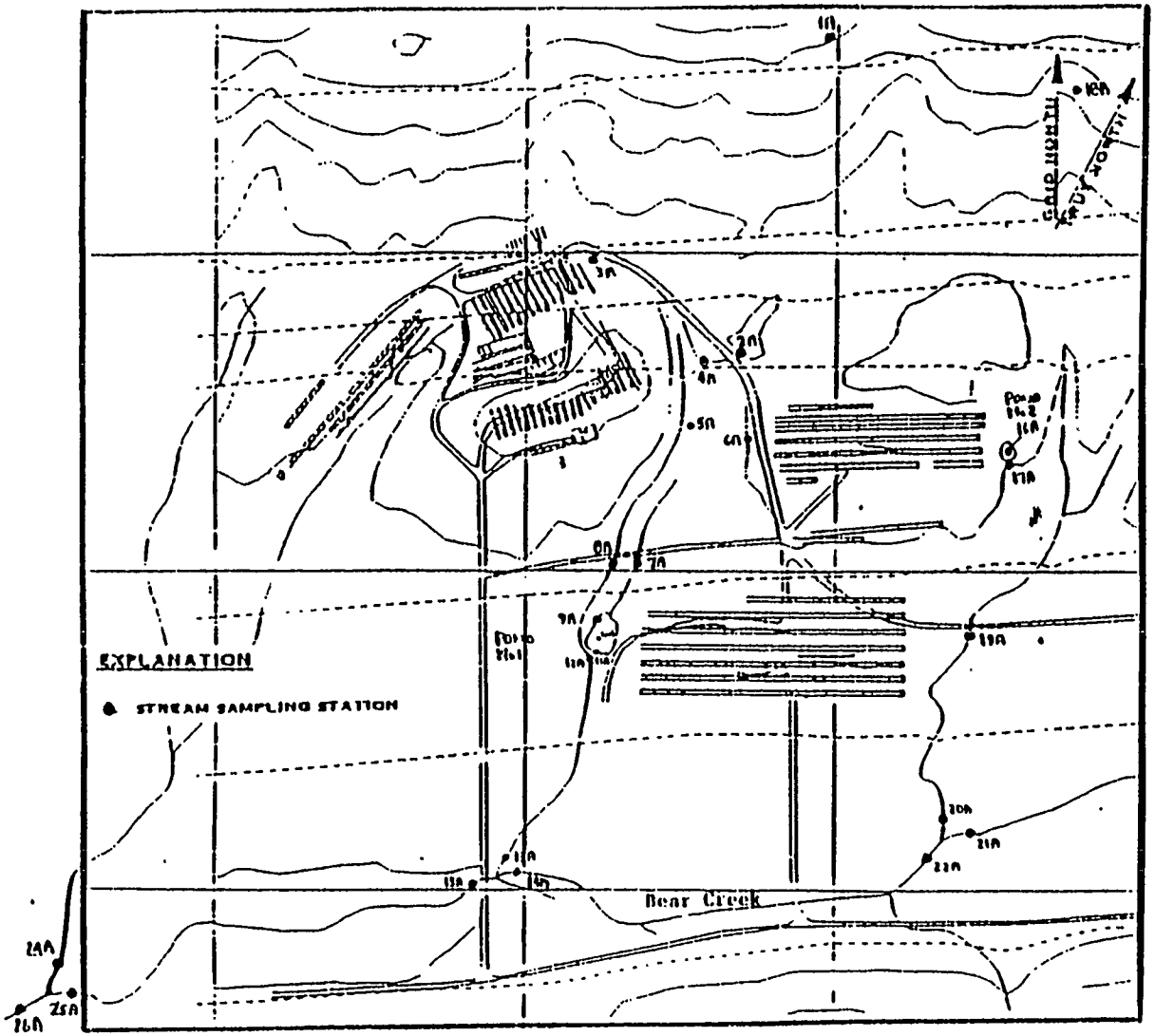


FIGURE 6.58
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL SODIUM IN WATER	DISSOLVED SODIUM	SODIUM IN SEDIMENT
1A	4.4	4.5	140
2A	3.5		170
3A	3.3		140
4A			440
5A	34		250
6A	320		
7A	19	19	1100
8A	1.2	1.2	170
9A			440
10A SUB-SURFACE	17		
10A SURFACE	111		
11A			490
12A	12	12	200
13A	14	13	710
14A	16	15	310
15A	22	20	340
16A SUB-SURFACE	14		
16A SURFACE	14		
17A			400
19A	50		
20A			440
21A			400
22A			240

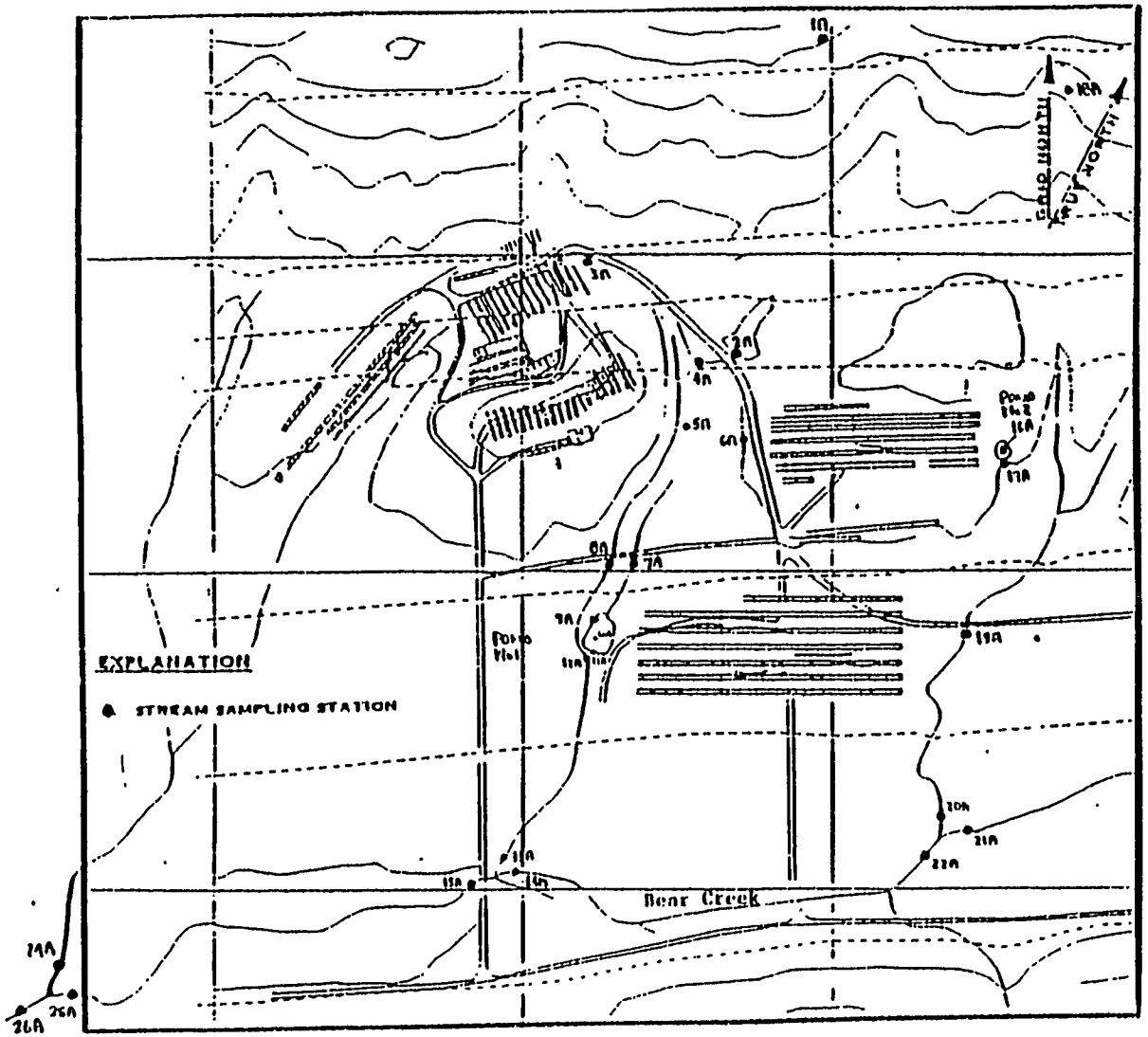


FIGURE 6.59
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL STRONTIUM IN WATER	DISSOLVED STRONTIUM	STRONTIUM IN SEDIMENT
1A	0.010	0.014	18
2A	0.042		16
3A	0.025		24
4A			13
5A	0.16		5.9
6A	0.19		
7A	0.17	0.16	14
8A	0.054	0.069	13
9A			21
10A SUB-SURFACE	0.14		
10A SURFACE	0.14		
11A			23
12A	0.1	0.095	5.3
13A	0.093	0.089	12
14A	0.13	0.11	59
15A	0.14	0.13	5.4
16A SUB-SURFACE	0.0044		
16A SURFACE	0.0040		
17A			18
19A	0.079		
20A			23
21A			16
22A			15

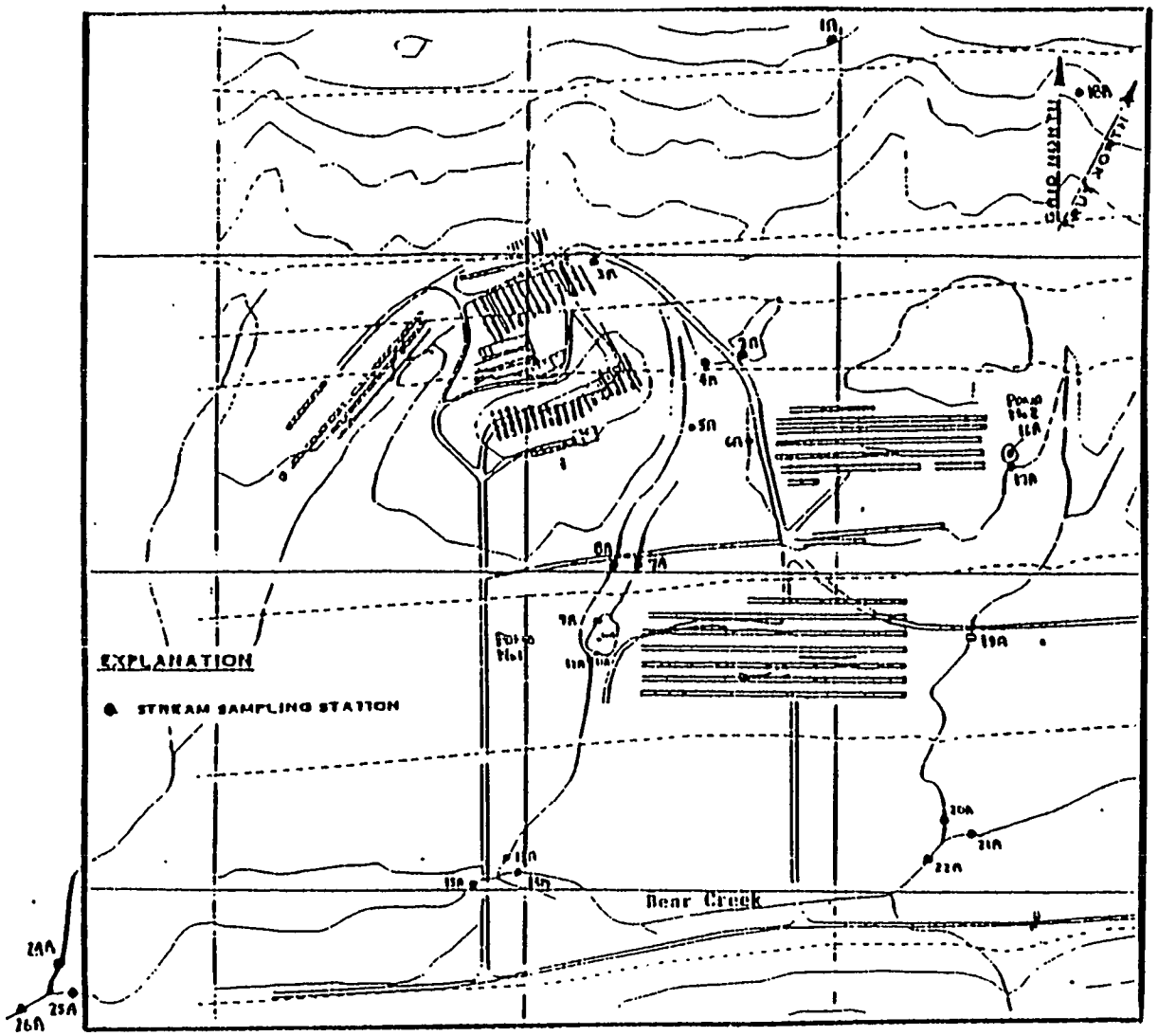


FIGURE 6.40
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL THALLIUM IN WATER	DISSOLVED THALLIUM	THALLIUM IN SEDIMENT
1A	<0.3	<0.3	<50
2A	<0.3		<50
3A	<0.3		<50
4A			<50
5A	<0.3		<50
6A	<0.3		
7A	<0.3	<0.3	<50
8A	<0.3	<0.3	<50
9A			<50
10A SUB-SURFACE	<0.3		
10A SURFACE	<0.3		
11A			<50
12A	<0.3	<0.3	<50
13A	<0.3	<0.3	<50
14A	<0.3	<0.3	<50
15A	<0.3	<0.3	<50
16A SUB-SURFACE	0.4		
16A SURFACE	<0.3		
17A			<50
19A	<0.3		
20A			<50
21A			<50
22A			<50

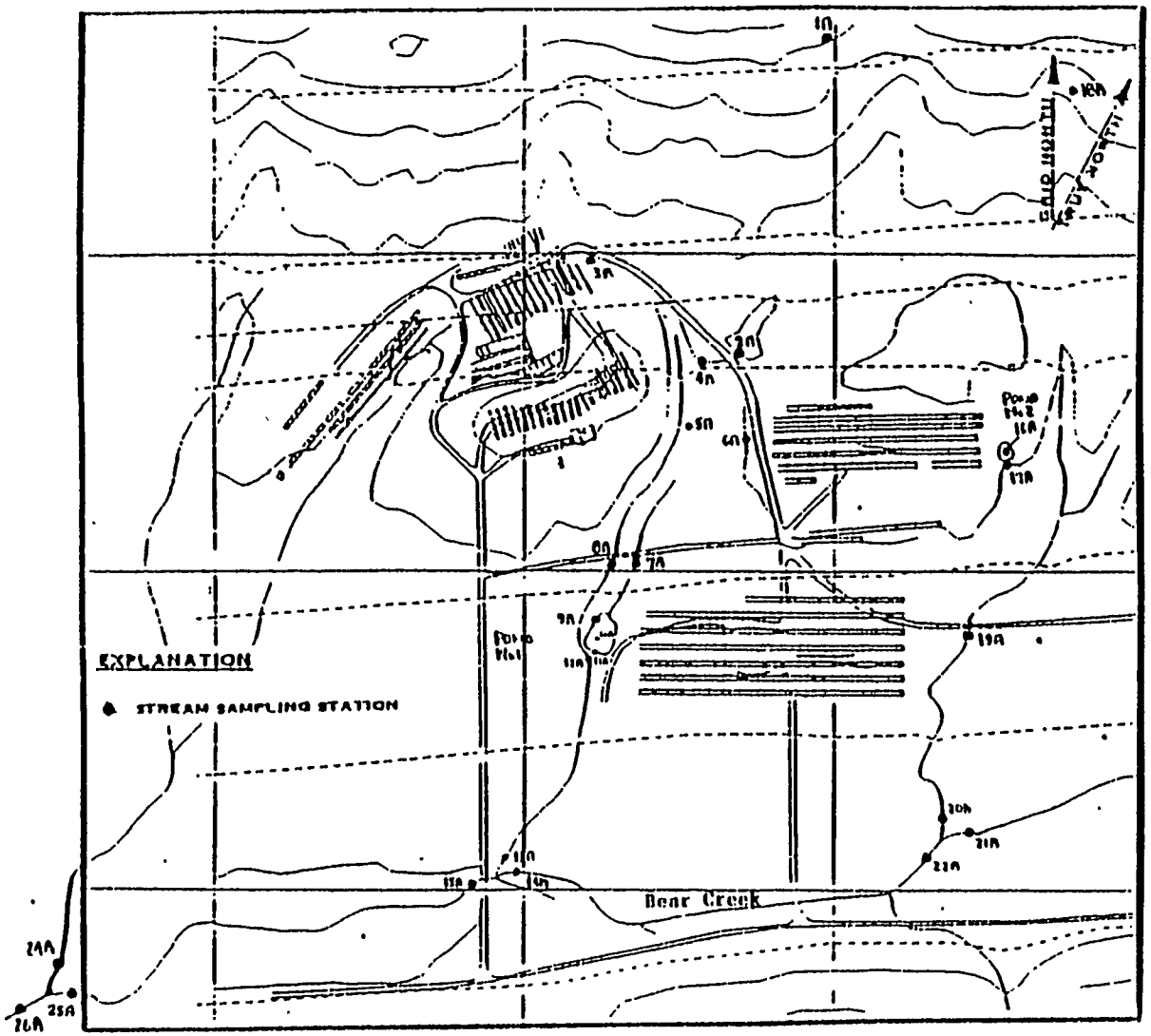


FIGURE 6-61
METAL (DETERMINED BY ICAP/AA ANALYSES)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL TIN IN WATER	DISSOLVED TIN	TIN IN SEDIMENT
1A	0.3	<0.3	<50
2A	<0.3		70
3A	<0.3		40
4A			80
5A	0.3		<50
6A	<0.3		
7A	<0.3	<0.3	40
8A	0.3	<0.3	40
9A			<50
10A SUB-SURFACE	<0.3		
10A SURFACE	<0.3		
11A			<50
12A	<0.3	<0.3	<50
13A	<0.3	<0.3	40
14A	<0.3	<0.3	<50
15A	<0.3	<0.3	80
16A SUB-SURFACE	<0.3		
16A SURFACE	<0.3		
17A			<50
18A	<0.3		
20A			<50
21A			<50
22A			<50

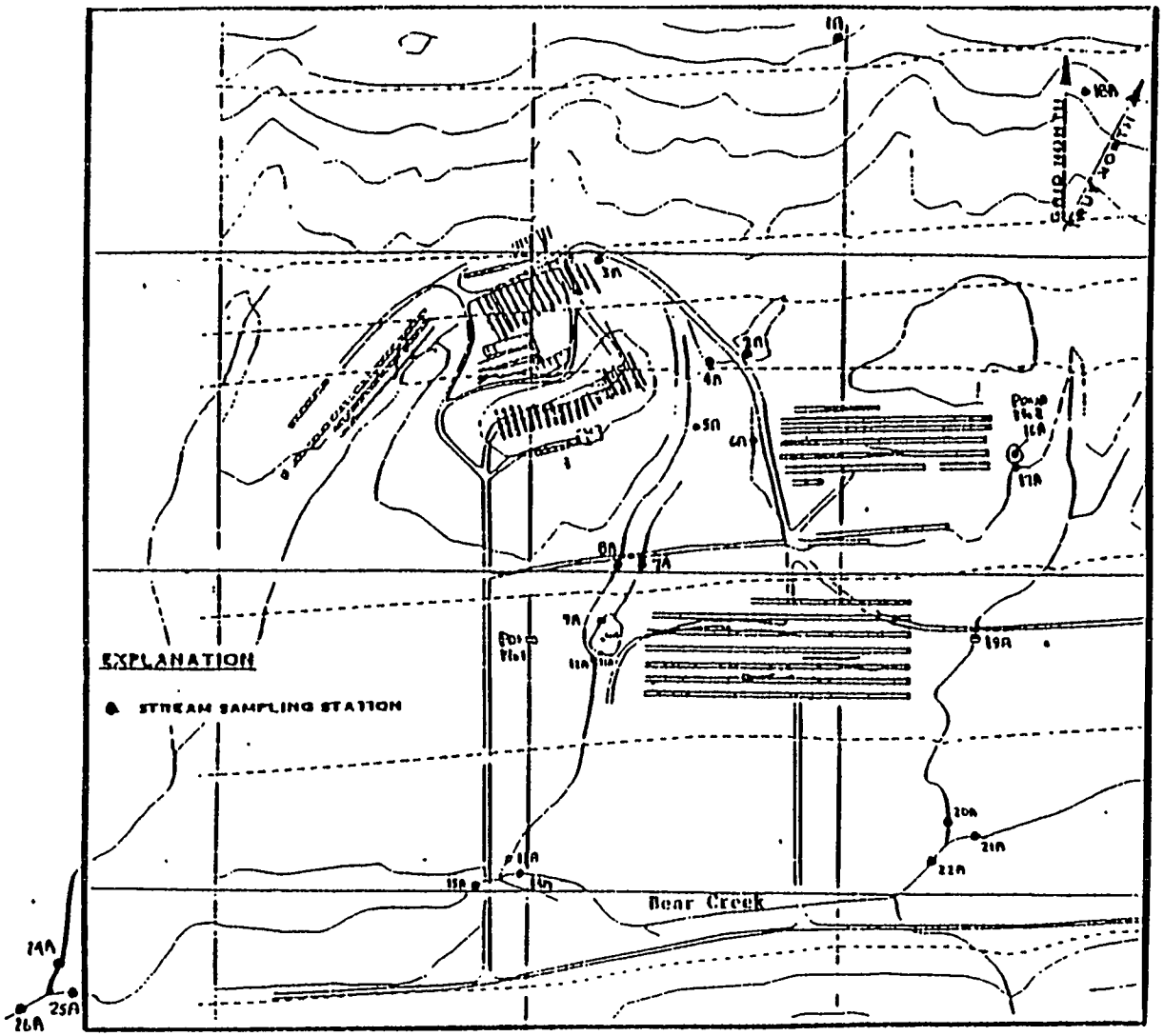


FIGURE 6.62
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL TITANIUM IN WATER	DISSOLVED TITANIUM	TITANIUM IN SEDIMENT
1A	<0.003	<0.003	170
2A	0.032		350
3A	0.035		200
4A			100
5A	0.032		350
6A	0.003		
7A	0.003	<0.003	400
8A	0.050	<0.003	150
9A			600
10A SUB-SURFACE	0.007		
10A SURFACE	<0.003		
11A			370
12A	0.010	<0.003	300
13A	0.012	<0.003	390
14A	0.006	<0.003	260
15A	<0.003	<0.003	150
16A SUB-SURFACE	0.003		
16A SURFACE	<0.003		
17A			750
18A	0.005		
19A			270
20A			195
21A			101
22A			

