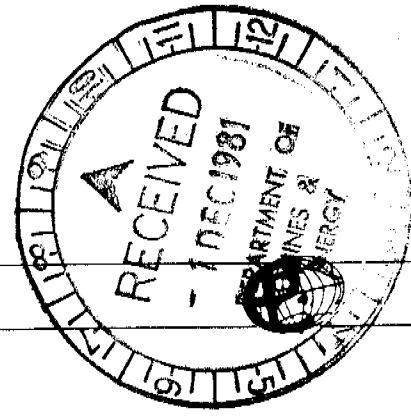
61 Heytesbury Road,
SUBIACO, 6008, Western Australia.
Telephone: 382 1066



Pacific Exploration Consultants Pty. Ltd.

EXPLORATION LICENCE 1599

PINE CREEK

1:250,000 MAP SHEET

NORTHERN TERRITORY

By:

H.J. Garlick., M.Sc., D.I.C., B.Sc., M.I.M.M., C. Eng., M.C.I.M.M., M.A.I.M.E.
Consulting Geologist
PACIFIC EXPLORATION CONSULTANTS PTY. LTD.

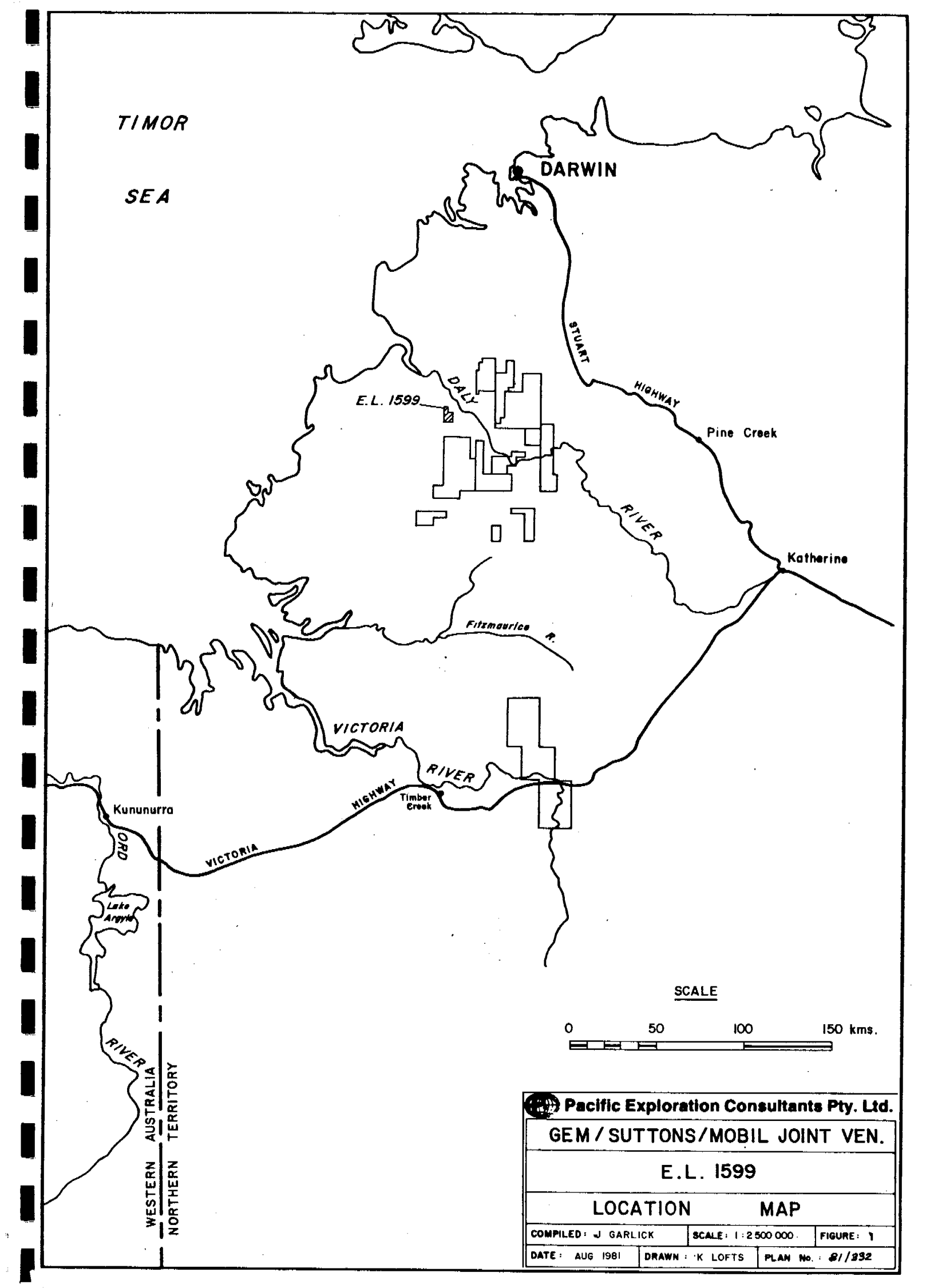
for and on behalf of:
GEM EXPLORATION & MINERALS LTD.

SEPTEMBER, 1981

TABLE OF CONTENTS

LIST OF FIGURES

CUMULATIVE FREQUENCY DISTRIBUTION LOG-PROBABILITY CURVES



Pacific Exploration Consultants Pty. Ltd.

GEM / SUTTONS / MOBIL JOINT VEN.

E.L. 1599

LOCATION MAP

COMPILED: J GARLICK	SCALE: 1:2 500 000	FIGURE: 1
DATE: AUG 1981	DRAWN: K LOFTS	PLAN No.: 81/232

1.0 SYNOPSIS

Exploration Licence 1599 occupies approximately 23km^2 of terrain and is situated in close proximity to the Elizabeth Downs homestead locality, Daly River, Northern Territory (Pine Creek 1:250,000 sheet SD 52-8).

On a regional scale, the area was regarded as prospective for kimberlite exploration, based largely on the region's tectonic similarity with the Halls Creek Mobile Zone, Western Australia, where kimberlite is known to occur.

During the latter half of 1980, Gem Exploration and Minerals Limited entered into a joint venture agreement with the Suttons Motors Group of Companies and Mobil Energy & Minerals Inc., which gave Gem the right to explore for diamonds and other minerals of interest within E.L. 1599.

Geologically, the licence occupies area central to the Lichfield Province tectonic unit. The area comprises an Archaean? to early middle Proterozoic age granitoid mass within the eastern area sector whilst the western sector is occupied by a cover rock veneer of Cambro-Ordovician sediments belonging to the Daly River Group of Palaeozoic sediments.

Exploration work took the form of a regional helicopter-borne gravel sample programme together with a geochemical stream sediment sampling programme. The gravel samples consisted of the collection of 20kg of minus 4mm sized gravel particulates, and, the geochemical samples comprised 20g of minus 80 mesh sized sediment.

The gravel samples were processed at the Company's mineral processing laboratory in Perth to provide a non-magnetic concentrate suitable for binocular microscope scanning for kimberlitic indicator minerals. The geochemical samples were analysed by a commercial laboratory for Co, Cu, Pb, Zn, Ni, Cr, Ag, As, Nb, La.

The sampling programme yielded 4 samples with an average density distribution of 1 sample per 5.75km^2. The gravel sample results were reviewed for kimberlitic indicator minerals, and the geochemical results were appraised after statistical treatment to establish anomalous levels of elemental concentration for each element.

Both the gravel and geochemical sample programme results failed to detect evidence for kimberlite occurrence. It should be noted in this regard however that the exploration approach used during the survey assumed that the target would shed the normal suite of kimberlitic indicator minerals.

It is recommended that any further investigation of the licence area for possible kimberlite occurrence excludes the traditional sampling techniques in favour of remote sensing and/or bulk sampling methods.

2.0 INTRODUCTION & OBJECTIVE

2.1 Exploration licence 1599 comprises an area of approximately 23km^2 and is situated proximally to Elizabeth Downs homestead locality, Daly River, Northern Territory. The tenement is depicted on the western margin of the Pine Creek 1:250,000 map sheet (SD 52-8), and, occurs on the 1:100,000 Daly River (5070) map sheet (Figure 1).

2.2 During the latter half of 1980, Gem Exploration & Minerals Limited entered into an agreement with the Suttons Motors Group and Mobil Energy & Minerals Inc., which gave Gem the right to explore for and mine diamonds within E.L. 1599 to the exclusion of any other minerals.

2.3 On a regional scale, the area was regarded as a prospective area for kimberlite occurrence, based largely on the region's tectonic similarity with the Halls Creek Mobile Zone, Western Australia, where kimberlite is known to occur.

2.4 The exploration programme managed by Gem Exploration was regional both in philosophy and methodology and consisted of a regional helicopter borne detrital mineral and geochemical stream sediment sampling programme over E.L. 1599 with a preferred sample density of 1 sample per 10km^2 or better.

2.5 The exploration programme formed part of a first pass appraisal of the licence area which also incorporated regional sampling within an area bounded by latitude 13°20'S - 14°20'S and longitude 130°20'E - 131°10'E but confined to the exploration licences held by the Suttons, and Suttons/Mobil, Group joint ventures.

2.6 The objective of this report is to present a final report based on an appreciation of the geology of the area and document the exploration programme conducted.

3.0 REGIONAL GEOLOGICAL SETTING

3.1 In a regional sense, the area under consideration consists of basement metamorphics of Archaean and Lower Proterozoic age, highly folded Lower Proterozoic geosynclinal rocks with associated Middle Proterozoic granitic intrusions, and relatively flat-lying and gently folded Proterozoic Platform sedimentary rocks and Palaeozoic sedimentary basin deposits.

3.2 In terms of the regional tectonic evolution of the area, the Daly River area appears to be linked with the north-north-eastern extension of the major strike-slip fault zone comprising the Halls Creek and Fitzmaurice Mobile Zones. These Mobile Zones are regarded as having a major role in the tectonic evolution of Northern Australia. In particular, in the Daly River area, the major strike-slip fault pattern has been interpreted as being the position of the western limb of a major rift structure which initiated the development of the Pine Creek Geosyncline (1). In view of this interpretation, the possibility exists within the area for mantle derived intrusives of the kimberlitic type.

3.3 The hiatus of metamorphism, deformation, and granitic emplacement in the region was associated with the cessation in the development of the Pine Creek Geosyncline and took place approximately 1800 m.y. ago. Following this major orogenic event the area has remained relatively stable apart from relatively minor uplifts followed by erosion and marine transgressions. The similarity in the tectonic evolution of the area with the Halls Creek Mobile Zone which is known to contain kimberlitic intrusives is believed to enhance the prospectivity of the Daly River area for kimberlite exploration.