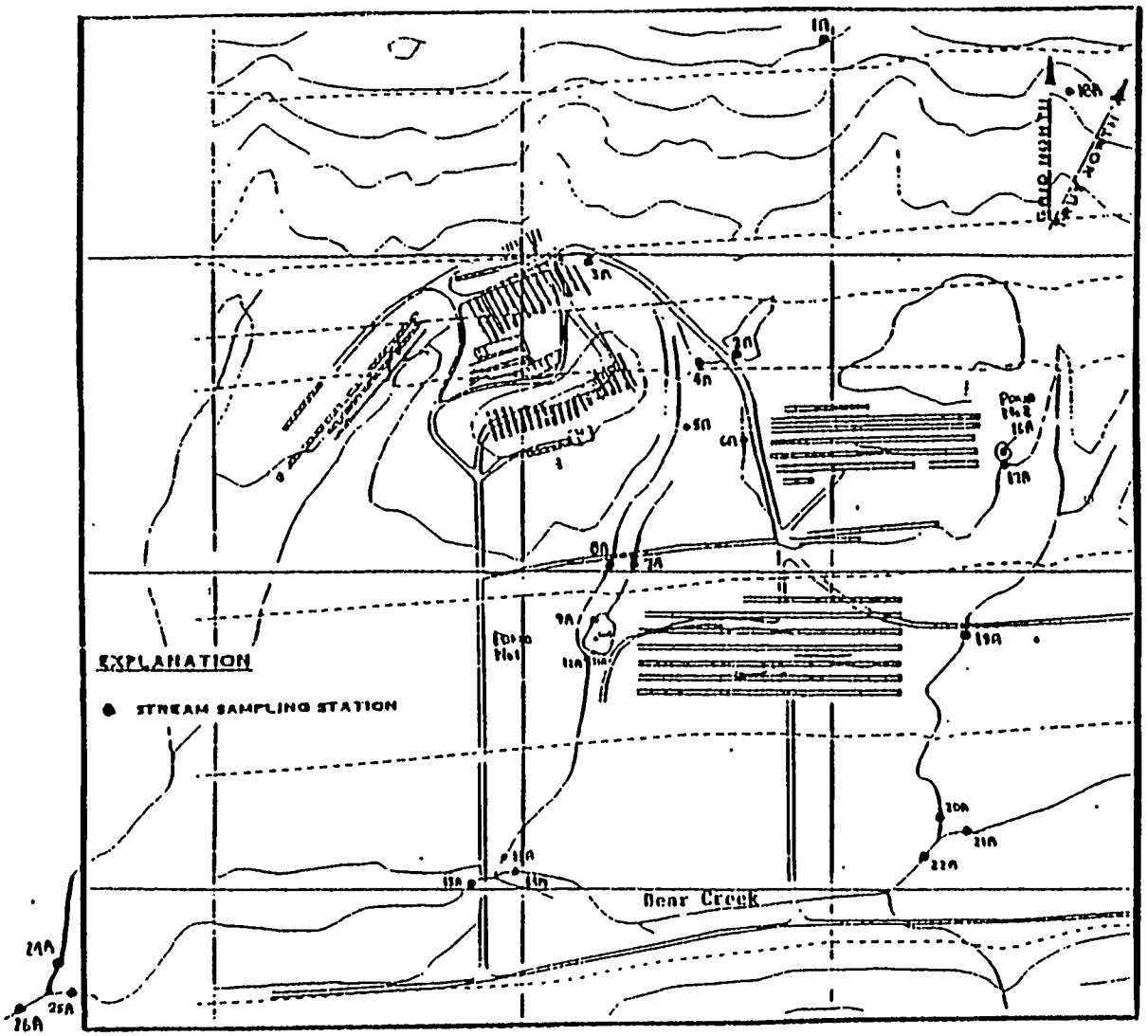


FIGURE 6 & 6A
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL VANADIUM IN WATER	DISSOLVED VANADIUM	VANADIUM IN SEDIMENT
1A	<0.01	0.03	17
2A	<0.01		44
3A	<0.01		24
4A			23
5A	<0.01		63
6A	<0.01		
7A	<0.01	0.01	33
8A	0.14	<0.01	35
9A			24
10A SUB-SURFACE	<0.01		
10A SURFACE	<0.01		
11A			37
12A	0.01	<0.01	14
13A	<0.01	<0.01	33
14A	<0.01	0.01	24
15A	<0.01	<0.01	37
16A SUB-SURFACE	<0.01		
16A SURFACE	<0.01		
17A			14
19A	<0.01		
20A			24
21A			19
22A			23

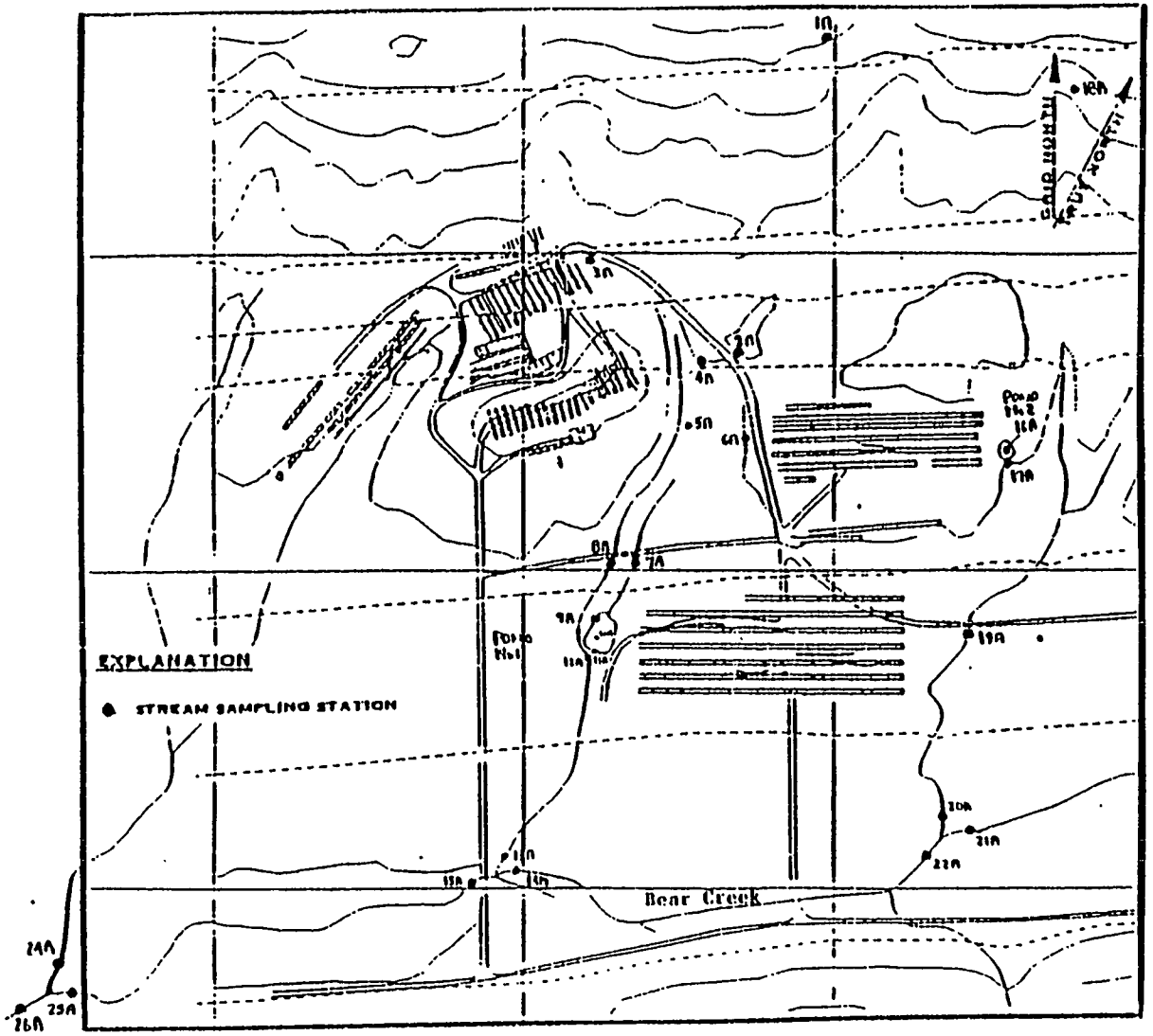


FIGURE 6 & 6A
METAL (DETERMINED BY ICAP/AA ANALYSES)
UNIT-PPM (PARTS/MILLION)
BURSAL GROUNDS

STATION	TOTAL ZINC IN WATER	DISSOLVED ZINC	ZINC IN SEDIMENT
1A	<0.01	<0.01	34
2A	<0.01		36
3A	0.04		49
4A			98
5A	0.03		14
6A	<0.01		
7A	<0.01	<0.01	37
8A	0.12	<0.01	49
9A			36
10A SUB-SURFACE	<0.01		
10A SURFACE	<0.01		
11A			32
12A	<0.01	<0.01	33
13A	<0.01	<0.01	33
14A	<0.01	<0.01	33
15A	<0.01	<0.01	100
16A SUB-SURFACE	<0.01		
16A SURFACE	<0.01		
17A			34
19A	<0.01		
20A			44
21A			41
22A			34

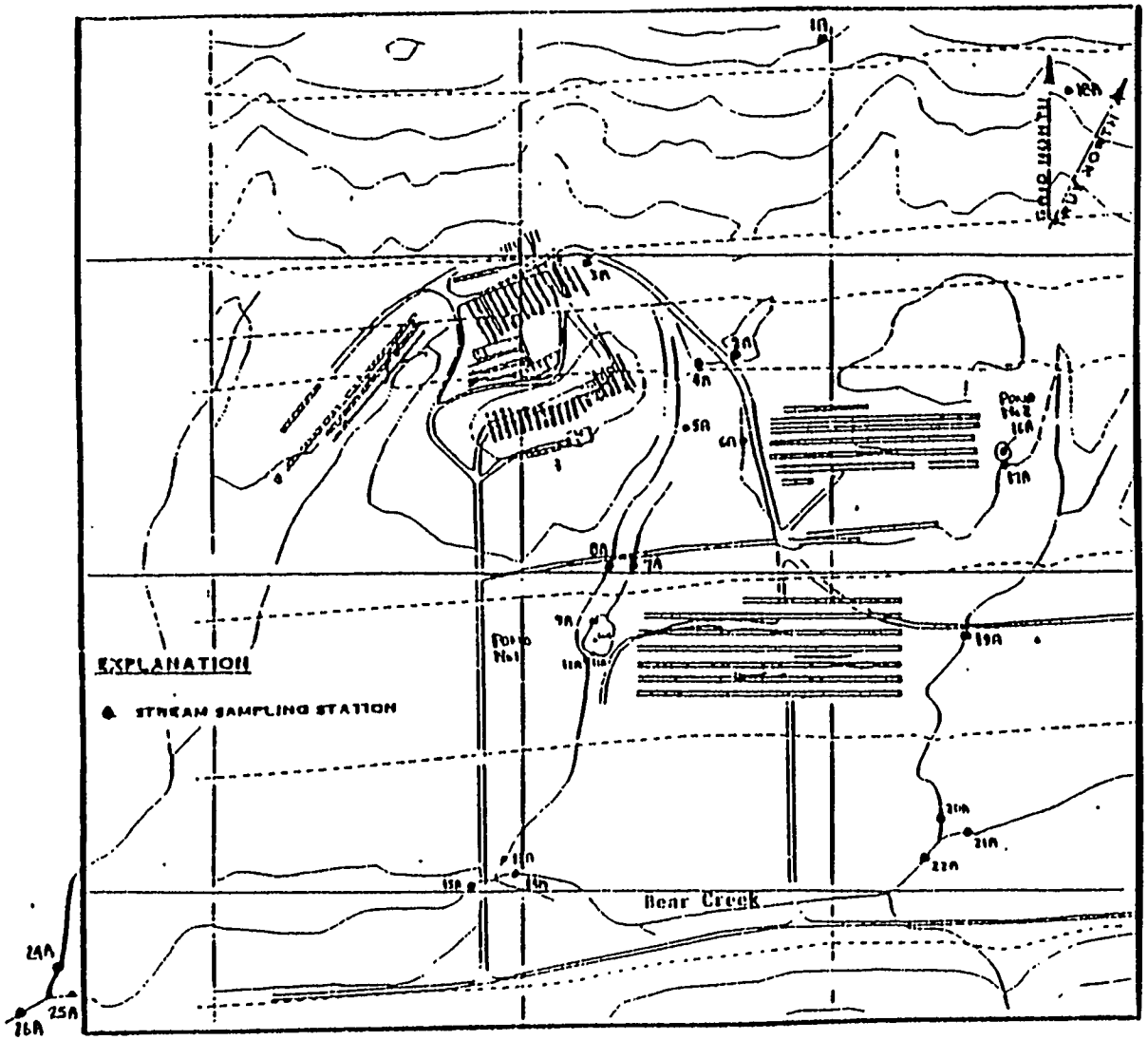


FIGURE 6.65
METAL (DETERMINED BY ICAP/AA ANALYSIS)
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL URANIUM IN WATER	DISSOLVED URANIUM	URANIUM IN SEDIMENT
1A	<0.5	<0.5	<200
2A	<2		<200
3A	<2		<200
4A			<200
5A	<2		<200
6A	<2		
7A	<2	<0.5	<200
8A	<2	<0.5	<200
9A			<200
10A SUB-SURFACE	<2		
10A SURFACE	<0.5		
11A			<200
12A	<2	<0.5	<200
13A	<2	<0.5	<200
14A	<0.5	<0.5	<200
15A	<0.5	<0.5	<200
16A SUB-SURFACE	<0.5		
16A SURFACE	<0.5		
17A			<200
19A	0		
20A			372
21A			<200
22A			<200

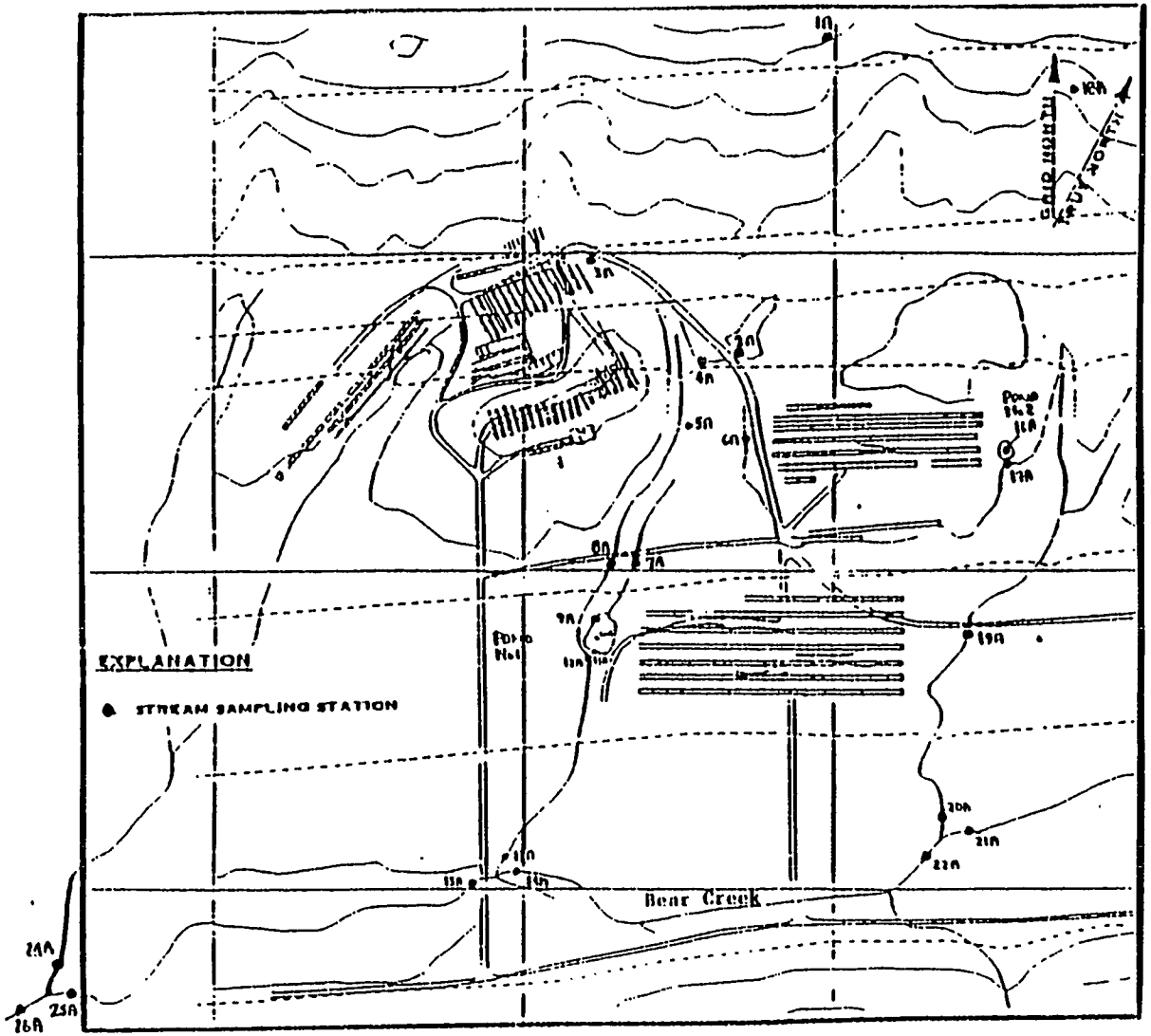


FIGURE 6.44
CYANIDE
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL CYANIDE IN WATER	CYANIDE IN SEDIMENT
1A	<0.01	<0.5
2A	<0.01	<0.5
3A	<0.01	0.5
4A		<0.5
5A	<0.01	<0.5
6A		
7A	<0.01	0.24
8A	<0.01	0.35
9A		<0.5
10A SUB-SURFACE	<0.01	
10A SURFACE	<0.01	
11A		<0.5
12A	<0.01	0.5
13A	<0.01	0.17
14A	0.01	<0.5
15A	0.01	<0.5
14A SUB-SURFACE	<0.01	
14A SURFACE	<0.01	
17A		<0.5
19A	0.01	
20A		
21A		<0.5
22A		<0.5