3.4 The main tectonic units of the Daly River area include from west to east; the Litchfield Province which is generally regarded as an Archaean to Lower Proterozoic basement complex forming the western margin of the Pine Creek Geosyncline; a central zone representing part of the Pine Creek Geosyncline of Lower Proterozoic pelitic and psammitic sediments with interbedded tuffs and associated granite plutons of Middle Proterozoic age; an eastern and southern zone made up of cover rocks to the underlying Pine Creek Geosyncline sediments.

The latter cover rocks include; Upper Proterozoic sediments of the Tolmer and Auvergne Groups, Palaeozoic sediments, and minor Mesozoic outliers which form the Daly River Basin.

3.5 The Litchfield Province forms the western most sector unit of the Pine Creek Geosyncline and extends over an area of 8500 km^2 from the eastern boundary of the Bonaparte Gulf to the Giants Reef Fault. The Province is composed of a number of granitoids which have a compositional range from adamellite to granodiorite, and, an age range of Archaean for some of the granitoids in the southern portion of the Province to Middle Proterozoic in the northern portion (2). The granitoid margins are migmatised and transitional into large surrounding areas of metasediments, varying in metamorphic grade from greenschist to upper amphibolite/granulite grade. An Archaean age is postulated for the metasediments of the Hermit Creek Metamorphics located south of the Daly River whilst the metasediments north of the Daly are regarded as having an Early Proterozoic age and probably correlative with the Burrell Creek Formation of the Pine Creek Geosyncline (2,3).

3.6 Two periods of metamorphism affected the Litchfield Province; an older regional phase and a younger thermal phase which was related to the intrusion of the Mid Proterozoic granitoids. These granitoids were probably formed 1800 m.y. ago during the orogenesis known elsewhere in the Pine Creek Geosyncline (2).

3.7 In addition to the granitoid and metasedimentary areas, there are minor areas of unmetamorphosed gabbro, dolerite, and quartz-dolerite of Middle Proterozoic age. Cover rocks include quartz sandstones of Middle Proterozoic age and Cambro-Ordovician sandstones of the Daly River Basin sequence.

3.8 The Pine Creek Geosyncline which regionally is composed of metasediments and extrusives, is represented in the area by the Finnis River Group which forms the upper part of this Lower Proterozoic succession. Essentially, the Finnis River Group comprises a monotonous sequence of sandstone, slate, greywacke, and minor arkose, quartzite, conglomerate and schist. In the west, greywacke and conglomerate of the Burrell Creek Formation, made up largely of volcanic detritus, grade laterally and upwards to quartz sandstone and minor conglomerate of the Chilling

Sandstone (3). Apart from these sedimentary sequences, in the south west of the area, the Berinka volcanics overlie and possibly intrude the Burrell Creek Formation to form a sequence of felsic to intermediate lavas and intrusive derivatives.

3.9 Towards the end of sedimentation in the Pine Creek Geosyncline, a suite of continental tholeiites were intruded into the sedimentary pile. This suite of rocks, known as the Zamu Dolerite and its age equivalent Ti Tree Granophyre both occur as sills and minor dykes in the Burrell Creek and Chilling Sandstone Formations of the area.

3.10 Following the cessation of sedimentation in the Geosyncline there was a prolonged period of orogenesis which resulted in a tightly folded greenschist facies environment developed over the area under consideration. The final igneous event which is preserved in the area and associated with the Geosynclines' evolution, is the intrusion of late orogenic granites which have a consistent Middle Proterozoic age grouping (4).

3.11 Notable granitic intrusions within the central zone of the Daly River area include from north to south; a small exposure of Cullen Granite north-north-east of Daly River Mission, the Allia Granite of the central area, and the Soldiers Creek Granite in the Collia, Buldiva, and Muldiva tin areas.

3.12 The Cover Rock Formations which occupy the southern and eastern sectors of the area include those formations belonging to the Tolmer and Auvergne Groups of Upper Proterozoic age and the Palaeozoic sequence in the Daly River Group. Additionally, outliers of Late Jurassic to Early Cretaceous sediments remain preserved in certain areas.

3.13 The Tolmer Group crops out along the western margin of the Daly River Basin. The outcrop is bounded to the south by the Collia Fault. Although the age of the Group is in doubt, on the basis of the basal units' unconformable relationship with Mid-Proterozoic granite, the Group is currently designated as Upper Proterozoic in age.

3.14 Essentially, the Tolmer Group consists of sediments associated with a shallow water marine environment, yielding a sequence of sandstone, dolomite, and minor shale units to a total maximum thickness of 1000m.

3.15 The Auvergne Group crop out in the south west of the area. The Group consists of a shallow water sequence up to 600m thick of arenaceous and argillaceous sediments with minor dolomite units.

3.16 The Daly River Basin Group comprises an intermittently occurring basal conglomerate unit, superceeded by a tholeiitic basalt sequence regarded as part of the Eo-Cambrian Antrim Plateau Basalt unit which occurs both in the Daly River area, the Victoria River Basin region, and portions of the West and East Kimberley Region. Successive units in the Daly River Basin Group comprises a sequence of limestone, sandstone, and siltstone units which were deposited in shallow water associated with a regional marine transgression.

3.17 The Mesozoic outliers in the area consist of mainly sandstone and conglomerate units laid down under mainly terrestial shallow lake conditions.

4.0 REGIONAL MINERAL OCCURRENCE AND PREVIOUS MINING ACTIVITY

4.1 Recorded mineral occurrence and previous mining activity in the region is centred around Daly River area and the Wingate Mountain area. The available recorded details are tabulated on Table 1 & 2.

4.2 In summary, the recorded mineral occurrences fall mainly within the Lower Proterozoic Pine Creek Geosyncline environment and have the following mineral and rock associations :

1) Daly River Area: Cu, Cu-Au, Ag-Pb-Cu mineral assemblages occurring along shear zones are associated with Lower Proterozoic sediments; notably the slate units of the Burrell Creek Formation. These occurrences are located 10-20 km north of Daly River Mission.

2) Wingate Mountain Area: Auriferous quartz reefs are associated with shear zones and anticlinal fold axes in the Burrell Creek Formation at Fletchers Gully.

Cassiterite is associated with quartz-mica-tourmaline pegmatites genetically linked with the Allia and Soldiers Creek Granite intrusions of Middle Proterozoic age. In addition to pegmatites located within granite terrain, surrounding metasediments of the Burrell Creek Formation are also mineralised with cassiterite bearing pegmatite intrusions. The notable tin centres of Muldiva, Buldiva, and Collia are located in the Wingate Mountains area where the majority of tin won was from eluvial and alluvial workings.

4.3 The evidence obtained from recorded mineral occurrence within the area strongly suggests that all the deposit types are vein type deposits associated mainly with early Middle Proterozoic granite intrusions. Within this category of deposits, it appears that vein-type deposits containing : Au, Sn, Ag-Pb, W, Ta, Cu, Bi associations are the most probable deposit types likely to be located by future exploration within the area based on previous exploration and prospecting results. However, more recent interpretations regarding the geological environment present, together with a consideration of the structural evolution of the region suggests that the area is prospective for uranium mineralisation on the one hand, and, a potential site for mantle derived plutons on the other.

TABLE 1 : RECORDED MINERAL OCCURRENCES : DALY RIVER AREA : NORTHERN TERRITORY

PROSPECT NAME	TONNE	GRADE	CONTAINED METAL TONNE	PRODUCTION PERIOD	ASSOCIATED METALS	COMMENTS
DALY RIVER	6000	20% Cu	1200 Cu	1884-1918		**Mineralisation** occurs as bunches & stringers hosted to slate of Burrell Creek Formation and localised along a northward trending shear zone. **Lode Material** consists of malachite, azurite, chalcocite with quartz and limonite gangue. **Workings** consist of an open pit 70m long, 30m wide, 30m deep together with 5 shafts up to a depth of 36m. **Comment**: No zone of secondary enrichment recorded; primary ore consists of low grade disseminated chalcopyrite.
WHEAL DANKS GROUP	500	28% Cu	140 Cu	1887-1904	Gold	**Mineralisation** occurs along northward extension of Daly River Prospect shear zone. **Workings** consist of three separate small groups of excavations which include small open cuts and several shafts to a maximum depth of 30m. **Assay Data** from Wheal Danks & Wheal Danks South of lode and dump material yielded average assay values of from 2-4% Cu and 1.5 - 4.5 gms/tonne Au.
EMPIRE	143	nd	nd	nd		**Mineralisation** occurs along a north trending shear zone which has a surface expression of 46m over 1m wide. **Workings** consist of 2 shafts sunk to depths of 6 and 12m respectively.

PROSPECT NAME	TONNE	GRADE	CONTAINED METAL TONNE	PRODUCTION PERIOD	ASSOCIATED METALS	COMMENTS
WALLABY	30	35% Cu	10 Cu	nd	Silver Lead	**Mineralisation** consists of two separate lodes developed along shear zones; one lode is associated with copper mineralisation, the other silver-lead mineralisation. **Workings** over the copper lode include a shaft sunk to 12m; workings over the silver-lead lode include several costeans and two shafts to 11m. **Assay Data** from the silver-lead lode range up to 5% Pb, 3 gms/tonne Au, and 120 gms/tonne Ag.
WARRS	nd	nd	nd	nd		**Mineralisation** Copper mineralisation in quartz filled shears hosted to slate of the Burrell Creek Formation. **Workings** consist of shallow prospecting pits and shafts over a total strike length of 152m.
KNOWLES FARM	nd	nd	nd	nd		**Mineralisation** recorded in surface gossan material yielded high silver-lead assays with subordinate copper and gold. **Workings** consist of several costeans only.
MARION HILL	nd	nd	nd	nd		**Mineralisation**: Recorded copper occurrence.

Information Source: Crohn, P.W., 1968: The mines and mineral deposits of the Katherine-Darwin region. In Walpole, B.P., Crohn P.W., Dunn, P.R., & Randal, M.A., Geology of the Katherine-Darwin Region, Northern Territory. Bull. Bur. Miner. Resour. Geol. Geophys. Aust., 82, 171-282.