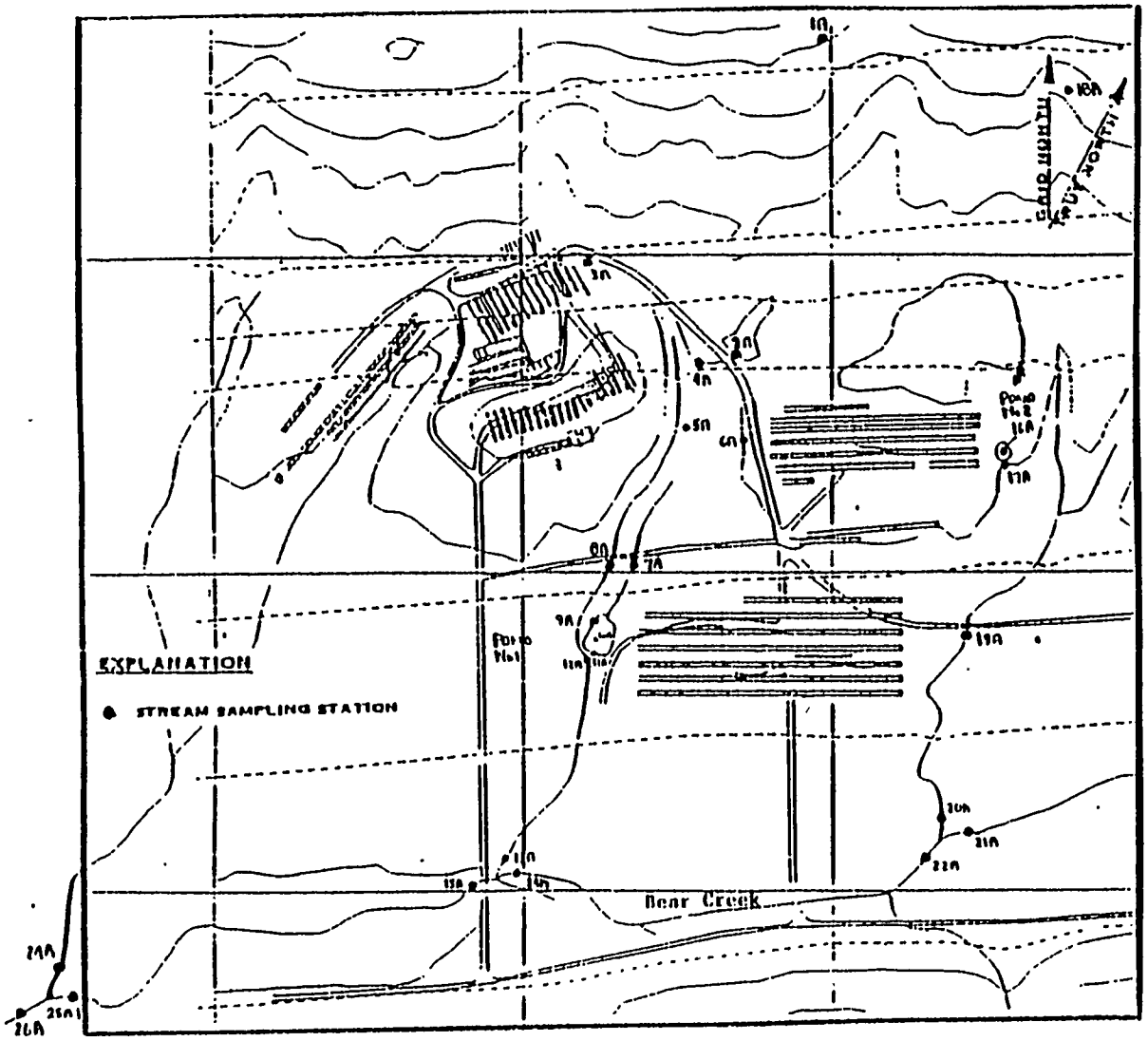


FIGURE 6-67
PHENOLS
UNIT-PPM (PARTS/MILLION)
BURIAL GROUNDS

STATION	TOTAL PHENOLS IN WATER	PHENOLS IN SEDIMENT
1A	<0.01	0.03
2A	<0.01	0.3
3A	<0.01	<0.4
4A		0.13
5A	0.01	0.3
6A		
7A	<0.01	<0.3
8A	<0.01	0.04
9A		0.01
10A SUB-SURFACE		
10A SURFACE	0.03	
11A		3.7
12A	<0.01	0.23
13A	<0.01	0.08
14A	<0.01	0.11
15A	<0.01	0.1
16A SUB-SURFACE	0.01	
16A SURFACE	0.03	
17A		3.3
19A	<0.01	
20A		
21A	<0.01	0.13
22A	<0.01	0.14

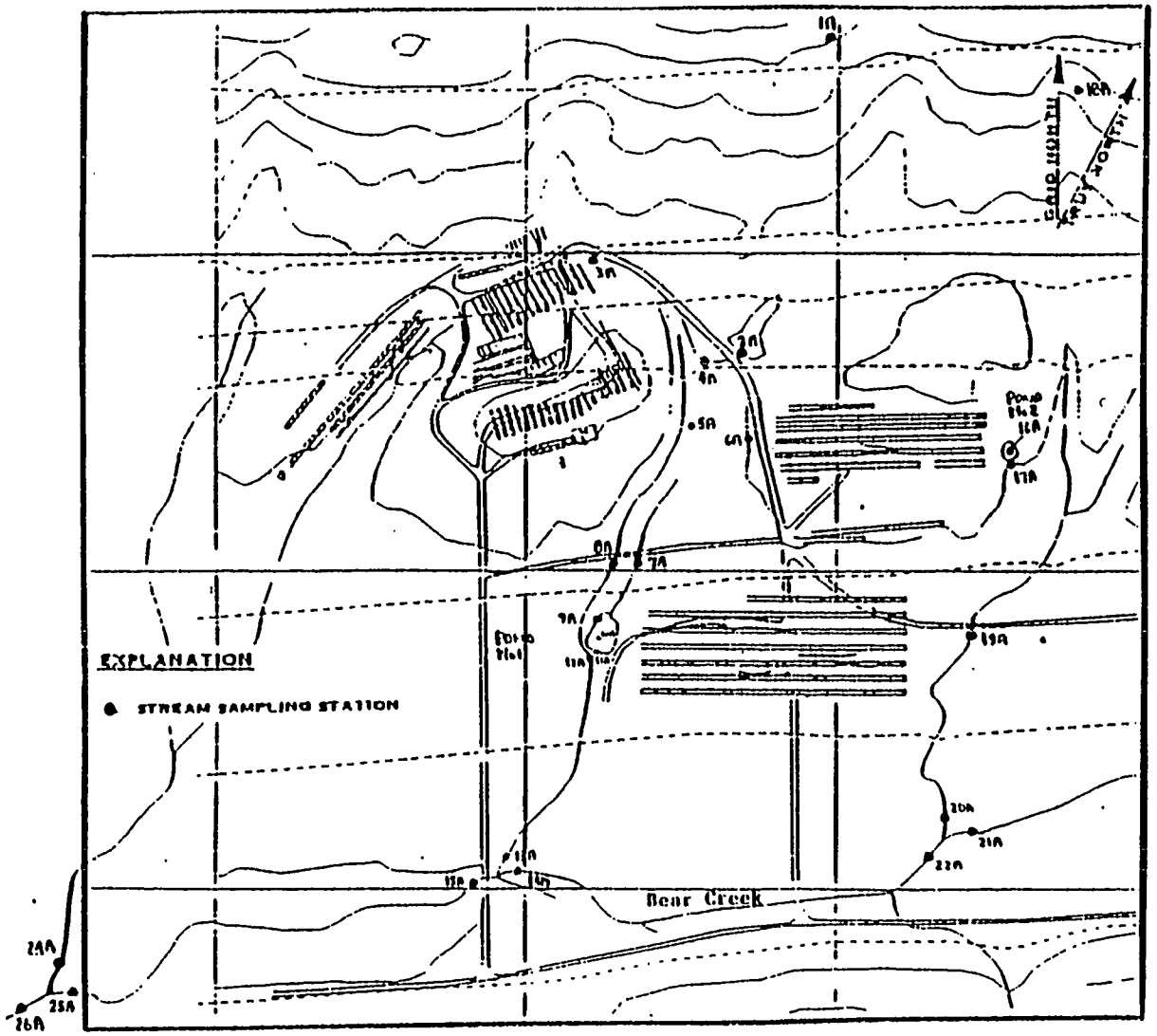


FIGURE 6-6B
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	TOTAL SUSPENDED SOLIDS
1A	30
2A	140
3A	74
4A	
5A	133
7A	10
8A	2910
9A	
10A SUB-SURFACE	11
10A SURFACE	1000
11A	
11A	140
13A	40
14A	11
15A	11
16A SUB SURFACE	43
16A SURFACE	100
17A	
19A	43
20A	
21A	
22A	
23A	
24A	
25A	
26A	

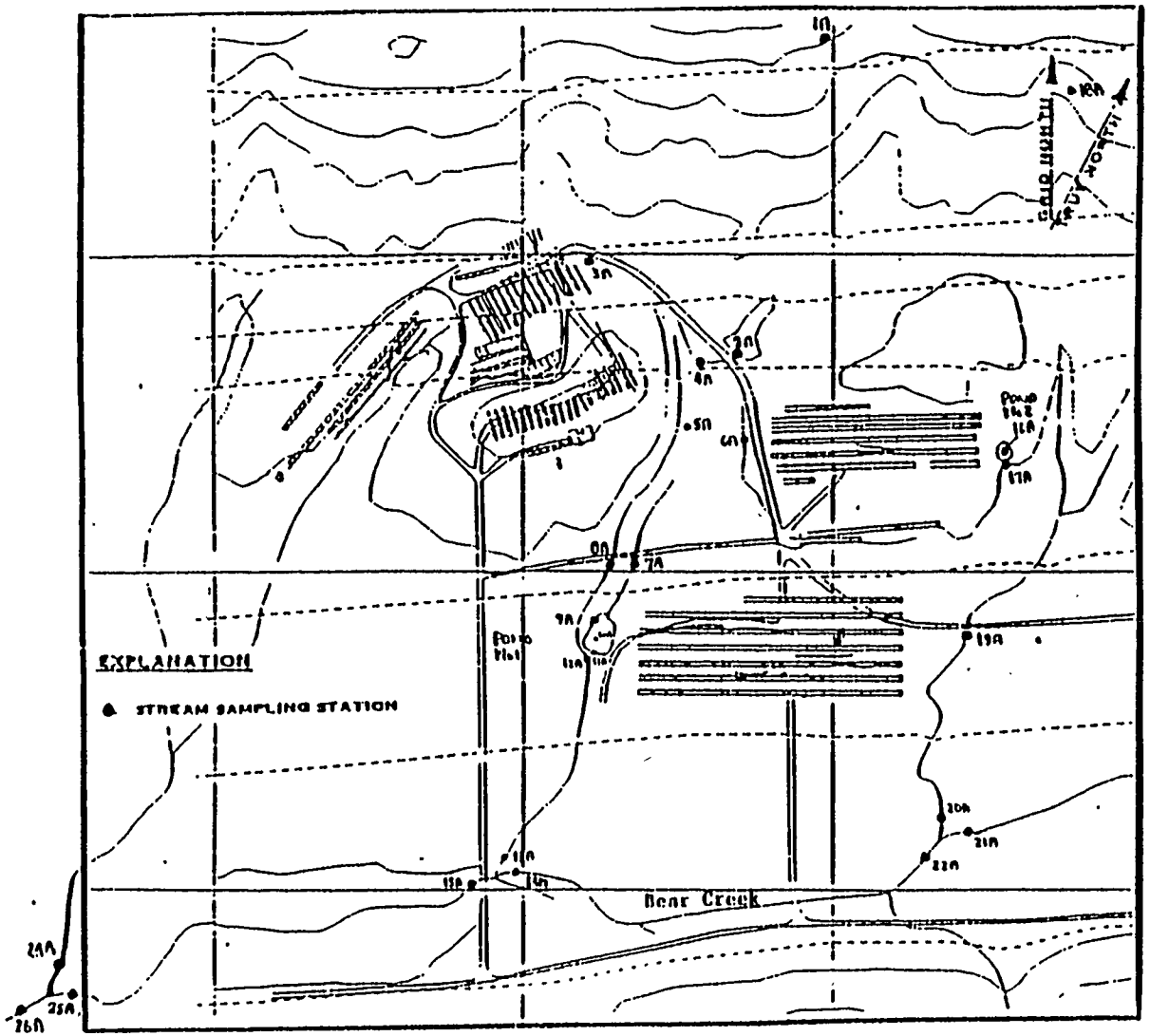


FIGURE 6-69
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANTS
ON RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	TOTAL DISSOLVED SOLIDS
1A	196
2A	143
3A	134
4A	
5A	443
7A	786
8A	143
9A	
10A SUR	
SURFACE	438
10A	
SURFACE	376
11A	
12A	430
13A	416
14A	213
15A	[illegible]
16A SUR	
SURFACE	143
16A	
SURFACE	80
17A	
19A	410
20A	
21A	
22A	
23A	
24A	
25A	
26A	

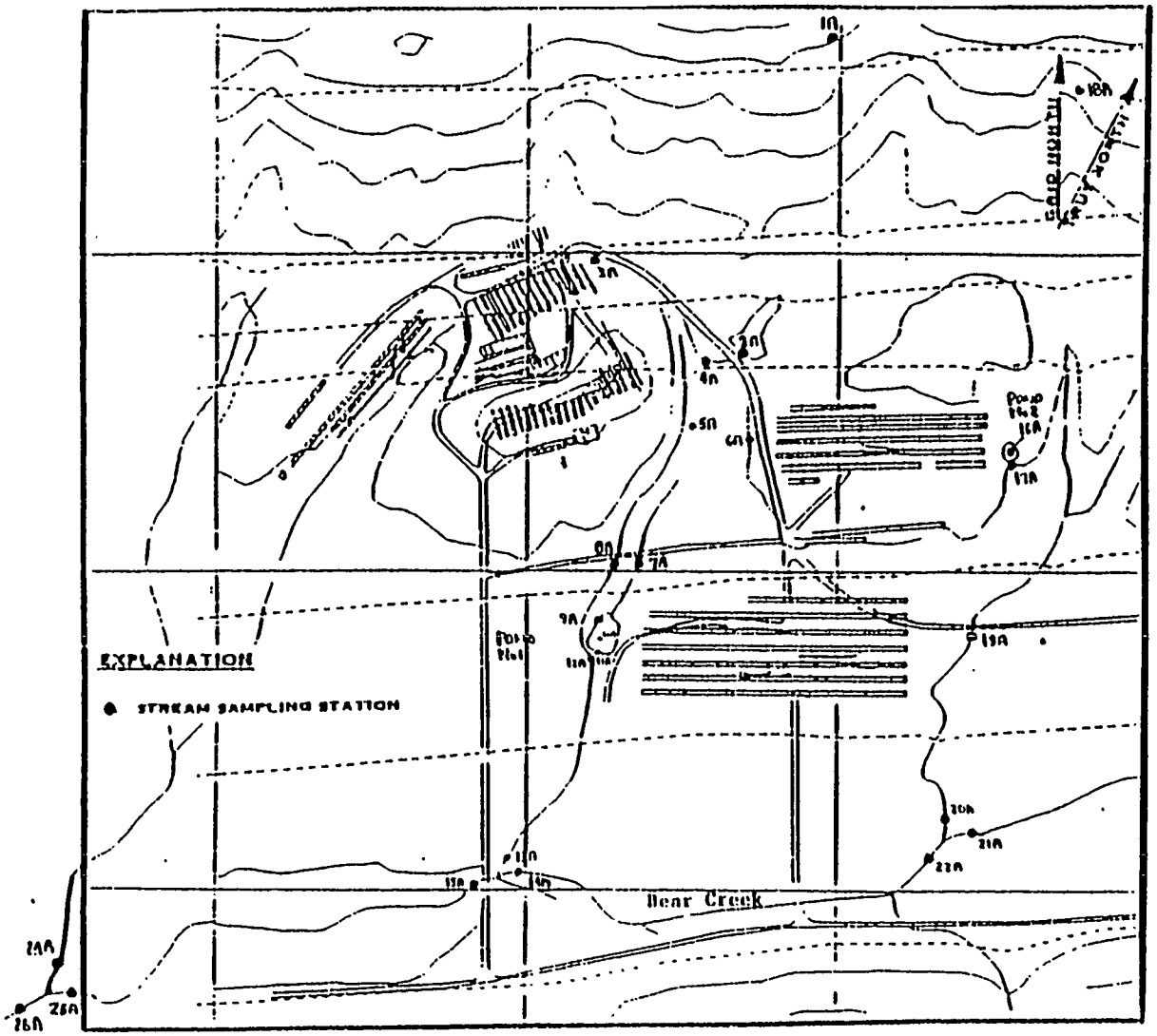


FIGURE 6-70
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PEN (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	PHENOLPHATHALINE ALKALINITY (AS CACO3)
1A	<1
2A	<1
3A	<1
4A	
5A	<1
7A	<1
8A	<1
9A	
10A SUB SURFACE	<1
10A SURFACE	<1
11A	
12A	<1
13A	<1
14A	<1
15A	<1
16A SUB-SURFACE	<1
16A SURFACE	<1
17A	
19A	<1
20A	
21A	
22A	
23A	
24A	
25A	
26A	

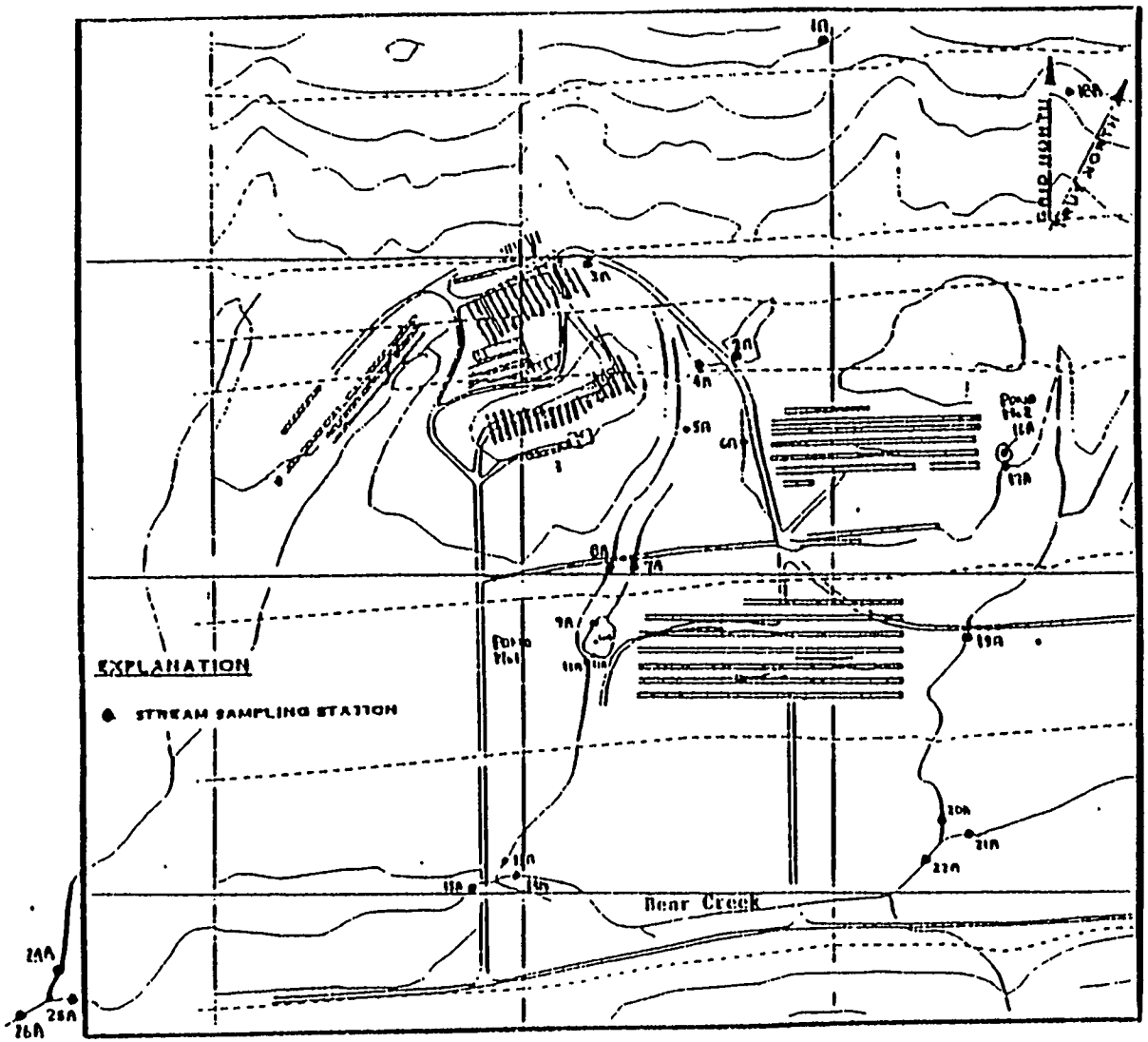


FIGURE 6.71
MISCELLANEOUS CONVENTIONAL OR NON-CONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	METHYL ORANGE ALKALINITY (AS CACO3)
1A	[illegible]
2A	[illegible]
3A	[illegible]
4A	
5A	[illegible]
7A	[illegible]
8A	[illegible]
9A	
10A SUB-SURFACE	[illegible]
10A SURFACE	[illegible]
11A	
12A	[illegible]
13A	[illegible]
14A	[illegible]
15A	[illegible]
16A SUB-SURFACE	[illegible]
16A SURFACE	[illegible]
17A	[illegible]
19A	
20A	
21A	
22A	
23A	
24A	
25A	
26A	