TABLE 2 : RECORDED MINERAL OCCURRENCES : WINGATE MOUNTAINS AREA : NORTHERN TERRITORY

PROSPECT NAME	TONNE	GRADE	CONTAINED METAL TONNE	PRODUCTION PERIOD	ASSOCIATED METALS	COMMENTS
FLETCHERS GULLY	nd	nd	75.09kg Au	1905-10 1922-29 1934-43 1945-46		**Mineralisation:** Auriferous quartz reefs filling fissures and tension-cracks are hosted to the basal shale unit of the Burrell Creek Formation. Mineralisation appears to be concentrated close to the axis of an anticline trending northwesterly. **Workings** consist of a number of adits, shafts and limited underground workings over a total strike length of 61m to a depth of 30m. Reef widths generally narrow and irregular.
FLETCHERS GULLY	nd	nd	6.5	1910 1922-23 1937-44		**Mineralisation:** Cassiterite occurs nearby Fletchers Gully Gold Mine in minor pegmatite dykes associated with the Allia Granite. **Workings** consist of minor excavations only.
MULDIVA	nd	nd	nd	1922-23 Mainly Alluvial		**Mineralisation:** Tin was won in small quantities from quartz-mica-tourmaline-cassiterite lodes intruded into metamorphosed sediments in close proximity to the Soldiers Creek Granite; the largest lode ranged from 0.3m to 0.6m in width, and was traced for 45m.

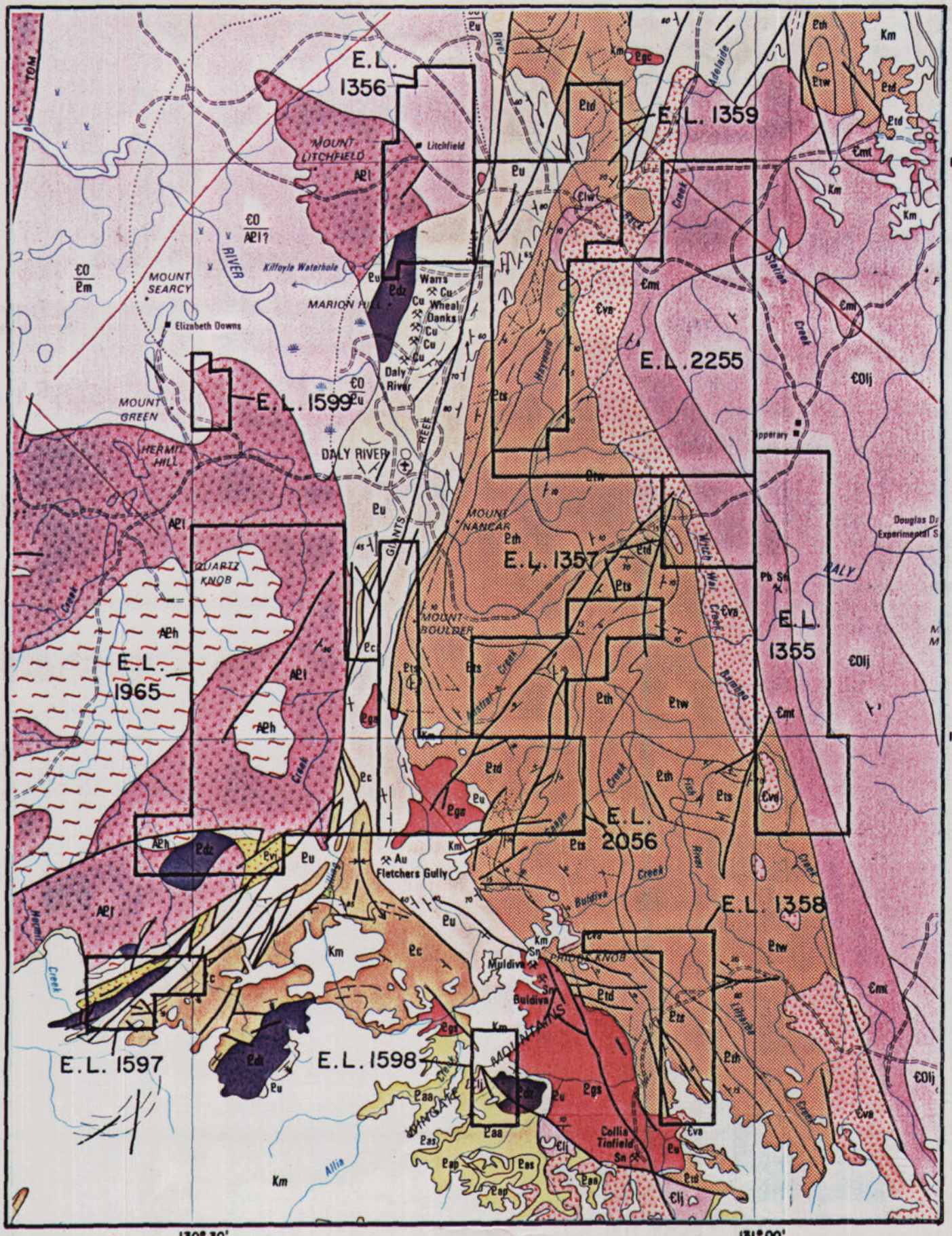
PROSPECT NAME	TONNE	GRADE	CONTAINED METAL TONNE	PRODUCTION PERIOD	ASSOCIATED METALS	COMMENTS
BULDIVA	nd	nd	nd	1922-23 Mainly Alluvial		**Mineralisation:** Tin was won from numerous small pegmatite lenses in the Soldiers Creek Granite, from the basal unit of the Burrell Creek Formation; from a basal conglomerate in the overlying Cretaceous Mullaman Beds, more recently from unconsolidated eluvial and alluvial deposits.
COLLIA	nd	nd	85.6 Sn	1922-29 1948-53 1961 1966-67 Mainly Alluvial		**Mineralisation:** Although quartz-tourmaline-cassiterite dykes have been located in the Soldiers Creek Granite, production has come from selective mining of eluvial and alluvial pockets of detrital cassiterite concentrations.
COLLIA	nd	nd	nd	nd		**Mineralisation:** Native copper traces are recorded in Antrim Plateau Basalts located near Collia.
DALY RIVER BASIN	nd	nd	nd	nd		**Mineralisation:** Vein type barite occurrences have been recently worked in the Dorisvale area. These occurrences occur in Upper Proterozoic sediments regionally associated with the Dorisvale Fault-line. Lead occurrences are recorded in the Tindall Limestone unit of the Daly River Basin sequence.

Information Sources:

Crohn, P.W., 1978: The mines and mineral deposits of the Katherine-Darwin region in Walpole, B.P., Crohn, P.W., Dunn, P.R., & Randal, M.A., Geology of the Katherine-Darwin Region, Northern Territory. Bull. Bur. Miner. Resour. Geol. Geophys. Aust., 82, 171-282.

Pontifex, I.R., & Mendum, J.R., 1972: Fergusson River: Sheet SD/52-12: Explanatory Notes. B.M.R., 20-22.

Sweet, I.P., 1977: The Precambrian Geology of the Victoria River Region, Northern Territory. Bull. Bur. Miner. Resour. Geol. Geophys. Aust., 62.



Pacific Exploration Consultants Pty. Ltd.

GEM/SUTTONS/MOBIL JOINT VENT.

REGIONAL GEOLOGY OF E.L.'S

PINE CREEK PROJECT

COMPILED: J GARLICK	SCALE: 1:800 000	FIGURE: 2
DATE: SEPT 1981	DRAWN: K LOFTS	PLAN No.: 81/342

LEGEND

MESOZOIC — BATHURST TERRACE

Km : Petrel Formation : Medium to coarse sandstone, conglomerate; mainly terrestrial.

PALAEOZOIC — DALY RIVER BASIN — DALY RIVER GROUP

Olo : Oolloo Limestone : Flaggy limestone, commonly silicified.

Eo : Undivided Cambrian & Ordovician sediments.

EOlj : Jinduckin Formation : Ferruginous sandstone & siltstone, minor marl, dolomite and chert.

EOlm : Manbulloo Limestone : Limestone, partly silicified.

Emt : Tindall Limestone : Crystalline limestone, chert nodules.

Ewb : Buckingham Bay Sandstone : Coarse white sandstone, clayey sandstone.

Eva : Antrim Plateau Volcanics : Massive & vesicular basalt.

Elj : Jarong Conglomerate : Boulder and pebble conglomerate.

Elw : Witch Wai Conglomerate : Ferruginous sandy boulder & pebble conglomerate.

ADELAIDEAN ? — VICTORIA RIVER BASIN — AUVERGNE GROUP

Pae : Spencer Sandstone : Quartz sandstone, minor silty sandstone.

Pal : Lloyd Creek Formation : Algal and oolitic dolomite.

Pap : Pinkerton Sandstone : White massive quartz sandstone, minor shale and siltstone.

Pas : Saddle Creek Formation : Basal blocky cross-bedded sandstone, upper flaggy quartz sandstone.

Paa : Angalarri Siltstone : Grey-green siltstone and shale.

CARPENTARIAN — PINE CREEK GEOSYNCLINE — TOLMER GROUP

Ptw : Waterbag Creek Formation : Ferruginous sandstone & siltstone.

Pth : Hinde Dolomite : Dolomite and minor limestone, dolomitic siltstone.

BULDIVA SANDSTONE

Pts : Stray Creek Sandstone : Flaggy quartz sandstone, siltstone & shale.

Ptd : Depot Creek Sandstone : Massive quartz sandstone, pebble bands.

PINE CREEK GEOSYNCLINE

Pga : Allia Creek Granite : Adamellite, granodiorite, tonalite.

Pgc : Cullen Granite : Granite, adamellite, aplite dykes.

Pgs : Soldiers Creek Granite : Coarse muscovite-biotite adamellite and granodiorite.

EARLY PROTEROZOIC — RIVER GROUP

Pdz : Zamu Dolerite : Basaltic sills, olivine dolerite, quartz dolerite, dolerite and granophyre.

Pdt : Ti-Tree Granophyre : Granophyre.

Pc : Chilling Sandstone : White quartz sandstone, ripple-marked and cross-bedded, minor conglomerate, siltstone and tuff.

ARCHAEAN - EARLY PROTEROZOIC — FINNIS — LITCHFIELD BLOCK

Pvi : Berinka Volcanics : Acid and minor intermediate lava, minor sandstone and tuff interbeds, granophyric acid intrusive rocks.

Pu : Burrell Creek Formation : Siltstone, shale, greywacke siltstone.

Psk : Koolpin Formation : Ferruginous siltstone with chert bands and nodules, pyritic carbonaceous shale, silicified dolomite, minor phyllite, jasper & banded iron formation.

Pm : Schist, gneiss.

Aph : Hermit Creek Metamorphics : Quartz-mica schist, phyllite, tremolite schist, amphibolite, migmatite.

Apl : Litchfield Complex : Granite, adamellite, granodiorite, tonalite, migmatite, pegmatite, garnetiferous in places.

Pacific Exploration Consultants Pty. Ltd.