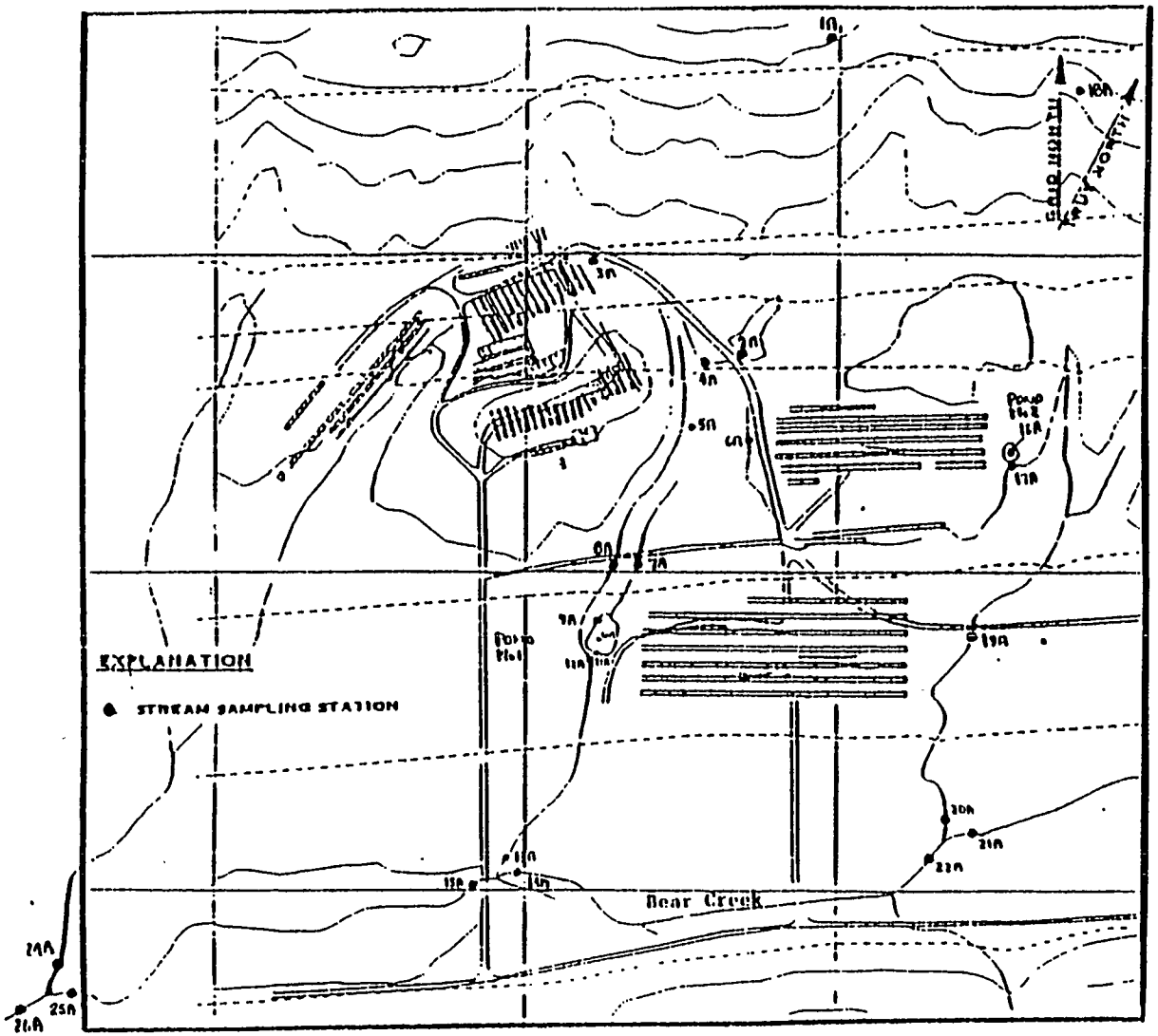


FIGURE 6.32
MISCELLANEOUS CONVENTIONAL OR INORGANIC POLLUTANTS
OR RELATED PARAMETERS
UNITS=PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	CONDUCTIVITY (UMHOS/CM)
1A	[illegible]
2A	[illegible]
3A	[illegible]
4A	
5A	[illegible]
7A	[illegible]
8A	[illegible]
9A	
10A SUB-SURFACE	[illegible]
10P SURFACE	[illegible]
11A	
12A	[illegible]
13A	[illegible]
14A	[illegible]
15P	[illegible]
16A SUB-SURFACE	[illegible]
16A SURFACE	[illegible]
17A	[illegible]
18A	
19A	
20A	
21A	
22A	
23A	
24A	
25A	
26A	

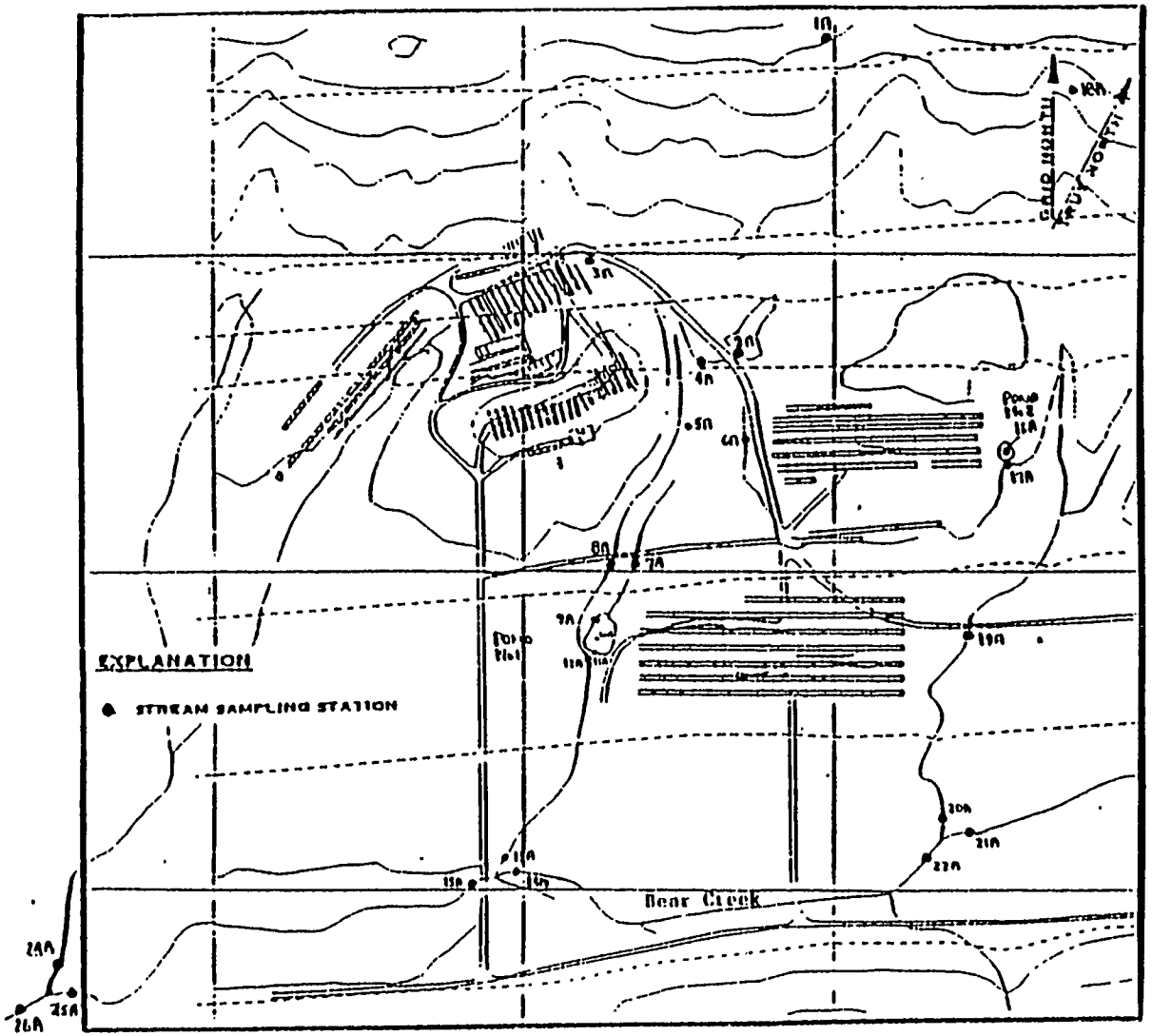


FIGURE 6-73
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PEN (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	SULFATE
1A	4
2A	8
3A	1
4A	
5A	12
7A	1
8A	22
9A	
10A SUB-SURFACE	1
10A SURFACE	5
11A	
12A	7
13A	24
14A	24
15A	32
16A SUB SURFACE	1
16A SURFACE	5
17A	
18A	24
19A	
20A	
21A	
22A	
23A	
24A	
25A	
26A	

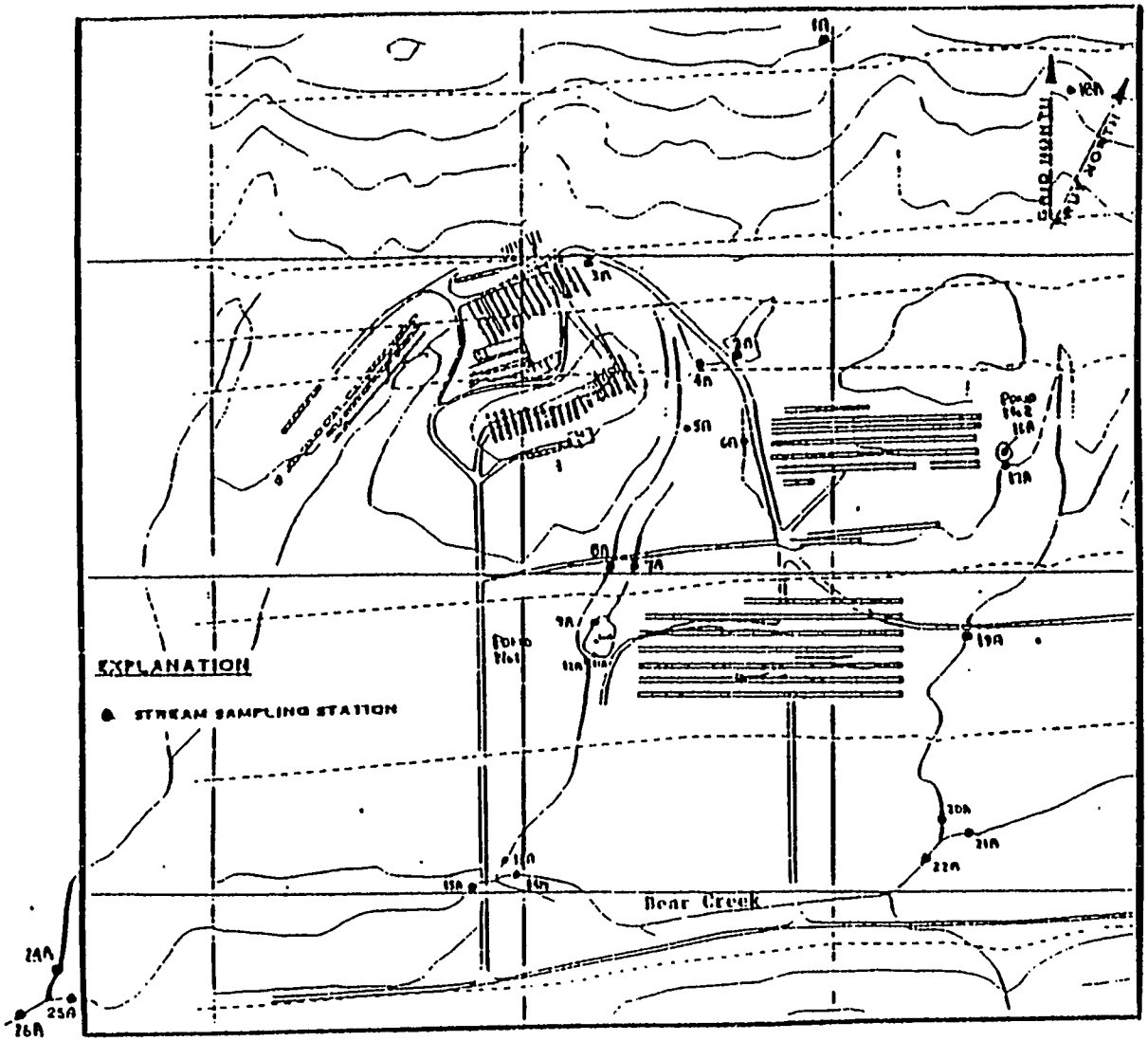


FIGURE 6-74
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	CHLORIDE
1A	1
2A	1.5
3A	3
4A	
5A	130
7A	1[illegible]6
8A	2.5
9A	
10A SUB-SURFACE	110
10A SURFACE	3
11A	
12A	115
13A	116
14A	37
15A	130
16A SUB-SURFACE	156
16A SURFACE	165
17A	
18A	30
20A	
21A	
22A	
23A	
24A	
25A	
26A	

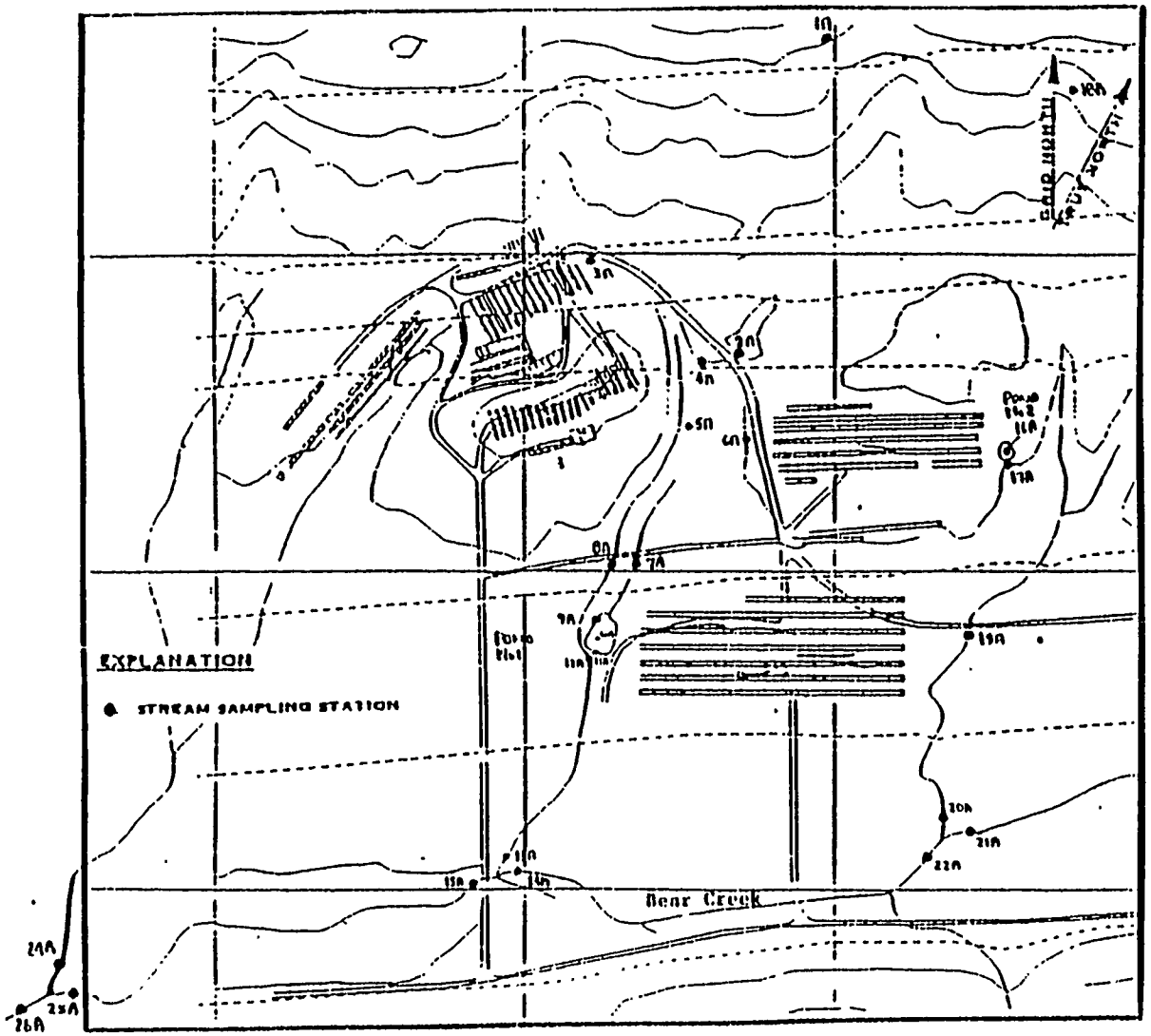


FIGURE 6.75
MISCELLANEOUS CONVENTIONAL OR NON-CONVENTIONAL POLLUTANTS
ON RELATED PARAMETERS
UNIT=PPM (PARTS/MILLION) UNLESS OTHERWISE NOTED
BURIAL GROUNDS

STATION	DISTANCE	H
1A	0.33	
2A	0.25	
3A	0.33	
4A		
5A	0.33	
7A	0.31	
8A	0.33	
9A		
10A SUB-SURFACE	0.33	
10A SURFACE	<.3 31	
11A		
12A	<.0 01	
13A	0.06	
14A	30	
15A	32	
16A SUB-SURFACE	<.3 01	
16A SURFACE	<.0 01	
17A		
18A	.0	
19A		
20A		
21A		
22A		
23A		
24A		
25A		
26A		

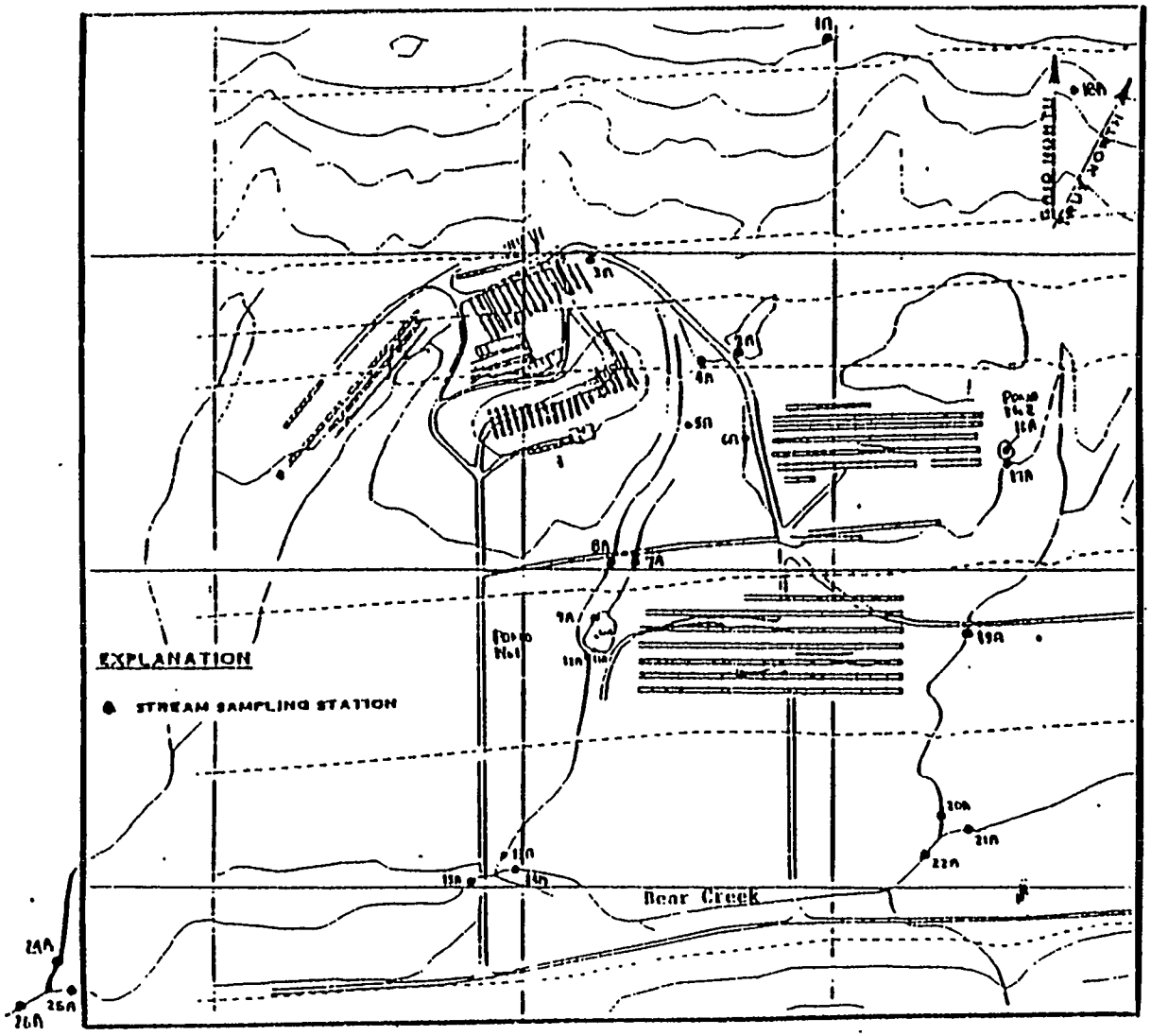


FIGURE 5-7A
MISCELLANEOUS CONVENTIONAL OR NON-CONVENTIONAL POLLUTANTS
ON RELATED PARAMETER
UNIT-PER PARTS/MILLION UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	AMMONIA	H
1A	0.05	
2A	0.10	
3A	0.3	
4A		
5A	0.1	
7A	0.21	
8A	0.10	
9A		
10A SUB-SURFACE	0.08	
10A SURFACE	0.3	
11A		
12A	0.15	
13A	0.14	
14A	0.43	
15A	0.10	
16A SUB-SURFACE	0.3	
16A SURFACE	0.1	
17A		
18A	0.13	
19A		
20A		
21A		
22A		
23A		
24A		
25A		
26A		