GEM/SUTTONS/MOBIL JOINT VENTURE

REGIONAL GEOLOGY OF E.L.'S

PINE CREEK PROJECT

COMPILED: J GARLICK	SCALE:	FIGURE 2
DATE: AUG 1981	DRAWN: K LOFTS	PLAN No. 81/343

5.0 LOCAL GEOLOGICAL SETTING

5.1 Exploration Licence 1599 occupies a small area central to the Litchfield Province tectonic unit.

5.2 The area comprises a granitoid mass which occurs within the eastern sector of the exploration licence and a cover rock veneer of Cambro-Ordovician sediments belonging to the Daly River Group which occupy the western sector area.

5.3 The granitoid mass forms isolated tors surrounded by a deep granitic soil in an otherwise flat poorly drained area with relief up to 40m. The granitoid forms part of the main granitic complex of the southern portion of the Litchfield Province. This granitic complex is largely made up of grey garnetiferous granodiorite which ranges from massive to gneissic and contains numerous xenoliths; tonalite, adamellite, granite, and some basic rocks occur (5).

5.4 The history of intrusion is not completely understood but it appears an Archaean age for the inception of the southern granitic province is favoured although granitic type intrusive activity has been dated within the complex up to early Middle Proterozoic, which suggests a multi-phase intrusive cycle spanning a considerable timeframe.

6.0 EXPLORATION PROGRAMME

6.1 Area selection for potential diamond and kimberlite environments within Australia has over the last ten years been largely based on conceptual models generated from knowledge of kimberlite geology from African, Russian, Indian, and North American occurrences. This logical approach to selecting prospective search areas therefore became a largely empirical exercise in Australia where until recently definitive kimberlite was unknown.

6.2 Within the last few years, discoveries of kimberlite in South Australia, and more recently, Western Australia, have aided in the refinement of area selection techniques based on Australian evidence.

6.3 The significant discovery of kimberlites within the Halls Creek Mobile Zone, Western Australia, and more particularly within the East Kimberley section of this tectonic zone, has enhanced the prospectivity of the prolongation of the zone into the Northern Territory. In this regard, the north-north-east trending Fitzmaurice Mobile Zone and its prolongation along the western side of the Pine Creek Geosyncline are of particular importance.

6.4 The selection of the Daly River area as a regional target area for kimberlite exploration was largely based on the following area characteristics:

1) The area comprises in a regional sense; the Litchfield Province, an area of Archaean metamorphics intruded by granitoids of ?Archaean to early Middle Proterozoic age; a central zone of Lower Proterozoic metamorphosed and highly deformed metasediments intruded by early Middle Proterozoic granites; an eastern zone of relatively undeformed cover rocks of Middle to Upper Proterozoic and Phanerozoic age. This area essentially stabilised during the Middle Proterozoic providing a suitable tectonic environment for kimberlite emplacement.

2) The empirical significance of the tectonic link between the kimberlite-bearing Halls Creek Mobile Zone, and, the Fitzmaurice Mobile Zone noted in 6.3 above.

3) The significance of the eastern margin of the Litchfield Province, defined by the Giants Reef Fault, as marking the western limb of the regional rift structure which initiated the development of the Pine Creek Geosyncline early in the Lower Proterozoic. This major rift structure which developed across the northern Australian continent may have facilitated the development of mantle derived plutons within the marginal areas of the structure.

6.5 Based upon the above broad indicators, the area was regionally explored to test the efficacy of the points put forward. The following exploration programme, detailed below, was conducted over the area.

6.6 EXPLORATION PROGRAMME

PHASE 1 : **REGIONAL DETRITAL MINERAL AND GEOCHEMICAL SAMPLING**

OBJECTIVE : Definition of kimberlite indicator mineral and/or diamond distribution. Definition of detrital minerals of possible commercial interest, viz. gold, cassiterite and tantalum minerals.

METHOD & SAMPLE TYPE : **Stream Gravel Sampling**
Collection of a minimum of 20 kg of deep-creek gravel from heavy mineral trap sites within current drainage channels. Screened on site to -4mm. Preferred sample density: 1 sample per $10km^2$.

: **Geochemical Stream Sediment Sampling**
Collection of a minimum of 20 g of -80 mesh material from current drainage channels. Preferred sample density 1 sample per $10km^2$.

MANPOWER : 2 x 2 man sampling crew with both vehicle and helicopter support (Jet Ranger Series 2). Senior Geological supervision.

Support staff based in Kununurra providing transport vehicle for sample transportation, and supplies.

SAMPLE PROCESSING :

Stream Gravel Processing

Sizing and gravitational minerals processing to provide a non-magnetic mineral concentrate for binocular microscope scanning and identification of anomalous detrital grains. Processing conducted at Gem Exploration Laboratory, Perth.

Methodology

- Wet screening of -4mm sample to yield a -2mm sizing.
- Rough concentration of -2mm material on a Wilfley table to yield a concentrate containing all heavy minerals.
- Concentration of heavy minerals with a specific gravity of 2.9 or greater by heavy liquid separation in TBE (Tetrabromoethane).
- Sizing of concentrate into -2 + 1mm; -1 + 0.8mm; -0.8 + 0.5mm size fractions.
- Magnetic separation.
- Non-magnetic fraction washed in ultrasonic bath.
- Non-magnetic fraction observed under binocular microscope.
- Anomalous grains electron probed for positive mineral identification at W.A.I.T., Perth.

: **Geochemical Sample Processing**

Geochemical trace-element analysis conducted by commercial laboratory, Perth.

Elemental Scan: Copper, lead, zinc, cobalt, nickel, chromium, silver, gold : Analytical Method : Atomic Absorption Spectrophotometry (AAS).

: Niobium, Lanthanum, Strontium, Tantalum, Arsenic, Wolfram, Tin, and Uranium : Analytical Method : X-Ray Fluorescence Spectrometry (XRF).

7.0 GRAVEL SAMPLE PROGRAMME RESULTS

7.1 The regional gravel sampling programme conducted over E.L. 1599 yielded a total of 4 twenty kilogramme samples giving an average sample density distribution of one sample per 5.75km^2.

7.2 The sample location plan is represented on figure 3. Detailed minerographic reports on each sample concentrate appear in Appendix 1.

7.3 No detected detrital minerals pertinent to the occurrence of kimberlite were located within the sampled area.

8.0 GEOCHEMICAL STREAM SEDIMENT SAMPLING PROGRAMME RESULTS

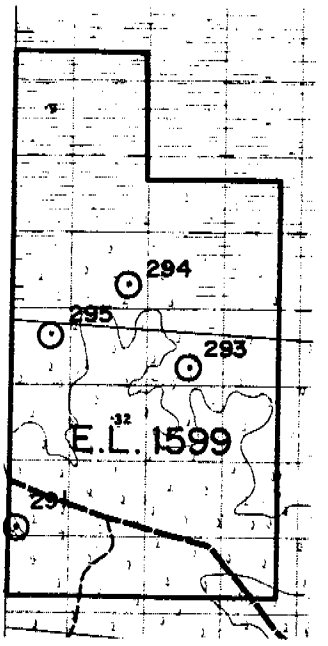
8.1 The geochemical sample distribution pattern is shown on figure 3.

8.2 The majority of the geochemical samples were analysed for ten elements, namely; Co, Cu, Pb, Zn, Ni, Cr, Ag, As, Nb and La. This partial scan, compared with the planned elemental scan, section 6, may be completed should the company feel further expenditure is justified. The analytical results are detailed in Appendix 2.

8.3 The geochemical analyses obtained from E.L. 1599 were incorporated with all the geochemical stream sediment data available from adjacent licences in the Gem/Suttons, Gem/Suttons/Mobil joint ventured areas. These data were statistically treated following Lepeltier's methodology, with the objective of obtaining for each element, a background and threshold value (7). The incorporation of all the available data was necessary in order to give a meaningful value for both background and threshold values.

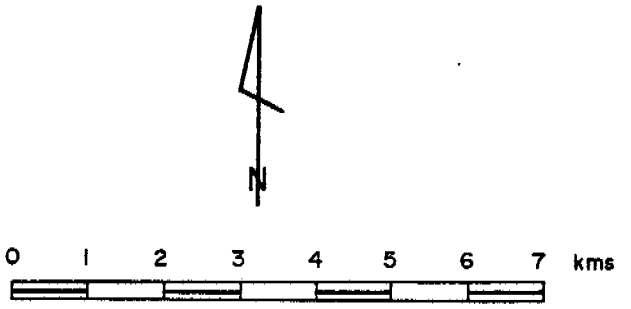
8.4 The statistical treatment of these data was completed by manual methods to produce the cumulative frequency distribution plots presented on log-probability graph-paper; Figures 1A - 7A, 13A, 14A. The number of values used per plot varied from 329 - 363; the variability being a function of the values available above analytical detection limit together with those values which were regarded as being representative. Additionally, because of the low population of arsenic and silver values recorded above detectable limits the indicated threshold value was subjectively selected at As 10ppm and Ag 1.5ppm.

8.5 The threshold values (background plus 2 standard deviations) derived from the cumulative frequency distribution plots were applied to the results obtained from E.L. 1599 and no anomalies were apparant in the results data pertinent to the discovery of kimberlite.



LEGEND

⊙ GRAVEL & STREAM SEDIMENT GEOCHEMICAL SAMPLE LOCATION



SAMPLE PREFIX PCDR
DALY RIVER SHEET

Pacific Exploration Consultants Pty. Ltd.

GEM/SUTTONS/MOBIL JOINT VENT.

SAMPLE LOCATION PLAN

E.L. 1599 NORTH TERRITORY

COMPILED: J GARLICK	SCALE: 1:100 000	FIGURE: 3
DATE: AUG 1981	DRAWN: K LOFTS	PLAN No.: 81/332

9.0 CONCLUSIONS & RECOMMENDATIONS

9.1 The regional gravel and stream sediment geochemical survey conducted over E.L. 1599 failed to detect evidence for the presence of kimberlite within the area shedding a normal suite of kimberlite indicator minerals or an appropriate geochemical signature.

9.2 It is therefore recommended that no additional exploration for kimberlite intrusives is conducted over this Exploration Licence using the traditional kimberlite exploration search techniques.

BIBLIOGRAPHY

1. **ROSSITER, A.G. & FERGUSON, J.,** A Proterozoic tectonic model for Northern Australia and its economic implications. In Ferguson, J., & Goleby, A.B., (Editors), Uranium in the Pine Creek Geosyncline. Proceedings of the International Uranium Symposium on the Pine Creek Geosyncline. 1980. pp. 209-232.

2. **BERKMAN, D.A.,** The geology of the Litchfield Province, N.T. In Ferguson, J., & Goleby, A.B. (Editors), Uranium in the Pine Creek Geosyncline. Proceedings of the International Uranium Symposium on the Pine Creek Geosyncline. 1980. pp. 299-306.