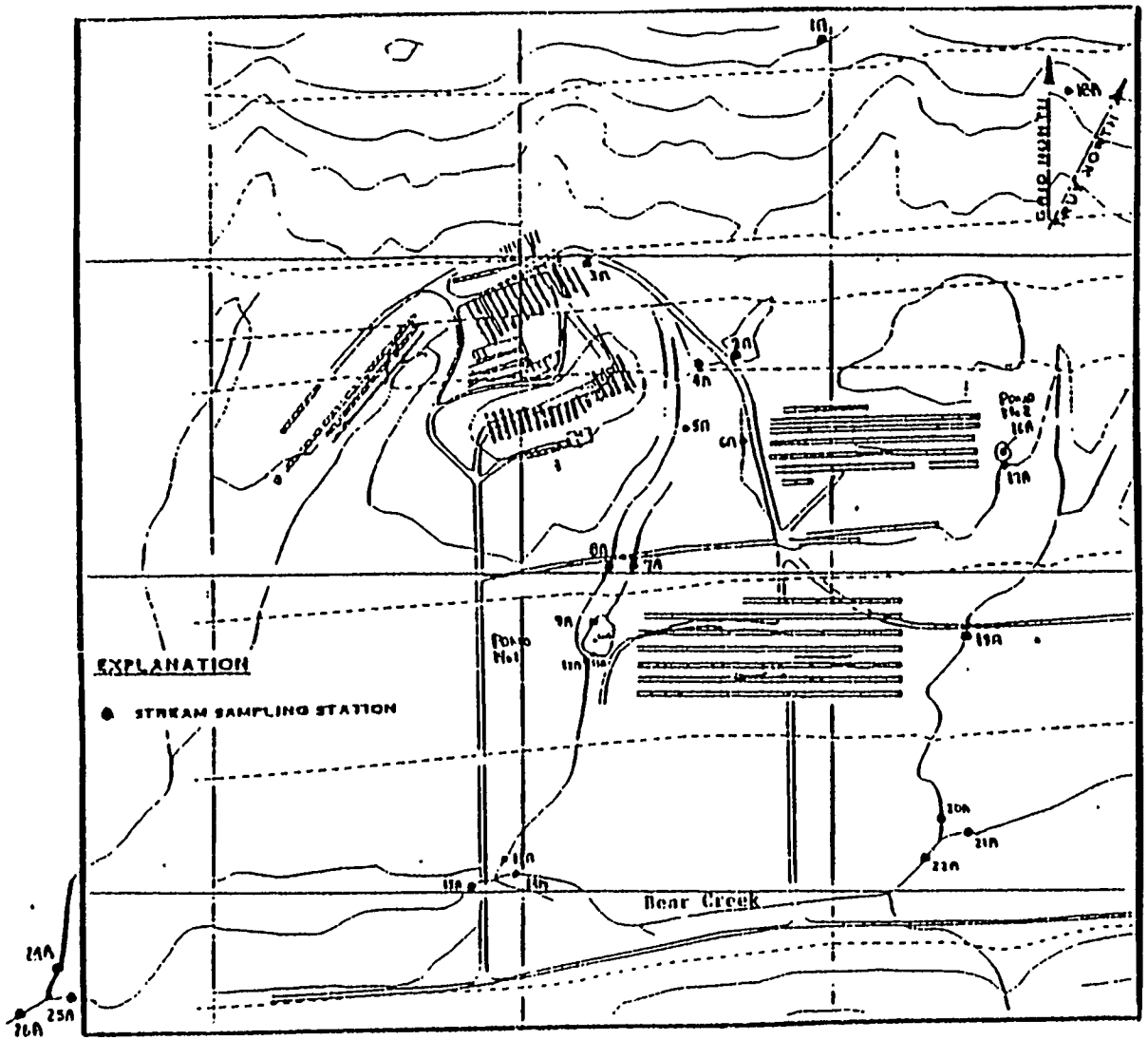


FIGURE 6.77
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-EPH (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	ORTHO PHOSPHATE P
1A	0.01
2A	<0.01
3A	<0.01
4A	
5A	<0.01
7A	<0.01
8A	<0.01
9A	
10A SUB-SURFACE	0.01
10A SURFACE	0.04
11A	
12A	<0.01
13A	<0.01
14A	<0.01
15A	<0.01
16A SUB SURFACE	0.01
16A SURFACE	0.01
17A	
19A	0.01
20A	
21A	
22A	
23A	
24A	
25A	
26A	

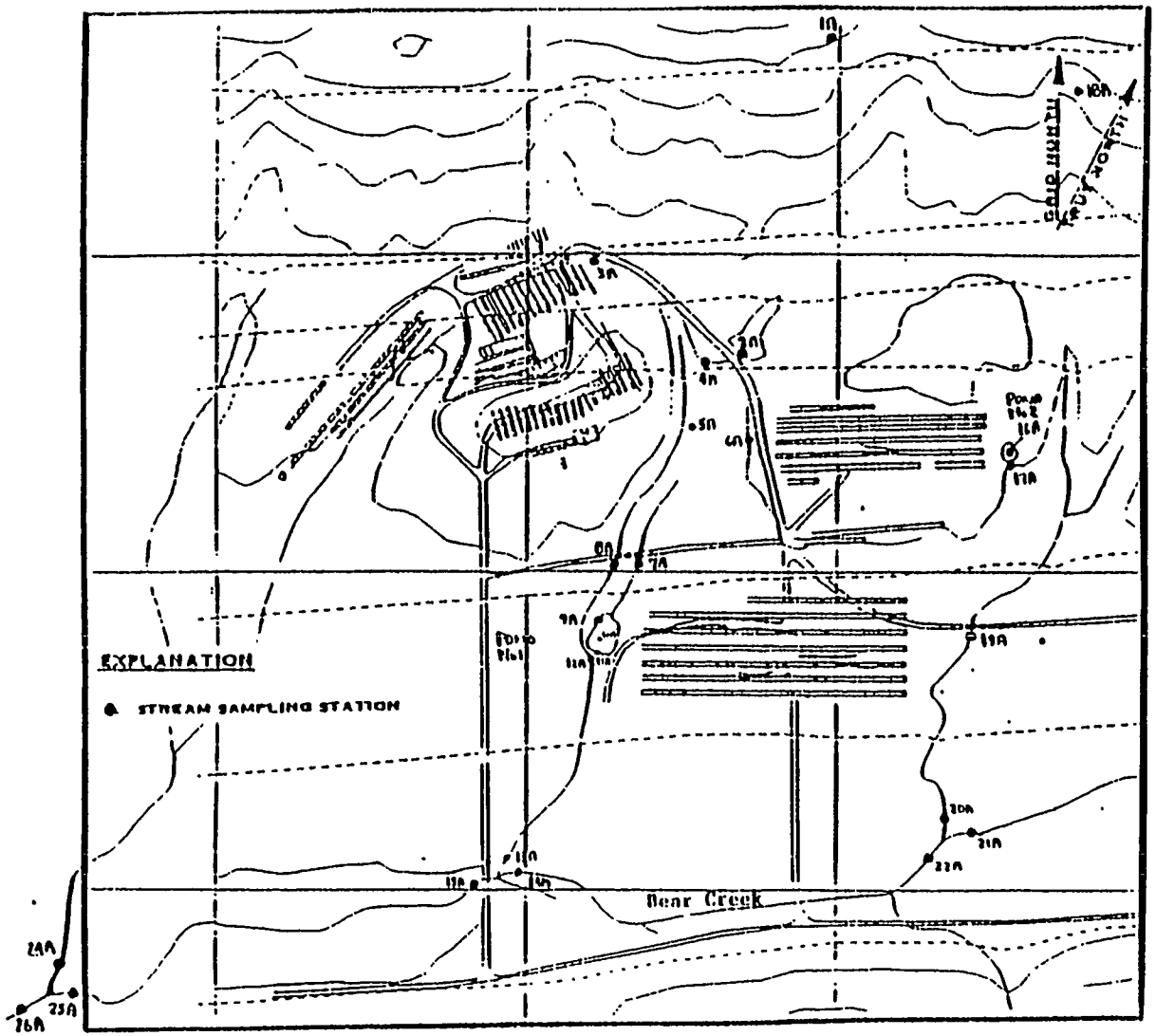


FIGURE 6-78
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	FLUORIDE
1A	0.1
2A	0.4
3A	0.5
4A	
5A	0.2
7A	0.9
8A	0.3
9A	
10A SUB-SURFACE	0.1
10A SURFACE	0.5
11A	
12A	0.33
13A	0.1
14A	0.3
15A	0.2
16A SUB-SURFACE	0.15
16A SURFACE	0.14
17A	
19A	0.1
20A	
21A	
22A	
23A	
24A	
25A	
26A	

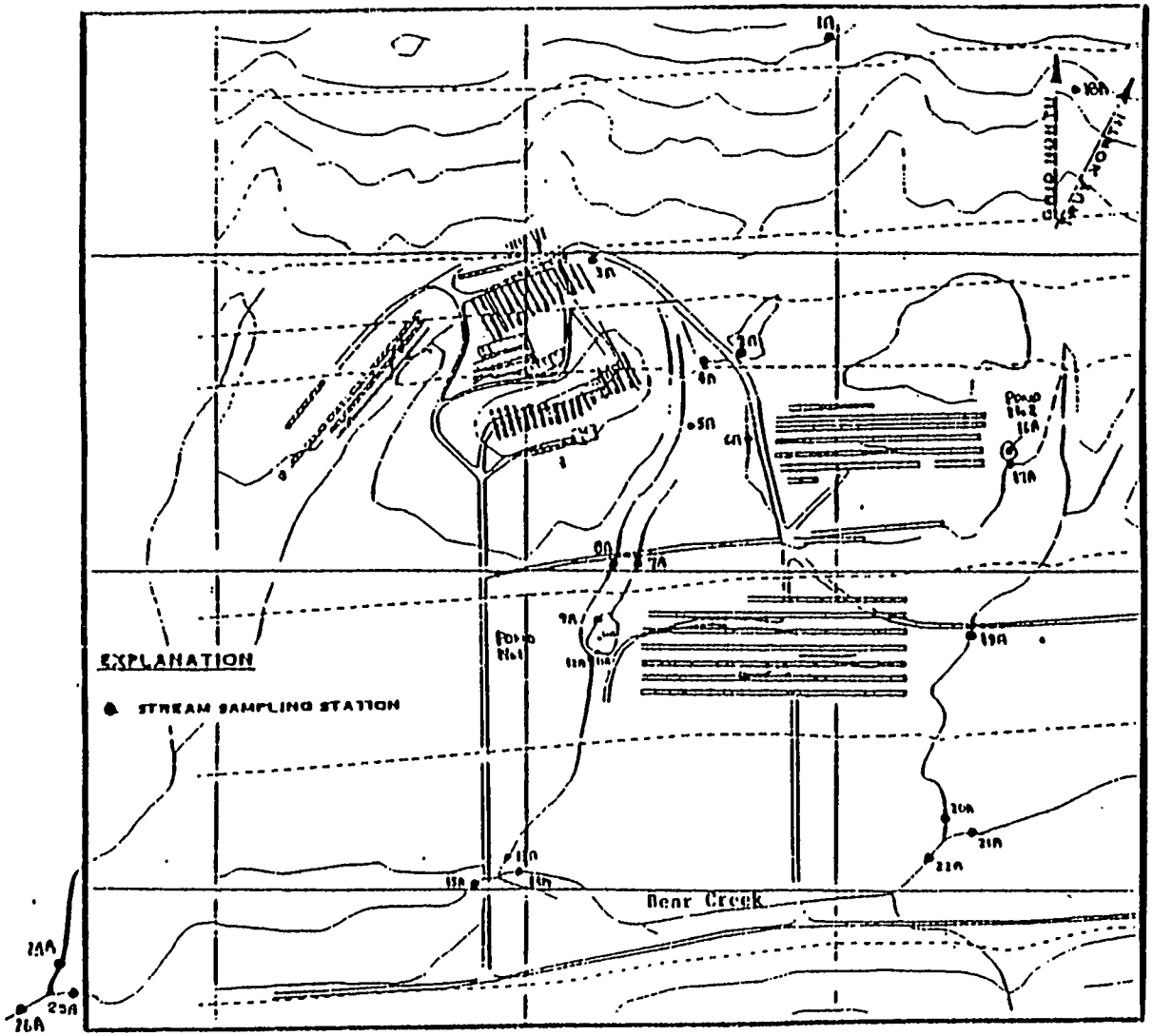


FIGURE 6 /9
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANTS
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	TOTAL KJELDAHL NITROGEN
1A	0.15
2A	0.4
3A	0.4
4A	
5A	1
7A	0.6
8A	3.7
9A	
10A SUB-SURFACE	0.50
10A SURFACE	1
11A	
12A	0.95
13A	0.7
14A	3.13
15A	1
16A SUB SURFACE	1.2
16A SURFACE	1
17A	
19A	0.05
20A	
21A	
22A	
23A	
24A	
25A	
26A	

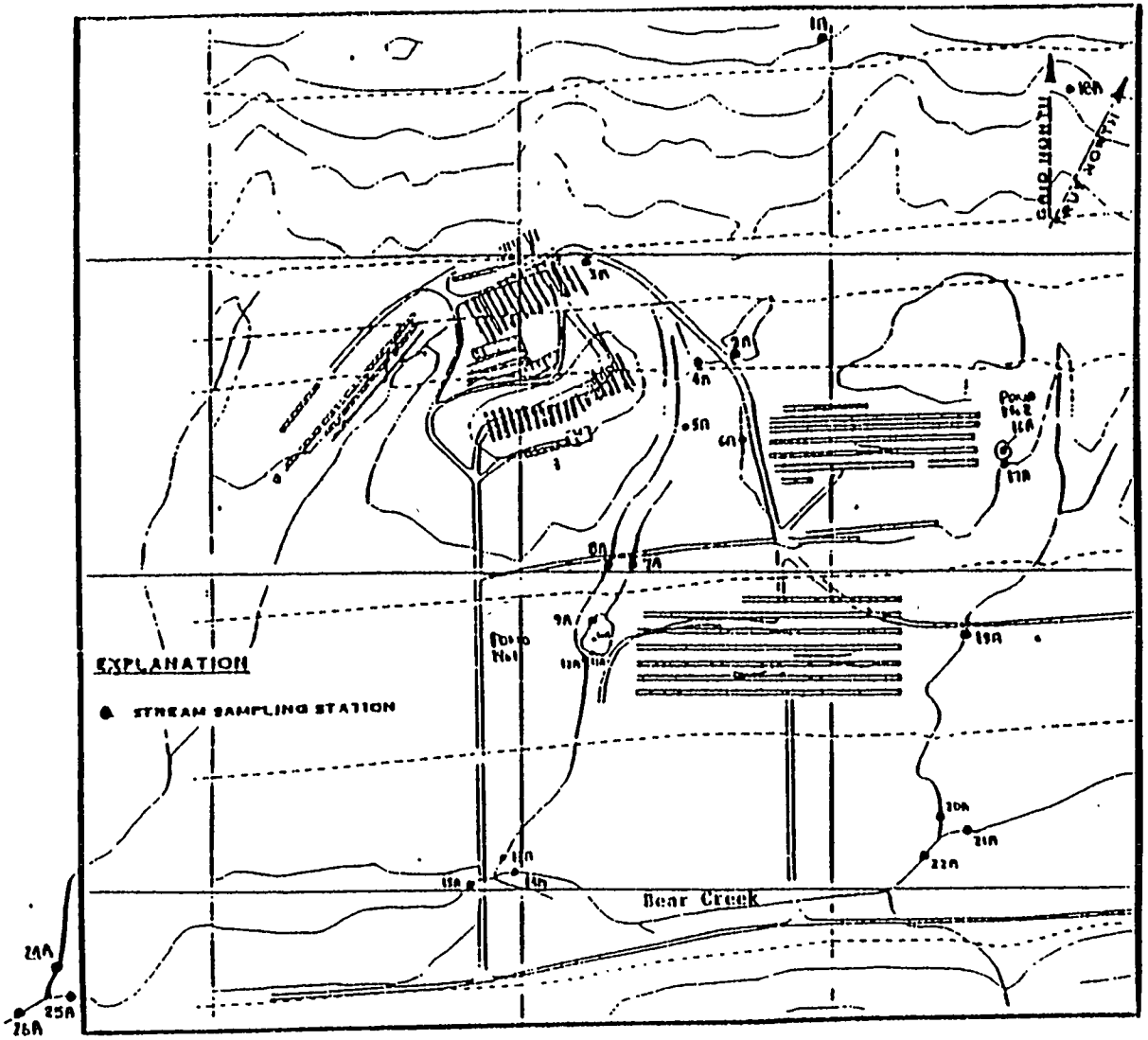


FIGURE 6-80
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	CHEMICAL OXYGEN DEMAND
1A	[illegible]
2A	[illegible]
3A	[illegible]
4A	
5A	[illegible]
7A	[illegible]
8A	[illegible]
9A	
10A SUB-SURFACE	[illegible]
10A SURFACE	[illegible]
11A	
12A	[illegible]
13A	[illegible]
14A	[illegible]
15A	[illegible]
16A SUB-SURFACE	[illegible]
16A SURFACE	[illegible]
17A	
18A	[illegible]
20A	
21A	
22A	
23A	
24A	
25A	
26A	

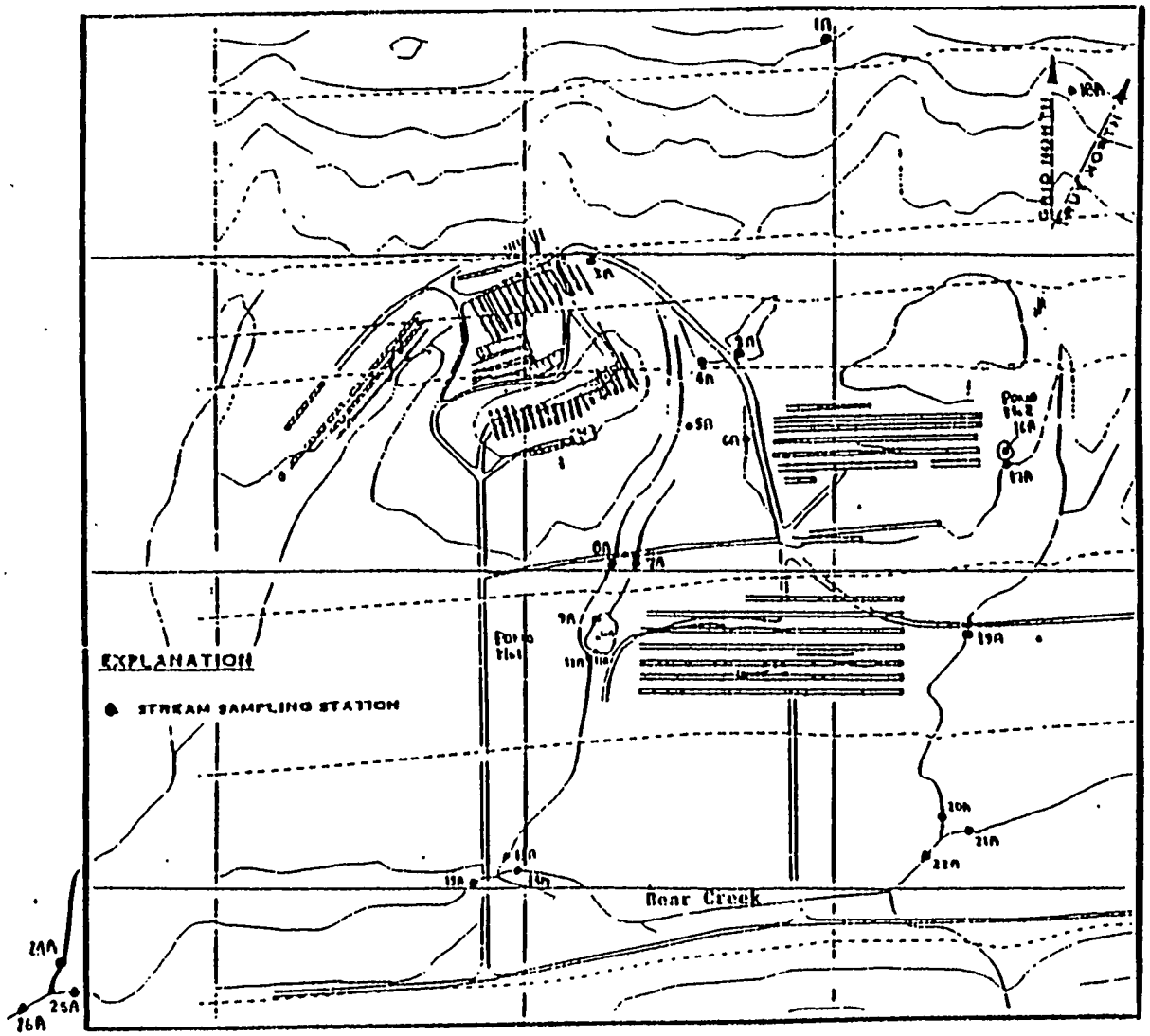


FIGURE 6.81
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANTS
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	DISSOLVED ORGANIC CARBON
1A	1
2A	14
3A	10
4A	
5A	4
7A	4
8A	4
9A	
10A SUB-SURFACE	10
10A SURFACE	41
11A	
12A	11
13A	14
14A	3
15A	4
16A SUB-SURFACE	45
16A SURFACE	41
17A	
18A	14
19A	
20A	
21A	
22A	
23A	
24A	
25A	
26A	

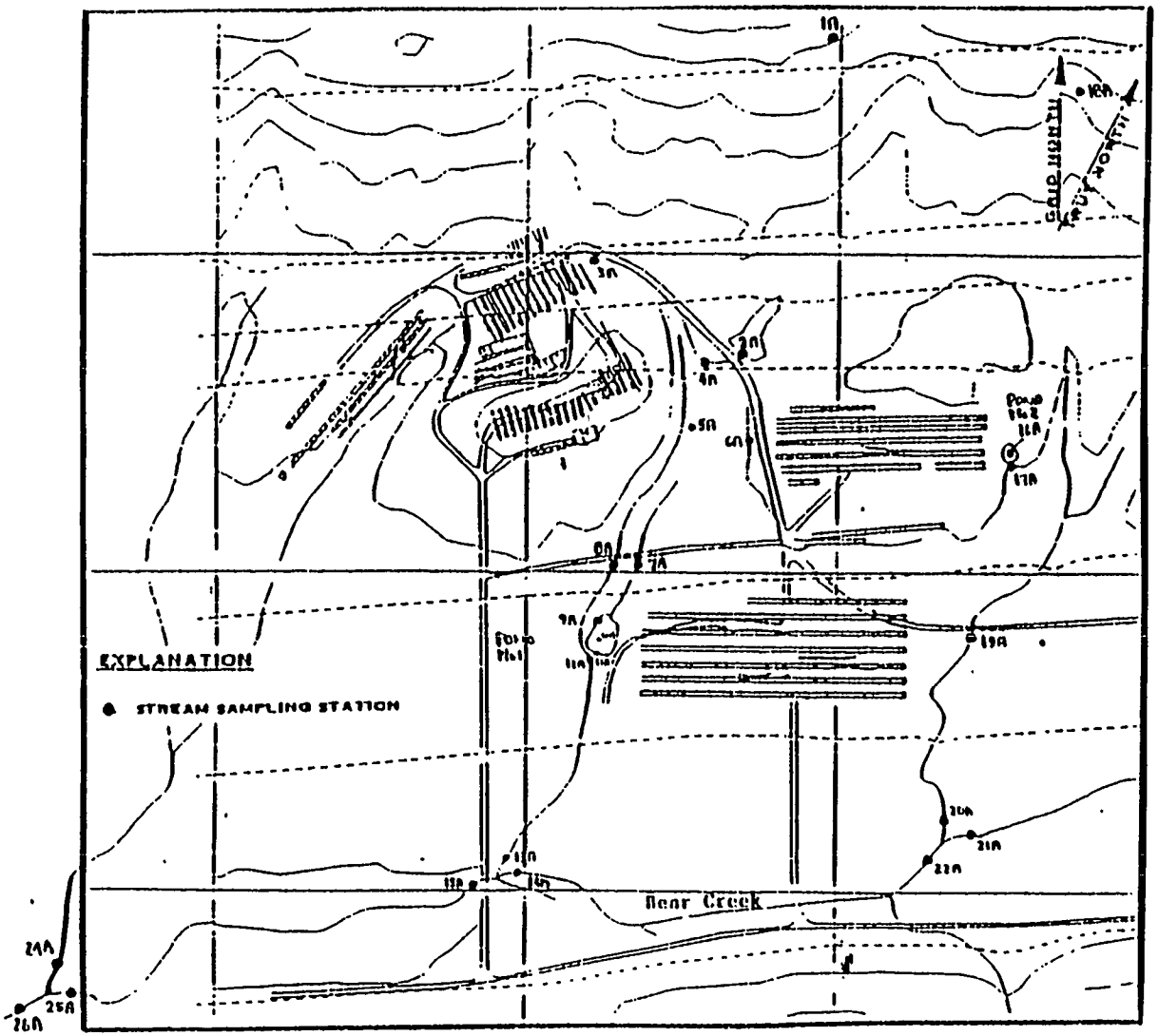


FIGURE 6-82
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANTS
ON RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	TOTAL ORGANIC CARBON
1A	3
2A	19
3A	7
4A	
5A	9
7A	13
8A	5
9A	
10A SUB	
SURFACE	34
10A	
SURFACE	184
11A	
12A	11
13A	16
14A	30
15A	9
16A SUB	
SURFACE	46
16A	
SURFACE	41
17A	
19A	13
20A	
21A	
22A	
23A	
24A	
25A	
26A	

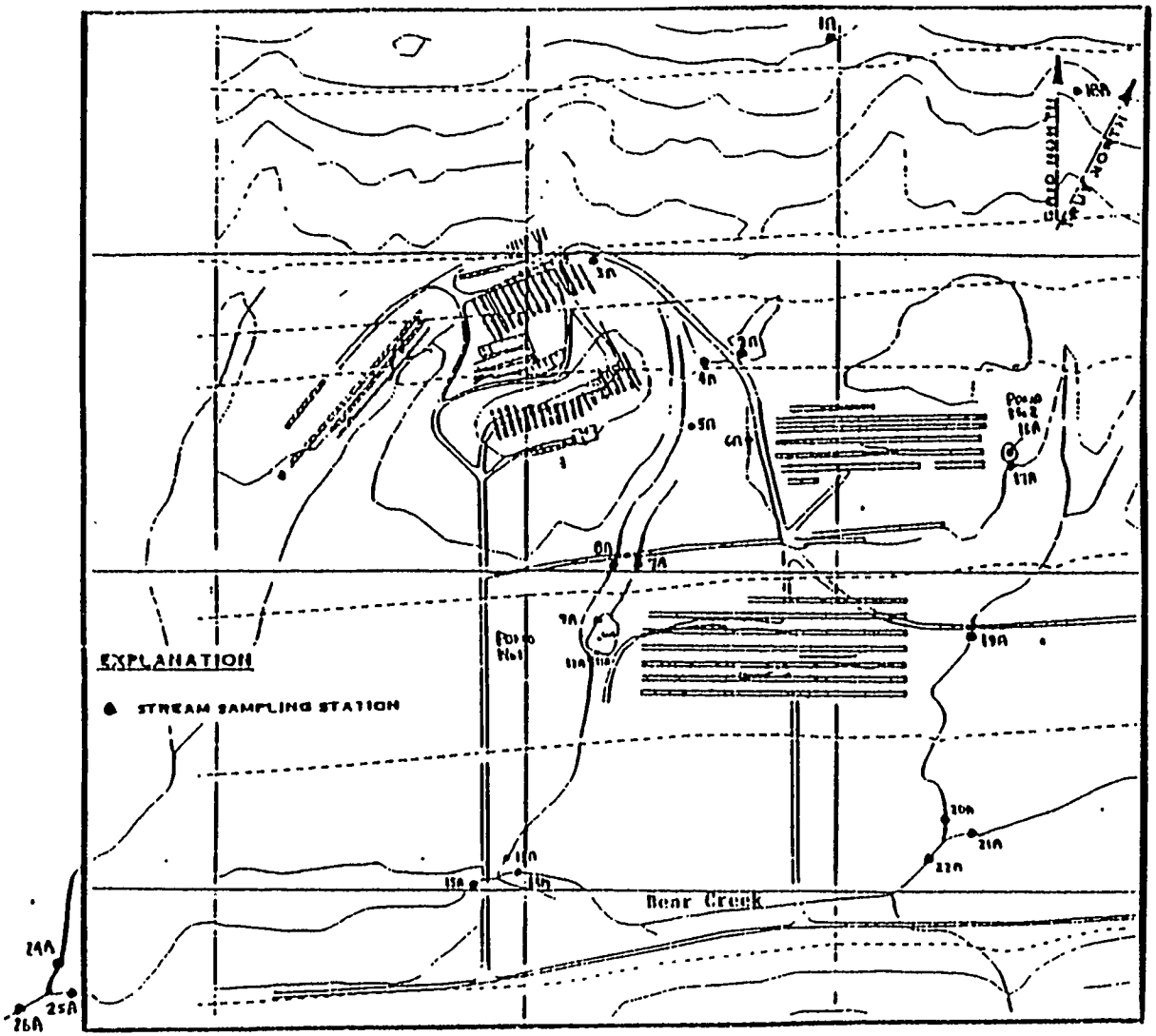


FIGURE 6.81
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	BIOCHEMICAL OXYGEN DEMAND
1A	1
2A	2
3A	<1
4A	
5A	3
7A	4
8A	4
9A	
10A, SUB-SURFACE	5
10A SURFACE	111
11A	
12A	9
13A	4
14A	3
15A	3
16A SUB-SURFACE	11
16A SURFACE	3
17A	
18A	1
19A	
20A	
21A	
22A	
23A	
24A	
25A	
26A	

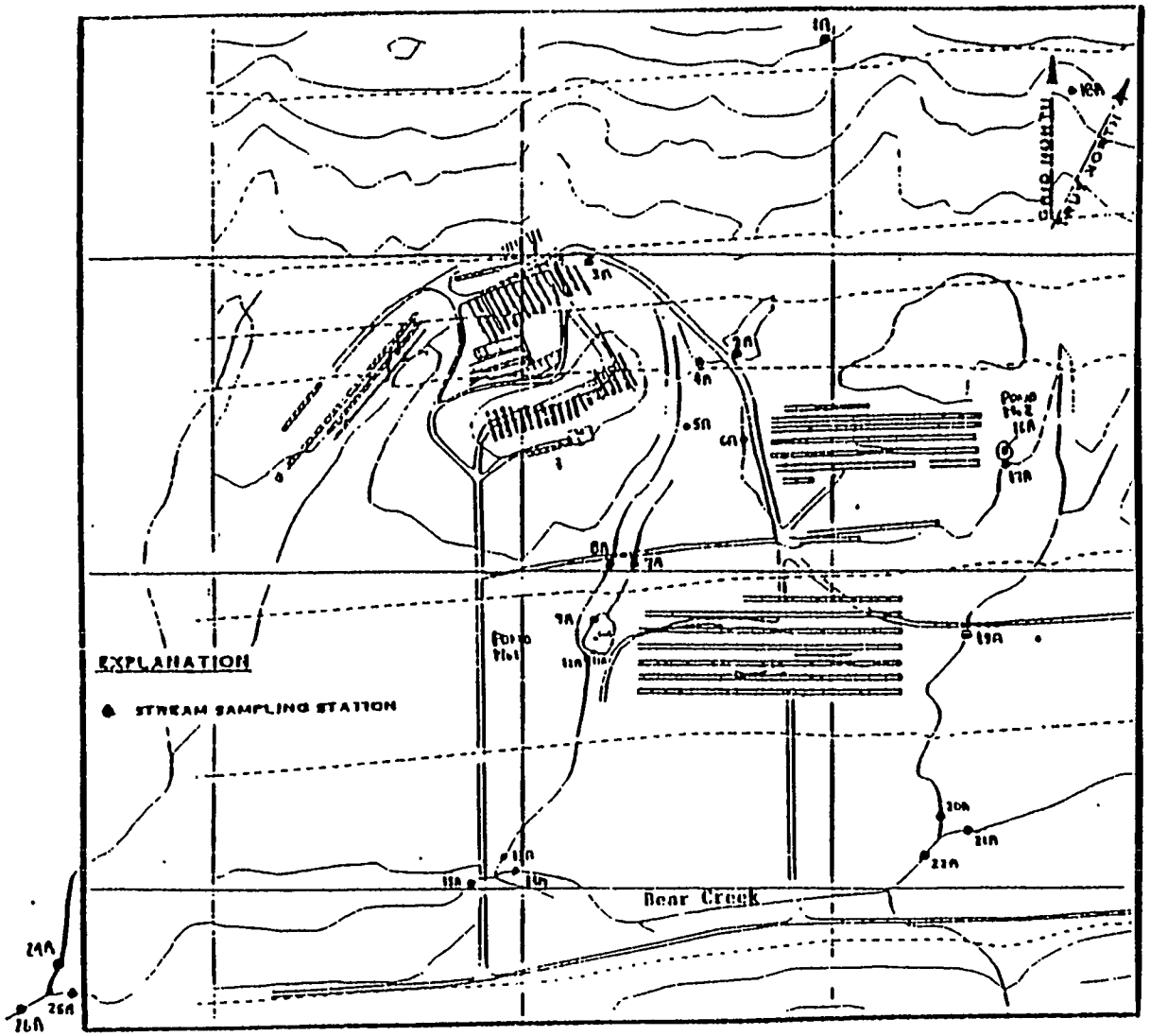


FIGURE 6.84
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM PARTS/MILLION, UNLESS OTHERWISE STATED
SURFAC GROUNDS

STATION	PH (IN PH UNITS)
1A	7.[illegible]*
2A	6.40*
3A	7.[illegible]*
4A	
5A	6.[illegible]*
7A	6.[illegible]*
8A	7.[illegible]*
9A	
10A SUB-SURFACE	7.[illegible]*
10A SURFACE	
11A	
12A	6.[illegible]*
13A	6.[illegible]*
14A	8.[illegible]*
15A	7.[illegible]*
16A SUB SURFACE	5.[illegible]*
16A SURFACE	6.[illegible]*
17A	
18A	3.[illegible]*
19A	6.[illegible]
20A	6.[illegible]
21A	6.[illegible]
22A	7.[illegible]
23A	7.[illegible]
24A	7.[illegible]
25A	7.[illegible]
26A	7.[illegible]

* THIS VALUE REPRESENTS A MEAN, SAMPLE SIZE=3

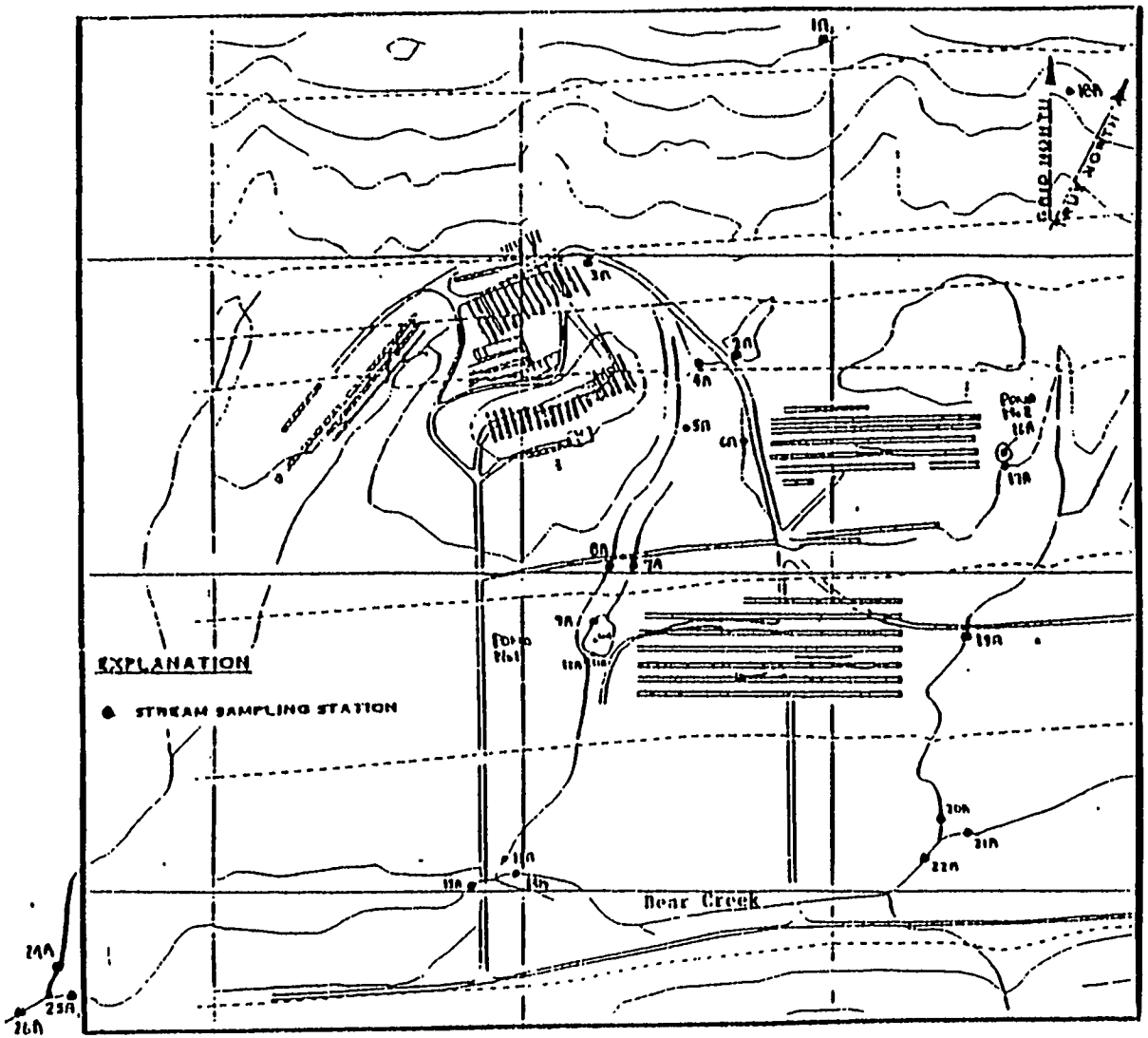


FIGURE 6-85
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	REDOX (IN MV)
1A	[illegible]*
2A	[illegible]*
3A	[illegible]*
4A	
5A	[illegible]*
7A	[illegible]*
8A	[illegible]*
9A	
10A SUB-SURFACE	[illegible]*
10A SURFACE	
11A	
12A	[illegible]*
13A	[illegible]*
14A	[illegible]*
15A	[illegible]*
16A SUB-SURFACE	[illegible]*
16A SURFACE	[illegible]*
17A	
19A	[illegible]*
20A	[illegible]
21A	[illegible]
22A	[illegible]
23A	[illegible]
24A	[illegible]
25A	[illegible]
26A	[illegible]

* THIS VALUE REPRESENTS A MEAN, SAMPLE SIZE=3

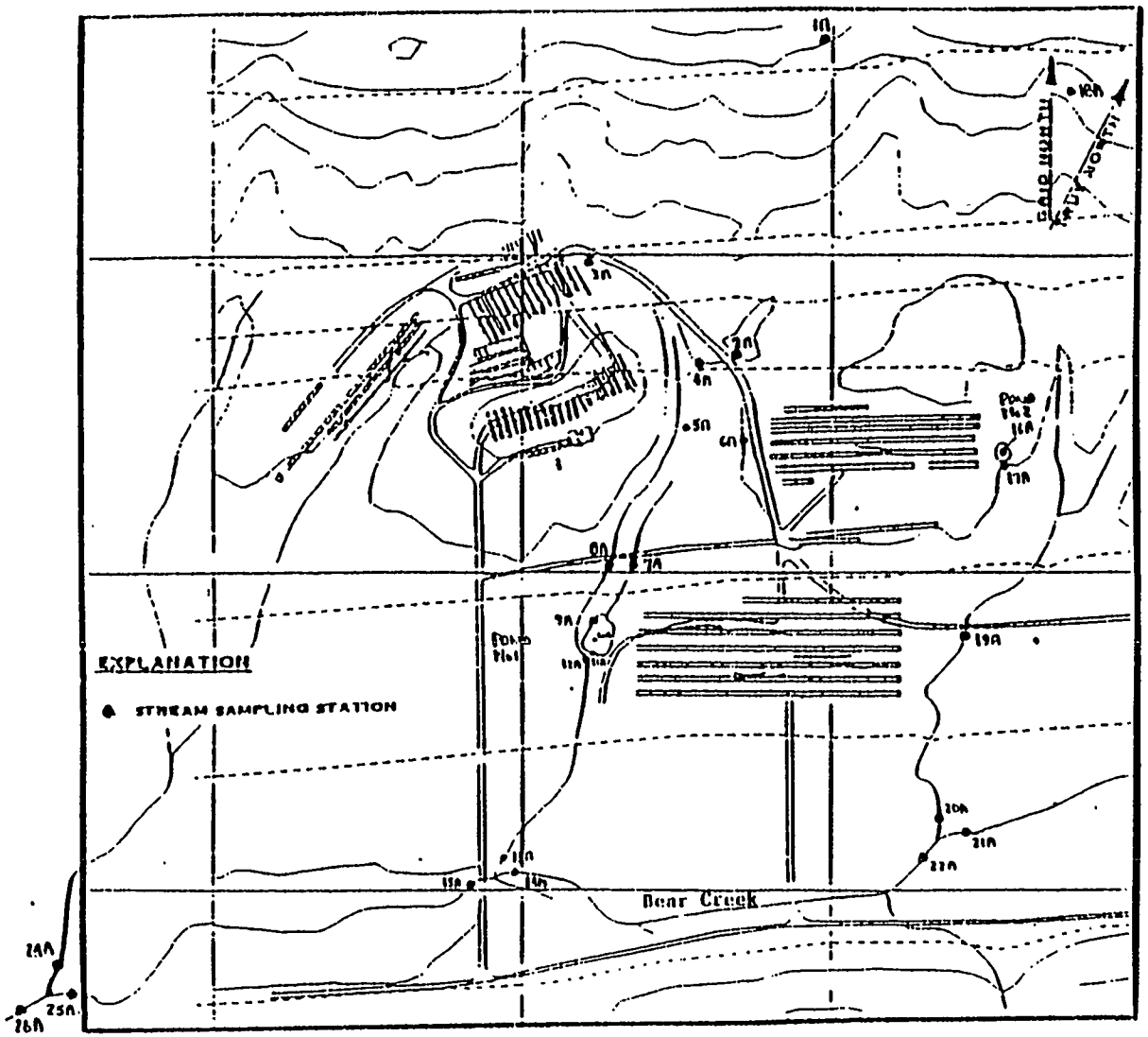


FIGURE 6-46
MISCELLANEOUS CONVENTIONAL OR NON-CONVENTIONAL POLLUTANTS
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE NOTED
BURIAL GROUNDS

STATION	DISSOLVED OXYGEN
1A	9.3
2A	
3A	6.9
4A	
5A	
7A	9.2
8A	8.8
9A	
10A SUB-SURFACE	
10A SURFACE	
11A	
12A	8.3
13A	10.4
14A	9.3
15A	8.2
16A SUB-SURFACE	
16A SURFACE	
17A	
19A	7.3
20A	7.5
21A	9.3
22A	9.3
23A	7.9
24A	9.4
25A	7.0
26A	8.8