3. **NEEDHAM, R.S., CRICK, I.H., & STUART, P.G.,** Regional geology of the Pine Creek Geosyncline. In Ferguson, J., & Goleby, A.B. (Editors), Uranium in the Pine Creek Geosyncline. Proceedings of the International Uranium Symposium on the Pine Creek Geosyncline. 1980. pp. 1-22.

4. **RILEY, G.H.,** Granites ages in the Pine Creek Geosyncline. In Ferguson, J., & Goleby, A.B., (Editors), Uranium in the Pine Creek Geosyncline. Proceedings of the International Uranium Symposium on the Pine Creek Geosyncline. 1980. pp. 69-72.

5. **WALPOLE, B.P., CROHN, P.W., &** Geology of the Katherine-Darwin Region, Northern Territory. B.M.R. BULL. 82. 1968. pp. 1-169.

6. **CROHN, P.W.,** The Mines and Mineral deposits of the Katherine-Darwin region. In Walpole et el. Geology of the Katherine-Darwin region, Northern Territory. B.M.R. BULL. 82. 1968. pp. 171-247

7. **LEPELTIER, C.,** A simplified statistical treatment of geochemical data by graphical representation. Economic Geology. Volume 64. 1969. pp. 1969. pp. 538-550.

APPENDIX I

REGIONAL GRAVEL SAMPLE RESULTS

EXPLORATION LICENCE 1599: PINE CREEK PROJECT:

NORTHERN TERRITORY

PINE CREEK PROJECT

WEEK ENDING 15-3-1981 SAMPLE OBSERVATION - WEEKLY SUMMARY

SAMPLE NUMBER	RESULTS	COMMENTS
PCDR 291	N.I.	Mainly limonite, ilmenite. Minor tourmaline. Trace of monazite, rutile, garnet, amphibole, pyroxene.
PCDR 293	N.I.	Very Small Sample. Mainly limonite. Also ilmenite, tourmaline, garnet, zircon, sillimanite, monazite, actinolite.
PCDR 294	N.I.	Mainly limonite. Minor monazite, ilmenite. Trace of xenotime, rutile, zircon, garnet.
PCDR 295	N.I.	Mainly limonite, ilmenite. Trace of monazite, garnet, zircon, tourmaline.

APPENDIX 2

REGIONAL GEOCHEMICAL STREAM SEDIMENT RESULTS

EXPLORATION LICENCE 1599: PINE CREEK PROJECT

NORTHERN TERRITORY

SAMPLE NO.	Zn	Co	Cu	Ni	Pb	As	Cr	Ag	Nb	La
PCDR										
BULK 291	5	20	5	20	30	X	40	0.5	23	159
BULK 293	2	15	5	15	25	X	45	X	19	149
BULK 294	3	15	15	20	30	X	45	0.5	37	137
BULK 295	2	15	5	15	30	X	55	0.5	27	133

APPENDIX 3

FINANCE : EXPLORATION AND ADMINISTRATIVE EXPENDITURE

E.L. 1599

EXPENDITURE TO 31st DECEMBER 1980

DIRECT EXPLORATION COSTS

		$
1.	MOBILISATION AND DEMOBILISATION	142.00
2.	CONTRACT GEOLOGIST AND CONTRACT SAMPLING CREW PAYMENTS	225.00
3.	VEHICLE AND HELICOPTER CONTRACT PAYMENTS	756.00
4.	SAMPLE TRANSPORTATION COSTS TO PERTH LABORATORY	50.00
5.	FIELD SUPPLIES AND CONSUMABLES	170.00

INDIRECT EXPLORATION COSTS

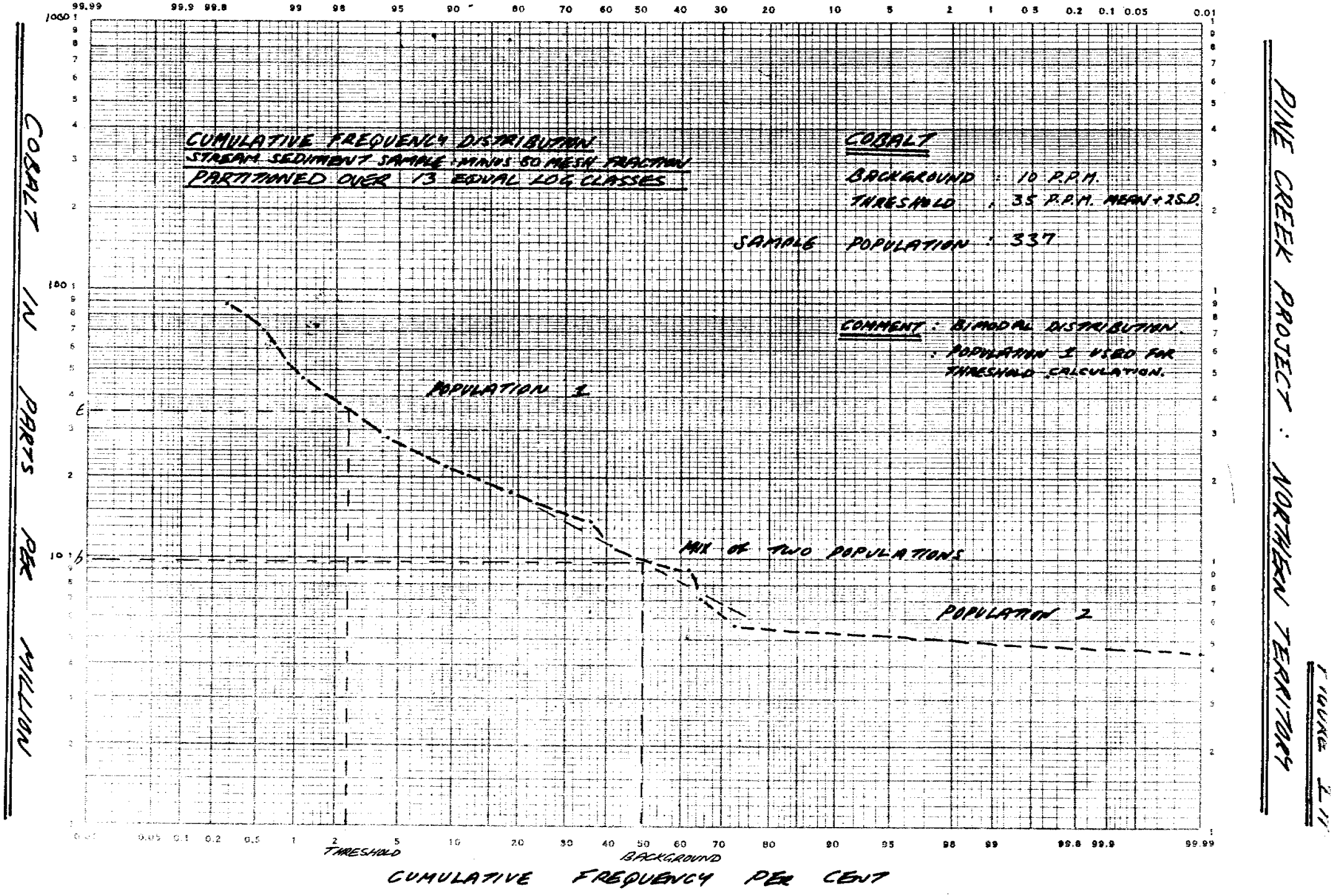
1.	ADMINISTRATION COSTS	73.00
	TOTAL	$1,416.00

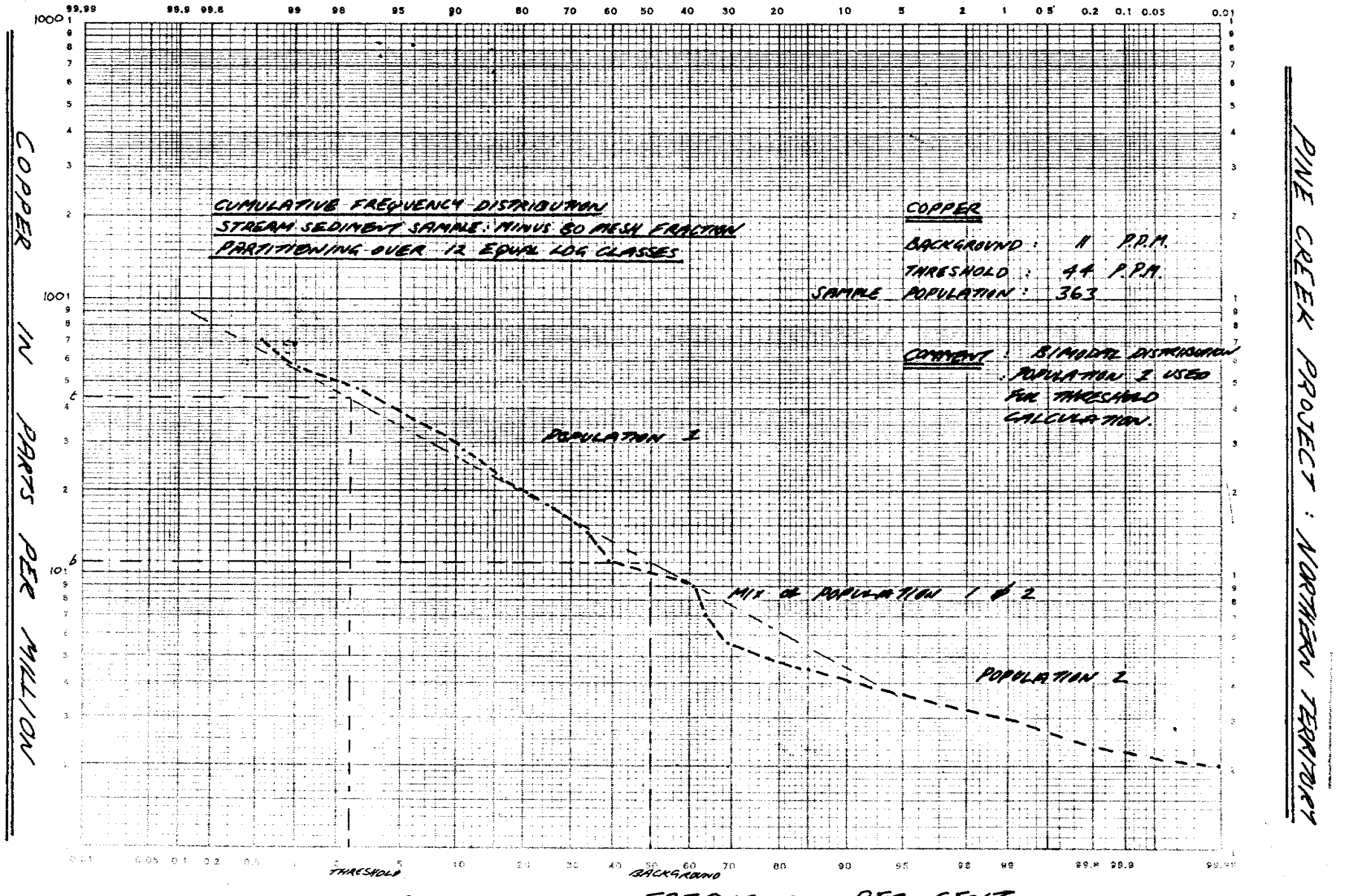
Since 31.12.80 there has been further expenditure for laboratory tests, analysis and review also preparation of reports, applicable to this E.L. for approximately $1,000.00

Total Expenditure by Gem $2,416.00

This E.L. is also being explored in a separate joint Venture by Sutton / Mobil for which a separate report has been submitted with an expenditure of $60,309.00.