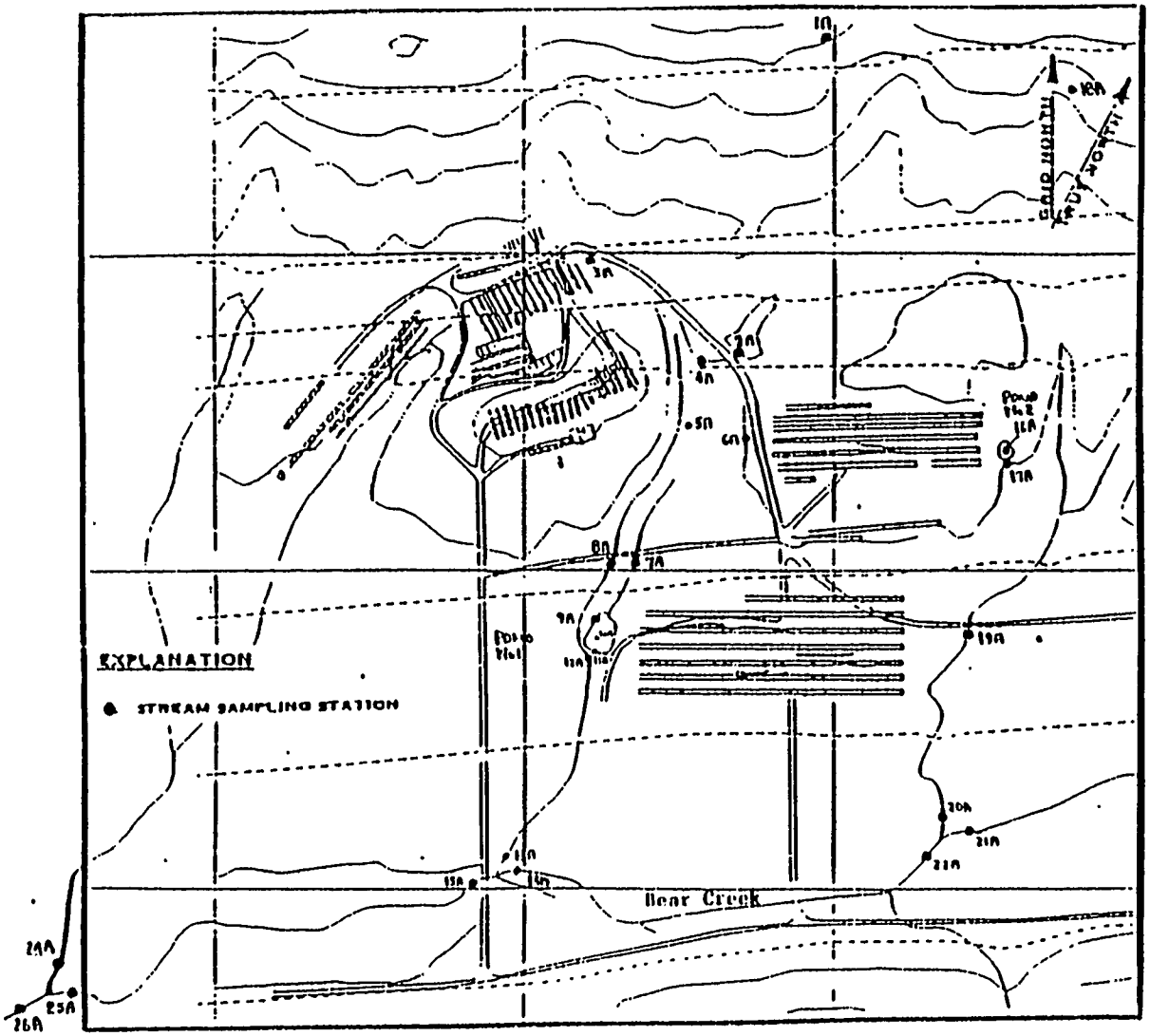


FIGURE 6 B7
MISCELLANEOUS CONVENTIONAL OR NON-CONVENTIONAL POLLUTANTS
OR RELATED PARAMETER
UNIT-PER (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	WATER TEMP (IN DEGREES CENTIGRADE)
1A	13.0
2A	15.8
3A	16.7
4A	
5A	14.1
7A	15.5
8A	14.3
9A	
10A SUB-SURFACE	13.0
10A SURFACE	
11A	
12A	14.1
13A	13.1
14A	14.5
15A	14.1
16A SUB-SURFACE	17.7
16A SURFACE	19.9
17A	
19A	15.1
20A	13.4
21A	13.0
22A	13.7
23A	10.3
24A	9.1
25A	13.9
26A	9.2

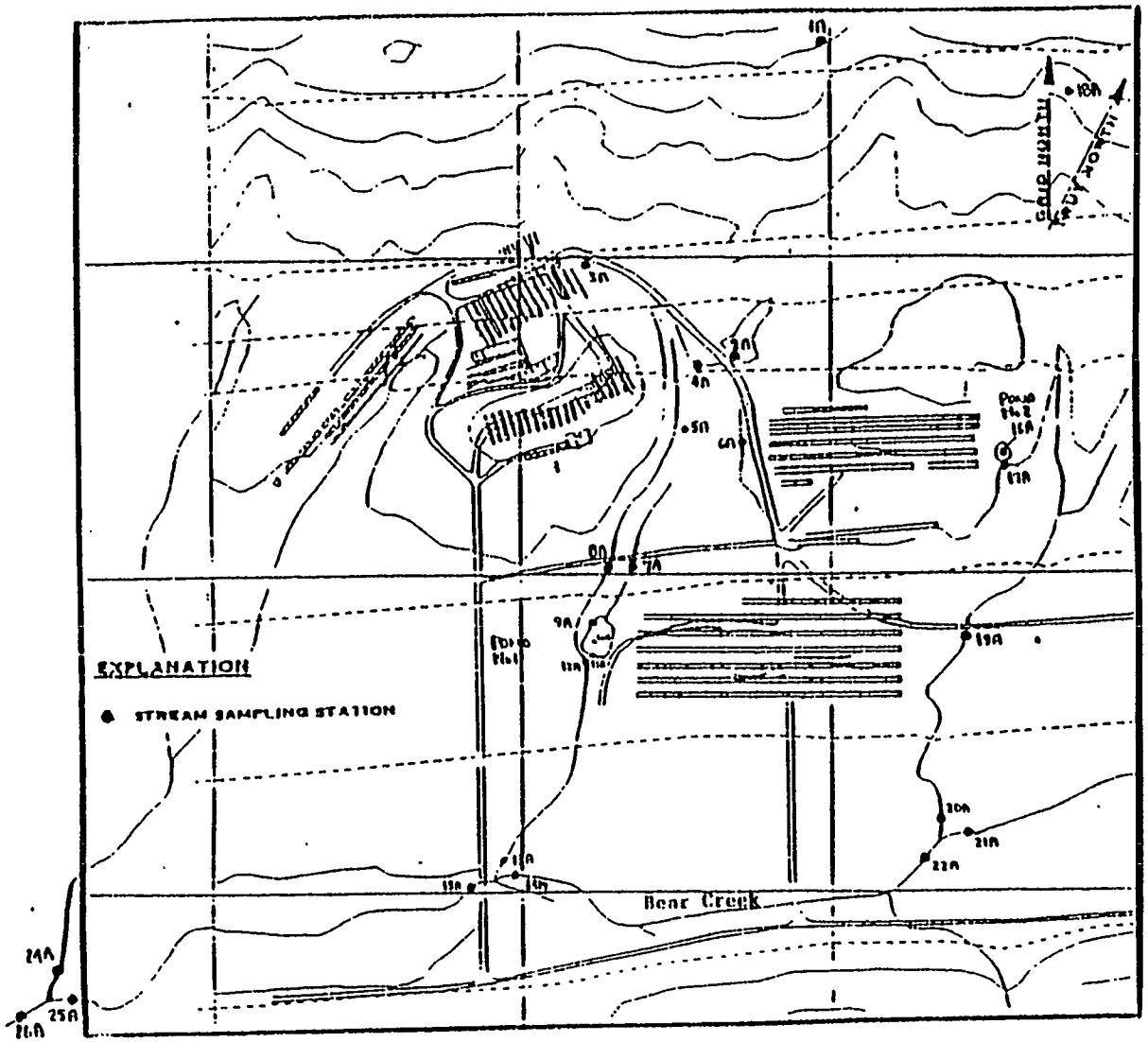


FIGURE 6.88
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	OIL & GREASE IN WATER
1A	[illegible]
2A	[illegible]
3A	[illegible]
4A	
5A	[illegible]
7A	[illegible]
8A	[illegible]
9A	
10A SUB SURFACE	
10A SURFACE	[illegible]
11A	
12A	[illegible]
13A	[illegible]
14A	[illegible]
15A	[illegible]
16A SUB SURFACE	[illegible]
16A SURFACE	[illegible]
17A	
18A	[illegible]
19A	
20A	[illegible]
21A	[illegible]
22A	[illegible]
23A	
24A	[illegible]
25A	[illegible]
26A	[illegible]

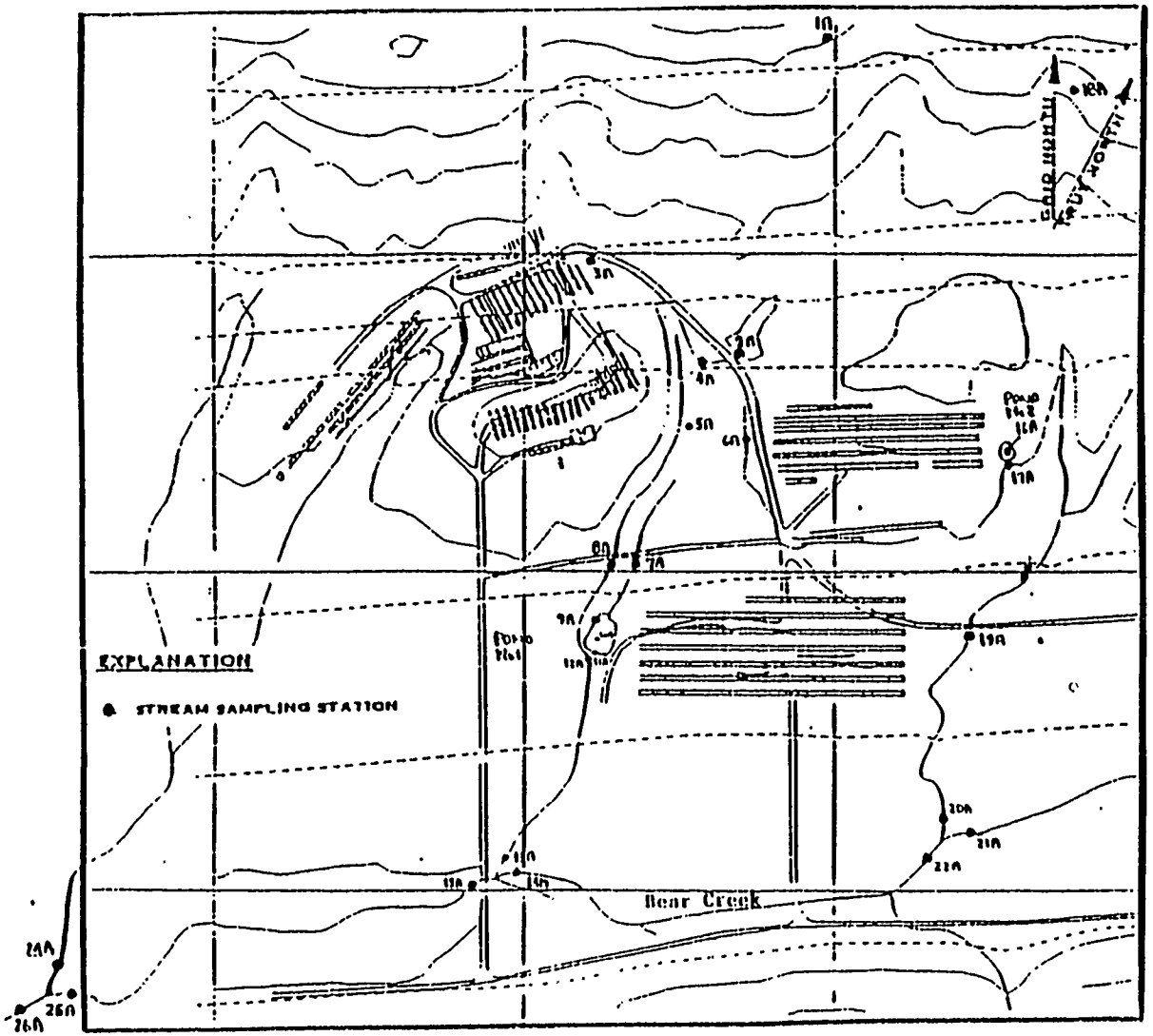


FIGURE 6.89
MISCELLANEOUS CONVENTIONAL OR NONCONVENTIONAL POLLUTANT
OR RELATED PARAMETER
UNIT-PPM (PARTS/MILLION) UNLESS OTHERWISE STATED
BURIAL GROUNDS

STATION	OIL & GREASE IN SEDIMENT
1A	434
2A	339
3A	586
4A	587
5A	1630
7A	1238
8A	385
9A	55378
10A SUB-SURFACE	
10A SURFACE	
11A	59739
12A	1154
13A	1117
14A	91
15A	463
16A SUB-SURFACE	
16A SURFACE	
17A	59071
19A	
20A	
21A	199
22A	349
23A	
24A	3444
25A	148
26A	152

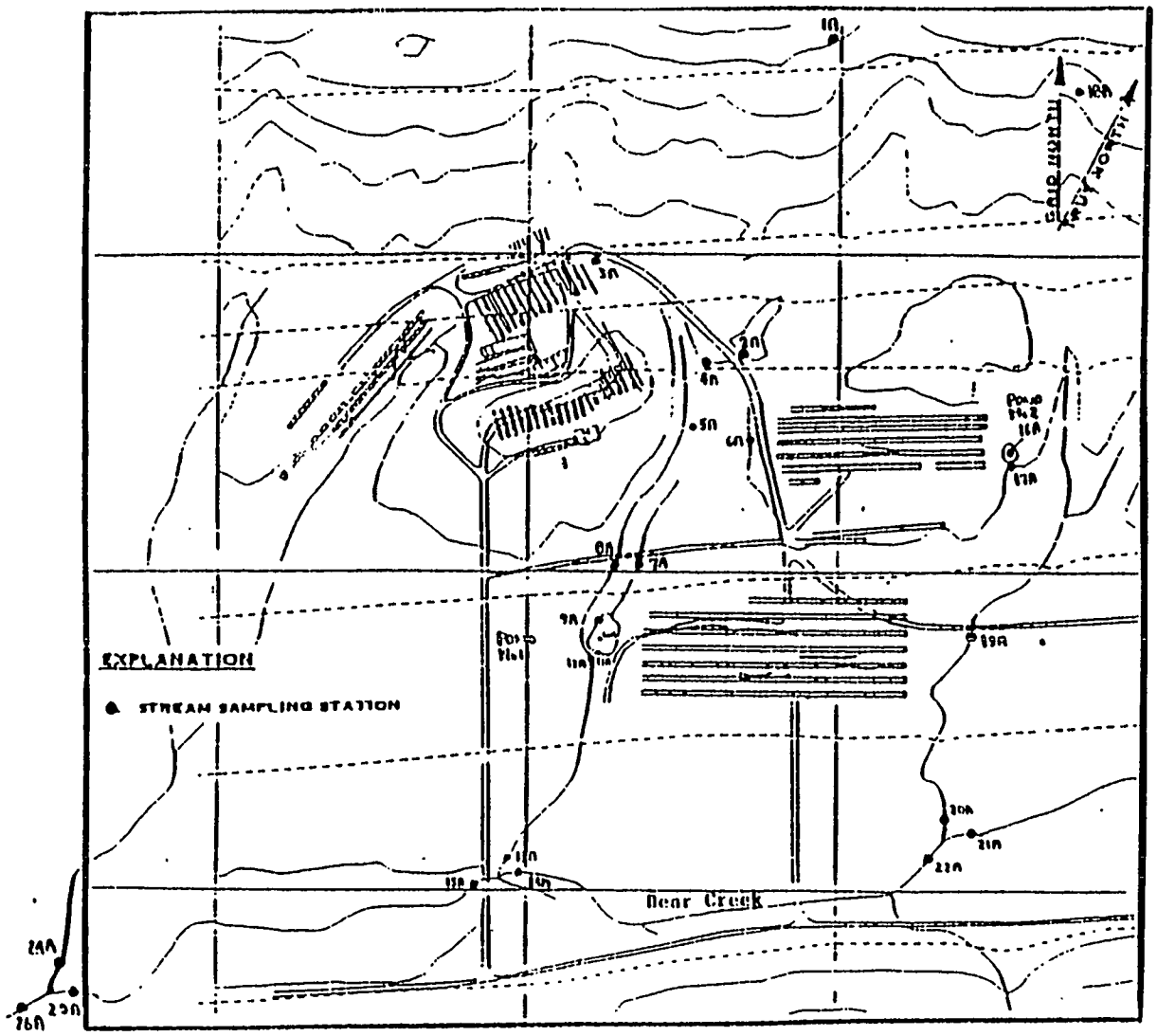


FIGURE 6.90
ACID EXTRACTABLE ORGANIC
PRIORITY POLLUTANT
IN WATER
UNIT-PPB (PARTS/BILLION)
BURIAL GROUNDS

STATION	1,4 DIHLIHYLPHENOL (N XYLENOL)
4A	
WATER	
PHASE	11
4A	
OIL	
PHASE	N
18A	
SURFACE	
OIL	
PHASE	N

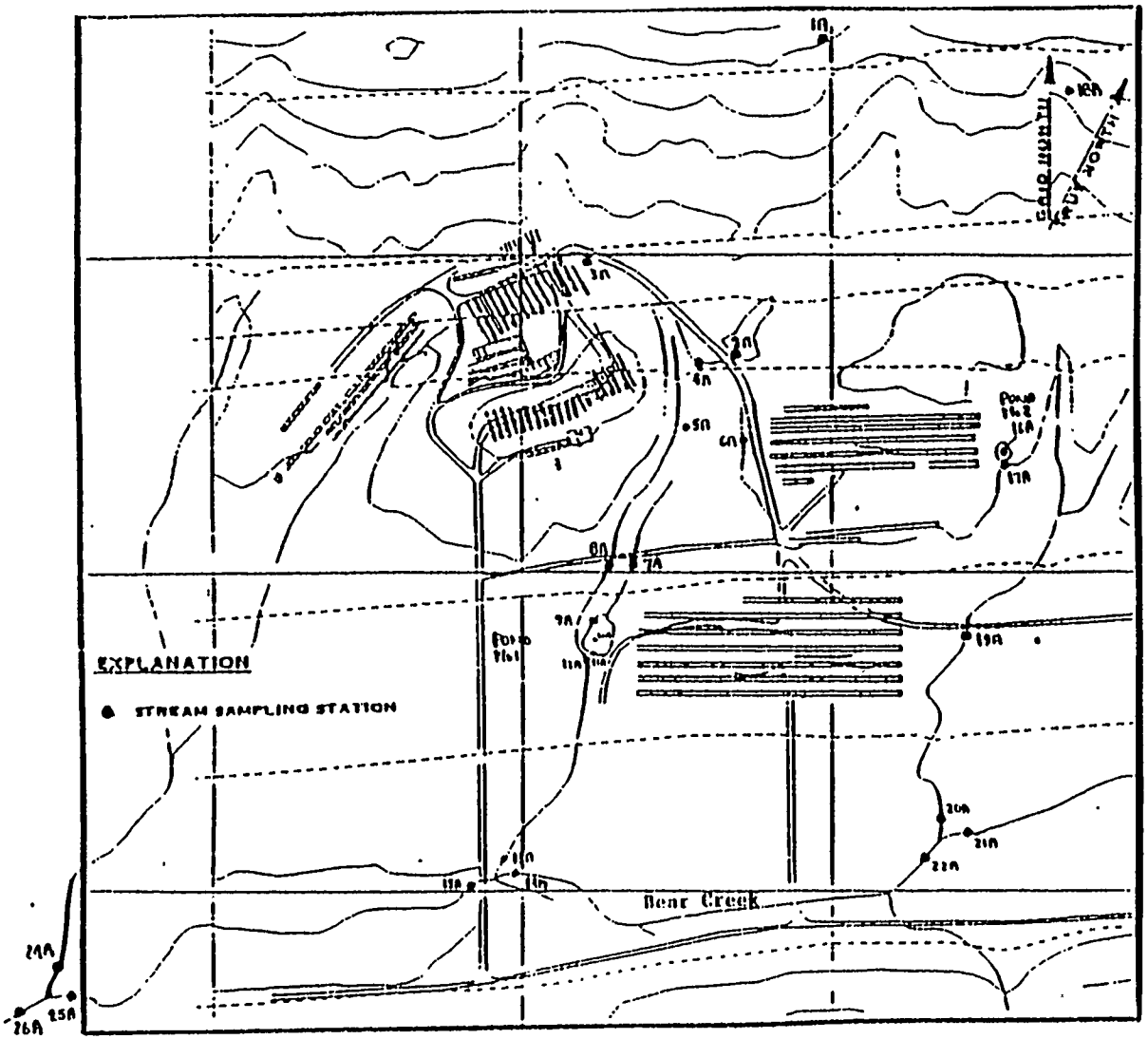


FIGURE 6-91
BASE NEUTRAL EXTRACTABLE ORGANIC
PRIORITY POLLUTANTS
IN WATER
UNIT-PPB (PARTS-MILLION)
BURIAL GROUNDS

STATION	DIBUTYL-ETHYLHEXYL PHTHALATE
4A WATER PHASE	620
4A OIL PHASE	370
1BA SURFACE OIL PHASE	300

7.0. ASSESSMENT OF BIOLOGICAL INFORMATION

7.1 SHORT-TERM SURVIVAL OF BLUEGILL SUNFISH IN WATER FROM Y-12 OIL RETENTION PONDS

The following is the report prepared by J. M. Giddings of Oak Ridge National Laboratory, Environmental Sciences Division.