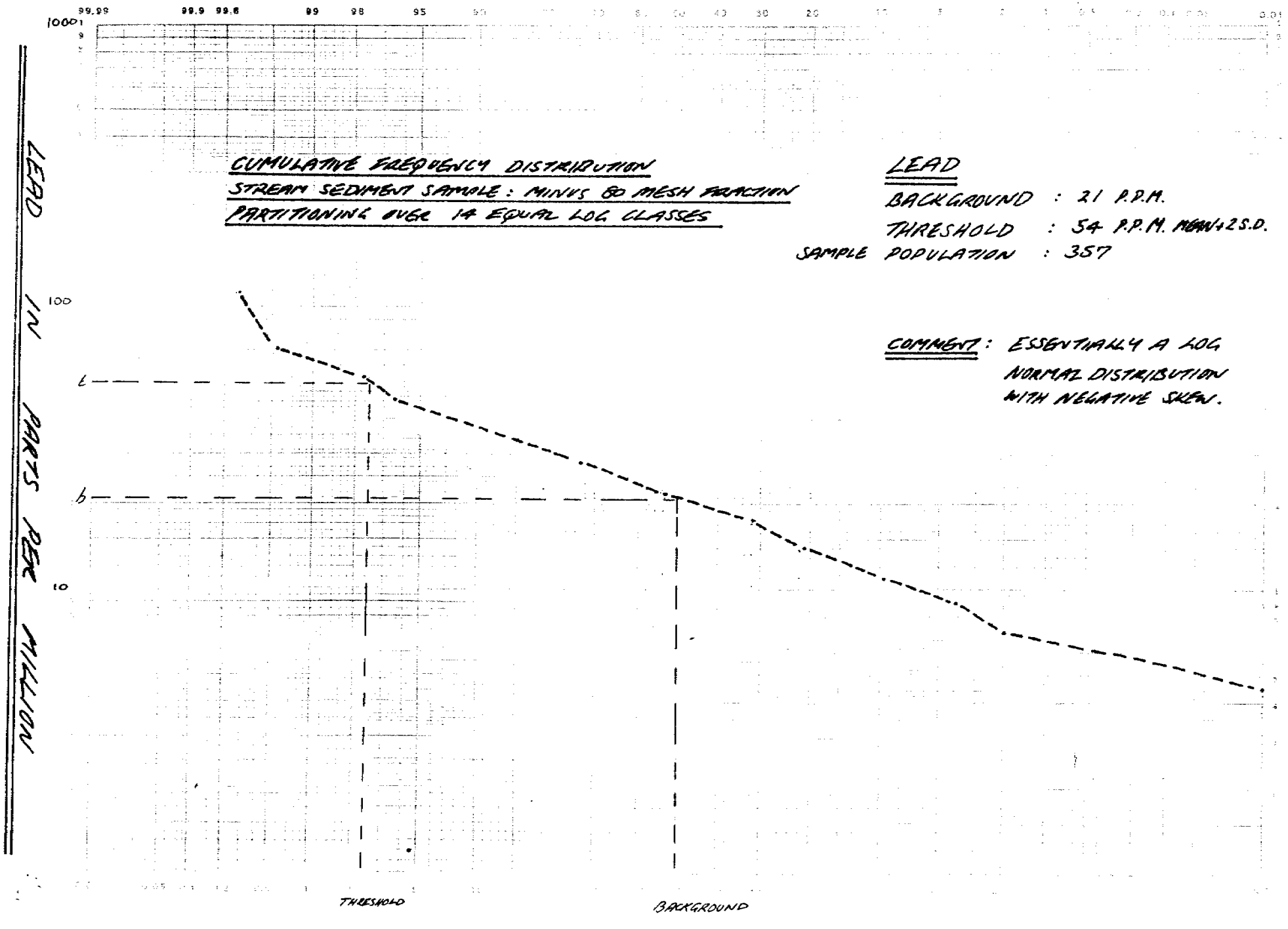
TOTAL EXPENDITURE. $62,725.00.


PINE CREEK PROJECT : NORTHERN TERRITORY
FIGURE 2.11
COBALT IN PARTS PER MILLION
CUMULATIVE FREQUENCY DISTRIBUTION
STREAM SEDIMENT SAMPLE - MINUS 80 MESH FRACTION
PARTITIONED OVER 13 EQUAL LOG CLASSES
COBALT
BACKGROUND : 10 P.P.M.
THRESHOLD : 35 P.P.M. MEAN + 2S.D.
SAMPLE POPULATION : 337
COMMENT : BIMODAL DISTRIBUTION.
: POPULATION 1 USED FOR THRESHOLD CALCULATION.
POPULATION 1
MIX OF TWO POPULATIONS
POPULATION 2
THRESHOLD
BACKGROUND
CUMULATIVE FREQUENCY PER CENT


PINE CREEK PROJECT : NORTHERN TERRITORY
COPPER IN PARTS PER MILLION
CUMULATIVE FREQUENCY DISTRIBUTION
STREAM SEDIMENT SAMPLE : MINUS 80 MESH FRACTION
PARTITIONING OVER 12 EQUAL LOG CLASSES
COPPER
BACKGROUND : 11 P.P.M.
THRESHOLD : 44 P.P.M.
SAMPLE POPULATION : 363
COMMENT : BIMODAL DISTRIBUTION
: POPULATION 1 USED FOR THRESHOLD CALCULATION.
POPULATION 1
MIX OF POPULATION 1 & 2
POPULATION 2
a
b
THRESHOLD
BACKGROUND
CUMULATIVE FREQUENCY PER CENT

PINE CREEK PROJECT : NORTHERN TERRITORY

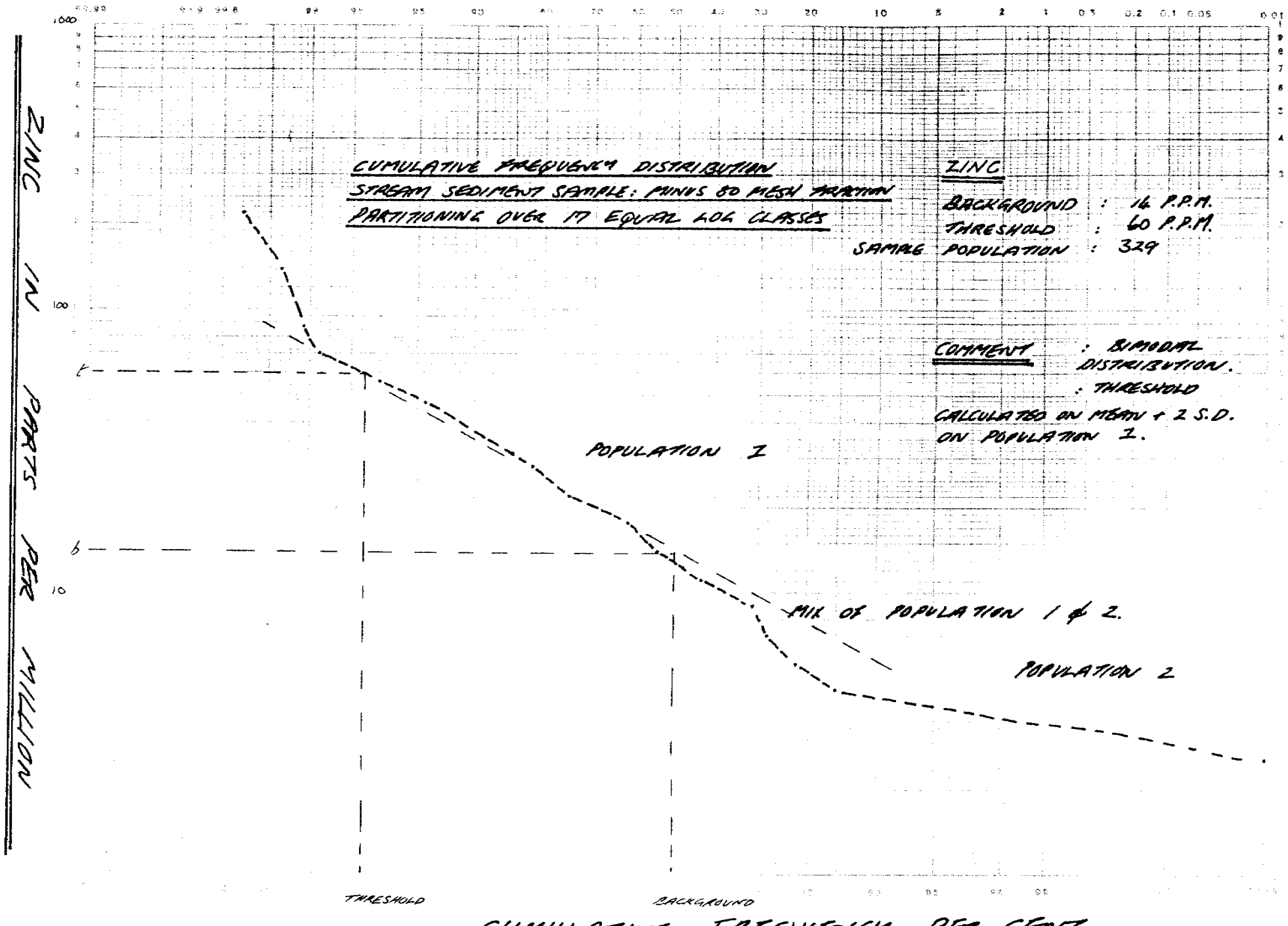
FIGURE 3A



CUMULATIVE FREQUENCY DISTRIBUTION
STREAM SEDIMENT SAMPLE : MINUS 80 MESH FRACTION
PARTITIONING OVER 14 EQUAL LOG CLASSES

LEAD
BACKGROUND : 21 P.P.M.
THRESHOLD : 54 P.P.M. MEAN+2S.D.
SAMPLE POPULATION : 357

COMMENT: ESSENTIALLY A LOG NORMAL DISTRIBUTION WITH NEGATIVE SKEW.

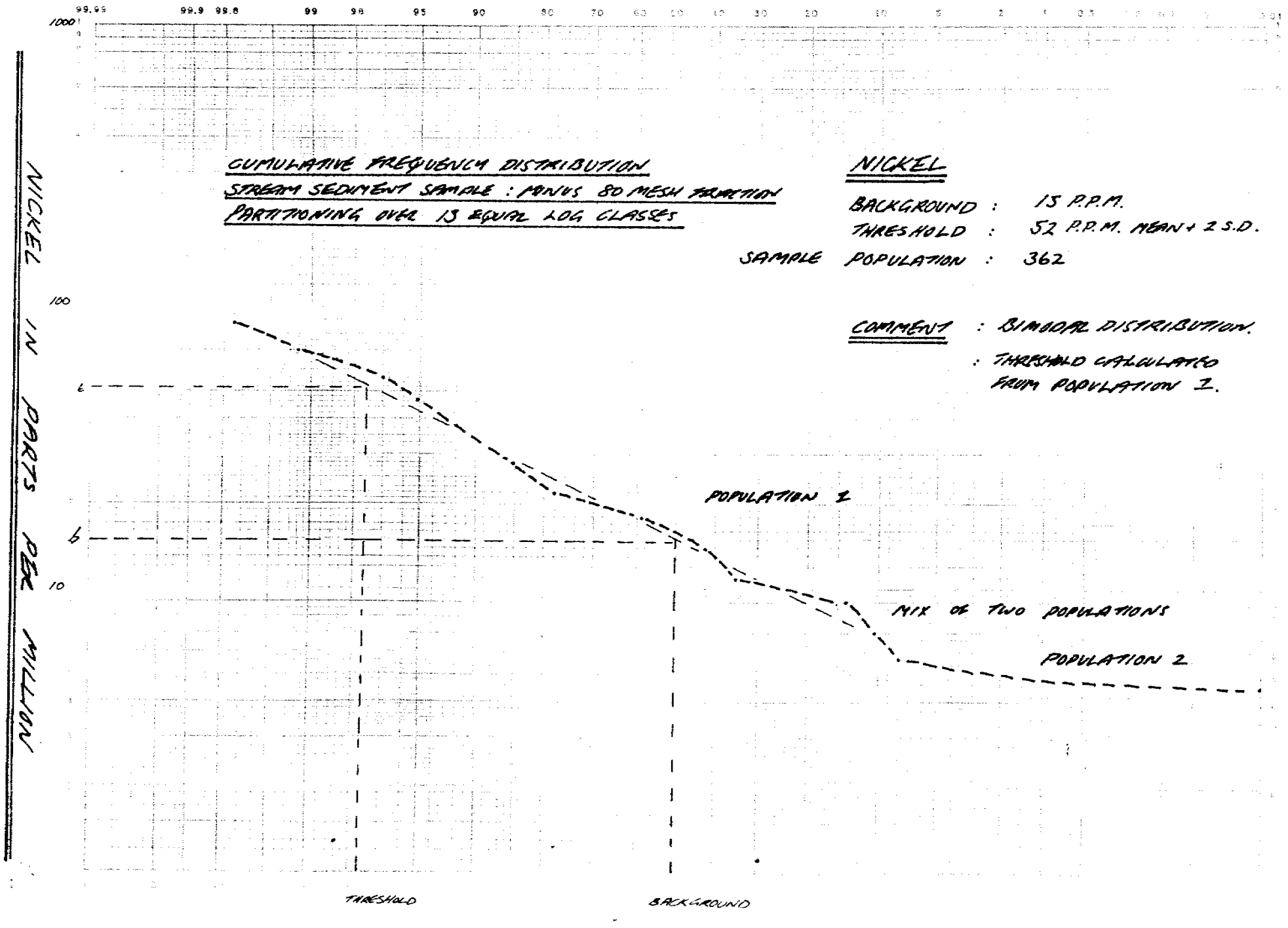


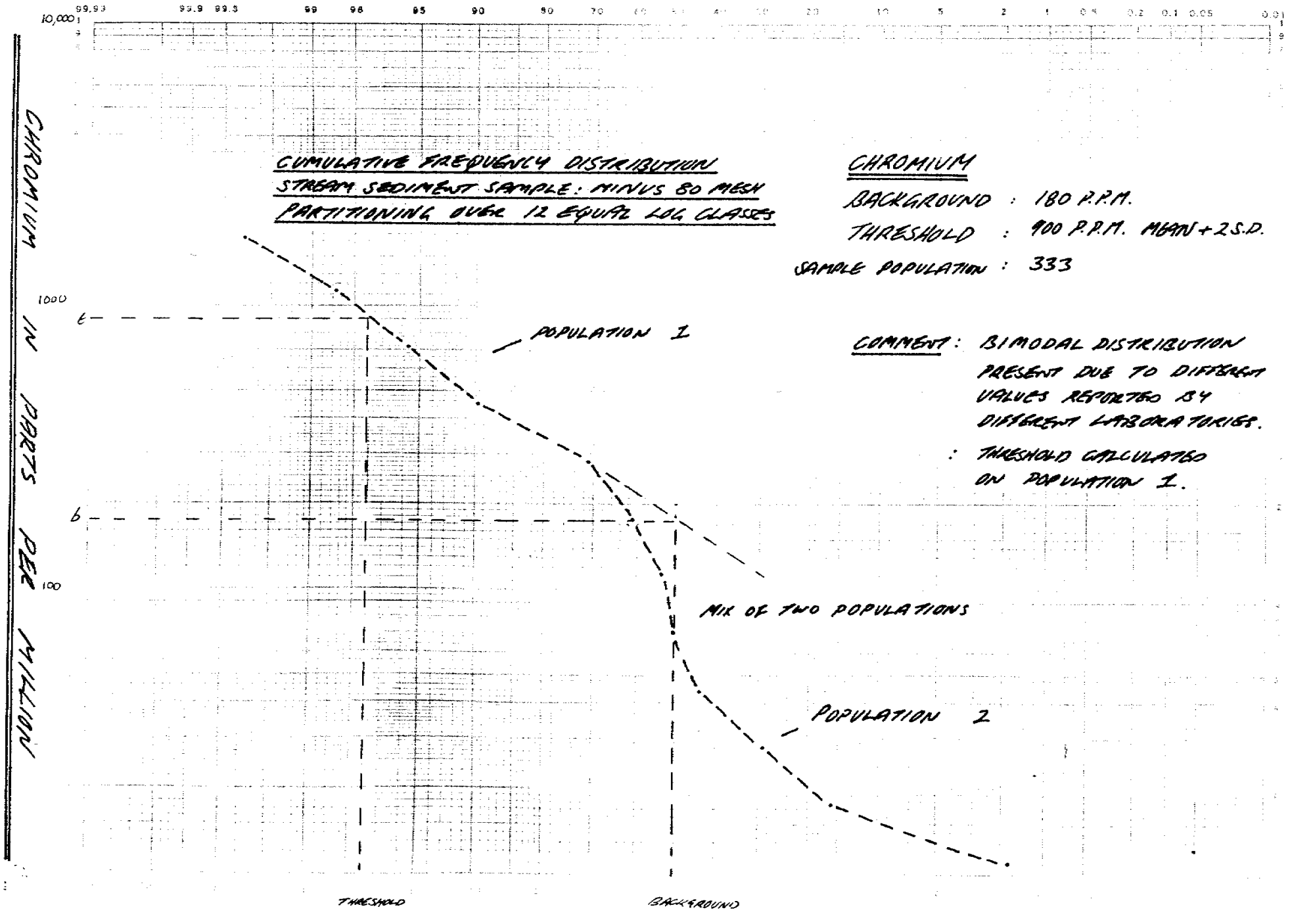
PINE CREEK PROJECT : NORTHERN TERRITORY

FIGURE 4A

PINE CREEK PROJECT : NORTHERN TERRITORY

FIGURE 5A





CUMULATIVE FREQUENCY DISTRIBUTION
STREAM SEDIMENT SAMPLE: MINUS 80 MESH
PARTITIONING OVER 12 EQUAL LOG CLASSES

CHROMIUM

BACKGROUND : 180 P.P.M.

THRESHOLD : 900 P.P.M. MEAN + 2 S.D.

SAMPLE POPULATION : 333

COMMENT: BIMODAL DISTRIBUTION PRESENT DUE TO DIFFERENT VALUES REPORTED BY DIFFERENT LABORATORIES.

: THRESHOLD CALCULATED ON POPULATION 1.