7.1.1 Procedure

Water was collected from Oil Retention Pond 1 (outlet and inlet) and Pond 2 on the afternoon of January 3, 1984. Samples were transported in 10-L polyethylene bottles to the Aquatic Ecology Laboratory (Building 1504) for toxicity screening with bluegill sunfish (*Lepomis macrochirus*). The water reached room temperature (21 C) overnight. On the morning of January 4, 6 liters of each sample were placed in 20 liters aquaria. Table 7.1 shows the dissolved oxygen, pH, and conductivity measurements.

Table 7-1

Characteristics of water samples at beginning of bioassay

	Pond 1 inlet	Pond 1 outlet	Pond 2	Tap water
Dissolved Oxygen (mg/L)	8.0	7.4	8.9	9.0
pH	6.85	6.93	5.39	7.63
Conductivity (umho)	700	640	40	224

A fourth aquarium contained dechlorinated tap water (from the same source as that in which the fish stocks are routinely maintained. Five fish (average length = 3.85 cm; average weight = 0.78 g) were then placed in each aquarium. The aquaria were inspected at intervals over the next 5 days.

The fish were not fed during the test.

7.1.2 Results

All fish remained alive and visibly unharmed when the test was terminated at 9:00 a.m. on January 9, 1984, following 5 days exposure.

7.1.3 Conclusion

The water entering and leaving Oil Retention Pond 1 and that retained in Oil Retention Pond 2 is of a quality that permits the survival of bluegill sunfish for at least 5 days.

7.1.4 Notes

(1) Possible long-term effects on survival, growth, and reproduction were not addressed in this screening test.

(2) Bluegill were selected as test organisms because they are a widely-used, standard bioassy species (among those recommeded by the U.S. Environmental Protection Agency for aquatic bioassays), and because they are typical inhabitants of streams in this region. Other species would be expected to differ in their sensitivity to chemical substances in the waters tested; bluegill are accepted as representative warm-water fish by the EPA.

7.2 BIOTIC CHARACTERIZATION OF SMALL STREAMS IN THE VICINITY OF OIL RETENTION PONDS 1 AND 2 NEAR THE Y-12 PLANT

The following is the report prepared by J. M. Loar and D. K. Cox of Oak Ridge National Laboratory's Environmental Sciences Division.

7.2.1 Introduction

On December 8, 1983, Y-12 Waste Management contacted Environmental Sciences Division (C. W. Gehrs, Aquatic Ecology Section Head) for assistance in obtaining information on the aquatic biota in streams near the two oil retention ponds west of the Y-12 Plant (Figure 7-1). Site visits were made on December 9 and 16 and preliminary sampling was conducted on December 20, 1983. The limited data collected in this initial reconnaissance of streams in the study area provided guidance for designing a more comprehensive quantitative survey that was conducted January 6-8, 1984, and are the subject of this report. The limited scope of this survey was necessitated by the deadline of January 20, 1984, for submission of a final report to Y-12.

7.2.2 Methods

Quantitative sampling of fish and benthic macroinvertebrates were conducted at sites in (1) Bear Creek above and below the confluence with Stream 1A, a small tributary that drains Oil Retention Pond 1 (Stations 1 and 2, respectively), (2) Stream 1A, just above the confluence with Bear Creek (Station 3), and (3) Stream 2, a small uncontaminated tributary of Bear Creek that flows adjacent to Bear Creek Road (Station 4, control). In addition, qualitative sampling was conducted at several sites in the watersheds of Oil Retention Ponds 1 and 2 (Table 7-1). These sites, shown in Figure 7-1, included (1) Stream 1A, immediately below Pond 1 (Station 5); (2) the diversion ditch that carries surface runoff from portions of Burial Grounds B, C, D, and the area north of Burial Ground A to Stream 1A just below the pond (Station 6); (3) Stream 1A above the diversion ditch (Station 77), and (4) Oil Retention Pond 2 (Station 8). No samples could be taken

above or below Pond 2 because of insufficient flows, and no samples were taken from Oil Retention Pond 1.

7.2.3 Benthic Macroinvertebrates

Benthic macroinvertebrates were sampled at Stations 1B-4B (three samples per site) by placing a 27-x 33-cm metal frame on the bottom of the stream in riffle area. A 363- m-mesh drift net was held at the downstream end of the metal frame, and the stream bottom within the frame was thoroughly agitated with a metal rod. Suspended materials were transported into the net by the stream flow. The net was washed several times with stream water to concentrate the sample and to remove fine sediments. The sample was transferred to glass jars, preserved in approximately 10% formalin, and returned to the laboratory for later processing.

In the laboratory, all samples were washed using a standard No. 35 mesh (500 m) seive and placed in a large white tray. Large pieces of debris (e.g., leaves, twigs) were examined for organisms and removed. A sugar flotation technique was utilized to separate the organisms from the debris in the sample. The contents of the tray were covered by a saturated sucrose solution and agitated to facilitate separation. Organisms that floated to the surface and those that did not were removed from the tray and identified by taxonomic order or family. The individuals in each taxonomic group were collectively weighed to the nearest 0.1 g.

7.2.4 Fishes

The fish community at Stations 1F-4F was sampled using a Smith-Root Type XV backpack electroshocker. The unit utilizes a gasoline-powered

generator capable of delivering up to 1200 V of pulsed direct current. A pulse frequency of 120 Hz was used at all times, and the output voltage was adjusted to the optimal value, based on the water conductivity at the site as measured with a Hydrolab Digital 4041. Concurrent measurements of temperature and pH were also taken with this instrument.

At each of the sampling stations (1F-4F) a representative reach was electrofished by making a single pass upstream and downstream. The length of the reach varied among sites (from 22 to 115 m), depending on fish abundance and accessibility for sampling. Captured fish were held in a 0.64-cm-plastic-mesh cage until sampling at a site was completed. Fish were anesthetized in the field with MS-222 (Tricane methanesulfonate), enumerated by species, and all the individuals of a given species collectively weighed to the nearest 0.5 g on a triple-beam balance. After weighing, fish were released to the stream. In a preliminary sampling conducted on December 20, 1983, representative individuals of each species were collected by seining, preserved in 10% formalin, and returned to the laboratory for identification. Unpublished taxonomic keys of Etnier (1976) were used to identify species. The identification of the mountain redbelly dace (*Phoxinus oreas*) and common shiner (*Notropis cornutus*) collected in the present study was also aided by comparison with specimens collected in December 1983 from Ish Creek, a small stream on the south slope of West Chestnut Ridge, and identified as *P. oreas* and *N. cornutus* by D. A. Etnier, University of Tennessee. Estimates of the water surface area sampled at each site were obtained by measuring the total length of the reach and the width at 5-m intervals. Water depth was also measured at three equally spaced intervals accross transects located at 5-m intervals along the reach.

7.2.5 Results and Discussion

7.2.5.1 Benthic Macroinvertebrates

Qualitative sampling at sites in the vicinity of Oil Retention Pond 1 and in Pond 2 resulted in the collection of very few organisms (Table 7-1). Very low densities were also found in quantitative samples taken from Stream 1A, which drains Oil Retention Pond 1, and in Bear Creek near the confluence with Stream 1A (Tables 7-2 and 3). Relatively high densities and biomass of benthic organisms were observed in Stream 2, a small uncontaminated tributary of Bear Creek that drains a small watershed on the north slope of Chestnut Ridge. Although some of the differences in benthic community composition between this site (Station 4) and the others can be attributed to substrate differences (e.g., the large amounts of detritus in Stream 2 in comparison to the predominately small rubble and gravel at Stations 1 and 2), there was a depauperate benthic fauna in Bear Creek and Stream 1A. Previous studies of two small undisturbed streams (upper White Oak Creek and Walker Branch) that drain small watersheds on the south slope of Chestnut Ridge near the east end of Oak Ridge National Laboratory indicated a diverse assemblage of benthic macroinvertebrates (Dahlman et al. 1977; Loar et al. 1981).

7.2.5.2 Fishes

The four fish species collected at the four sampling sites (Table 7-4) are common inhabitants of small streams on the DOE Oak Ridge Reservation. These four species, for example, were the most abundant fishes found by electrofishing in Ish Creek, a small undisturbed tributary of the

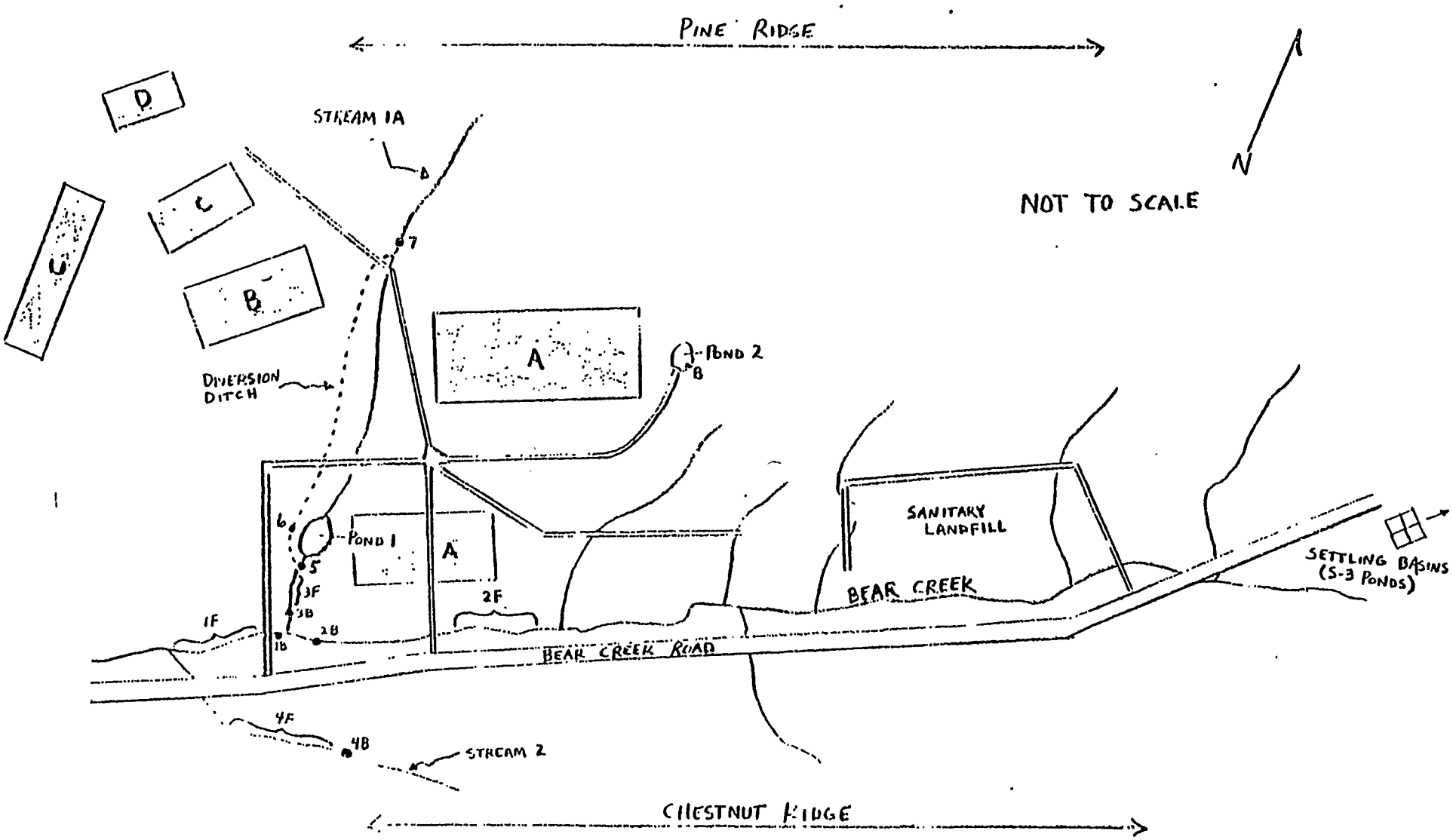


Figure 7-1

Location of benthic macroinvertebrate (1B-4B) and fish (1F-4F) sampling stations in the vicinity of the Y-12 Oil Retention Ponds. Limited qualitative sampling was conducted at the stations designated 5 to 8. Approximate locations of Burial Grounds A, B, C, and D are also shown.

Table 7-1

Description of qualitative sampling conducted near Oil Retention Ponds 1 and 2 west of the Y-12 Plant, December 20. 1983

Station	Location	Method	Sampling results
5	Stream 1A just below Oil Retention Pond 1	Kick-seining	No organisms found
6	Diversion ditch just west of Oil Retention Pond 1	Kick-seining	No organisms found
7	Stream 1A above the diversion ditch	Kick-seining	Few Isopoda; unidentified salamander
8	Oil Retention Pond 2	Dip-netting; removal of sediment/litter from margins of ponds	No organisms found

Table 7-2

Total number and weight (g, in parentheses) of benthic macroinvertebrates in each of three 27-x 33-cm bottom samples collected from four sampling sites in the vicinity of Y-12 Oil Retention Pond 1, January 6, 1984. Sampling locations are shown in Fig. 1

	Sampling station			
Sample No.	1B	2B	3B	4B
1	0	0	0	63(0.8)
2	0	2(0.1)	3(0.1)	46(2.2)
3	0	2(1.8)	0	25(1.0)
Mean no./m^2 (g/m^2)	0	14.9(7.1)	11.2(0.4)	501.3(15.3)
Substrate	Coarse gravel embedded in sand and silt; leaf packs uncommon	Same as Station 1B	Sand, silt, mud, and detritus/ leaves; orange precipitate covered much of bottom; patches of periphyton	Deep soft mud covered by leaves and woody debris; water cress abundant

Table 7-3

Density (mean no./m^2) of various benthic macroinvertebrate taxa in bottom samples collected from four sampling sites in the vicinity of Y-12 Oil Retention Pond 1, January 6, 1984. Sampling locations are shown in Fig. 1. Biomass (wet weight, g/m^2) in parentheses. NC = None collected

	Sampling station			
Taxon	1B	2B	3B[a]	4B
Amphipoda	NC	NC	NC	67.3(0.6)
Annelida	NC	7.5(0.4)	NC	NC
Chironomidae	NC	NC	NC	273.1(0.7)
Decapoda	NC	NC	NC	22.4(7.1)
Isopoda	NC	NC	NC	86.1(1.9)
Oligochaeta	NC	NC	11.2(0.4)	NC
Sialidae	NC	3.7(1.5)	NC	NC
Tipulidae	NC	3.7(5.2)	NC	7.5(3.7)
Tricoptera	NC	NC	NC	44.9(1.3)

[a]Damselfly mymph collected by kick-seining on December 20, 1983.

Table 7-4

Species composition, as numbers and biomass (g, in parentheses), of the fish community at four sampling sites near Y-12 Oil Retention Pond 1, January 7-8, 1984. Sampling locations are shown in Fig. 1

Species	Sampling station			
	1F	2F	3F	4F
Blacknose dace (*Rhynichthys atratulus*)	8 (21.0)	1 (1.5)	2 (2.5)	59 (19.5)
Common shiner (*Notropis cornutus*)	3 (22.5)	0	1 (6.5)	0
Creek chub (*Semotilus atromaculatus*)	42 (204.5)	4 (76.5)	10 (64.0)	2 (1.0)
Mountain redbelly dace (*Phoxinus oreas*)	39 (64.0)	1 (3.5)	35 (51.0)	0
Total (all species combined)				
Density (no./m^2)	0.30	0.03	1.68	0.35
Biomass (g/m^2)	1.00	0.41	4.33	0.12
Physical characteristics of sampling site				
Length of stream sampled (m)	115	91	22	70
Mean width (m)	2.7	2.2	1.3	2.5
Mean depth (cm)	19	13	10	6
Conductivity (S/cm)	260	1005	477	286
Water temperature (^oC)	8.5	0.5	1.5	7.6
pH	7.1	7.6	7.5	7.3

Clinch River that drains the south slope of Chestnut Ridge west of Route 95 (Table 7-5). The presence of fish in the lower reaches of Stream 1A is consistent with the results of a bioassay conducted on the water from Oil Retention Pond 1 which showed no mortality to bluegill sunfish after 96 hours (Giddings 1984). Finally, the very high density and biomass of fish at Station 3F may be associated with the abundant periphyton growth observed in the winter or may be linked to the chemical composition of the effluent from Oil Retention Pond 1.

No aquatic species listed as threatened or endangered by either the U.S. Fish and Wildlife Service or the State of Tennessee were found. However, the mountain redbelly dace (Phoxinus oreas), which is abundant in Bear Creek (Table 7-4), has been identified by the Tennessee Wildlife Resources Agency as a species in need of management. This classification is assigned to those species which, although not considered threatened within the state, may not currently exist at or near their optimum carrying capacity (Kitchings, in press).

There can be little doubt that Y-12 Plant operations have had an adverse impact on the benthic communities of Bear Creek and some of its tributaries. The very low benthic densities at Station 2B just above the confluence with Stream 1A suggest that the source of impact is not limited to the effluent from Oil Retention Pond 1. The relatively low fish density at Station 2F also implies an upstream perturbation (such as the S-3 ponds).

Further evidence of upstream impact(s) is available from the results of biological sampling conducted ten years prior to the present study. Benthic macroinvertebrates and fish were sampled in Bear Creek between September 1974 and March 1975 at two sites located 50 m above and 100 m

Table 7-5

Species composition of the fish community, expressed as the total number of individuals collected in the sampling reach, in Ish Creek, a small undisturbed watershed on the south slope of Chestnut Ridge. The mouth of the creek is located at Clinch River Kilometer 30.7. Sampling was conducted in December 1983, using the sampling methods described in this report for Bear Creek

	Sampling site[a]			
Species	ICK 0.6	ICK 1.2	ICK 2.3	ICK 2.4
Centrarchidae				
Redbreast sunfish (*Lepomis auritus*)	2	0	0	0
Cyprinidae				
Blacknose dace (*Rhinichthys atratulus*)	21	47	5	14
Bluntnose minnow (*Pimephales notatus*)	1	0	0	0
Common shiner (*Notropis cornutus*)	28	2	0	0
Creek chub (*Semotilus atromaculatus*)	15	21	17	8
Mountain redbelly dace (*Phoxinus oreas*)	21	9	11	6
Total (all species combined)				
Density (no./m^2)	0.24	0.63	1.46	0.32
Biomass (g/m^2)	0.86	1.36	1.98	0.46
Physical characteristics of sampling site				
Length of stream sampled (m)	152.0	89.0	8.4	52.0
Mean width (m)	2.4	1.4	2.7	1.7
Mean depth (cm)	22	14	29	13
Conductivity (S/cm)	103	101	36	36
Water temperature (^oC)	9.6	8.7	7.7	7.7
pH	8.0	7.8	7.5	7.5

[a]ICK = Ish Creek Kilometer; ICK 0.0 is at the mouth of Ish Creek; ICK 2.3 is a large pool.

below the Y-12 Sanitary Landfill site (B. G. Blaylock, unpublished data). The west end of the landfill is approximately 1.4 stream kilometers above the confluence of Stream 1A with Bear Creek. No benthic organisms or fish were collected at either of the two sites, and in situ fish bioassays conducted just above and 500 m below the landfill resulted in 100% mortality after 24 hours.

The results of the 1974-75 study differ significantly from those of the present survey, although an adequate explanation for the differences is difficult. The presence of fish in 1984 at Station 2F, which is approximately 500 m below the site of the 1974 bioassays, may be indicative of changes in water quality that have occurred over the past 10 years. On the other hand, the occurrence of fish in this region of Bear Creek may only be a temporary phenomenon reflecting short-term changes in water quality (e.g., residency is re-established after major storm events). Because of its periodic occurrence, such a phenomenon may not have been detected by the limited sampling conducted in 1974-1975. In view of the information currently available, both explanations of the difference in results between the two studies seem equally plausible.

7.2.6 Future Studies

Additional studies are needed to address several important issues. Recommendations for future studies include the following:

(1) More extensive seasonal sampling of the benthic macroinvertebrate and fish communities should be conducted:

(a) to obtain a complete inventory of the aquatic biota in the Bear Creek watershed,

(b) to investigate the potential recovery of biotic communities downstream of the confluence of Stream 1A with Bear Creek, and

(c) to identify specific sources of impact to aquatic biota in Bear Creek above the confluence with Stream 1A.

(2) In situ and acute bioassays should be conducted to provide guidance and to assist with identification of potential sources of impact.

(3) Chronic bioassays should be conducted to determine the effects on biota of long-term exposure to various effluent sources.

(4) Studies should be conducted to determine the role and significance of storm events on the downstream transport of contaminants and their effects on the establishment and/or recovery of the biotic communities in Bear Creek.

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