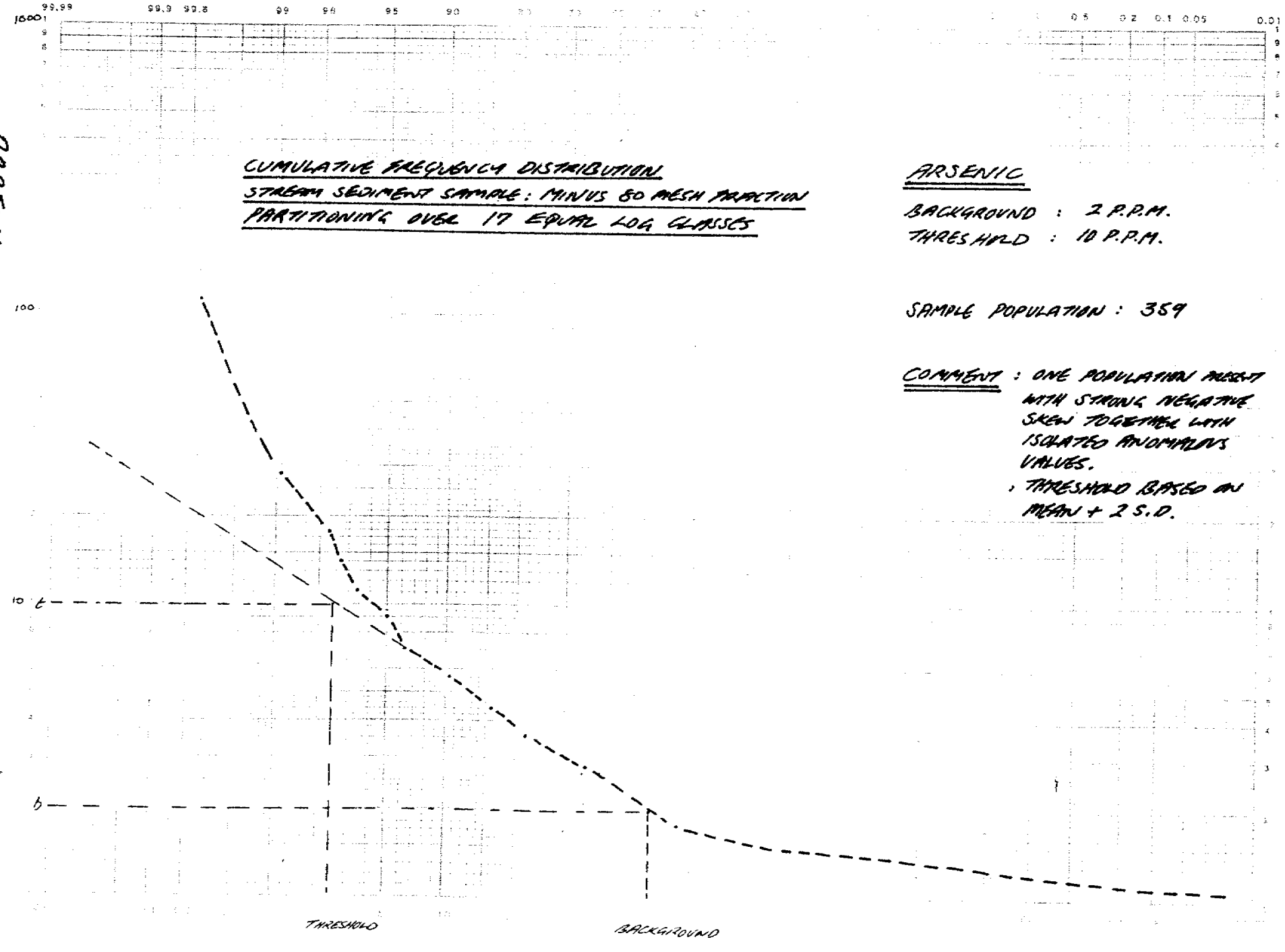
PINE CREEK PROJECT : NORTHERN TERRITORY

FIGURE 6A

PINE CREEK PROJECT : NORTHERN TERRITORY

FIGURE 24

ARSENIC IN PARTS PER MILLION



CUMULATIVE FREQUENCY DISTRIBUTION
STREAM SEDIMENT SAMPLE: MINUS 80 MESH FRACTION
PARTITIONING OVER 17 EQUAL LOG CLASSES

ARSENIC

BACKGROUND : 2 P.P.M.
THRESHOLD : 10 P.P.M.

SAMPLE POPULATION : 359

COMMENT : ONE POPULATION PRESENT WITH STRONG NEGATIVE SKEW TOGETHER WITH ISOLATED ANOMALOUS VALUES.
, THRESHOLD BASED ON MEAN + 2 S.D.

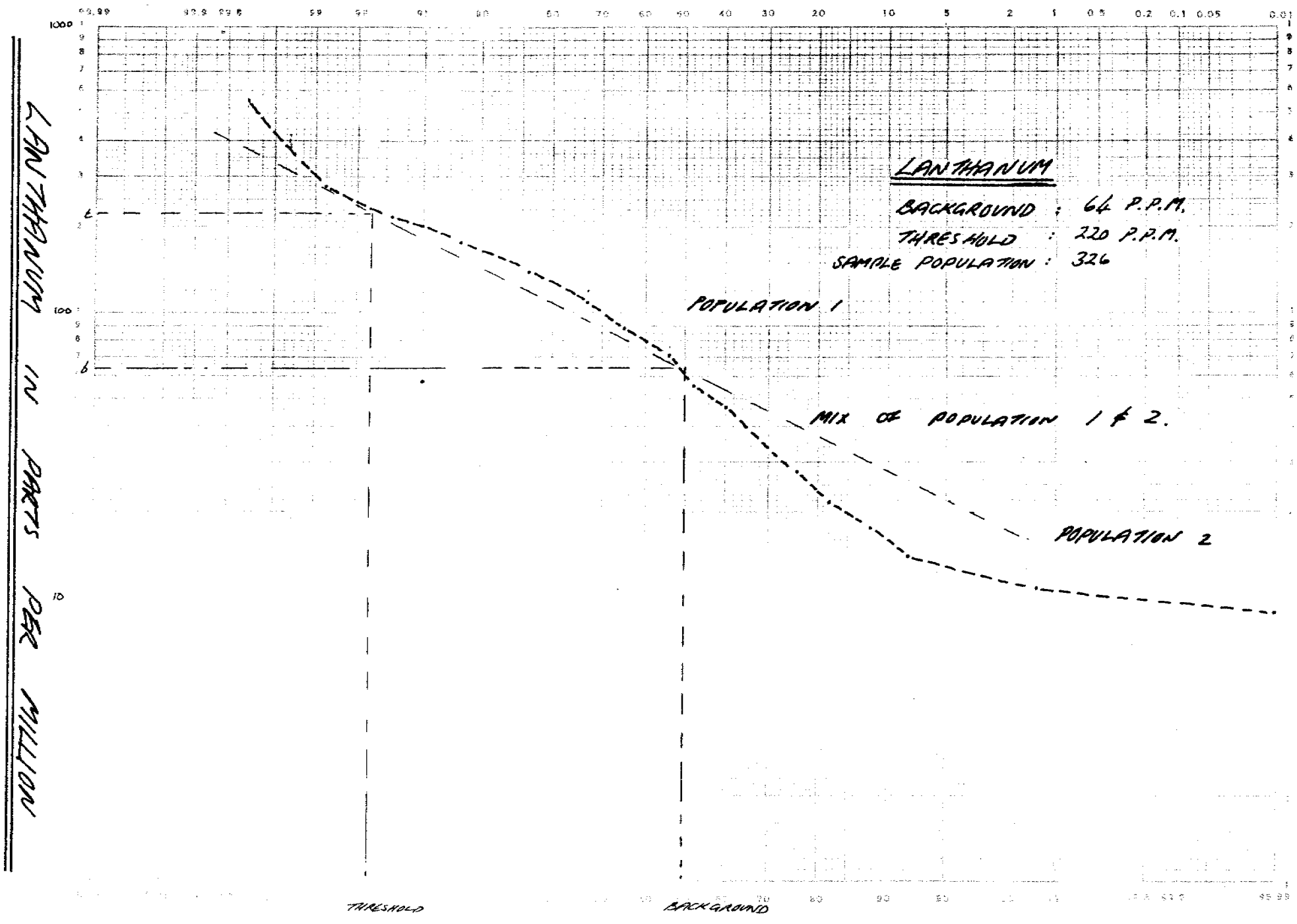
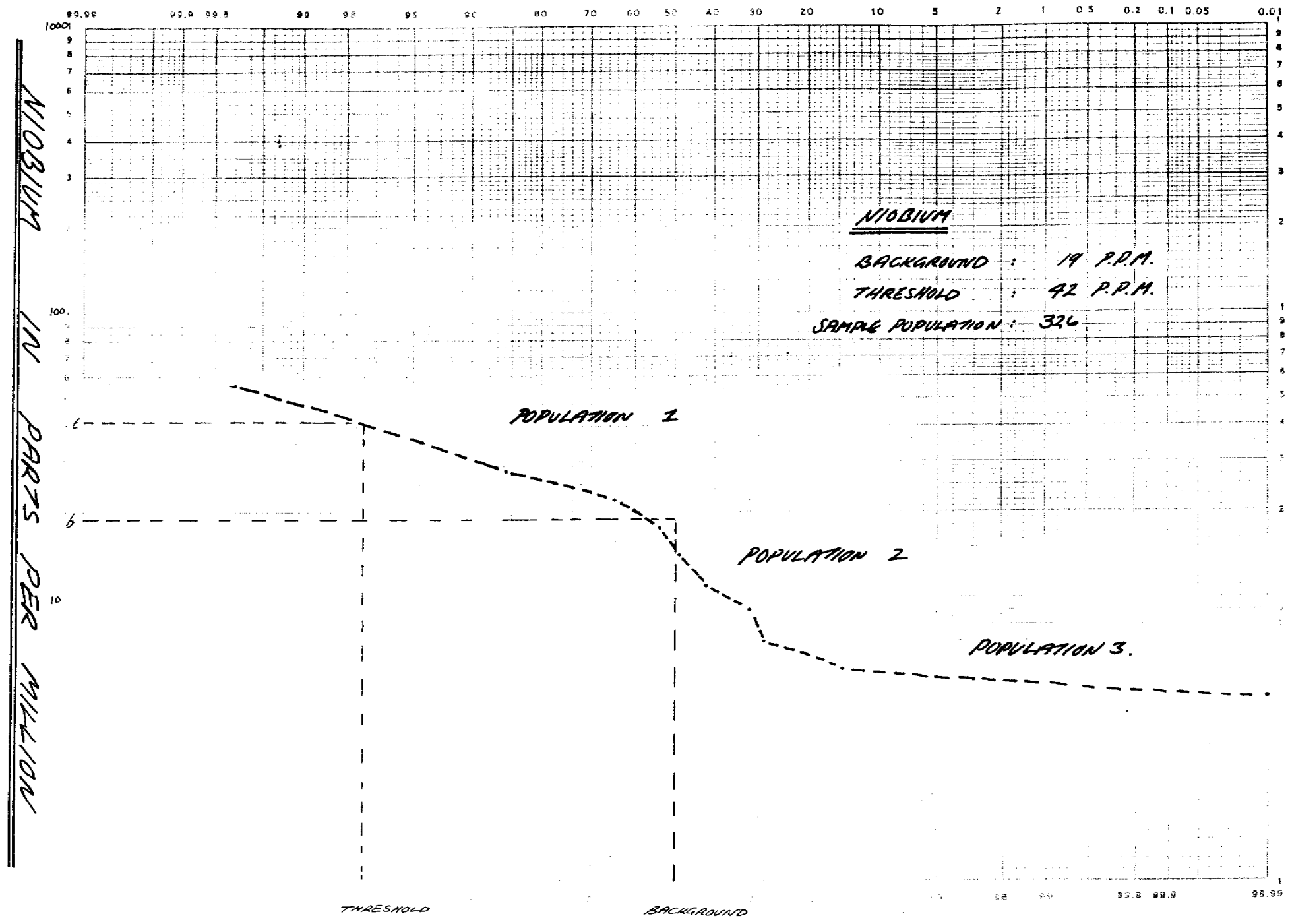


FIGURE 13A

PINE CREEK PROJECT : NORTHERN TERRITORY



PINE CREEK PROJECT: NORTHERN TERRITORY

FIGURE 14A